January 2022

Salinas Valley Groundwater Basin
Monterey Subbasin
Groundwater Sustainability Plan

Marina Coast Water District

Salinas Valley Basin Groundwater Sustainability Agency

Prepared by:

EKI environment & water

Montgomery & Associates

Acknowledgement

MCWD GSA and SVBGSA gratefully acknowledge the funding contribution from the California Department of Water Resources. Funding for this GSP has been provided in part from Proposition 1 (Round 2) and Proposition 68 (Round 3) grants from the Sustainable Groundwater Management Grant Program.

MCWD GSA and SVBGSA gratefully acknowledge participation from subbasin stakeholders, who participated in over twenty public meetings that were held during the development of the GSP and provided over 400 oral comments and 46 written comment letters during the GSP process.

MCWD GSA Board Members

Jan Shriner, President

Herbert Cortez, Vice President

Thomas Moore, Director

Gail Morton, Director

Matt Zefferman, Director

SVBGSA Member Agencies

County of Monterey

Monterey County Water Resources Agency

City of Salinas

City of Soledad

City of Gonzales

King City

Castroville Community Services District

Monterey One Water

SVBGSA Board Members

Steve Adams, South County Cities Member

Luis Alejo, Other GSA Eligible Entities Member

John Bramers, Agriculture, Pressure Member

Janet Brennan, Environment Member

Caroline Chapin, Public Member

Brenda Granillo, CPUC Regulated Water Company Member

Bill Lipe, Agriculture, Upper Valley Member

Steve McIntyre, Agriculture, Forebay Member

Colby Pereira, Agriculture, Eastside/Langley Member and Chair

Anthony Rocha, City of Salinas Member

Ron Stefani, Disadvantaged Community or Public Water System Member

Monterey Subbasin Planning Committee

Beverly Bean

Patrick Breen

Sarah Hardgrave, Chair

Robert Jacques

Margaret-Anne Coppernoll

Ron Stefani

Janet Brennan

Max Storms

Gary Kreeger

Elaheh Esfahanian

MCWD GSA Staff

Remleh Scherzinger, General Manager

Patrick Breen, Water Resources Manager

Roger Masuda, General Counsel

Kelly Cadiente, Director of Administrative Services

Derek Cray, Operations and Maintenance Manager

Teo Espero, IT Administrator

SVBGSA Staff

Donna Meyers, *General Manager*

Emily Gardner, Deputy *General Manager*

Gary Petersen, *Senior Advisor*

Les Girard, General Counsel

Merida Alvarez, Administrative Assistant

Ann Camel, Administrative Support

Harrison Tregenza, Clerk of the Board

Technical Consultants

EKI Environment & Water (EKI)

Vera Nelson, P.E., Principal-in-Charge

Tina Wang, P.E., Water Resources Engineer

Aaron Lewis, Hydrogeologist/Water Resources Engineer

Qiwen Zhang, Water Resources Engineer

Chris Heppner, Ph.D., Senior Hydrogeologist

Tyler Colyer, P.E., Civil Engineer

Nigel Chen, Ph.D., Hydrogeologist

Jaclyn Catania, GIS and Data Coordinator

Montgomery & Associates (M&A)

Derrik Williams, P.G., C.Hg., Principal Hydrogeologist
Abby Ostovar, Ph.D., Water Policy Specialist
Tiffani Canez, Hydrogeologist
Joseph Oliver, Senior Hydrogeologist
Staffan Schorr, Principal Hydrogeologist
Greg Nelson, P.G., Senior Hydrogeologist
Victoria Hermosilla, Hydrogeologist
Michael Levengood, GIS and Data Coordinator
Trevor Pontifex, Hydrogeologist
Jon Reeves, Hydrogeologist

Wallace Group

Kari Wagner, P.E., Principal/Director of Water Resources
Greg Hulburd, P.E., Senior Civil Engineer

Wood Group

Matt Baillie, P.G., C.Hg., Senior Hydrogeologist

Paris Kincaid Wasiewski

Valerie Kincaid, Principal

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

List of Abbreviations

AB	Assembly Bill
AEM	airborne electromagnetic
AF	acre-foot
AFF	Aqueous Film-Forming Foam
AFY	acre-feet per year
Ag	Agricultural
AGF	Aqua Geo Frameworks
AMBAG	Association of Monterey Bay Area Governments
ARAS	applicable or relevant and appropriate
ASBS	Areas of Special Biological Significance
ASR	Aquifer Storage and Recovery
ATW	Advanced treated water
AWPF	Advanced Water Purification Facility
AWTP	Advanced Water Treatment Plant
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
BMPs	Best Management Practices
BOS	bottom of screen
CA	California
CALGreen	California Green
CASGEM	California Statewide Groundwater Elevation Monitoring
CCC	California Coastal Commission
CCGC	Central Coast Groundwater Coalition
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CCTAG	Climate Change Technical Advisory Group
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFI	Community Facilities and Infrastructure
cfs	cubic feet per second
CIFP	Capital Improvement and Financing Plan
COCs	constituents of concern
COVID	coronavirus disease of 2019
CPE	Communication and public engagement
CPUC	California Public Utilities Commission
CSD	Community Services District
CSIP	Castroville Seawater Intrusion Project
CSLC	California State Lands Commission

CT	Carbon Tetrachloride
CUS	California Utility Service
CWC	California Water Code
DAC	Disadvantaged Community
DACs	disadvantaged communities
DDW	Division of Drinking Water
DEM	digital elevation model
DMS	Data Management System
DOF	Department of Finance
DOSD	Division of Safety of Dams
DPR	direct potable reuse
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EHRS	Environmental Health Review Services
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESCA	Environmental Services Cooperative Agreement
ESD	Explanations of Significant Difference
ET	evapotranspiration
FFA	Federal Facility Agreement
fm	formation
FO	Fort Ord
FODIS	Fort Ord Data Integration System
FORA	Fort Ord Reuse Authority
ft	foot
ft msl	foot mean sea level
ft/ft	foot per foot
GAMA	Groundwater Ambient Monitoring and Assessment Program
GDE	Groundwater dependent ecosystem
GEMS	Groundwater Extraction Management System
GMP	Groundwater Management Plan
GPCD	Gallons per Capita per Day
gpm/ft	gallon per minute per foot
GPS	Global Positioning System
GRRP	Groundwater Replenishment Reuse Project
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
HCP	Habitat Conservation Plan
HLA	Harding Lawson Associates
HMP	Habitat Management Plan

HSC	Healthy and Sustainable Communities
HUC	Hydrologic Unit Codes
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
IPR	indirect potable reuse
IRWM	Integrated Regional Water Management
IRWMP	Integrated Regional Water Management Plan
ISW	interconnected surface water
IWRMP	Integrated Regional Water Management Plan
JPA	Joint Powers Authority
Kqm	granitic rocks of the Galiban Range
LCIP	Local Coastal Implementation Plan
LCLUP	Local Coastal Land Use Plan
LCP	Local Coastal Program
LF	linear foot
LU	land use
LUST	leaking underground storage tank
M&I	municipal & industrial
MBARD	Monterey Bay Air Resources District
MBAS	Methylene blue active substances
MBGWFM	Monterey Subbasin Groundwater Flow Model
MBNMS	Monterey Bay National Marine Sanctuary
MCC	Monterey County Code
MCFCWCD	Monterey County Flood Control and Water Conservation District
MCHD	Monterey County Health Department
MCL	Maximum Contaminant Level
MCPWD	Monterey County Public Works Department
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
MG	million gallons
mg/L	milligram per liter
MGD	million gallon per day
Mmy	Monterey Formation
MOA	Memorandum of Agreement
MPWMD	Monterey Peninsula Water Management District
MRSWMP	Monterey Regional Stormwater Management Program
MRWPCA	Monterey Regional Water Pollution Control Agency
Msm	Santa Margarita Sandstone
Msu	Unnamed Miocene Sedimentary Rocks
MTBE	methyl tert butyl ether
Mus	Unnamed Miocene Sandstone

MWELO	Model Water Efficient Landscape Ordinance
M&I	Municipal and Industrial
NAD	North American Datum
NAD83	North American Datum of 1983
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NLs	notification levels
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRCS	USDA Natural Resources Conservation Service
O&M	Operations and Maintenance
ohm/cm	ohms centimeter
OS	open space
OSWCR	Online System for Well Completion Reports
OU	Operable Unit
OUCTP	Operable Unit Carbon Tetrachloride Plume
PCE	tetrachloroethylene
PFAS	per- and poly-fluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxA	perfluorohexanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PLSS	Public Land Survey System
PS	public service
PWM	Pure Water Monterey
Q	alluvium
QA/QC	Quality Assurance/Quality Control
Qae	Aromas Sand
Qal	Alluvium
QAPP	Quality Assurance Project Plan
Qd	Dune Sand
Qfl	Floodplain Deposits
Qo/Qvf	Old Alluvium / Valley Fill Deposits
Qod	Older Dune Sand
Qof	Pleistocene Dissected Alluvium
QT	Paso Robles Formations
Qt	Terrace deposit
Qtc	Colluvium and talus, undivided
RCDMC	Resource Conservation District of Monterey County

RFP	Request for Proposals
RGP	Regional General Permit
RI/FS	Remedial Investigation Feasibility Study
RMA	Routine Maintenance Agreement
RMS	Representative Monitoring Site
ROD	Records of Decision
ROW	Right of Way
RP	reference point
RTP	Regional Treatment Plant
RUWAP	Regional Urban Water Augmentation Project
RWQCB	Regional Water Quality Control Board
SAFER	Safe and Affordable Funding for Equity and Resilience
SB	Senate Bill
SBMMP	Seaside Basin Monitoring and Management Program
SCEP	Stakeholder Communication and Engagement Plan
SDRF	State Disaster Response Fund
SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
SMCL	secondary maximum contaminant level
SMCs	sustainable management criteria
SMP	Salinas River Stream Maintenance Program
SRDF	Salinas River Diversion Facility
SSURGO	Soil Survey Geographic Database
SVA	Salinas Valley Aquitard
SVBGSA	Salinas Valley Basin Groundwater Sustainability Agency
SVIHM	Salinas Valley Integrated Hydrologic Model
SVOM	Salinas Valley Operational Model
SVRP	Salinas Valley Reclamation Plant
SVWP	Salinas Valley Water Project
SWI	seawater intrusion
SWIG	Seawater Intrusion Working Group
SWPPP	State Water Board Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TAMC	Transportation Agency for Monterey County
TBD	to be determined
TCE	trichloroethylene
TDS	total dissolved solids
Tsm	Santa Margarita Sandstone
U.S.	United States
ug	micrograms

ug/L	micrograms per liter
US	United States
US EPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
UV	ultraviolet
UWMP	Urban Water Management Plan
VOC	volatile organic compound
WDR	Waste Discharge Requirement
WL	water level
WWTP	Wastewater Treatment Plant
WY	water year

EXECUTIVE SUMMARY

ES.1 Introduction

On September 16, 2014, the California legislature enacted the Sustainable Groundwater Management Act (SGMA) whose primary purpose is to achieve and/or maintain sustainability within the state's high and medium priority groundwater basins. Key tenets of SGMA are the concept of local control, use of best available data and science, and active engagement and consideration of all beneficial uses and users of groundwater. As such, SGMA empowers certain local agencies to form Groundwater Sustainability Agencies (GSAs) whose purpose is to manage basins sustainably through the development and implementation of Groundwater Sustainability Plans (GSPs). Under SGMA, GSPs are required to contain certain elements, the most significant of which include: a Sustainability Goal; a description of the area covered by the GSP ("Plan Area"); a description of the Basin Setting, including the hydrogeologic conceptual model, historical and current groundwater conditions, and a water budget; locally-defined sustainability criteria; networks and protocols for monitoring sustainability indicators; and a description of projects and/or management actions that will be implemented to achieve or maintain sustainability. SGMA also requires a significant element of stakeholder outreach to ensure that beneficial uses and users of groundwater are given the opportunity to provide input into the GSP development and implementation process.

This GSP covers the entire Monterey Subbasin (Department of Water Resources [DWR] Basin 3-004.10), which encompasses 30,850 acres (or 48.2 square miles) in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California (Figure ES-1). The Monterey Subbasin (Subbasin) has been designated by the California Department of Water Resources (DWR) as medium priority. As such, the Subbasin is required to develop a GSP by January 2022 and achieve sustainability by 2042. The GSP has been co-developed by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) pursuant to a Framework Agreement. The Framework Agreement outlines the Management Areas to be established within the Subbasin, which are later formalized in this GSP. The Framework Agreement further establishes a basis for information developed by the two agencies to be integrated into a single GSP for the Monterey Subbasin.

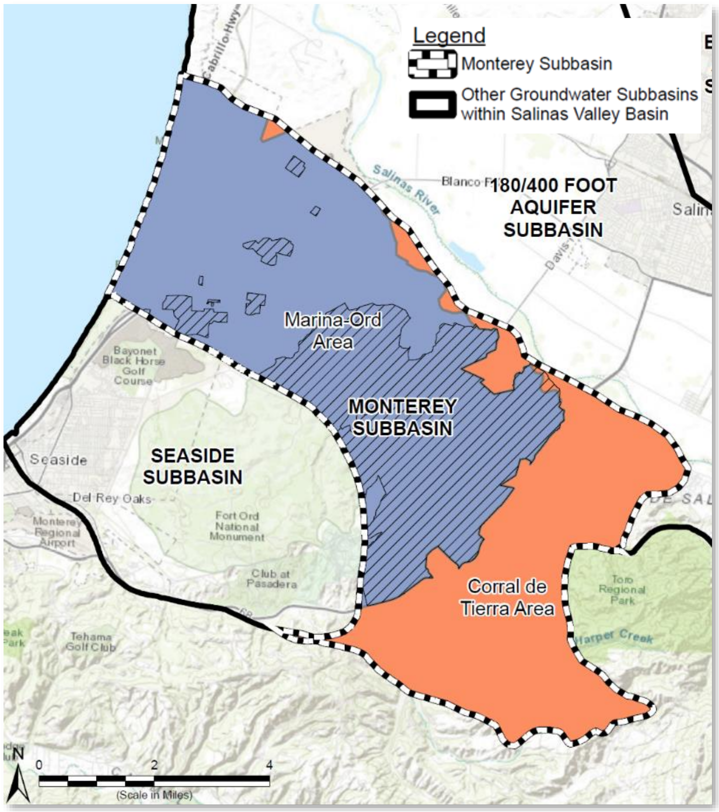


Figure ES-1. Monterey Subbasin

ES.2 Communications and Stakeholder Engagement

The Subbasin GSAs (MCWD GSA and SVBGSA) developed a Framework Agreement regarding GSP development. Pursuant to this agreement, the GSAs have established two Management Areas within the Subbasin. These Management Areas include the Marina-Ord Management Area (Marina-Ord Area) and the Corral de Tierra Management Area (Corral de Tierra Area) (Figure ES-2). The Marina-Ord Area consists of the lands within the City of Marina, City of Seaside, and the former Fort Ord. The Corral de Tierra Area consists of the remainder of the Subbasin, which includes lands generally located south of State Route 68 and a few parcels along the northern subbasin boundary with the 180/400-Foot Aquifer Subbasin.

MCWD GSA has prepared GSP components for the Marina-Ord Area and the SVBGSA has prepared GSP components for the Corral de Tierra Area. Both GSAs have worked collaboratively to develop and implement stakeholder engagement plans for the GSP. Each GSA has also guided stakeholder engagements efforts within their respective Management Areas.

As part of intra-basin coordination, regular Technical Subcommittee meetings have been held by the GSAs and Steering Committee meetings were scheduled and held on an as needed basis. In addition, stakeholders and beneficial users within each management area have been provided a variety of opportunities for public engagement including: GSA Board meetings, Stakeholder

Workshops, One-on-one meetings with selected stakeholders, and Website communications. SVBGSA also established a SVBGSA Monterey Subbasin Planning Committee that met 13 times to develop and provide feedback on draft GSP chapters. The Monterey Subbasin GSA websites (https://www.mcwd.org/governance_meetings.html and https://svbgsa.org) also contain materials presented at meetings as well as a schedule for upcoming meetings and other workshops open to the public.

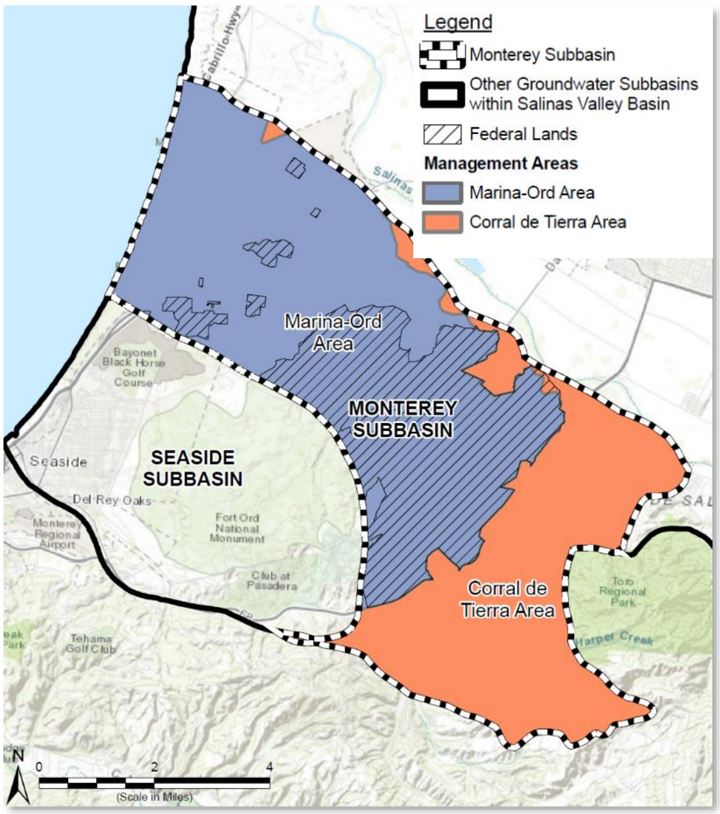


Figure ES-2. Management Areas

ES.3 Plan Area

The Monterey Subbasin is a medium-priority groundwater subbasin in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California. The Subbasin is covered by the MCWD GSA and SVBGSA and lies entirely within Monterey County. The Subbasin is bounded on the northeast by the 180/400-Foot Aquifer Subbasin (DWR Basin 3-004.01) and on the southwest by the Seaside Subbasin (DWR Basin 3-004.08). The GSAs have established two management areas within the Subbasin, which are the Marina-Ord Area and the Corral de Tierra Area.

The majority of the Subbasin is undeveloped land. Urban uses, including the municipalities of Marina and Seaside, make up primary water users in the Subbasin. Small areas of agriculture, approximately 500 acres of truck nursery and berry crops, are located along the northern subbasin boundary adjoining the 180/400-Foot Aquifer Subbasin. Urban and agricultural water users in the Subbasin rely entirely on groundwater.

A significant number of groundwater monitoring programs exist in the Subbasin and data from these programs have been used to develop the GSP and will continue to be utilized as a part of GSP implementation. The programs and entities that conduct them include:

- California Statewide Groundwater Elevation Monitoring (CASGEM) Program;
- United States Geological Survey (USGS);
- Groundwater Ambient Monitoring and Assessment (GAMA) Program;
- State Water Resource Control Board's (SWRCB's) Division of Drinking Water;
- MCWD, Monterey County Water Resources Agency (MCWRA), and Monterey Peninsula Water Management District (MPWMD);
- Central Coast Regional Water Quality Control Board (CCRWQCB); and
- United States Army Corps of Engineers.

ES.4 Hydrogeologic Conceptual Model

The Monterey Subbasin is located at the northwestern end of the Salinas Valley Groundwater Basin, an approximately 90-mile-long alluvial basin underlying the elongated, intermountain valley of the Salinas River. The Subbasin includes the portions of the Monterey Bay coastal plain, south of the approximate location of the Reliz Fault, as well as upland areas to the southeast of the coastal plain. Topography generally slopes down to the northwest towards Monterey Bay, ranging from sea level at the shoreline to 1,900 ft msl in the southeastern corner of the Subbasin. Soils within the Subbasin are predominantly of Hydrologic Soil Group A in the coastal plain area, indicating high infiltration rates and low runoff potential. In the Fort Ord hills area, soils predominately belong to Hydrologic Soil Groups C and D, with below average and low infiltration rates, respectively, and moderately high and high runoff potential, respectively. A mix of Hydrologic Soil Groups A through D exists in the Corral de Tierra Area east of El Toro Creek.

The Monterey Subbasin is hydrostratigraphically complex and represents a transition zone between the more defined, laterally continuous aquifer system along the central axis of the Salinas Valley and the less continuous aquifer systems towards the Sierra de Salinas. The water-bearing strata within the Subbasin include river and sand dune deposits of Holocene and Pleistocene age, the Aromas Sand and Paso Robles Formation of Plio-Pleistocene age, the Purisima Formation of Pliocene age, and the Santa Margarita Formation of Miocene age (Greene, 1970; Harding ESE, 2001; Geosyntec, 2007). The Monterey Formation of Miocene age, or the bottom of the Subbasin, represents the relatively non-water-bearing bedrock that underlies the Subbasin.

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The principal aquifers within the Marina-Ord Area include the unconfined Dune Sand Aquifer and the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifers. Hydraulic conductivity of the aquifers underlying the Marina-Ord Area varies by aquifer and location. Groundwater production generally occurs from the 180/ 400-Foot Aquifers and the Deep Aquifers.

Natural groundwater recharge occurs through infiltration of surface water, deep percolation of excess applied irrigation water, and deep percolation of infiltrating precipitation. Most of the Marina-Ord Area has good recharge potential due to the high permeability of the Dune Sand Aquifer which subsequently recharges the underlying 180-Foot and 400-Foot Aquifers.

Within the southern Corral de Tierra Area, the aquifers have historically been described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). Based on best available information as well as many wells that span multiple formations, these geologic formations are grouped together to form the El Toro Primary Aquifer System for the Corral de Tierra Area. Natural groundwater recharge occurs through infiltration of surface water if and where it occurs, and deep percolation of infiltrating precipitation. Most of the Corral de Tierra Area has good recharge potential due to the high permeability of soils which subsequently recharges the underlying sandy, gravelly layers of the Aromas Sand and Paso Robles Formation.

The primary surface water bodies in the Subbasin are the Salinas River, and Toro Creek, which is generally perennial below the confluence with Watson Creek (Feikert, 2001). Recorded streamflows at USGS gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 AFY for Toro Creek, however not all years registered flow (GeoSyntec, 2007). The Salinas River crosses into the Subbasin in two locations in the Corral de Tierra Area and may provide some recharge in areas that do not have the Salinas Valley Aquitard that generally defines the 180/400-Foot Aquifer Subbasin.

ES.5 Current and Historical Groundwater Conditions

Groundwater conditions in the Subbasin are described for each of DWR's six sustainability indicators identified below.

- Chronic Lowering of Groundwater Levels – Groundwater elevations have generally been stable for over three decades in the Dune Sand Aquifer, the upper and lower 180-Foot Aquifer, and the 400-Foot Aquifer within the northern Marina-Ord Area. Since the mid-2000s, groundwater levels have been declining in 400-Foot Aquifer wells located in the southwestern portion of the Marina-Ord Area and in Deep Aquifer wells. Decreases in groundwater elevations in the Deep Aquifers are the result of increased production from the Deep Aquifers in the Salinas Valley Groundwater Basin. Groundwater level declines observed in the Deep Aquifers range from about 20 ft to 50 ft over the last two decades. Groundwater level declines have also been observed historically within the El Toro Primary Aquifer System in the Corral de Tierra Area. Groundwater level declines in the El Toro Primary Aquifer System range from about 20 ft to 80 ft over the last two decades.

- Changes in Groundwater Storage – Modeling results indicate an average annual loss of storage of 4,434 acre-feet per year (AFY) over the historical period (Water Year [WY] 2004-2018) in the Monterey Subbasin. This loss in storage is due to declining groundwater levels. There has been a minimal loss in storage due to seawater intrusion during the historical period as there has been negligible expansion of the seawater intrusion front. Seawater that enters the Monterey Subbasin from the ocean flows toward the 180/400-Foot Aquifer Subbasin boundary, where groundwater levels are lower in the seawater intruded aquifers.
- Seawater Intrusion – Seawater intrusion has been documented in the northern portion of the Monterey Subbasin in the lower 180-Foot and 400-Foot Aquifers. MCWRA and others have implemented a series of engineering projects and management actions to address seawater intrusion within the Salinas Valley Groundwater Basin. These projects and actions include the development of the Castroville Seawater Intrusion Project (CSIP), the Salinas Valley Water Project (SVWP), and well construction moratoriums, among other actions. Although these actions have managed to slow the advancement of the seawater intrusion front and reduce its impacts, seawater intrusion remains an ongoing threat. To date, seawater intrusion has not been reported in the Deep Aquifers.
- Groundwater Quality – Known groundwater quality concerns in the Marina-Ord Area include elevated chloride and TDS concentrations and legacy point-source contamination from former Fort Ord. Such point source contamination is being addressed by the United States Army Corps of Engineers (Army) and includes contaminants such as Volatile Organic Compounds (VOCs) and per- and poly-fluoroalkyl substances (PFAS). The primary source of high TDS and chloride concentrations in groundwater within the Marina-Ord Area is seawater intrusion. In the Corral de Tierra Area, the most prevalent water quality concern is naturally occurring arsenic.
- Subsidence – No measurable subsidence has been recorded anywhere in the Monterey Subbasin.
- Depletion of Interconnected Surface Waters – Surface water streams within the Subbasin are generally small intermittent streams that flow only after storm events, and are unlikely to be connected to groundwater, except for the lower reaches of El Toro Creek and two potential locations along the Salinas River near the Monterey-180/400-Foot Aquifer Subbasin boundary where the Salinas River intercepts the Subbasin in a small portion of the Corral de Tierra Area.

ES.6 Water Budget Information

Water budgets provide an accounting and assessment of the total annual volume of surface water and groundwater entering and leaving the Subbasin. This GSP presents three water budgets – historical (Water Year [WY] 2004-2018), current (WY 2015-2018), and a 50-year projected (WY 2019-2068) water budget period. Water budgets for each timeframe are presented for the Subbasin as a whole. In addition, zone budgets are presented for each management area.

The water budget information is based on the numerical Monterey Subbasin Groundwater Flow Model (i.e., "Monterey Subbasin Model" or "MBGWFM"), which was developed for the Subbasin. The MBGWFM uses the USGS Newton formulation of the Modular Three-Dimensional Groundwater Modeling platform (MODFLOW-NWT) to solve the governing groundwater flow equations. Table ES-1 summarizes inflows to and outflows from the basin-wide groundwater system by water source type during the historical water budget period and current water budget period. Water budget components include recharge, well pumping, net inter-basin flow, and net river exchange.

ES.6.1 Historical Water Budget Period

Although estimated groundwater recharge (10,055 AFY) exceeded pumping in the Monterey Subbasin (5,651 AFY) during the historical period, the net estimated annual change in groundwater storage in the Monterey Subbasin was -4,434 AFY. This value is negative indicating a loss of storage during the historical period. Inter-basin outflows accounted for the majority of the Subbasin's groundwater outflow over the historical period. Net inter-basin outflows (8,999 AFY) well exceeded groundwater pumping and were close to the total estimated recharge in the Subbasin. These estimated outflows are reflective of the large inland gradients that exist between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin. Groundwater levels in the 180/400-Foot Aquifer Subbasin are more than 40 feet below sea level in the 180- and 400-Foot Aquifers and have recently declined to over 100 feet below sea level in the Deep Aquifers. These results demonstrate the relationship and interdependence between inter-basin inflows, outflows, and the Subbasin water budget and the need for coordinated sustainable groundwater management in all of these subbasins.

The loss in storage is reflected in the groundwater level declines that have been observed in the 400-Foot Aquifer and Deep Aquifers within the Marina-Ord Area and within the El Toro Primary Aquifer in the Corral de Tierra Area. The negative net annual change in storage indicates that the Monterey Subbasin was in overdraft during the historical period.

ES.6.2 Current Water Budget Period

The current basin-wide water budget is based upon water years 2015 through 2018 and is also presented in Table ES-1. The current water budget includes the same water budget components as the historical water budget but characterizes basin conditions over a much shorter period of time during which recharge was much higher than during the historical period. As such, the net annual change in groundwater storage (-1,609 AFY) was much smaller during the current period. However, this value is likely not representative of long-term conditions as it is not reflective of the long-term hydrologic cycle.

Table ES-1. Historical and Current Groundwater Water Budget Results, Monterey Subbasin

Net Annual Groundwater Flows (AFY) (a)	Historical Annual Inflows/Outflows WY 2004 - 2018	Current Annual Inflows/Outflows WY 2015 - 2018
Recharge		
• Rainfall, leakage, irrigation	**10,055**	**12,060**
Well Pumping		
• Well Pumping	**-5,641**	**-5,274**
Net Inter-Basin Flow (Presumed Freshwater) (b)		
• Seaside Subbasin	918	1,334
• 180/400-Foot Aquifer Subbasin	-9,393	-9,307
• Ocean	-524	-574
	-8,999	**-8,547**
Net Inter-Basin Flow (Presumed Seawater) (b)		
• 180/400-Foot Aquifer Subbasin	-2,872	-3,258
• Ocean	2,872	3,258
	0	**0**
Net Surface Water Exchange		
• Salinas River Exchange	**151**	**153**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-4,434**	**-1,609**

Notes:

(a) Positive values indicate a net inflow and negative values indicate a net outflow.
(b) All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400-Foot Aquifer Subbasin boundary, as evidenced by negligible expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period.

ES.6.3 Projected Water Budget Period

Projected water budgets provide estimates of future conditions of water supply and demand within a basin, as well as the aquifer response to implementation of the Plan over the planning and implementation horizon. The projected water budget uses the same tools and methodologies that were used for the historical and current water budget, with updated inputs for climate variables (i.e., precipitation and ET), land use (water demand), and future subbasin boundary conditions. Given that historical water budget results indicate that conditions in the Monterey Subbasin are highly sensitive to conditions in adjacent subbasins, projected water budget results are presented for three alternative sets of boundary conditions in the 180/400-Foot Aquifer Subbasin. These boundary conditions include:

- Minimum Threshold (MT) Boundary Conditions: where groundwater levels along the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary are raised to water level MTs established in the 180/400-Foot Aquifer Subbasin GSP.
- Measurable Objective (MO) Boundary Conditions: where groundwater levels along the Monterey and 180/400-Foot Aquifer Subbasin boundary are raised to water level MOs established in the 180/400-Foot Aquifer Subbasin GSP.

- Seawater Intrusion (SWI) Protective Boundary Conditions: Where groundwater levels along the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary are set to levels protective against further seawater intrusion within the 180- and 400- Foot aquifers. In the absence of the installation of a hydraulic injection and/or extraction barrier, these SWI protective elevations represent the minimum groundwater elevations that would be needed in the coastal portions of the 180/400-Foot Aquifer Subbasin to stop further seawater intrusion consistent with the MTs for seawater intrusion established in the 180/400-Foot Aquifer Subbasin GSP.

Each of these boundary condition scenarios is predicated on the assumption that the 180/400-Foot Aquifer Subbasin will be managed to its SMCs over the 50-year projected model period. In addition, boundary conditions for the Seaside Subbasin, which is an adjudicated subbasin, are assumed to remain stable at Fall 2017 levels[1].

The chief purpose of this projected water budget analysis is to assess the magnitude of the net water supply deficit that would need to be addressed through Projects and Management Actions to prevent Undesirable Results and achieve the Sustainability Goal.

Projected water budget results are also presented for three alternative sets of hydrology and climate conditions including:

- Baseline (Historical Analog) Conditions: a 50-year analog period developed using a sequence of historical hydrologic input information that reflects the Subbasin's long-term average hydrologic conditions
- 2030 ("Near future") Climate Conditions: A water budget scenario based on 2030 climate change factors published by DWR.
- 2070 ("Late future") Climate Conditions: A water budget scenario based on 2070 "central tendency" climate change factors published by DWR.

Table ES-2 shows the water budget results under a "no project" scenario, which assumes all future projected water demands in the Monterey Subbasin will be met with groundwater. This table provides water budget results under the identified variable boundary conditions and 2030 climate conditions. As shown in Table ES-2, the net annual change in groundwater storage is expected to be minimum.

[1] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period. See discussion in Section 6.5.2.

Table ES-2. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Monterey Subbasin

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows 2030 Climate Conditions		
		Minimum Threshold Boundary Conditions	Measurable Objective Boundary Conditions	Seawater Intrusion Protective Boundary Conditions
Recharge				
● Rainfall, leakage, irrigation	**10,055**	**10,928**	**10,928**	**10,928**
Well Pumping				
● Well Pumping	**-5,641**	**-10,955**	**-10,955**	**-10,955**
Net Inter-Basin Flow				
● Seaside Subbasin	918	2,414	1,258	-453
● 180/400-Foot Aquifer Subbasin	-12,265	-5,583	-3,412	-295
● Ocean (Presumed Freshwater)	-524	-725	-752	-794
● Ocean (Presumed Seawater)	2,872	2,939	2,369	1,308
	-8,999	**-955**	**-537**	**-234**
Net Surface Water Exchange				
● Salinas River Exchange	**151**	**261**	**254**	**279**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-4,434**	**-721**	**-310**	**18**

Notes:

(a) Positive values indicate a net inflow and negative values indicate a net outflow.

As shown in this table, the projected net annual change in groundwater storage ranges between -721 and 18 AFY for the "No Project" scenario. The net annual change in groundwater storage is significantly lower than that calculated for the historical period (-4,434 AFY) and indicates that Monterey Subbasin inflows and outflows would be close to balanced under any of these boundary condition scenarios. A review of climate scenario results indicates that this conclusion is true under all identified climate change scenarios, as rainfall and recharge are projected to increase under future climate scenarios within the Subbasin. As such, these projected water budget results indicate that overdraft conditions within the Monterey Subbasin will be substantially mitigated if adjacent basins are managed sustainably and SMCs are achieved.

Projected water level elevations for the "No Project" scenario were also compared to water level MTs and MOs established in the Marina-Ord Area WBZ and Corral de Tierra Area WBZ, to determine if projects and management actions need to be implemented to meet SMCs in these Management Areas. Figure ES and Figure ES depict average projected changes in groundwater elevations at RMS wells in the Marina-Ord Area and Corral De Tierra WBZ under the "No Project" scenario with variable boundary conditions. These figures also identify the average change in water levels required to reach MTs and MOs at RMS wells in each management area.[2]

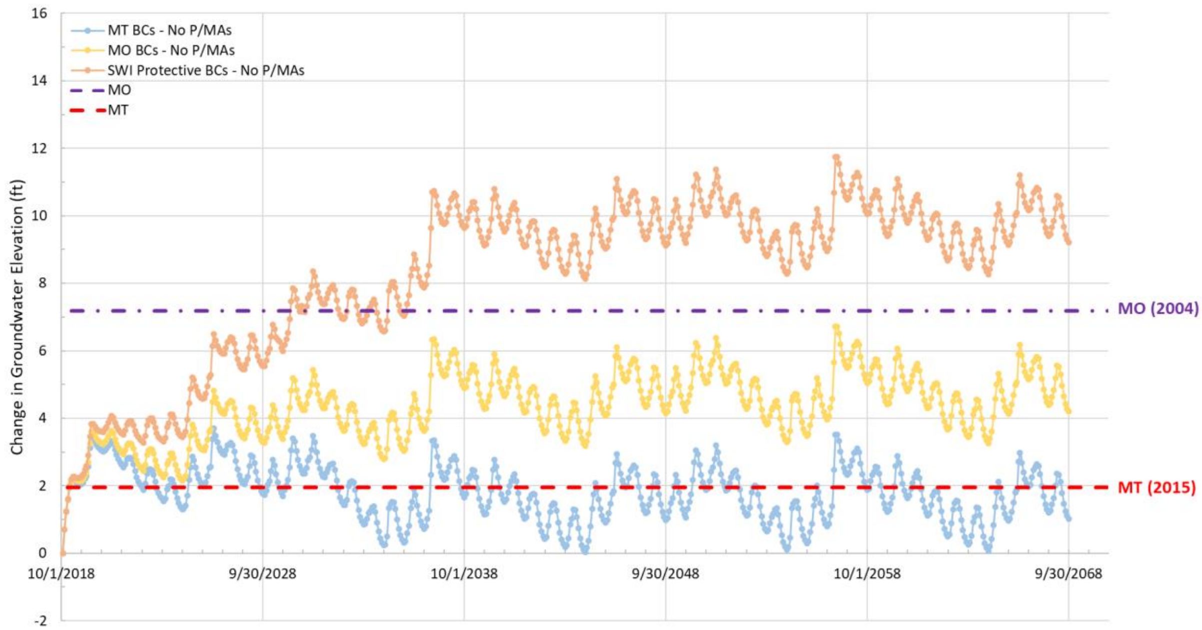


Figure ES-3. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ

---

[2] This figure shows average projected groundwater elevation changes in the 35 RMS wells in the Marina-Ord Area with respect to those modeled at the end of the historical period (i.e., 2018). The MT and MO elevations shown on this graph reflects their average elevations with respect to 2018 water levels at the RMS wells. For example, MTs, which are set based on 2015 water levels, are on average 2 feet higher than 2018 water levels in these RMS wells.

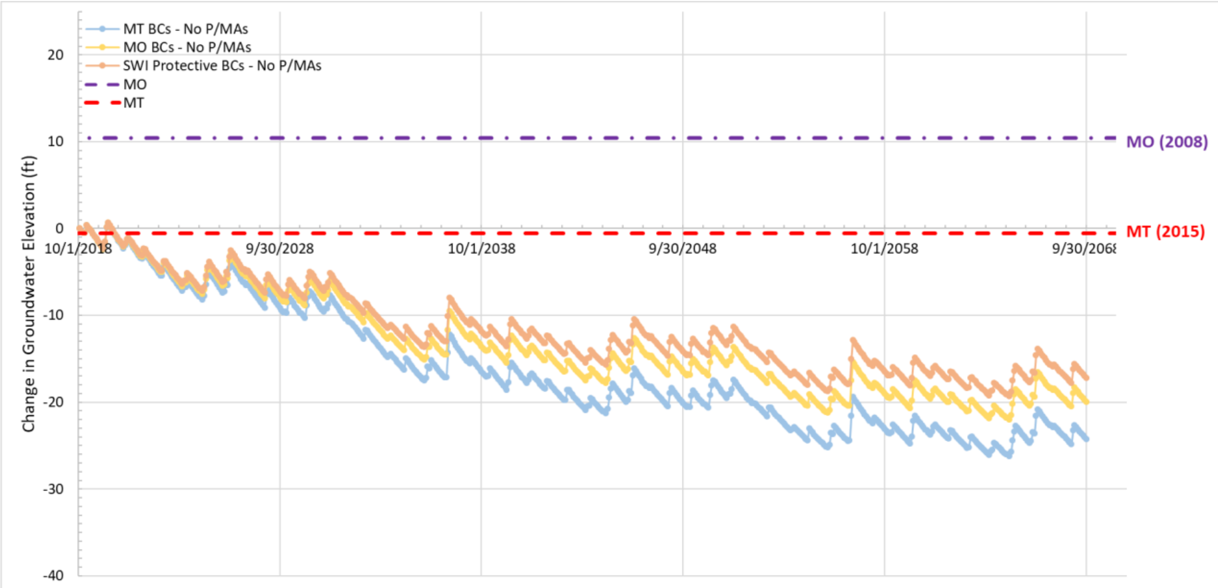


Figure ES-4. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Corral de Tierra Area WBZ

As shown on Figure ES, groundwater elevations in the Marina-Ord Area WBZ are projected to stabilize under all boundary conditions scenarios within the first ten years of GSP implementation. However, the resulting average groundwater elevation varies significantly between the various boundary scenarios. These results indicate that projects and/or management actions may be required to consistently maintain water levels above MTs and to achieve MOs within the Marina-Ord Area unless SWI protective boundary conditions are achieved in the adjacent subbasins.

As shown on Figure ES, groundwater elevations in the Corral de Tierra Area WBZ are projected to stabilize in the last ten years of the 50-year analog period. However, they stabilize at levels that are on average 17 to 25 feet lower than groundwater elevation MTs and 28 to 36 feet lower than groundwater elevations MOs even if SMCs are achieved in adjacent subbasins under these boundary condition scenarios. These results suggest that projects and/or management actions will be required to raise water levels above MTs and to achieve MOs within the Corral de Tierra Area WBZ.

ES.6.4 Sustainble Yield

SGMA defines sustainable yield as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the Subbasin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result" (CWC §10721(w)). Determination of the sustainable yield for the Subbasin is supported by water budget information and, more importantly, depends upon whether undesirable results are avoided within the timeframes required by SGMA. As discussed above, the attainment of MTs and MOs, which are established to avoid undesirable results and achieve basin sustainability, should be considered in the estimation of sustainable yield under SGMA.

The sustainable yield of the Monterey Subbasin is significantly affected by recharge, pumping, and conditions in adjacent subbasins. As such, the sustainable yield established based on historical overdraft has significant uncertainty, does not address all undesirable results. It also does not consider future conditions in adjacent subbasins which are projected to change as these subbasins move toward sustainability. A first-order estimate of the historic sustainable yield based on overdraft is provided Section 6.5. The historical and current sustainable yield estimates are for information only and do not guide groundwater management activities in this GSP.

Projected water budget results have been used to estimate the projected sustainable yield. The sustainable yield has been evaluated by Management Area (i.e., water budget zone) as conditions vary and independent SMCs have been established for each area.

Projected water budget results under the "no project" scenario support the conclusion that 9,870 AFY can be pumped from the Marina-Ord Area WBZ without long-term loss in storage. These calculations provide only first-order estimates of the magnitude of the Marina-Ord Area WBZ sustainable yield. Comparison of projected groundwater levels within the Marina-Ord Area WBZ under the "no project" and "project" scenarios presented in Section 9.6 with established groundwater level MTs and MOs provides significant insight regarding the projected sustainable yield as defined under SGMA. As discussed above, the attainment of MTs and MOs for all sustainability indicators, which are established to avoid undesirable results and achieve basin sustainability, should be considered in the estimation of sustainable yield under SGMA. As discussed in Sections 6.5.4, 9.6, and 9.6.1, projected groundwater level data indicate that:

- Under the "no project" scenario, groundwater levels in RMS wells stabilize and are generally higher than MTs during non-drought periods under all identified boundary conditions and climate scenarios, and reach MOs if SWI Protective Boundary Conditions are achieved in adjacent subbasins.
- Under the "Project" scenario, groundwater levels stabilize and are higher than MTs and reach MOs in RMS wells within the Marina-Ord Area WBZ, if MT and MO boundary conditions are achieved in adjacent subbasins, respectively.

These results indicate that the projected sustainable yield of the Marina-Ord Area WBZ ranges from approximately 4,400 AFY if adjacent subbasins are managed to their groundwater level MTs and adjudication goals as defined in their respective groundwater planning documents, to approximately 9,900 AFY if adjacent subbasins are managed to SWI protective groundwater levels[3]. As such, the actual sustainable yield of the Marina-Ord area will be impacted by the

[3] In the absence of the installation of a seawater intrusion extraction or injection barrier, SWI Protective Boundary Conditions will be required to achieve seawater intrusion MTs in the 180/400-Foot Aquifer Subbasin.

groundwater levels achieved and methods used to address seawater intrusion and reach SWI MTs within adjacent subbasins, e.g., groundwater recharge, seawater intrusion extraction or injection barrier, or a combination of methods. Therefore, a coordinated approach will be required to reach sustainability within the Monterey subbasin and adjacent subbasins. Further, although these projected budget results provide potential insight into the sustainable yield of the Marina-Ord Area, confirmation that these quantities could be extracted without inducing seawater intrusion has to be verified.

A first-order estimate of the projected sustainable yield of the Corral de Tierra Area WBZ is 2,100 AFY. This estimate of sustainable yield is the sustainable yield to hold groundwater levels where they are after the first 20 years of GSP implementation if there are no projects undertaken. Since groundwater levels are declining, this groundwater level would be significantly below current groundwater levels in the Corral de Tierra Area and below the groundwater level MTs. Therefore, this sustainable yield estimate of 2,100 AFY is likely an overestimate of the true sustainable yield where all undesirable results are avoided.

ES.7 Monitoring Networks

The MCWD GSA and SVBGSA developed the Monterey Subbasin's SGMA Monitoring Network to: (1) collect sufficient data to assess sustainability indicators relevant to the Subbasin, (2) evaluate potential impacts to the beneficial uses and users of groundwater, and (3) assess the effectiveness of the P/MAs implemented by the GSAs. The proposed SGMA Monitoring Network was developed to ensure sufficient spatial distribution and spatial density. The monitoring networks for the six sustainability indicators are described below.

- Chronic Lowering of Groundwater Levels – The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells. The groundwater elevation monitoring network in the Marina-Ord Area consists of over 390 wells, in which water levels are measured by U.S. Army, MCWRA, MPMWD, and/or the Seaside Groundwater Basin Watermaster. The groundwater elevation monitoring network in the Corral de Tierra Area consists of 13 wells, in which water levels are measured by MCWRA. Of these actively monitored wells, 35 have been selected as groundwater elevation representative monitoring site (RMS) wells in the Marina-Ord Area (2 to 6 wells per principal aquifer) and 13 have been selected as groundwater elevation RMS wells in the Corral de Tierra Area. In addition, the GSAs will incorporate groundwater level data from wells in adjacent subbasins and will continue to collaborate with agencies in adjacent subbasins. Areas where data gaps have been identified and additional monitoring is needed will be addressed by identifying an existing well or wells that meet valid monitoring well criteria, or drilling a new well or wells in these areas.
- Changes in Groundwater Storage – Data and minimum thresholds used to define undesirable results for chronic lowering of groundwater levels and seawater intrusion will also be used to assess reduction of groundwater storage. As such, the reduction of

groundwater storage monitoring network will consist of the same RMS wells as those used for groundwater elevation and seawater intrusion monitoring.

- Seawater Intrusion – The sustainability indicator for seawater intrusion is evaluated using the location of the 500 milligrams per liter (mg/L) chloride isoconcentration contour that is based on chloride concentrations, equivalent total dissolved solids (TDS) concentrations, and/or specific conductivity measurements. The seawater intrusion monitoring network consists of 42 RMS wells in the Marina-Ord area that are monitored by MCWD, U.S. Army, MCWRA, MPMWD, and/or the Seaside Groundwater Basin Watermaster. Areas where data gaps in this network have been identified overlap with areas where groundwater elevation monitoring data gaps exist and will be addressed concurrently.

- Groundwater Quality – The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing water supply wells. Separate minimum thresholds are set for the constituents of concern for public water system supply wells, on-farm domestic wells, and agricultural supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. Constituents of concern for drinking water are assessed at public water supply wells and on-farm domestic wells, and constituents of concern for crop health are assessed at agricultural supply wells. There is adequate spatial coverage to access the groundwater quality in the Subbasin, and as new domestic and agricultural supply wells are added to Ag Order 4.0, they will be added to the monitoring program.

- Subsidence – DWR has, and will be, collecting land subsidence data using InSAR satellite data, and will make these data available to GSAs. This subsidence dataset represents the best available data for the Monterey Subbasin and will therefore be used as the subsidence monitoring network.

- Depletion of Interconnected Surface Waters – Shallow groundwater elevations near potential locations of interconnected surface water will be used as a proxy metric for this indicator. As such, the interconnected surface water monitoring network will be comprised of RMS sites adjacent to potential interconnected surface waters where minimum thresholds and measurable objectives based on shallow groundwater levels are developed for depletion of interconnected surface water. Given the stable groundwater patterns in the Dune Sand Aquifer, there is no significant and unreasonable depletion of interconnected surface water under current conditions in the Marina-Ord Area. One RMS well is included in the interconnected surface water monitoring network in this area. In the event that future groundwater activities in the Subbasin or the adjacent 180/400-Foot Aquifer Subbasin may influence the condition of the Marina vernal ponds and/or the Dune Sand Aquifer, the GSAs will work with project proponents to install additional shallow groundwater monitoring wells. In the Corral de Tierra Area, the level of surface water interconnection with the principal aquifer is unclear. An analysis of shallow groundwater levels is used to identify areas of potential interconnection between surface water and groundwater. There are currently no known existing wells that could be included in the interconnected surface water monitoring network near the El Toro Creek or Salinas River. To fill this data gap, SVBGSA will work to install one shallow well near El Toro Creek into the interconnected surface water monitoring network and may work with the United States Geological Survey (USGS) to reactivate the stream gauge along Toro Creek. The conjunctive data collection will help correlate the potential seasonal flows with shallow groundwater and assess both the interconnectivity as well as the relationship with deeper wells in the area.

Data collected from the SGMA Monitoring Network will be uploaded to a Data Management System to be established and managed for the Monterey Subbasin and reported to the DWR in accordance with the Monitoring Protocols developed for the Subbasin.

ES.8 Sustainable Management Criteria

Sustainable Management Criteria (SMCs) are the metrics by which groundwater sustainability is judged under SGMA. Key terms related to SMCs under SGMA include the following:

- **Sustainability indicator** refers to any of the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, cause undesirable results, as described in California Water Code §10721(x).

  The six sustainability indicators relevant to this subbasin include chronic lowering of groundwater levels; reduction of groundwater storage; degraded water quality; land subsidence; seawater intrusion; and depletion of interconnected surface waters.

- **Undesirable Results** occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the Subbasin.

  The GSP Emergency Regulations requires that the description of undesirable results include (1) the cause of groundwater conditions that would lead to or has led to undesirable results; (2) a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the Subbasin (i.e., the undesirable result criteria); and (3) potential effects that may occur or are occurring from undesirable results. An example undesirable result criteria could be defined as: more than 10% of the measured groundwater elevations being lower than the minimum thresholds.

- **Significant and Unreasonable Conditions**

  Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, "Undesirable results occur when significant and unreasonable effects … are caused by groundwater conditions…". The SGMA BMP states that "the GSAs must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable, including reasons for justifying each *particular threshold selected." Therefore, this GSP adopts the phrase significant and unreasonable conditions to be the qualitative description of conditions used to justify selected minimum thresholds and undesirable results criteria.*

- **Measurable objectives** refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the Subbasin.

  Measurable objectives are goals that the GSP is designed to achieve.

- **Minimum threshold** refers to a numeric value for each sustainability indicator used to define undesirable results.

  Minimum thresholds are quantitative indicators of an unreasonable condition.

- **Interim milestone** refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

  Interim milestones are targets such as groundwater elevations that will be achieved every five years to demonstrate progress towards sustainability.

The SMCs detailed in Table ES-3 define the Subbasin's future conditions and commit the GSA to actions that will meet these objectives.

Table ES-3. Sustainable Management Criteria Summary

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Chronic lowering of groundwater levels	Measured through the groundwater elevation representative monitoring well network within each management area	**Marina-Ord Area:** Minimum groundwater elevations historically observed between 1995 and 2015 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers.	**Marina-Ord Area:** Groundwater elevations observed in 2004 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers.	Over the course of any one year, exceedance of more than 20% of groundwater level minimum thresholds in **either** (a) both the Dune Sand and upper 180-Foot Aquifers, or (b) both the lower 180-Foot and 400-Foot Aquifers, or (c) the Deep Aquifers, or (d) the El Toro Primary Aquifer System.	**Whole Subbasin:** Interim milestones are described in Table 8-3 for each RMS well that is defined in Chapter 7.
		Corral de Tierra Area: Groundwater elevations observed in 2015 in the El Toro Primary Aquifer System.	**Corral de Tierra Area:** Groundwater elevations observed in 2008 in the El Toro Primary Aquifer System.		

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Reduction in groundwater storage	Measured through the groundwater elevation and seawater intrusion representative monitoring well networks.	**Whole Subbasin:** Minimum thresholds for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage minimum threshold.	**Whole Subbasin:** Measurable objectives for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage measurable objective.	Over the course of any one year, (1) exceedance of more than 20% of groundwater level minimum thresholds in **either** (a) both the Dune Sand and upper 180-Foot Aquifers, or (b) both the lower 180-Foot and 400-Foot Aquifers, or (c) the Deep Aquifers, or (d) the El Toro Primary Aquifer System; OR (2) Exceedance of seawater intrusion minimum thresholds.	**Whole Subbasin:** Groundwater elevation and seawater intrusion interim milestones described respectively in Table 8-3 and Section 8.9.4.2 will serve as a proxy for reduction of groundwater storage interim milestones.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Seawater intrusion	Measured through seawater intrusion representative monitoring well network.	**Whole Subbasin:** The approximate location in 2015 of the 500 mg/L chloride concentration isocontour in the lower 180-Foot and 400-Foot Aquifers; Approximately 3,500 feet from the coast in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers. This distance is generally consistent with the location of Highway 1 in the Monterey Subbasin and seaward of groundwater extraction wells in the Subbasin. No seawater intrusion in the El Toro Primary Aquifer System.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedance of the minimum threshold is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives. No seawater intrusion above 500 mg/L chloride in RMS wells.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Degraded groundwater quality	Groundwater quality data downloaded annually from state sources.	**Whole Subbasin:** No additional exceedances of drinking water standards in potable supply wells or Basin Plan water quality objectives for agricultural supply wells as a result of GSP implementation. Exceedances are only measured in public water system supply wells and domestic and agricultural (ILRP) wells. See Table 8-5 for the list of constituents.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedances of minimum thresholds during any one year as a direct result of projects or management actions conducted pursuant to GSP implementation is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions
Subsidence	Measured using DWR-provided InSAR data.	**Whole Subbasin:** Zero net long-term subsidence, with no more than 0.1 foot per year of measured vertical displacement between June of one year and June of the subsequent year to account for InSAR measurement errors.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedances of minimum thresholds during any one year due to lowered groundwater elevations is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Depletion of interconnected surface water (ISW)	Measured through shallow groundwater elevations as a proxy near potential locations of ISW in the ISW representative monitoring well network.	**Whole Subbasin:** Minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of interconnected surface water.	**Whole Subbasin:** Identical to minimum threshold shallow groundwater elevations.	Any minimum threshold exceeded in a shallow groundwater well near any location of ISW for more than two consecutive years.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions.

ES.9 Projects and Management Actions

This GSP identifies projects and management actions that will allow the Monterey Subbasin to attain sustainability in accordance with §354.42 and §354.44 of the GSP Emergency Regulations. The goal of the projects and management actions is to address significant and unreasonable results related to the chronic lowering of groundwater levels and seawater intrusion in each management area.

The GSP highlights the hydraulic connection between the Monterey Subbasin and both the adjacent critically overdrafted 180/400-Foot Aquifer Subbasin and Seaside Subbasin. Reaching sustainability and achieving measurable objectives within the Monterey Subbasin will be affected by groundwater conditions and management within these adjacent subbasins and the greater Salinas Valley Basin. Therefore, projects, management actions, and implementation actions will need to be coordinated between subbasins to achieve sustainability. Regional coordination projects and multi-subbasin projects are included when they have the potential to directly benefit this Subbasin. Therefore, the Subbasin Groundwater Sustainability Agencies (GSAs) have developed a SGMA implementation approach that includes regional coordination actions, participating in regional, multi-basin projects, in addition to implementing local projects and management actions.

The projects and management actions for this GSP are summarized in Table 9-1 and include these major categories:

- **Multi-subbasin Projects** – Projects that provide supply augmentation to the Monterey Subbasin that require infrastructure or rely on a supply source outside the Monterey Subbasin. These projects are generally identified in multiple Salinas Valley Subbasin GSPs and expand upon how the project would be applied in the Monterey Subbasin. These multi-subbasin projects include:
    - Seasonal Release from Reservoirs with ASR and Direct Delivery
    - Regional Municipal Supply through brackish water desalination extracted from seawater intrusion barrier
    - Multi-benefit Stream Channel Improvements
- **Marina-Ord Area Local Projects and Management Actions** – Projects and management actions to be led by MCWD (or Marina-Ord Area agencies) that will primarily benefit the Marina-Ord Area. These projects and management actions include:
    - MCWD Demand Management Measures – Continued Conservation
    - Stormwater Recharge Management
    - Recycled Water Reuse through Landscape Irrigation and Indirect Potable Reuse
    - Monitoring Wells

- **Corral de Tierra Area Local Projects and Management Actions** – Projects and management actions to be led by SVBGSA that will primarily benefit the Corral de Tierra Area. These projects and management actions include:
    - Pumping Allocation and Control
    - Check Dams
    - Recharge from Surface Water Diversions
    - Wastewater Recycling for Reuse
    - Decentralized Residential In-lieu Recharge Projects
    - Decentralized Stormwater Recharge Projects
    - Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley (Artesian Well)

The potential projects presented in the GSP, if implemented in aggregate, are adequate to supply the entirety of projected groundwater demands in the Marina-Ord Area and significantly impact the projected demand in the Corral de Tierra Area.

The MCWD GSA and SVBGSA are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin and will be directly leading joint efforts to achieve sustainability and mitigate any residual overdraft. As described herein, regional, or multi-subbasin projects and management actions will need to be coordinated. For example, in the event that a seawater intrusion extraction barrier is constructed in the 180/400-Foot Aquifer Subbasin, impacts to groundwater levels, seawater intrusion, and cross-boundary flows will need to be assessed.

To demonstrate this future coordination, Implementation Action 1 (Support Implementation of the 180/400-Foot Aquifer Subbasin GSP and Seaside Watermaster Actions) describes the GSAs' plan to support projects and actions in adjacent subbasins, particularly those that will improve groundwater conditions near Monterey Subbasin boundaries and reduce the potential for seawater intrusion and decrease cross-boundary outflows from the Monterey Subbasin.

ES.10 Plan Implementation

Key GSP implementation activities to be undertaken by the MCWD GSA and SVBGSA over the next five years include:

- Data collection, monitoring, and reporting;
    - Annual monitoring and reporting
    - Updating the Data Management System
    - Improving monitoring networks
    - Addressing identified data gaps in the Hydrogeologic Conceptual Model (HCM)

- Conducting intra-basin and inter-basin coordination;
- Continuing communication and stakeholder engagement;
- Conducting periodic evaluations of the GSP;
- Implementing projects and management actions and preparing grant applications; and
- Developing a funding strategy.

1 INTRODUCTION

1.1 Purpose of the Groundwater Sustainability Plan (GSP or Plan)

The purpose of this Groundwater Sustainability Plan (GSP) is to meet the regulatory requirements set forth in the three-bill legislative package consisting of Assembly Bill (AB) 1739 (Dickinson), Senate Bill (SB) 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act (SGMA). SGMA defines sustainable groundwater management as the "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results". Undesirable results are defined by the Sustainable Groundwater Management Act (SGMA) as any of the following effects caused by groundwater conditions occurring throughout the Subbasin:

- Chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply;
- Significant and unreasonable reduction of groundwater storage;
- Significant and unreasonable seawater intrusion;
- Significant and unreasonable degraded water quality;
- Significant and unreasonable land subsidence; and/or
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

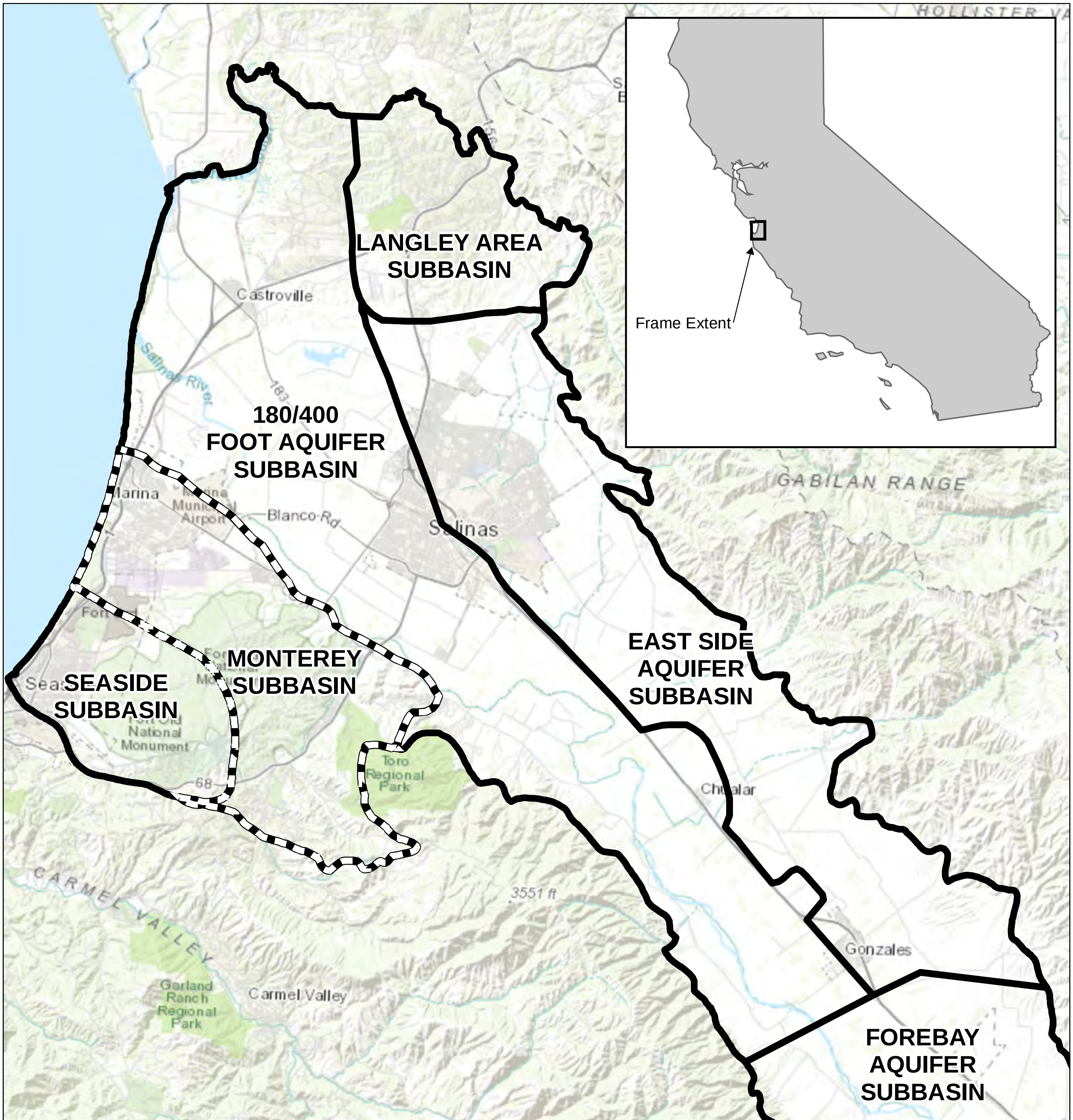
The Monterey Subbasin (Subbasin) has been designated by the California Department of Water Resources (DWR) as medium priority. The Monterey Subbasin is one of the nine subbasins in the Salinas Valley. It is located at the northwestern end of the Salinas Valley and borders the Pacific Ocean (Figure 1-1). This document satisfies the GSP requirement for the Monterey Subbasin and meets all of the regulatory standards.

This GSP has been co-developed by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) to meet SGMA regulatory requirements by January 31, 2022, deadline for medium and high priority basins while reflecting local needs and preserving local control over water resources. This GSP provides a path to achieve and document sustainable groundwater management within 20 years following Plan adoption and preserves the long-term sustainability of locally-managed groundwater resources now and into the future. This GSP was approved by the MCWD GSA Board on January 17, 2022 and by the SVBGSA Board on January 13, 2022 (Appendix 1-A).

1.2 Sustainability Goal

The sustainability goal of the Monterey Subbasin is to manage groundwater resources for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. The goal of this GSP is to ensure long-term viable water supplies to local communities at a reasonable cost. In addition, because the Subbasin is hydrologically connected with other Salinas Valley Basin Subbasins, this GSP aims to develop a coordinated approach to groundwater management within this Subbasin and neighboring Subbasins. The Subbasin will achieve long-term sustainability through implementation of inter- and intra-basin coordination as well as projects and management actions.

Several projects and management actions are included in this GSP and detailed in Chapter 9. These projects and management actions will diversify the Subbasin's water supply portfolio, increase supply reliability, and protect the Subbasin's groundwater resources against seawater intrusion. The Subbasin's historical efforts to invest in water conservation will continue under SGMA.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

N

0 4 8

(Scale in Miles)

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Monterey Subbasin

Marina Coast Water District

Monterey County, CA

November 2021

Figure 1-1

Path: X:\B60094\Maps\2021\09\Fig1-1_MontereySubbasin.mxd

1.3 Agency Information

The Monterey Subbasin is within the jurisdiction of the MCWD GSA and SVBGSA. The GSA boundaries are shown on Figure 1-2.

1.3.1 Name and Mailing Address of the Agency

This GSP has been prepared by MCWD GSA and SVBGSA. The following contact information is provided for each GSA that is a signatory to this GSP, pursuant to California Water Code §10723.8.

Marina Coast Water District Groundwater Sustainability Agency
Attn.: Remleh Scherzinger, General Manager
11 Reservation Road
Marina, CA 93933
http://www.mcwd.org

Salinas Valley Groundwater Sustainability Agency
Attn.: Donna Meyers, General Manager
1441 Schilling Place
Salinas, CA 93901
https://svbgsa.org

1.3.2 Organization and Management Structure of the Agencies

1.3.2.1 MCWD GSA

The MCWD GSA is a single agency GSA formed by MCWD and covering the areas within the MCWD service area within Monterey Subbasin, except for those areas owned by a federal government entity and thus not subject to SGMA. The GSA areas are shown on Figure 1-2. The MCWD GSA Board is comprised of the members of the MCWD Board.

1.3.2.2 SVBGSA

The SVBGSA is a Joint Powers Authority (JPA). The JPA membership comprises the County of Monterey, Monterey County Water Resources Agency (MCWRA), City of Salinas, City of Soledad, City of Gonzales, City of King, the Castroville Community Services District (CSD), and Monterey One Water (formerly the Monterey Regional Water Pollution Control Agency). The SVBGSA is governed and administered by an eleven-member Board of Directors, representing public and private groundwater interests throughout the Valley. When a quorum is present, a Majority Vote is required to conduct business. Some business items require a Super Majority Vote or a Super Majority Plus Vote. A Super Majority requires an affirmative vote by eight of the eleven Board members. A Super Majority Vote is required for:

- Approval of a GSP
- Amendment of budget and transfer of appropriations
- Withdrawal or termination of Agency members

A Super Majority Plus requires an affirmative vote by eight of the eleven Board members, including an affirmative vote by three of the four agricultural representatives. A Super Majority Plus Vote is required for:

- Decisions to impose fees not requiring a vote of the electorate or property owners
- Proposals to submit to the electorate or property owners' decisions to impose fees or taxes
- Limitations on well extractions (pumping limits)

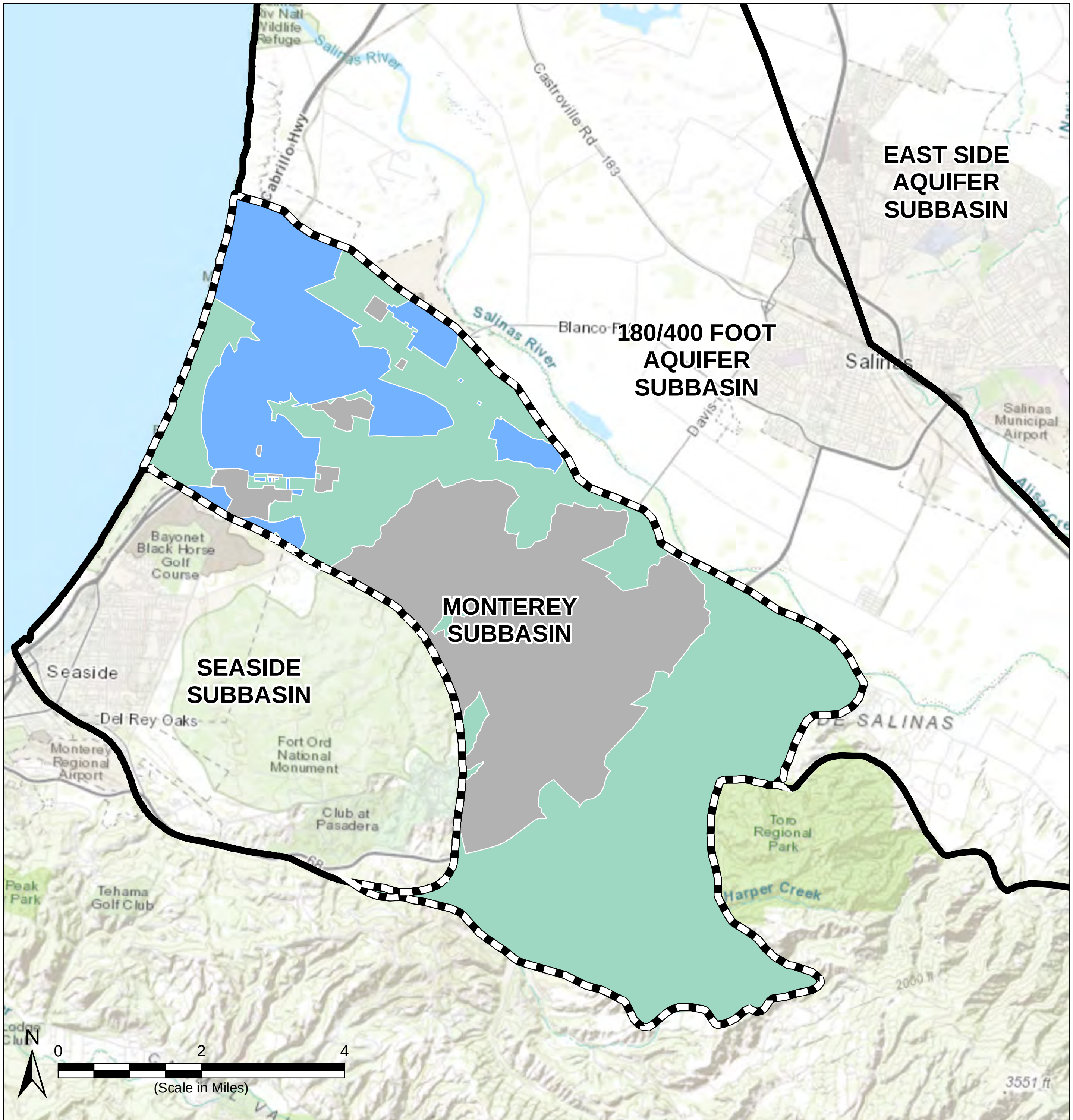
In addition to the Board of Directors, SVBGSA includes an Advisory Committee consisting of Directors and non-Directors. The Advisory Committee is designed to ensure participation by, and input to, the Board of Director by constituencies whose interests are not directly represented on the Board. The SVBGSA's GSA activities are led by a contract General Manager.

1.3.3 Plan Managers

The plan managers for this GSP are Remleh Scherzinger, General Manager of the MCWD, and Donna Meyers, General Manager of the SVBGSA. The contact information for Mr. Scherzinger and Ms. Meyers is provided below.

Remleh Scherzinger
General Manager
Marina Coast Water District
11 Reservation Road, Marina, CA93933-2099
831-883-5910
rscherzinger@mcwd.org

Donna Meyers
General Manager
Salinas Valley Basin Groundwater Sustainability Agency
1441 Schilling Place
Salinas, CA 93901
meyersd@svbgsa.org
https://svbgsa.org



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- SVBGSA
- MCWD GSA
- Federal Land (Source 3)

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
3. Parcels retained by the federal government in the former Fort Ord are provided by Army Corps of Engineers on 12 Spetember 2019.

Basin GSAs

Marina Coast Water District
Monterey County, CA
November 2021

Figure 1-2

Path: X:\B60094\Maps\2021\09\Fig1-2_Basin GSAs.mxd

1.3.4 Legal Authority of the GSAs

Both GSAs involved in the development of this GSP were formed in accordance with the requirements of California Water Code §10723 et seq.

1.3.4.1 MCWD GSA

MCWD GSA is formed in accordance with the requirements of California Water District Law, California Water Code §34000 by MCWD. MCWD provides water supply to residents within its service area within the City of Marina and the former Fort Ord, and is therefore a local agency under California Water Code §10721 with the authority to establish itself as a GSA.

1.3.4.2 SVBGSA

SVBGSA is a JPA that was formed in accordance with the requirements of California Government Code §6500 et seq. In accordance with California Water Code §10723 et seq, the JPA signatories are all local agencies under California Water Code §10721 with water or land use authority and are all independently eligible to serve as GSAs:

- The County of Monterey has land use authority over the unincorporated areas of the County, including areas overlying the Monterey Subbasin. The County of Monterey is therefore a local agency under California Water Code §10721 with the authority to establish itself as a GSA.
- The Monterey County Water Resources Agency (MCWRA) is a California Special Act District with broad water management authority in Monterey County.
- The City of Salinas is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents.
- The City of Soledad is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents.
- The City of Gonzales is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents.
- The City of King is incorporated under the laws of the State of California. The City provides water supply and land use planning services to its residents.
- The Castroville Community Services District is a local public agency of the State of California, organized and operating under the Community Services District Law, Government Code §6100 et seq. Castroville CSD provides water services to its residents.
- Monterey One Water is itself a joint powers authority whose members include many members of the SVBGSA.

Upon establishing itself as a GSA, the SVBGSA retains all the rights and authorities provided to GSAs under California Water Code §10725 et seq. as well as the powers held in common by the members.

1.3.5 Coordination Agreements

As the MCWD GSA and SVBGSA have developed a single GSP for the entire Monterey Subbasin, a Coordination Agreement per GSP Emergency Regulations §357.4 is not required between these two parties. Nonetheless, MCWD GSA and SVBGSA have successfully entered into a Framework Agreement regarding responsibilities and coordination for GSP development in the 180/400 Subbasin and the Monterey Subbasin, included as Appendix 1-B. The Framework Agreement was adopted by MCWD GSA in December 2018 and SVBGSA in January 2019.

The Framework Agreement outlines the Management Areas to be established within the Subbasin, which are later formalized in this GSP (see Figure 1-3 and detailed discussion below). According to the Framework Agreement, MCWD GSA has prepared GSP components for the Marina-Ord Management Area and SVBGSA has prepared GSP components for the Corral de Tierra Management Area. The Framework Agreement further establishes a basis for information developed by the two agencies to be integrated into a single GSP for the Monterey Subbasin, including a coordination and stakeholder engagement process, information exchange principles, as well as the acknowledgement that coordinated methodologies are to be developed for the water budget and monitoring network analysis.

1.4 Management Areas

This GSP establishes two Management Areas within the Monterey Subbasin in accordance with GSP Emergency Regulations §351(r) and §354.20. The Management Areas include

- Marina-Ord Area: This Management Area consists of the lands within the City of Marina, City of Seaside, and the former Fort Ord, which are generally located north of State Route 68; and
- Corral de Tierra Area: This Management Area consists of the remainder of the Subbasin, which includes lands generally south of State Route 68 and a few parcels located along the northern subbasin boundary with the 180/400-Foot Aquifer Subbasin.

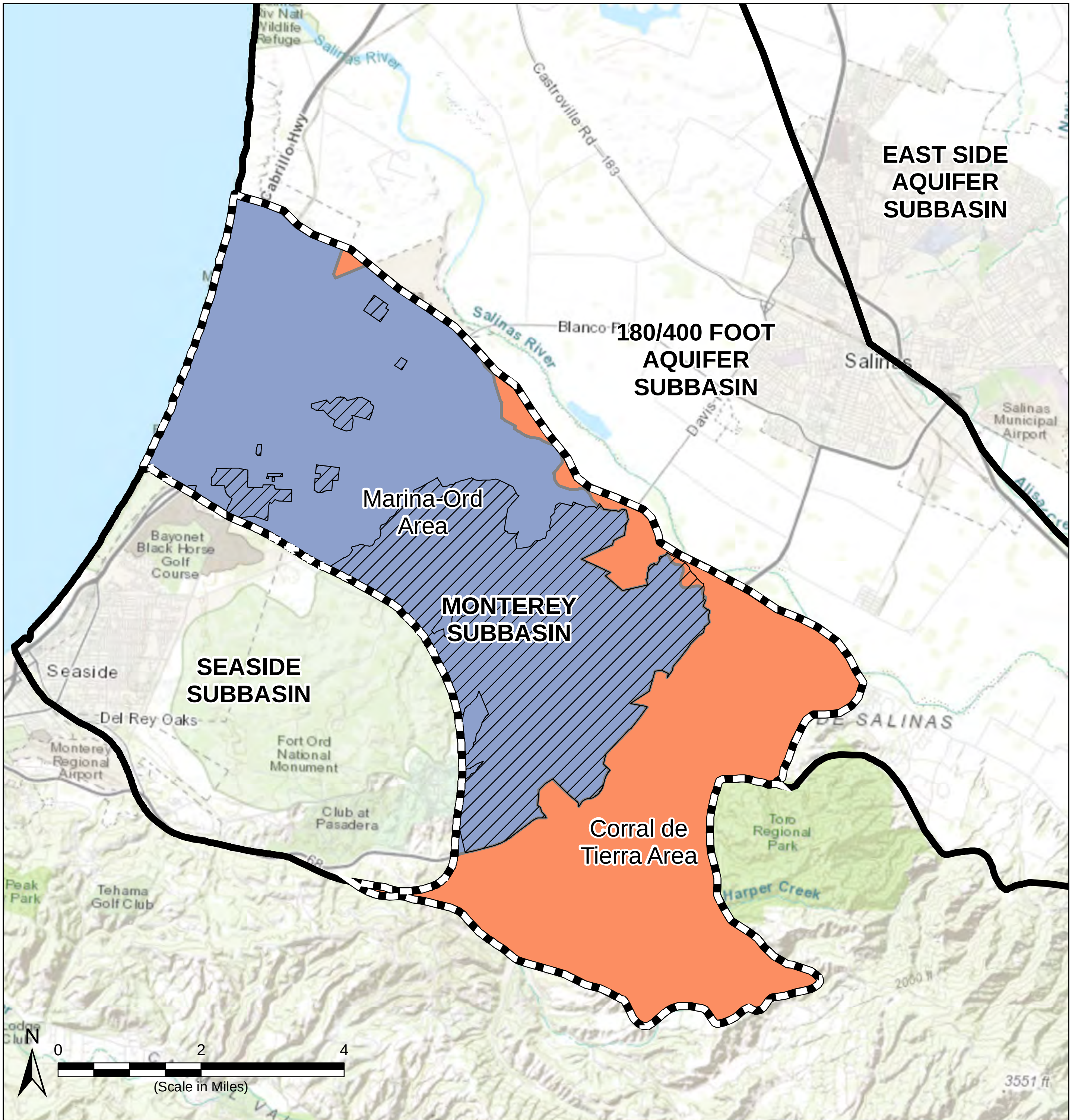
The Management Areas are developed considering the differences in jurisdictional, water use sector, and aquifer characteristics within these areas.

Jurisdictional and water use sector information for the Subbasin is presented in Section 3.1. Water use sectors within the Marina-Ord Area include municipal water use and minimal groundwater remediation use. The sole water purveyor within the Marina-Ord Area is the MCWD, which serves water within its service area and will serve any future redevelopment within the former Fort Ord. Water use sectors in the Corral de Tierra Area include municipal water use supplied by various small water systems as well as agricultural and grazing water use.

Aquifer characteristics within these Management Areas are discussed in Section 4.2 In general, hydrostratigraphy in the vicinity of the City of Marina consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas

Valley. Within the southern Corral de Tierra Area, the typical aquifer sequence recognized in the northern Salinas Valley is not present.

The Management Areas are developed to facilitate GSP implementation in these areas. Specifically, the establishment of the Marina-Ord Area allows MCWD GSA to plan, fund, and implement sustainable groundwater management for the redevelopment of the former Fort Ord, within and outside of its current jurisdictional area. Whereas, SVBGSA will tailor the management approach in the Corral de Tierra Area towards drinking water and agricultural users.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Federal Lands

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Management Areas

Marina Coast Water District
Monterey County, CA
November 2021

Figure 1-3

Path: X:\B60094\Maps\2021\09\Fig1-3_ManagementAreas.mxd

1.5 Overview of this GSP

The GSP covers the entire Monterey Subbasin and is developed jointly by the MCWD GSA and the SVBGSA. This GSP is developed in concert with GSPs for five other Salinas Valley Groundwater Basin subbasins subject to SGMA: the 180/400-Foot Aquifer Subbasin, the Forebay Aquifer Subbasin, the Upper Valley Aquifer Subbasin, the Langley Area Subbasin, and the Eastside Aquifer Subbasin. While this GSP is focused on the Monterey Subbasin, the GSP will be implemented in accordance with SVBGSA's role in maintaining and achieving sustainability for all subbasins within the Salinas Valley Groundwater Basin. The Monterey Subbasin is referred to as the Subbasin throughout this GSP, and the collection of Salinas Valley Groundwater Subbasins are collectively referred to as the Basin or the Valley.

Chapter 2 details the stakeholders that participated, and the processes followed to develop this GSP. Stakeholders worked together to gather existing information, define sustainable management criteria for the Subbasin, and develop a list of projects and management actions.

Chapters 3 through 6 describe the Basin Setting, present the hydrogeologic conceptual model, and describe historical and current groundwater conditions. It further establishes estimates of the historical, current, and future water budgets based on the best available information.

Chapter 7 and 8 proceed to detail required monitoring networks and define local sustainable management criteria.

Chapter 9 outlines projects and management actions for reaching sustainability in the Subbasin by 2042.

Additionally, GSP topics are discussed respectively for the Marina-Ord and Corral de Tierra Areas as necessary, acknowledging the hydrogeological differences and data gaps between these Management Areas. As part of the two GSAs' collaborative GSP development process, components for the Marina-Ord Area were prepared by MCWD GSA, and components for the Corral de Tierra Area were prepared by SVBGSA.

This GSP will be updated and adapted as new information and more refined models become available. This includes updating sustainable management criteria as well as projects and management actions to reflect updates and future conditions. Adaptive management will be reflected in the required five-year assessments and annual reports.

2 COMMUNICATIONS AND STAKEHOLDER ENGAGEMENT

This chapter includes a summary of information relating to notification and communication by the Groundwater Sustainability Agencies (GSAs) with other agencies and interested parties during Groundwater Sustainability Plan (GSP) development pursuant to GSP Emergency Regulations §354.10.

The Subbasin GSAs developed a Framework Agreement regarding GSP development as described in Section 1.3.5. The Framework Agreement states that the Marina Coast Water District (MCWD) GSA will prepare GSP components for the Marina-Ord Area of the Monterey Subbasin and that the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) will prepare GSP components for the Corral de Tierra Area of the Monterey Subbasin for incorporation into a single GSP. The Framework Agreement further states that the parties agree to work collaboratively to develop and implement stakeholder engagement plans for the GSPs while each party is responsible for guiding efforts within their respective plan preparation areas.

2.1 GSA Decision-Making Process

This section describes each GSA's governance structure and decision-making processes.

2.1.1 MCWD GSA Governance Structure

The MCWD GSA is a single agency GSA formed by MCWD within the Monterey Subbasin (Subbasin; California Department of Water Resources [DWR] 3-004.10) and 180/400-Foot Aquifer Subbasin (DWR 3-004.01) of the Salinas Valley Basin. The MCWD GSA Board is comprised of the members of the MCWD Board. GSA Board meetings are held jointly with MCWD Board meetings every third Monday of each month and are open to the public.

Key GSP development and implementation decisions are made by the GSA Board of Directors (Board). The Board considers staff, stakeholder, and public input captured and evaluated by the Steering Committee, MCWD stakeholder workshops, and direct communication with interested parties. The Board is the final decision-making body for adoption of GSPs completed by the GSA.

2.1.2 SVBGSA Governance Structure

SVBGSA is governed by a local and diverse 11-member Board and relies on robust science and public involvement for decision-making. The Board meets monthly, and all meetings are open to the public. The Board is the final decision-making body for adoption of GSPs completed by the GSA.

The SVBGSA Advisory Committee advises the SVBGSA Board. The Advisory Committee is comprised of 25 members. The Advisory Committee strives to include a range of interests in groundwater in the Salinas Valley and outlined in SGMA. Advisory Committee members live in the Salinas Valley or represent organizations with a presence or agencies with jurisdiction in the Basin including:

- All groundwater users
- Municipal well operators, Public-Utilities Commission-Regulated water companies, and private and public water systems
- County and city governments
- Planning departments/land use
- Local landowners
- Underrepresented communities (URCs)
- Business and agriculture
- Rural residential well owners
- Environmental uses

The Advisory Committee, at this time, does not include representation from:

- Tribes
- Federal government

The Advisory Committee will review its charter following GSP completion for additional members if identified as necessary by the Board. The Advisory Committee provides input and recommendations to the Board and uses consensus to make recommendations to the Board. The Advisory Committee was established by Board action and operates according to a Committee Charter which serves as the bylaws of the Advisory Committee. The Advisory Committee reviews and provides recommendations to the Board on groundwater-related issues that may include:

- Development, adoption, or amendment of the GSP
- Sustainability goals
- Monitoring programs
- Annual work plans and reports
- Modeling scenarios
- Inter-basin coordination activities
- Projects and management actions to achieve sustainability
- Community outreach
- Local regulations to implement SGMA
- Fee proposals
- General advisory

Subbasin planning committees were established in May 2020 by the Board of Directors to inform and guide planning for the five GSPs due in January 2022. Membership is 7-12 people per Subbasin Planning Committee and all meetings are Brown Act meetings.

Together the Board, Advisory Committee, and Subbasin Planning Committees are working to complete the six GSPs required within the SVBGSA jurisdiction. Subsequent to that, SVBGSA will complete a Salinas Valley Basin-wide Integrated Implementation Plan (IIP) that will detail project portfolios and groundwater sustainability programs to meet SGMA compliance for subbasins by 2042 and maintain sustainability through 2050. Once all the GSPs are filed, the Subbasin Planning Committees will transition to implementation committees.

2.2 Intra-basin Coordination

The MCWD GSA and SVBGSA have made intra- and inter-basin coordination a priority to ensure successful GSP development. Pursuant to the Framework Agreement, the GSAs has organized and convened regular meetings for coordinating GSP development and implementation for the Subbasin:

- The **Technical Committee** includes staff and technical consultants from MCWD GSA and SVBGSA. The Technical Committee meets bi-weekly to review draft GSP content prepared by each GSA and resolve differences.
- The **Steering Committee** includes the General Manager and one Board Member from each GSA, who will update each GSA Board of Directors. The Steering Committee reports back to each GSA's board. The Steering Committee oversees implementation of the Framework Agreement, reviews matters elevated by the Technical Committee, and works to reach consensus. The Steering Committee meetings are subject to the California Open Meeting Law ("Brown Act") and are open to the public.

These coordinated efforts, along with individual agency engagement strategies, aim to create a consistent understanding of subbasin conditions among stakeholders and facilitate integration of local and regional projects and management actions needed to achieve groundwater sustainability.

2.3 Communication and Public Engagement by MCWD GSA

MCWD GSA's program for Communication and Engagement is designed to effectively engage a variety of relevant stakeholders in the development of a GSP that will guide the GSA to demonstrate sustainability by January 31, 2042, and maintain sustainability through the Sustainable Groundwater Management Act (SGMA)'s 50-year planning timeline. Pursuant to the Framework Agreement, MCWD GSA's communication program focuses on development and implementation of GSP components within the Marina-Ord Area.

The GSA's Communication and Engagement efforts aim to support a GSP that best meets the needs of beneficial uses and users of groundwater in the Marina-Ord Area and reflects and incorporates stakeholder input as appropriate. As MCWD is the only water supplier within the Marina-Ord Area where water use is dominantly urban use, communication with stakeholders and beneficial users within the Marina-Ord Area hinges on dialogues with key stakeholder agencies identified in Section 2.3.1 below.

MCWD GSA's goal is to engage stakeholders early in the decision-making process to consider their interests and concerns and be open and transparent in any decisions that will have a substantial impact on beneficial users of groundwater in the Subbasin.

2.3.1 Defining and Describing Stakeholders in the Marina-Ord Area

MCWD GSA has identified beneficial uses and users of groundwater within the Marina-Ord Area per the interests listed in California Water Code (CWC) §10723.2, as well as additional stakeholders of interest.

Agriculture. There are no agricultural groundwater users within the Marina-Ord Area.

Domestic Water Users. Due to well installation requirements of the Monterey County and MCWD, only domestic wells that pre-date County and City ordinances or for urban irrigation may exist within the Marina-Ord Area. Although minimal, the exact quantity of domestic wells is not well known.

Municipal Well Operators and Public Water Systems. MCWD is the only municipal well operator and public water system within the Marina-Ord Area. MCWD provides water service to the City of Marina, City of Seaside, and the former Fort Ord Army Base. A portion of the former Fort Ord is retained for use by the U.S. Army, while the remainder is being converted to civilian use for redevelopment.

Local Land Use Planning Agencies. There are several local land use planning agencies located within the Marina-Ord Area, including the City of Marina, the City of Seaside, and the County of Monterey.

Environmental Users of Groundwater. Potential groundwater dependent ecosystems exist in the Marina-Ord Area within the lands of the City of Marina and Fort Ord National Monument. Lands within the Fort Ord National Monument are not subject to SGMA. The U.S. Army currently conducts remedial activities within the Fort Ord National Monument under the guidance of the Fort Ord Habitat Management Plan (U.S. Army, 1997) as well as U.S. Fish and Wildlife Services Biological Opinions.

Surface Water Users. There are no surface water users within the Marina-Ord Area.

The Federal Government. The U.S. Army and the U.S. Bureau of Land Management manage federal lands within the Marina-Ord Area that are not subject to SGMA. MCWD is the exclusive water purveyor to the U.S. Army for all Army and Federal facilities within the Marina-Ord Area. There is no current or planned groundwater use by the Bureau of Land Management on its lands.

California Native American Tribes. There are no identified California Native American tribal lands within the Subbasin.

Disadvantaged Communities (DACs). Census Tracts 141.02 and 142.04, which are recognized as Disadvantage Community Tracts, as well as several Disadvantage Community Block Groups (a statistical division of a census tract), overly the Marina-Ord Area (Figure 2-1). There are no Disadvantaged Community Places identified within the area[4]. Some of these disadvantaged community areas are missing income data and may include the student population from California State University Monterey Bay. These recognized disadvantaged communities are located within the urban areas of the City of Marina and receive water service from MCWD.

Groundwater Monitoring Entities. Monterey Peninsula Water Management District (MPWMD) and Monterey County Water Resources Agency (MCWRA) are Monitoring Entities in the Subbasin under the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Additionally, these agencies have water management authority in portions of the Marina and Ord Areas. The U.S. Army also monitors groundwater within former Fort Ord as part of its groundwater remedial efforts to address legacy groundwater contamination. Collaboration with these water agencies and the U.S. Army will be integral to the sustainable management of the Subbasin.

Other Groundwater Management Entities. The Monterey Subbasin is adjacent to the critically-overdrafted, high-priority 180/400-Foot Aquifer Subbasin and the adjudicated Seaside Subbasin of the Salinas Valley Basin. SGMA compliance within the 180/400-Foot Aquifer Subbasin is carried out by the MCWD GSA and SVBGSA. The adjudicated Seaside Subbasin is managed by the Seaside Groundwater Basin Watermaster. MCWD will inform, involve, and collaborate with SVBGSA and the Seaside Groundwater Basin Watermaster to ensure sustainable management of groundwater across basins.

Monterey One Water (M1W; formerly the Monterey Regional Water Pollution Control Agency) is a wastewater and recycled water agency serving municipalities of northern Monterey County including the Marina and Ord Areas. M1W provides advanced treated wastewater for Indirect Potable Reuse in the Seaside Subbasin and for irrigation in the Monterey Subbasin (the Pure Water Monterey). MCWD is collaborating with M1W to develop a new indirect potable reuse project to provide additional water supply and support future developments in the Marina and Ord Areas. MCWD will continue collaboration with M1W to develop reliable and cost-effective projects that benefit sustainable management of the Subbasin.

2.3.2 Venues for Public Engagement

MCWD GSA intends to provide a variety of opportunities for engagement with stakeholders. Below are the primary venues that MCWD GSA currently provides and will continue to provide to engage stakeholders and the public. Stakeholder input received has informed and/or are incorporated into corresponding sections of the GSP.

---

[4] DACs are identified based on having an average household income less than 80% of the State median, and Severely Disadvantaged Communities (SDACs) are identified based on having an average household income less than 60% of the State median (US Census American Community Survey, 2014).

MCWD GSA Board Meetings

MCWD GSA Board meetings are open to the public and are a venue for public engagement. During selected Board meetings, MCWD GSA's technical team provides status updates of GSP development, presents on key technical issues, and presents recommendations for the GSA Board to consider.

Stakeholder Workshops

Stakeholder workshops have been held to communicate progress on GSP technical components to stakeholders and to receive input on upcoming decisions and work efforts. Quarterly Stakeholder workshops that were open to the public were held during GSP development.

Additionally, MCWD GSA has been publicizing all stakeholder workshops and public meetings on its website (http://www.mcwd.org/governance_meetings.html) and to its list of stakeholders. MCWD GSA directly invites agencies and municipalities identified in Section 2.3.1 to each meeting through emails and mailings as appropriate.

One-on-One Meetings

The GSA's staff and technical team contacted interested parties for one-on-one meetings and conference calls to facilitate their input during the preparation of GSP materials and prior to the more formal meetings. The one-on-one meetings have been a venue for communication with targeted interest on specialized topics.

Website Communication

MCWD GSA has been and will continue to update its website with stakeholder workshop and GSA Board meeting materials, as well as additionally update the website with key GSP updates. Draft GSP chapters available for public review are posted on the website. A live GSP comment form is available on the website for ongoing comment submission on GSP chapters.

2.3.3 Public meeting summary

The list below identifies public meetings, workshops, and direct outreach specific to GSP development.

- MCWD Board meetings
    - GSP development planning and kickoff on March 19, 2018
    - SGMA update on April 16, 2018
    - SGMA update on May 20, 2019
    - GSP development update on February 16, 2021
    - GSP development update on August 16, 2021
    - GSP development update on October 18, 2021
    - GSP public hearing and adoption on January 17, 2022

- MCWD Stakeholder Workshops
  - Stakeholder Workshop #1 on August 25, 2020;
  - Stakeholder Workshop #2 on November 17, 2020;
  - Stakeholder Workshop #3 on March 11, 2021;
  - Stakeholder Workshop #4 on October 13, 2021; and
  - Stakeholder Workshop #5 on October 27, 2021.
- Direct Outreach
  - Website and live comment form maintenance
  - Interested parties list maintenance
  - One-on-one stakeholder meetings

This list will be updated throughout GSP implementation. Detailed meeting minutes and materials are available on the GSA website.

2.3.4 Communication and Public Engagement during GSP Implementation

MCWD GSA communication and public engagement actions that have taken place during GSP development will continue during GSP implementation, including

- Periodic GSA Board meeting updates and stakeholder workshops;
- One-on-one stakeholder communications;
- Posting of relevant announcements and information on the GSA website;
- Stakeholder list maintenance; and
- Stakeholder Communication and Engagement Plan (SCEP) evaluation and updates.

Continued communication and public engagement will be conducted in accordance with the GSAs' Implementation Agreement as described in Section 10.1.

MCWD GSA has been and will continue to hold periodic stakeholder workshops to inform the public on the progress of implementing the plan, including the status of projects and management actions. Meeting information and other materials from GSA Board meetings and public workshops will continue to be available on the MCWD GSA's website (https://www.mcwd.org/gsa_about.html). Meeting materials for past and future GSA Board that are open to the public are available at (https://www.mcwd.org/governance_meetings.html).

Critical to the success of the Monterey GSP will be public understanding of the projects and management actions planned for sustainability, as well as sustainability implementation actions and other groundwater management activities. These important actions are specifically described in Chapter 9. The GSAs' schedule to implement them during the first five years of GSP implementation is described in Sections 10.5 and 10.8. In addition, each project or management action may be subject to public noticing requirements during its planning and implementation phases, as detailed in their respective project descriptions in Chapter 9.

Additional important actions of GSP implementation will be the production of the required Annual Report by April 1 each year for the Monterey Subbasin. The Annual Report covers annual data collected each water year from October 1 through September 30. It is anticipated that the annual report will be prepared through a collaborated effect between the Subbasin GSAs. The Annual Report provides an annual benchmark for the Subbasin GSAs to provide to the public and stakeholders to assess progress towards sustainability. The Annual Report also includes assessment of the six sustainable management criteria (SMCs) for the Subbasin. The Annual Report provides an important opportunity to reengage subbasin stakeholders in its review and to discuss sustainability status and goals.

2.4 Communication and Public Engagement by SVBGSA

Given the importance of the Monterey GSP to the Corral de Tierra Area communities, residents, landowners, farmers, ranchers, businesses, and others, SVBGSA's program for communication and engagement is based on inclusive stakeholder input as the primary component of the Monterey GSP process. In order to encourage ongoing stakeholder engagement SVBGSA deployed the following strategies in the preparation of the Monterey Subbasin GSP and the Corral de Tierra Area:

- An inclusive outreach and education process conducted that best supports the success of a well- prepared GSP that meets SGMA requirements.
- Kept the public informed by distributing accurate, objective, and timely information.
- Invited input and feedback from the public at every step in the decision-making process.
- Established a Subbasin Planning Committee for the Subbasin and completed a comprehensive planning process with this Committee including engagement on key items with the Board of Directors and Advisory Committee
- Publicly noticed drafts of the Monterey Subbasin GSP and allowed for required public comment periods as required by SGMA.

Additionally, a rigorous review process for each chapter in the Monterey GSP and for the final plan was completed. This process ensured that stakeholders had multiple opportunities to review and comment on the development of the chapters.

2.4.1 Defining and Describing Stakeholders in the Corral de Tierra Area

SVBGSA has identified beneficial uses and users of groundwater within the Corral de Tierra Area in accordance with the interests listed in CWC §10723.2, as well as additional stakeholders of interest.

Agriculture. Includes row crops, field crops, vineyards, orchards, cannabis, and rangeland.

Domestic Water Users. Includes urban water use assigned to non-agricultural water uses in the census-designated places and rural residential wells used for drinking water. Urban water use includes small local water systems, small state water systems, and small and large public water systems. Stakeholders associated with this beneficial use include residential well owners, members of mutual water companies and local small or state small water systems and California Public Utilities Commission (CPUC)-regulated water companies including Alco Water Corporation, California Water Service Company, and California American Water.

California Native American Tribes. There are no identified California Native American tribal lands within the Subbasin.

Underrepresented communities (URCs) and Disadvantaged Communities (DACs). There are no identified URCs or DACs within the Corral de Tierra Area.

Environmental Users. Environmental users include the habitats and associated species maintained by conditions related to surface water flows and groundwater dependent ecosystems (GDEs). Environmental users include native vegetation and managed wetlands. Stakeholders associated with this beneficial use include the following: Sustainable Monterey County, League of Women Voters of Monterey County, Landwatch Monterey County, Friends and Neighbors of Elkhorn Slough, California Native Plant Society Monterey Chapter, Trout Unlimited, Surfriders, the Nature Conservancy (TNC) and the Carmel River Steelhead Association.

Local Land Use Planning Agencies and Groundwater Monitoring Entities: The local land use planning agency located within the Corral de Tierra Area is the County of Monterey. The groundwater monitoring entity is the Monterey County Water Resources Agency (MCWRA) in the Subbasin under the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Stakeholders associated with this beneficial use include the following: Monterey County, Monterey County Environmental Health Department and land use nonprofits such as Sustainable Monterey County, League of Women Voters of Monterey County, and Landwatch Monterey County.

Other Groundwater Management Entities. The Monterey Subbasin is adjacent to the critically-overdrafted, high-priority 180/400-Foot Aquifer Subbasin and the adjudicated Seaside Subbasin of the Salinas Valley Basin. SGMA compliance within the 180/400-Foot Aquifer Subbasin is carried out by the MCWD GSA and SVBGSA. The adjudicated Seaside Subbasin is managed by the Seaside Groundwater Basin Watermaster. SVBGSA will inform, involve, and collaborate with MCWD GSA and the Seaside Groundwater Basin Watermaster to ensure sustainable management of groundwater across basins.

2.4.2 Venues for Public Engagement and Public Meeting Summary

SVBGSA subbasin planning committees are comprised of local stakeholders and Board members and were appointed by the Board of Directors following a publicly noticed application process by the SVBGSA. Subbasin planning committees do the comprehensive work of plan development, review, and recommendations, with assistance provided by SVBGSA staff and technical consultants.

These committees represent constituencies that are considered important stakeholders to develop comprehensive subbasin plans for the Salinas Valley or are not represented on the Board. The SVBGSA GSP Subbasin planning committee was convened in July 2020. A list of the SVBGSA Subbasin Planning Committee members is included in the Acknowledgements section of this GSP.

Subbasin planning committee meetings are subject to the Brown Act and are noticed publicly on the SVBGSA website. Public comment is taken on all posted agenda items. Subbasin planning committees have been engaged in an iterative planning process that combines education of pertinent technical topics through presentations and data packets and receiving GSPs chapters for review and comment. A live GSP comment form is available on the SVBGSA website for ongoing comment submission on all GSP chapters. All GSP chapters were posted for public review and comment.

GSP chapters that have been taken to the SVBGSA Subbasin Planning Committee were also taken to the SVBGSA Advisory Committee for further review and comments. Community engagement and public transparency on SVBGSA decisions are paramount to building a sustainable and productive solution to groundwater sustainability in the Basin. At the conclusion of the planning process in August 2021 for the Monterey GSP, the SVBGSA held more than 38 planning meetings and technical workshops on each aspect of the Monterey Subbasin GSP.

In addition to regularly scheduled committee meetings, a series of workshops were held for the Monterey Subbasin Planning Committee as detailed below. These workshops are informational for committee members, stakeholders, and the general public and cover pertinent topics to be included in the GSPs. Workshops were timed to specific chapter development for the GSP. Subject matter experts were brought in as necessary to provide the best available information to Subbasin Planning Committee members.

Table 2-1. Subject Matter Workshops Held During GSP Preparation

Topic	Date
Brown Act and Conflict of Interest	July 22, 2020
Sustainable Management Criteria	July 28, 2020
Water Law	August 10, 2020
Salinas Valley Watershed Overview	August 26, 2020
Web Map Workshop	September 30, 2020
Town Hall – Domestic Wells & Drinking Water	October 28, 2020
Pumping Allocations	November 18, 2020
Funding Mechanisms	January 27, 2021
Water Budgets	February 24, 2021
Communications and Implementation	March 31, 2021
Technical Modeling Workshop – Salinas Valley Integrated Hydrologic Model (SVIHM) & Salinas Valley Operational Model (SVOM)	June 30, 2021

SVBGSA is focused on communication and public engagement targeted at the public, including beneficial users, regarding the development of the GSP for the Monterey Subbasin. actions (CPE Actions) that have taken place during GSP development will continue during implementation of all SVBGSA GSPs. CPE Actions provide the SVBGSA Board and staff a guide to ensure consistent messaging about SVBGSA requirements and other related information. CPE Actions provide ways that beneficial users and other stakeholders can provide timely and meaningful input into the GSA decision-making process. CPE Actions also ensure beneficial users and other stakeholders in the Basin are informed of milestones and offered opportunities to participate in GSP implementation and plan updates.

Notice and communication, as required by GSP Emergency Regulations §354.10, was focused on providing the following activities during the development of the Monterey Subbasin GSP**:**

- Clear decision-making process on GSP approvals and outcomes
- Robust public engagement opportunities
- Encouragement of active involvement in GSP development

2.4.3 Goals for Communication and Public Engagement

Ultimately, the success of the Monterey Subbasin GSP will be determined by the collective action of every groundwater user. In order to meet ongoing water supply needs, both for drinking water and for economic livelihoods, the Subbasin must achieve and maintain sustainability into the future. This outreach engages the public early and frequently, and keeps the internal information flow seamless among staff, consultants, committee members and the SVBGSA Board regarding the goals and objectives of the Monterey Subbasin GSP and associated monitoring and implementation activities.

Communications and Public Engagement (CPE) Actions provide outreach during the Subbasin planning efforts and assists SVBGSA in being receptive to stakeholder needs through communication tools. The CPE Actions also forecast how SVBGSA will communicate during GSP implementation.

The goals of the CPE Actions are:

1. To keep stakeholders informed through the distribution of accurate, objective, and timely information while adhering to SGMA requirements for engagement (noted above).
2. To articulate strategies and communications channels that will foster an open dialogue and increase stakeholder engagement during the planning process.
3. To invite input from the public at every step in the decision-making process and provide transparency in outcomes and recommendations.
4. To ensure that the Board, staff, consultants, and committee members have up-to-date information and understand their roles and responsibilities.
5. To engage the public on GSP Implementation progress especially for project and management actions and Annual Reports.

2.4.4 Communication and Outreach Objectives

The following are the communications and outreach objectives of the CPE Actions:

- Expand Audience Reach
- Maintain a robust stakeholder list of interested individuals, groups and/or organizations.
- Secure a balanced level of participants who represent the interests of beneficial uses and users of groundwater.
- Increase Engagement
- Keep interested stakeholders informed and aware of opportunities for involvement through email communications and/or their preferred method of communications.
- Publish meeting agendas, minutes, and summaries on the SVBGSA website: www.svbgsa.org.
- Inform and obtain comments from the general public through GSP online comment form and public meetings held on a monthly basis.
- Facilitate productive dialogues among participants throughout the GSP planning process.
- Seek the input of interest groups during the planning and implementation of the GSP and any future planning efforts.
- Increase GSP Awareness

- Provide timely and accurate public reporting of planning milestones through the distribution of outreach materials and posting of materials on the SVBGSA website for the GSP.
- Secure quality media coverage that is accurate, complete, and fair.
- Utilize social media to engage with and educate the general public.
- Track Efforts
- Maintain an active communications tracking tool to capture stakeholder engagement and public outreach activities and to demonstrate the reporting of GSP outreach activities.

2.4.5 Target Audiences and Stakeholders

SVBGSA stakeholders consist of other agencies and interested parties including all beneficial users of groundwater or representatives of someone who is. Under the requirements of SGMA, all beneficial uses and users of groundwater must be considered in the development of GSPs, and GSAs must encourage the active involvement of diverse social, cultural, and economic elements of the population.

There are a variety of audiences targeted within the Basin whose SGMA knowledge varies from high to little or none. Given this variance, SVBGSA efforts are broad and all-inclusive. Target audiences include:

- SVBGSA Board of Directors, Advisory Committee and Subbasin Planning Committees
- SVBGSA Groundwater Sustainability Fee Payers
- Partner agencies including Monterey County Environmental Health Department, County of Monterey, MCWRA, and the Greater Monterey County Integrated Regional Water Management Group (RWMG)
- Municipal and public water service providers
- Private and local small or state small water system providers
- Local municipalities and communities
- Elected officials within the Basin
- Beneficial uses and users of groundwater including, agriculture, domestic wells and local small or state small water systems, and environmental uses such as wetlands
- Diverse social, cultural, and economic segments of the population within the Basin including URCs
- The general public

Stakeholder involvement and public outreach is critical to the GSP development because it helps promote the plan based on input and broad support. The following activities summarize involvement opportunities and outreach methods to inform target audiences and stakeholders.

It is important to note that levels of interest will evolve and shift according to the GSP's implementation opportunities and priorities.

2.4.6 Stakeholder Database

A stakeholder database of persons and organizations of interest will be created and maintained. The database will include stakeholders that represent the region's broad interests, perspectives, and geography. It will be developed by leveraging existing stakeholder lists and databases and by conducting research of potential stakeholders that may be interested in one or all of the following categories: municipal users and groundwater users including agricultural, urban, industrial, commercial, institutional, rural, environmental, URCs, state lands and agencies, and integrated water management.

2.4.7 Key Messages and Talking Points

SVBGSA developed key messages focused on getting to know your GSA, an overview of groundwater sustainability planning for our community, and how we intend to continue outreach through implementation. These messages were guided by the underlying statements:

- The GSP process, both planning and implementation, is transparent and direct about how the GSP will impact groundwater users.
- SVBGSA represents the groundwater interests of all beneficial uses/users of the Corral de Tierra Area equitably and transparently to ensure that the Subbasin achieves and maintains sustainable groundwater conditions.
- SVBGSA is committed to working with stakeholders using an open and transparent communication and engagement process.
- As the overall GSP will be more comprehensive with an engaged group of stakeholders providing useful information, SVBGSA will create as many opportunities as possible to educate stakeholders and obtain their feedback on GSP implementation and plan updates.

These messages are being used by SVBGSA as the basis for specific talking points/questions and answers (Q&A) to support effective engagement with audiences (Appendix 2).

2.4.8 Engagement Strategies

SVBGSA utilizes a variety of tactics to achieve broad, enduring, and productive involvement with stakeholders during the development and implementation of the GSP. Below are activities that SVBGSA uses to engage the public currently and anticipated activities for GSP implementation:

- Develop and maintain a list of interested parties
- Offer public informational sessions and subject-matter workshops and provide online access via Facebook Live or via Zoom
- Basin tours (currently on hold due to coronavirus disease [COVID] restrictions)

- SVBGSA Web Map
- Annual Report presentations
- FAQS – Offer Frequently Asked Questions (FAQs) on several topics including SGMA, SVBGSA, GSP, projects, Monitoring Program, Annual Report, Programs and Groundwater Sustainability Fee
- Science of Groundwater – new examples (studies, etc.)
- Board, Advisory Committee, and other Committee Meetings
- Regular public notices and updates; Brown Act compliance
- Develop talking points for various topics and evolve as necessary
- Subbasin Implementation Committees
- Each subbasin's planning committee for GSP development will transition to a subbasin implementation committee to be convened for GSP updates and annual report reviews.
- Integrated Implementation Committee
- The Integrated Implementation Committee will be convened to discuss Basin wide aspects to the 6 GSPs in the Basin including public outreach.
- Online communications
- SVBGSA website: maintain with current information
- SVBGSA Facebook page: maintain and grow social media presence
- Direct email via Mailchimp newsletter
- Mailings to most-impacted water users and residents – topics to include: Annual Report dashboard, What does your GSA do with the Sustainability Fee?, newsletter that accompanies each tax bill.
- Media coverage. Appendix 2-B includes SVBGSA's media policy.
- Op-eds in the local newspapers
- Press releases
- Radio interviews
- Promote/Celebrate National Groundwater Week (held in December)
- Co-promotional opportunities and existing channels with agencies, committees, and organizations including email newsletters, social media, board meetings and mailings to customers.
- Talks and presentations to various stakeholder groups, associations, community organizations, and educational institutions.

- Educational materials

2.4.9 CPE Actions Timeline and Tactics

CPE Actions and GSP milestone requirements by phase include:

- Prior to initiating plan development: Share how interested parties may contact the GSA and participate in development and implementation of the plan submitted to DWR. (23 California Code of Regulations §353.6)
- Prior to GSP development: Establish and maintain an interested persons' list. (California Water Code §10723.4)
- Prior to and with GSP submission:
  - Record statements of issues and interests of beneficial users of basin groundwater including types of parties representing the interests and consultation process
  - Lists of public meetings
  - Inventory of comments and summary of responses
  - Communication section in GSP (23 California Code of Regulations §354.10) that includes: agency decision-making process, identification of public engagement opportunities and response process, description of process for inclusion, and method for public information related to progress in implementing the plan (status, projects, actions)

- Supporting tactics to be used to communicate messages and supporting resources available through GSP development and GSP implementation:
- SVBGSA website, updated regularly to reflect meetings and workshop offerings
- Direct email via Mailchimp sent approximately monthly to announce board meetings, special workshop offerings and other opportunities for engagement
- Outreach to local media to secure coverage of announcements and events, radio interviews, op-ed placement
- Workshops, information sessions and other community meetings
- Social media, specifically Facebook, updated regularly to share information and support other outreach efforts

2.4.10 CPE Actions – Annual Evaluation and Assessment

The annual evaluation and assessment of CPE Actions will include:

- What worked well?
- What didn't go as planned?

- Are stakeholders educated about the GSP development process and their own role?
- Is the timeline for implementation of the GSP clear?
- Has the GSA received positive press coverage?
- Do diverse stakeholders feel included?
- Has there been behavior changes related to the program goals? Or improved trust/relationships among participants?
- Community meeting recaps and next steps
- Lessons learned
- Budget analysis

2.4.11 Communication and Public Engagement during GSP Implementation

The communication and public engagement outlined above is also applicable, and is intended to continue through, GSP Implementation. Critical to the success of the Monterey GSP will be public understanding of the projects and management actions planned for sustainability, as well as sustainability implementation actions and other groundwater management activities.

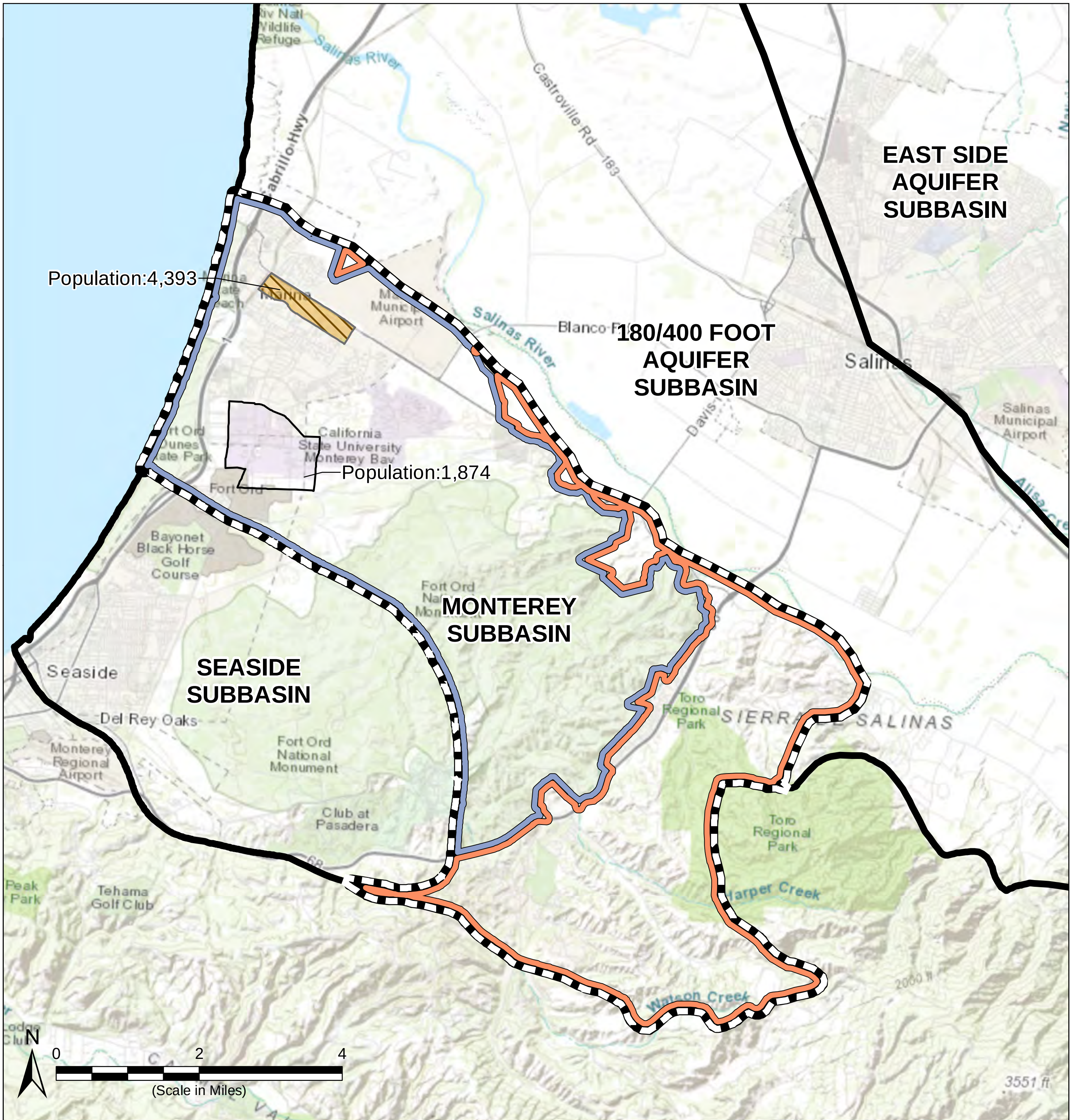
Additional important actions of GSP implementation will be the production of the required Annual Report by April 1 each year for the Monterey Subbasin. The Annual Report covers annual data collected each water year from October 1 through September 30. The Annual Report provides an annual benchmark for SVBGSA to provide to the public and stakeholders to assess progress towards sustainability. The Annual Report also includes assessment of the six Sustainable Management Criteria (SMCs) for the Subbasin. The Annual Report provides an important opportunity to reengage the Monterey Subbasin Committee in its review and to discuss sustainability status and goals.

2.5 Public comments on the GSP

Appendix 2-C includes a table that summarizes the public comments received as well as the Subbasin GSAs' responses and revisions made to the GSP. Appendix 2-D includes written public comments received during the GSP development. Additional detailed responses are included in Appendix 2-E. Public comments received during SVBGSA Subbasin Committee Meetings and responses are included in Appendix 2-F. Contents in Appendices 2-C through 2-E will be updated as more comments are received during GSP implementation.

2.6 Underrepresented Communities and DACs

As described in Section 2.3.1, disadvantaged communities are recognized within the urban areas of the City of Marina. These areas are shown on Figure 2-1. Due to well installation requirements of the Monterey County and the City of Marina, only a very small number of domestic wells that pre-date County and City ordinances exist within the city. In turn, these communities rely on water services provided by MCWD. The Subbasin GSAs has engaged residents of disadvantaged communities during the development and implementation of the GSP through engagement of MCWD customers and coordination with the City of Marina.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra

Disadvantaged Community Census Tract

Data Not Available

Severely Disadvantaged Community

Disadvantaged Community

Disadvantaged Community Census Place

Data Not Available

Severely Disadvantaged Community

Disadvantaged Community

Disadvantaged Community Census Block Group

Data Not Available

Severely Disadvantaged Community

Disadvantaged Community

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 19 November 2021.
2. DAC shapefiles acquired from DWR's DAC Mapping Tool on 19 November 2021 at https://data.cnra.ca.gov/dataset/dacs-census.

SDACs and DACs within the Monterey Subbasin

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 2-1

Path: X:\B60094\Maps\2021\09\Fig2-1_DACs.mxd

3 PLAN AREA

This section presents a description of the Plan Area, and a summary of the relevant jurisdictional boundaries and other key land use features potentially relevant to the sustainable management of groundwater in the Monterey Subbasin. This section also describes the water monitoring programs, water management programs, and general plans relevant to the Subbasin and their influence on the development and execution of this Groundwater Sustainability Plan (GSP).

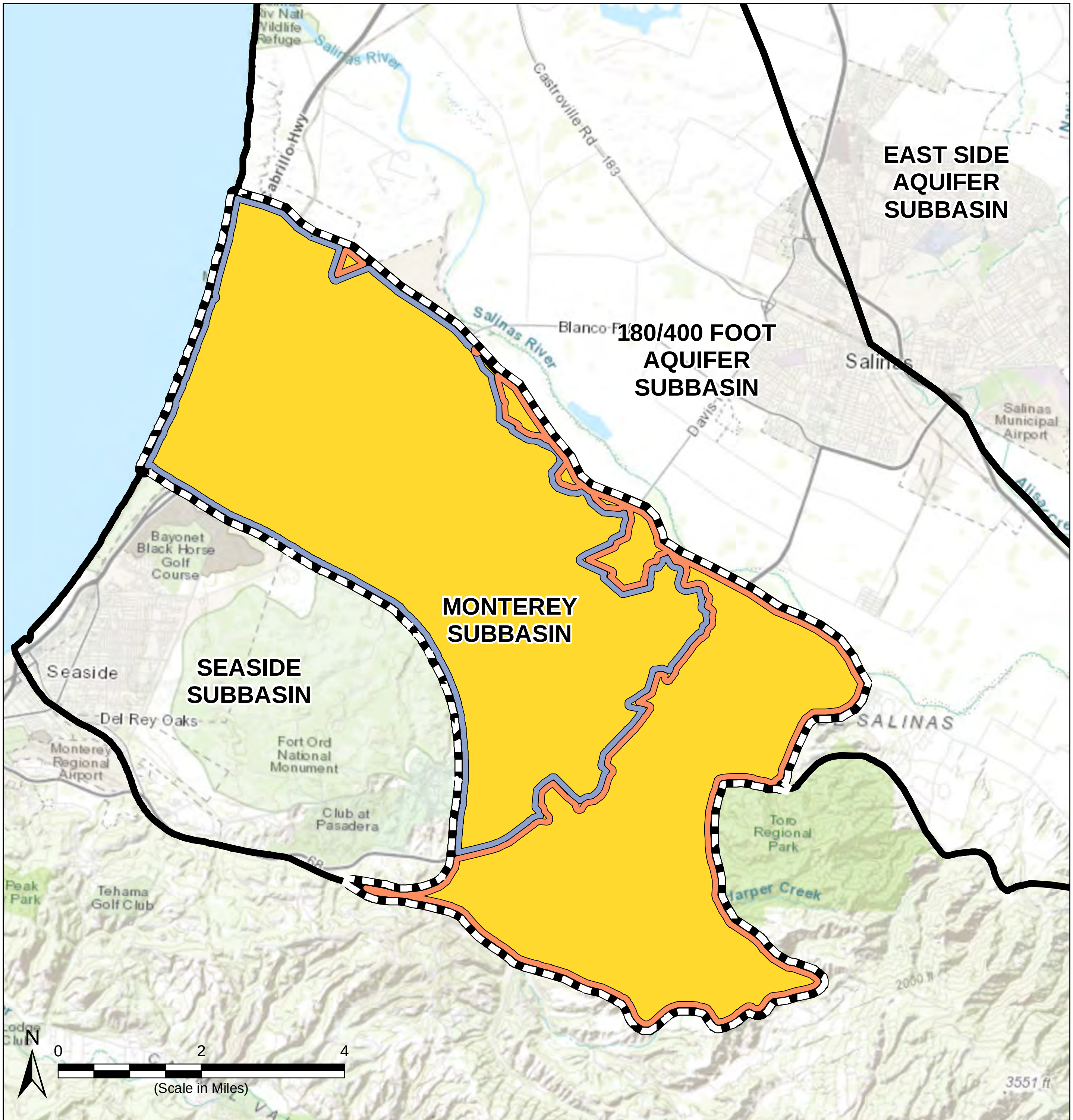
3.1 Summary of Jurisdictional Areas and Other Features

3.1.1 Plan Area Setting

This GSP covers the entire Monterey Subbasin (Department of Water Resources [DWR] Basin 3-004.10), which encompasses 30,850 acres (or 48.2 square miles) in the northwestern Salinas Valley Groundwater Basin in the Central Coast region of California (see Figure 3-1). The Subbasin is covered by the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) and lies entirely within Monterey County. The Subbasin is bounded on the northeast by the 180/400-Foot Aquifer Subbasin (DWR Basin 3-004.01) and on the southwest by the Seaside Subbasin (DWR Basin 3-004.08).

The GSAs have established two Management Areas within the Subbasin, as discussed in Section 1.4 and shown on Figure 3-1. These Management Areas are described as follows:

- Marina-Ord Area: This Management Area consists of the lands within the City of Marina, City of Seaside, and the former Fort Ord; and
- Corral de Tierra Area: This Management Area consists of the remainder of the Subbasin, which includes lands that are generally south of State Route 68 and a few parcels located along the northern subbasin boundary with the 180/400-Foot Aquifer Subbasin.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Plan Area

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Plan Area (Monterey Subbasin)

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-1

Path: X:\B60094\Maps\2021\09\Fig3-1_Plan Area.mxd

3.1.2 Jurisdictional Boundaries

The Subbasin falls entirely within Monterey County and contains the municipalities of Marina and Seaside. The City of Marina is located in the northern portion of the Subbasin and is a community of approximately 22,000 residents (DOF, 2020). The City of Seaside is on Highway 1 approximately two miles south of the City of Marina, and has a population of approximately 34,000 (DOF, 2020).

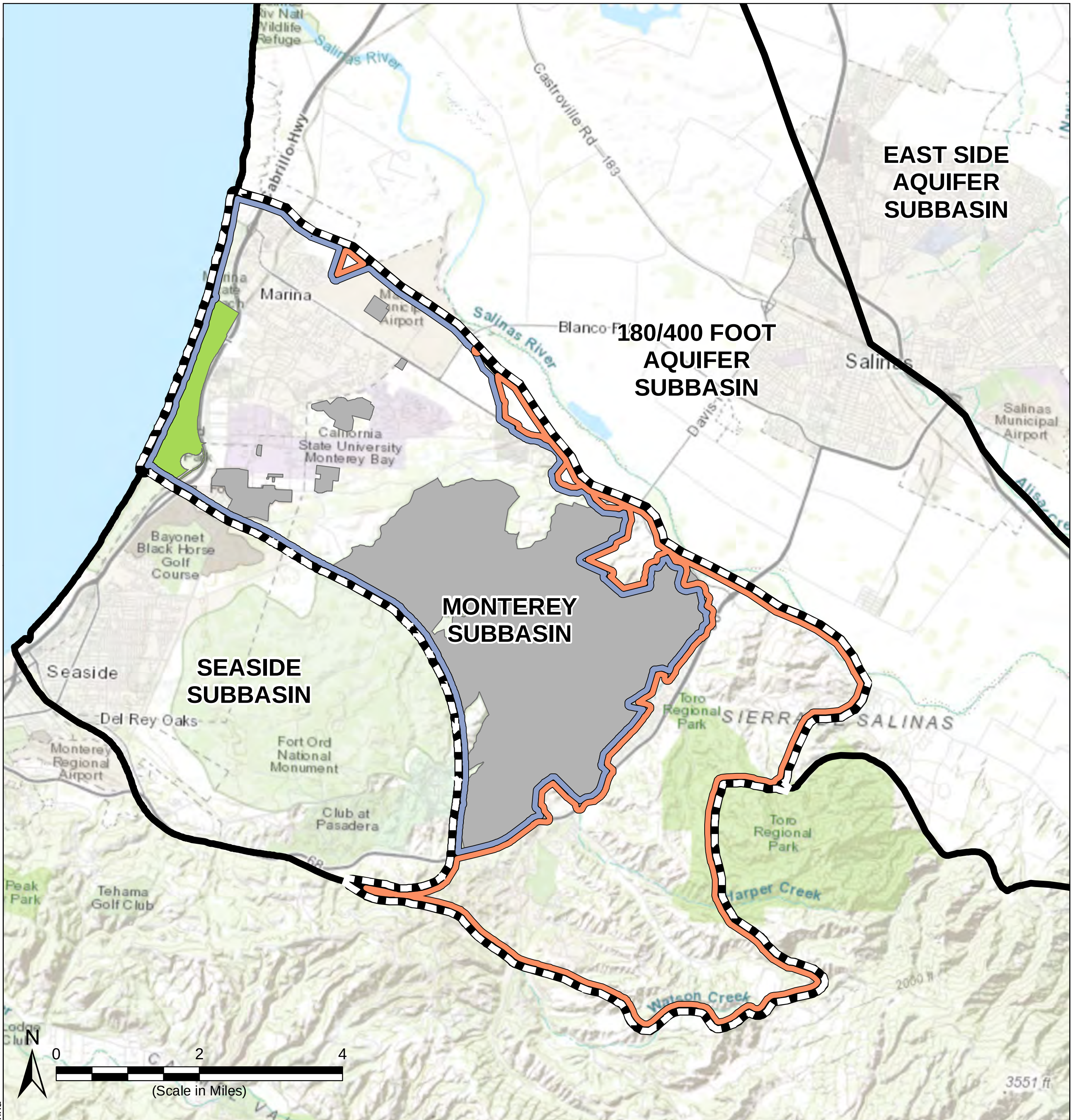
A large portion of the Subbasin was home to the 45-square mile former Fort Ord military base. The base was closed in 1994 and had since been undergoing conversion to civilian use. As of 2019, most of the property transfers have been completed, and environmental cleanup is ongoing. A large portion of the land is transferred to the Bureau of Land Management (BLM) as part of the National Conservation Lands and consists of the Fort Ord National Monument. A small portion of the base was retained by the U.S. Army for an active military installation. As shown on Figure 3-2, a total of 9,200 acres of the Subbasin is federally owned lands managed by the U.S. Army and the BLM located at the former Fort Ord. Those lands are not subject to the Sustainable Groundwater Management Act (SGMA).

The Fort Ord Dunes State Park, a state-owned park, is located along the western boundary of the Subbasin adjacent to the Pacific Ocean, with a total area of 916 acres.

According to the information made available by the DWR[5] in support of GSP development, there are no tribal lands within or in the vicinity of the Subbasin.

Areas under federal and state jurisdiction are shown on Figure 3-2.

[5] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Federal and State Jurisdiction

- State
- Federal

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. State land information obtained from DWR Dataset.
3. Parcels retained by the federal government in the former Fort Ord area are provided by Army Corps of Engineers on 12 September 2019.

Federal and State Jurisdictional Areas

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-2

Path: X:\B60094\Maps\2021\09\Fig3-2_Federal_and_State_Lands.mxd

3.1.3 Agencies with Water Management Responsibilities

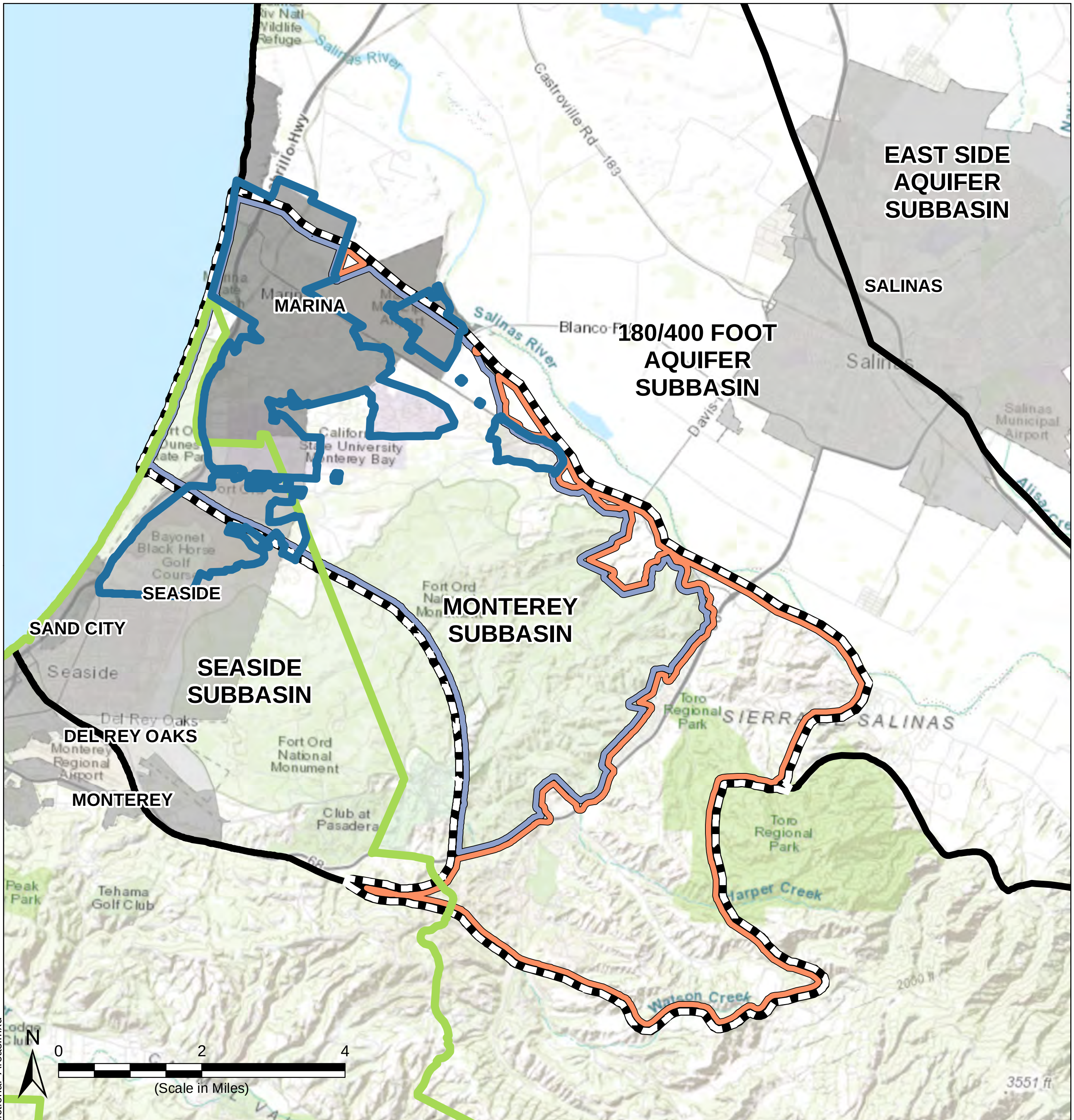
As shown on Figure 3-3, the main water supplier in the Subbasin is MCWD, which has a service area covering the entire City of Marina and all parcels within the Ord Subarea that currently receive potable water or that have received final land use development approvals by the applicable land use jurisdiction within its jurisdictional boundary. Within the former Fort Ord, MCWD is the exclusive water purveyor to all non-Federal lands and the U.S. Army for all Army and Federal facilities. By a 2001 deed from the Army through the Fort Ord Reuse Authority, MCWD owns all the water infrastructure within the former Fort Ord (MCWD, 2016). A small portion of MCWD's service area further extends into the 180/400-Foot Aquifer Subbasin.

The MCWD provides sewer collection services within its jurisdictional boundaries. Wastewater collected by MCWD is conveyed to the Monterey One Water (formerly Monterey Regional Water Pollution Control Agency) Regional Treatment Plant located in the 180/400-Foot Aquifer Subbasin.

The public water systems in the whole Monterey Subbasin are listed in Table 3-1 and shown on Figure 3-4. There are also over 60 State Small Water Systems (5-14 connections) and Local Small Water Systems (2-4 connections) in the Monterey Subbasin that provide water.

Table 3-1. Public Water Systems in the Monterey Subbasin

Water System No	Agency Name	Acres
CA2710017	Marina Coast Water District	19,476
CA2710012	California Water Service Company - Salinas Hills	2,626
CA2710004	California American Water Company - Monterey District	2,368
CA2710021	Toro Water Service No 2710021	2,168
CA2702009	Laguna Seca Recreation Water System	487
CA2700612	Laguna Seca Water Company	77
CA2702315	Corral De Tierra Country Club Water System	71
CA2701367	Tierra Meadows Home Owners Association Water System	44
CA2700775	Tierra Verde Mutual Water Company	21
CA2700731	Z Ranch Mutual Water Company	18
CA2702030	Cypress Community Church Water System	17
CA2700536	Corral De Tierra Estates Water Company	6
CA2701740	Bluffs Water System	6
CA2701681	Exxon Station Water System	1
	Total	**27,385**



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

MCWD

MPWMD

Cities

Del Rey Oaks

Marina

Monterey

Salinas

Sand City

Seaside

Sources

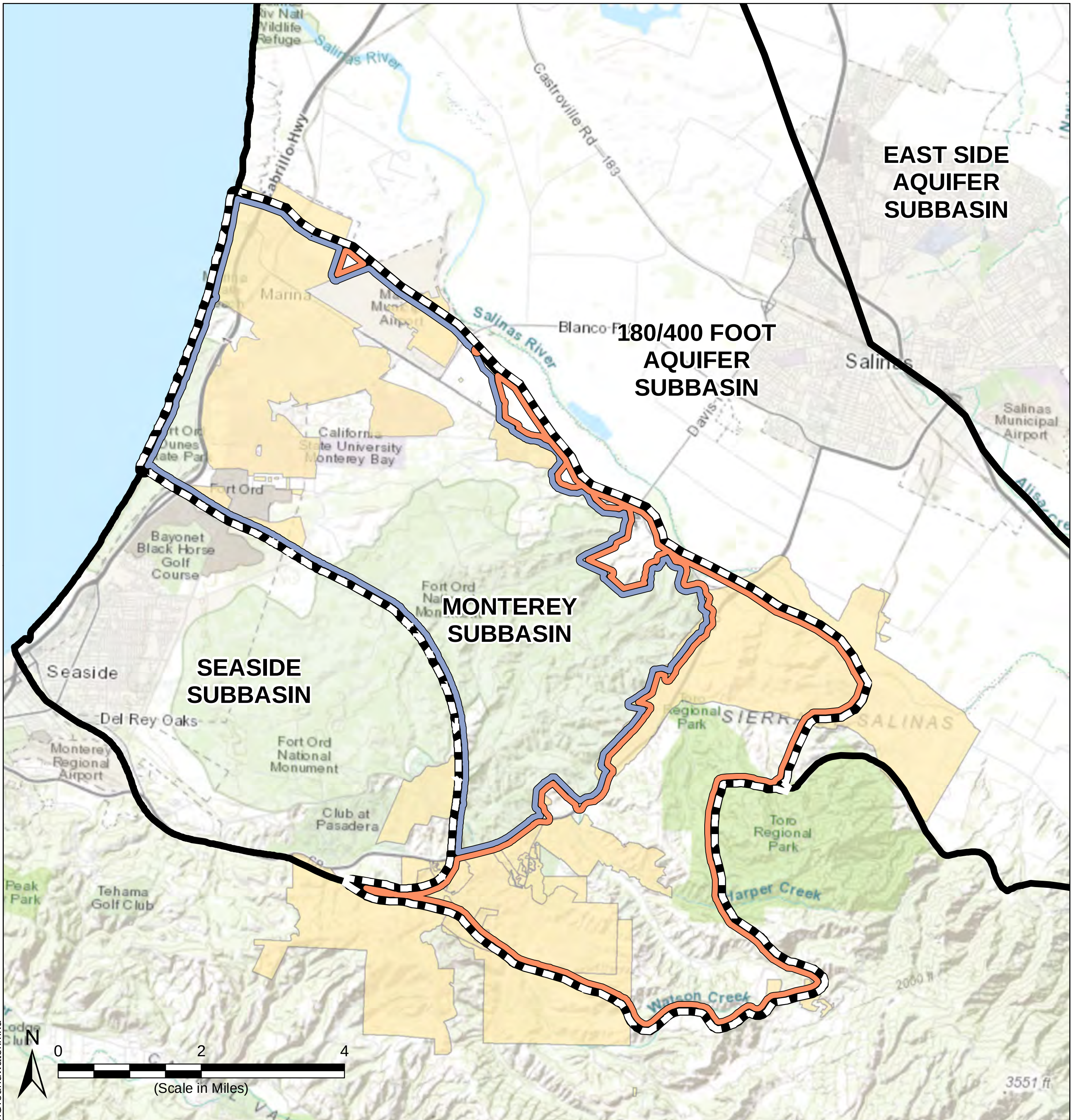
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. City Limits defined by Local Agency Formation Commission (LAFCO), Monterey County Geological Information System, accessed 11 July 2019.

Cities and Water District Judicational Areas

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-3

Path: X:\B60094\Maps\2021\09\Fig3-3_Cities_Water_District_Jurisdictional_Areas.mxd



Path: X:\B60094\Maps\2021\09\Fig3-4 MunicipalAreasDependentonGroundwater.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management

Marina-Ord

Corral de Tierra

Municipal Areas Dependent on Groundwater

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Municipal areas shown as public water system service areas dependent on groundwater, obtained from Tracking California https://trackingcalifornia.org/water/download.

Municipal Areas Dependent on Groundwater

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-4

Other agencies with water management responsibilities within the Subbasin include the Monterey County Water Resources Agency (MCWRA) and the Monterey Peninsula Water Management District (MPWMD). MCWRA governance areas include all lands within Monterey County, which includes the Subbasin. MPWMD manages groundwater and surface water in areas on the Monterey Peninsula and in the Carmel River Basin and includes the City of Seaside, which extends into the Subbasin. Management programs of these agencies are further discussed in Section 3.2.

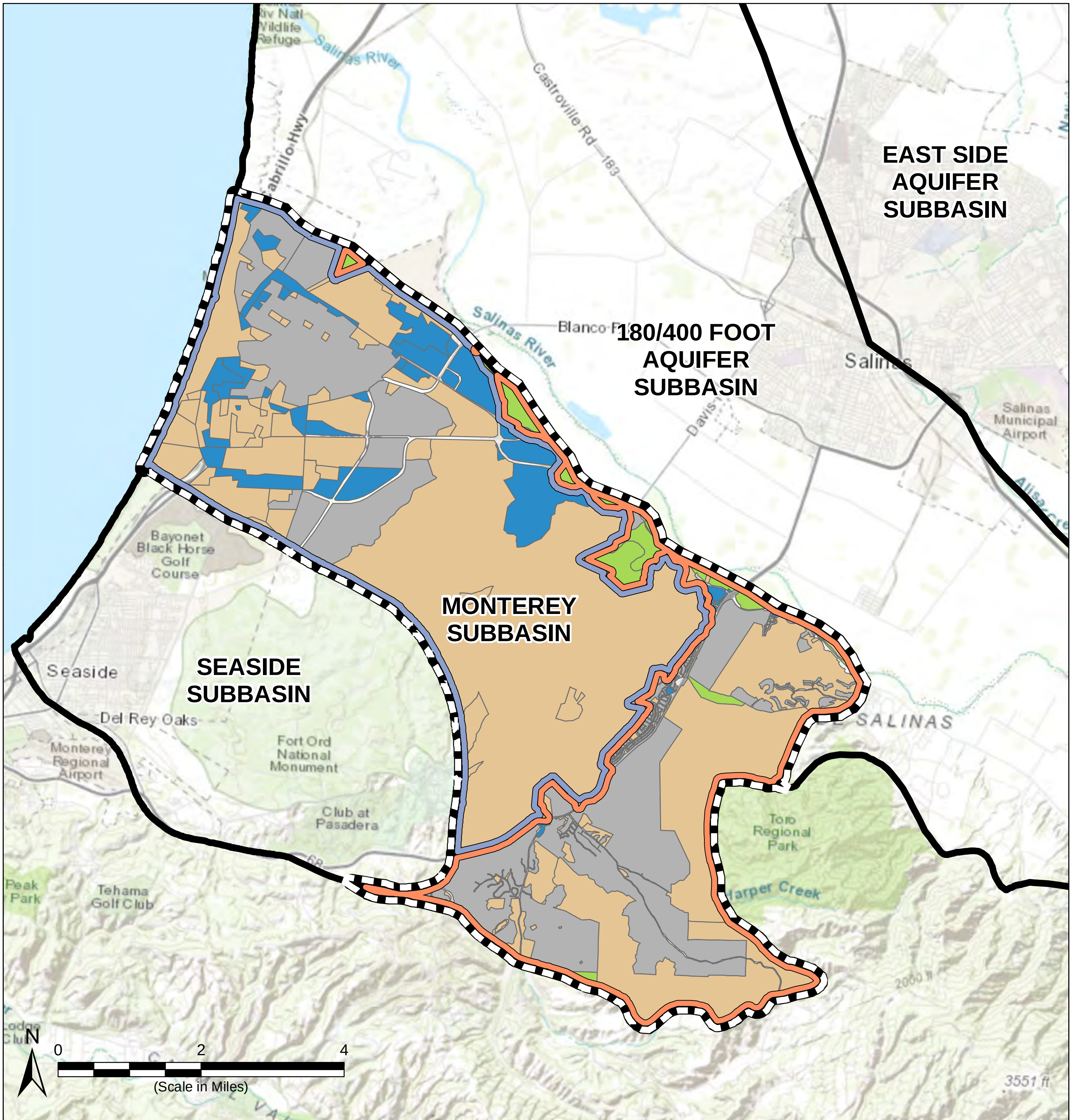
3.1.4 Adjudicated Areas and Alternative Areas

The Subbasin is not adjudicated and does not contain any areas covered by an Alternative Plan. However, this subbasin shares a jurisdictional boundary with the Seaside Adjudicated Subbasin. This boundary is based on a presumed groundwater flow divide between the two subbasins and may be vulnerable to future pumping or impacts to the groundwater conditions in either Subbasin. The adjudicated area is not managed by MCWD or the SVBGSA. The adjudicated Seaside Subbasin is managed by the Seaside Basin Watermaster.

3.1.5 Existing Land Use and Water Use

Land use planning authority in the Subbasin is the responsibility of the County of Monterey and the cities of Marina and Seaside. Redevelopment of the former Fort Ord was under the oversight of the Fort Ord Reuse Authority (FORA), established in 1994 and recently terminated in June 2020. Prior to its termination, FORA allocated assets/liabilities and transitioned land use planning within former Fort Ord to each of the local jurisdictions, including the Cities of Marina and Seaside, the City of Monterey, and the County of Monterey.

Figure 3-5 shows simplified land use designations within the Monterey Subbasin. The majority of the Subbasin is undeveloped land. Urban is the primary developed land use within the Subbasin, with approximately 5,500 acres of urban coverage. Small areas of agriculture, approximately 500 acres of truck nursery and berry crops, are located along the northern Subbasin boundary adjoining the 180/400-Foot Aquifer Subbasin. Urban and agricultural water uses in the Subbasin rely entirely on groundwater.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

Current Land Use

Open/Public/Military

Agriculture

Municipal

Residential

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Land use information are obtained from Monterey County Open Data, accessed 12 June 2020.

Land Use

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-5

Path: X:\B60094\Maps\2021\09\Fig3-5_Simpl_LandUse_TW.mxd

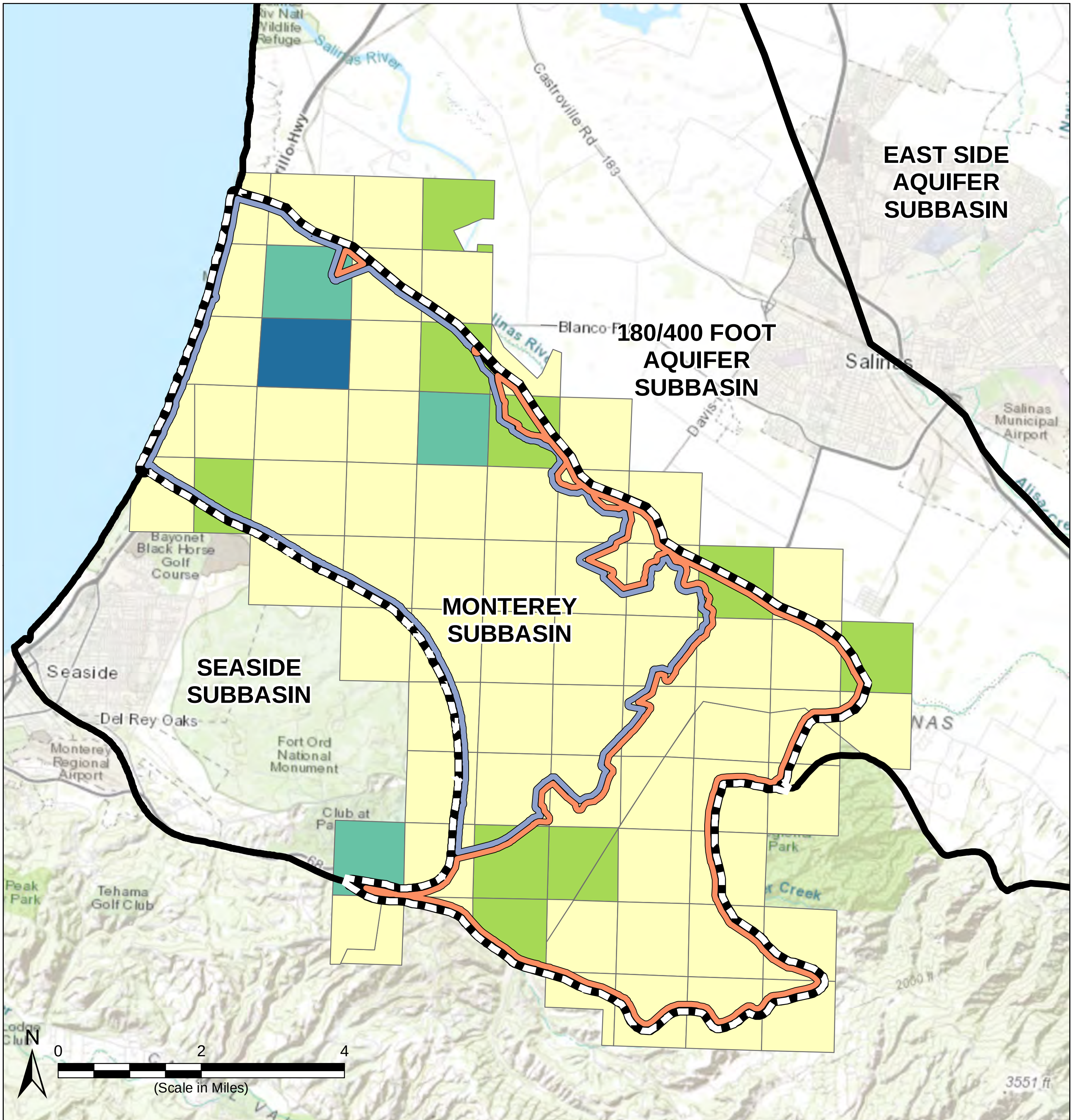
3.1.6 Well Density per Square Mile

Figure 3-6 through Figure 3-8 show the density of wells per square mile within the Subbasin, based on Well Completion Report records compiled by DWR. According to these records, 102 production wells, 304 domestic wells, and 17 public supply wells have been installed within the Public Land Survey Systems (PLSS) sections that fall partially or entirely within the Subbasin.

Groundwater is the primary water source for all water use sectors in the Subbasin. Municipal areas dependent on groundwater within the Subbasin are shown on Figure 3-4.

Within the Marina-Ord Area, MCWD is the exclusive water purveyor to all non-federal lands and to the Army for all Army and Federal facilities within the former Fort Ord. Due to well installation requirements of the Monterey County and the City of Marina (see Section 3.5.4), only a very small number of domestic wells that pre-date County and City ordinances exist within the Marina-Ord Area. Fort Ord contamination and seawater intrusion limit the use of the majority of these wells. In turn, these communities rely on water services provided by MCWD. MCWD operates seven active production wells that supply approximately 3,200 acre-feet per year (AFY) to its residents.

Within the Corral de Tierra Area, there are hundreds of domestic wells and small community water system wells shown in Figure 3-4 (GeoSyntec, 2007). The average domestic well depth is approximately 430 feet. The majority of these small systems are clustered in the Watson Creek and Harper Creek watersheds. The most recent and best available published historical groundwater demand in the Corral de Tierra Area southeast of Highway 68 estimated a groundwater extraction rate of 1,256 AFY for the El Toro Planning area which is an area that encompasses the Calera Creek, Watson Creek, Corral de Tierra, San Benancio Gulch, and El Toro Creek watersheds (GeoSyntec, 2007). The El Toro Planning area encompasses a large portion of the Corral de Tierra Area within the Monterey Subbasin as well as communities in the Sierra de Salinas immediately outside of the Subbasin. Therefore, the estimated volumes are not perfectly representative of the current water use in the Corral de Tierra Area. A more detailed analysis of groundwater extraction is included in Chapter 6. Groundwater is primarily used for municipal, domestic, and agricultural purposes.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra

Public Well Density

- 0
- 1
- 2
- 3 - 5
- 6 - 7

Notes

1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin.

Sources

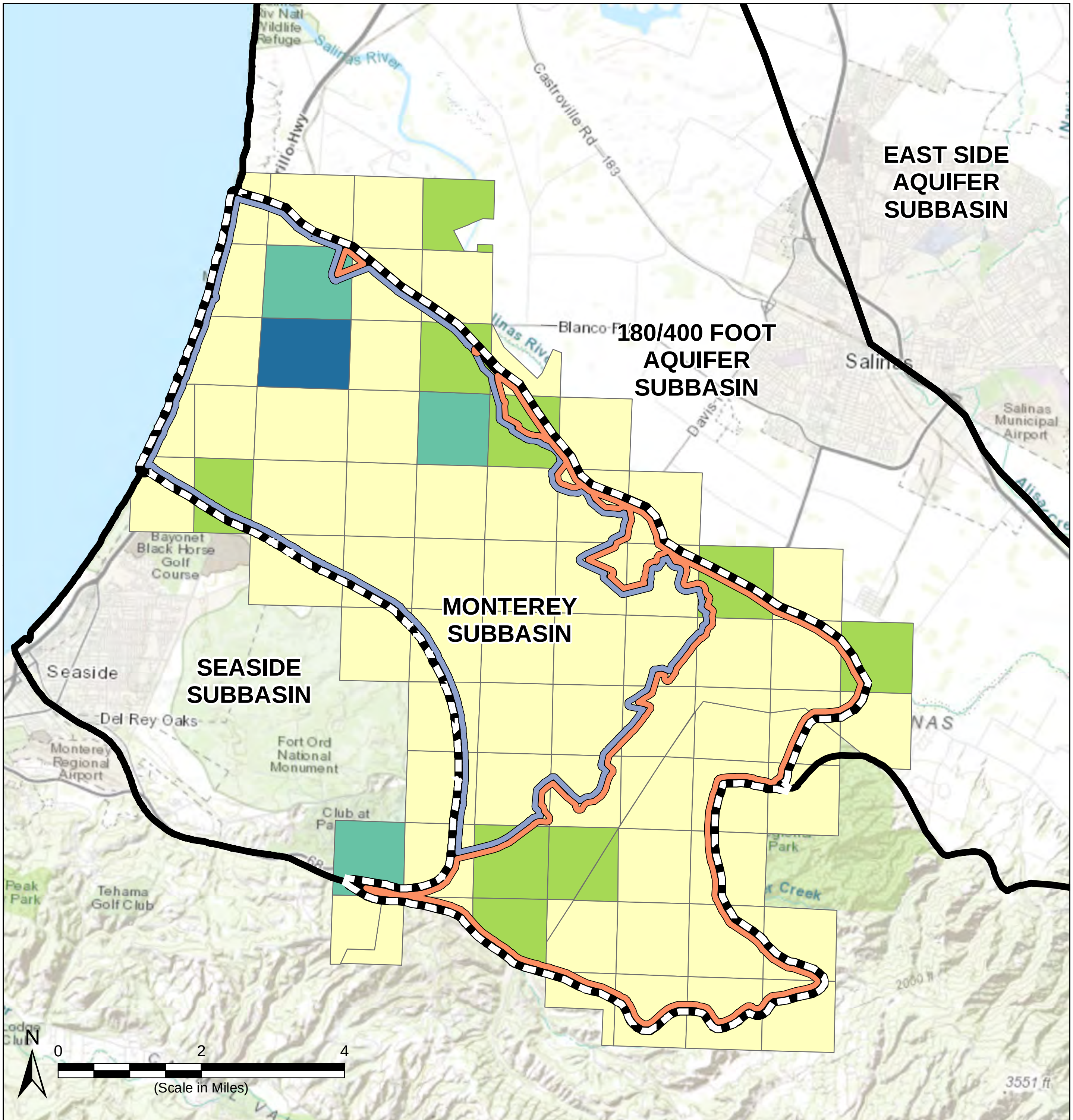
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.

Public Well Density

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-6

Path: X:\B60094\Maps\2021\09\Fig3-6_PublicWellDensity.mxd



Legend

Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area
Corral de Tierra

Public Well Density

0
1
2
3 - 5
6 - 7

Notes

1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin.

Sources

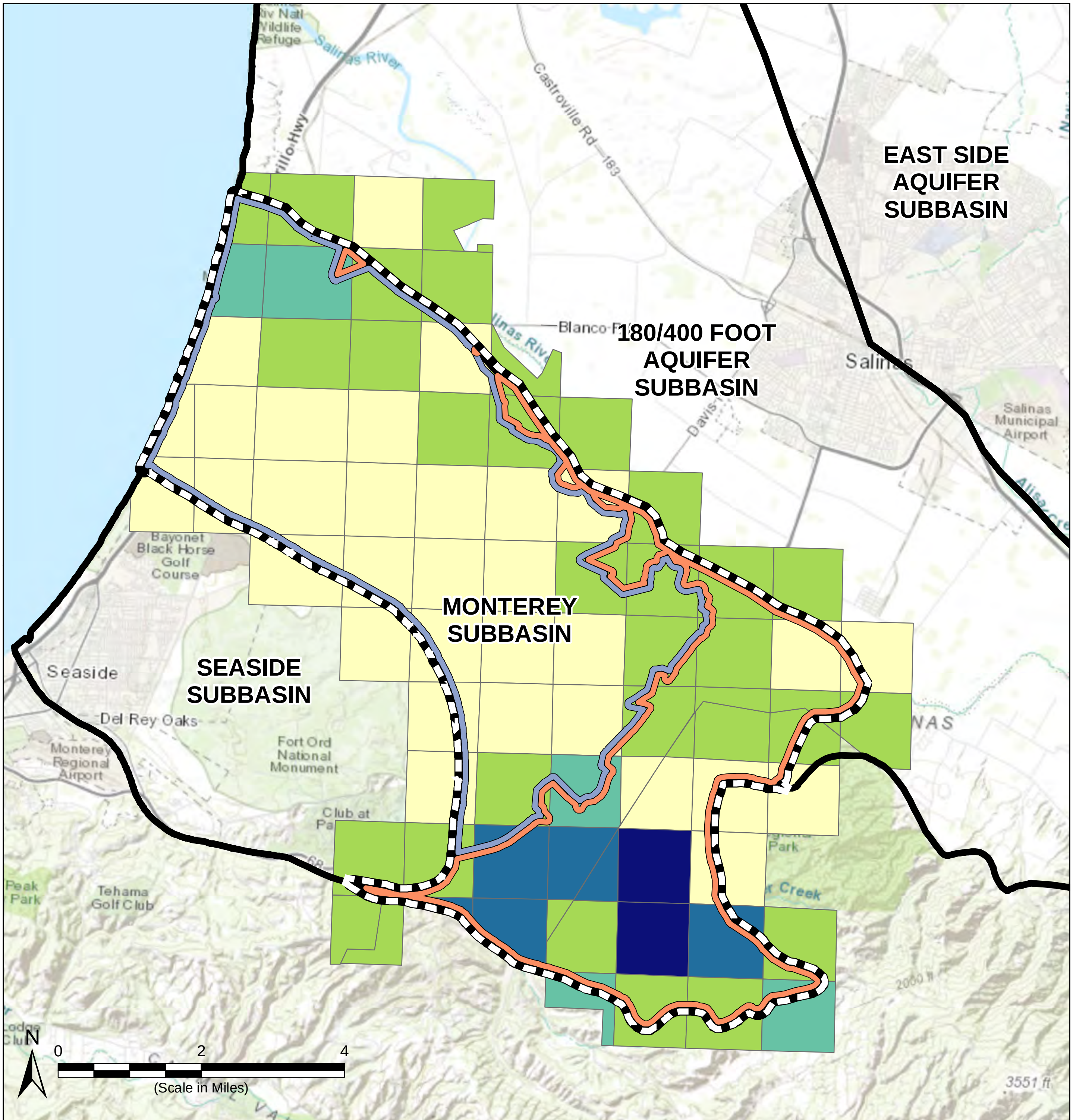
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.

Public Well Density

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-6

Path: X:\B60094\Maps\2021\09\Fig3-6_PublicWellDensity.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

Domestic Well Density

0

1 - 5

6 - 14

15 - 26

27 - 44

Notes

1. All locations are approximate.
2. Well density is shown on PLSS sections within the Subbasin

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Well count information obtained from Well Completion Report Map Application on February 15, 2018 and includes domestic wells, production wells, and public wells.

Domestic Well Density

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-7

Path: X:\B60094\Maps\2021\09\Fig3-7_DomesticWellDensity.mxd

3.2 Water Resources Monitoring and Management Programs

3.2.1 Existing Monitoring Programs

Existing groundwater monitoring in the Subbasin includes:

- The California Statewide Groundwater Elevation Monitoring (CASGEM) Program tracks long-term groundwater elevation trends in groundwater basins throughout California. The CASGEM program's mission is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. In the Subbasin, MCWRA and MPWMD are the CASGEM monitoring entities.
- The United States Geological Survey (USGS) collects surface water and groundwater data across the United States. Existing USGS monitoring wells and stream gauges are located within the Monterey Subbasin.
- The Groundwater Ambient Monitoring and Assessment (GAMA) Program is a comprehensive groundwater quality monitoring program created by the State Water Resources Control Board (SWRCB) in 2000. The GAMA Program monitors groundwater quality trends throughout California, including within the Monterey Subbasin.
- The SWRCB's Division of Drinking Water monitors groundwater quality from public water system wells. There are 15 active public water systems located within the Subbasin.
- Local small or state small water system wells are regulated by the Monterey County Department of Public Health. Local small water systems serve 2 to 4 service connections and state small water systems serve 5 to 14 connections. MCWD, MCWRA, and MPWMD each conduct periodic monitoring for groundwater elevation and quality in their production wells or selected wells in their respective areas. Additionally, MCWD has installed transducers in selected production wells.
- Multiple sites are monitoring groundwater quality as part of investigation or compliance monitoring programs through the Central Coast Regional Water Quality Control Board (CCRWQCB).
- MCWRA monitors seawater intrusion with a network of 152 monitoring wells, most wells located within the 180/400-Foot Aquifer Subbasin. The seawater intrusion monitoring network comprises a combination of production wells and dedicated monitoring wells. MCWRA collects groundwater extraction information from production wells in the Subbasin that have discharge pipes of three inches or greater in diameter. These data have been collected since 1993. Extraction information is self-reported by well owners, and this program does not extend into the entire geographic area of the Monterey Subbasin.
- The U.S. Army Corps of Engineers (the Army) conducts periodic monitoring for groundwater elevation and quality for remediation purposes in the former Fort Ord. Several additional sites are monitored for groundwater elevation and quality as part of

investigation or compliance monitoring programs through the Central Coast Regional Water Quality Control Board.

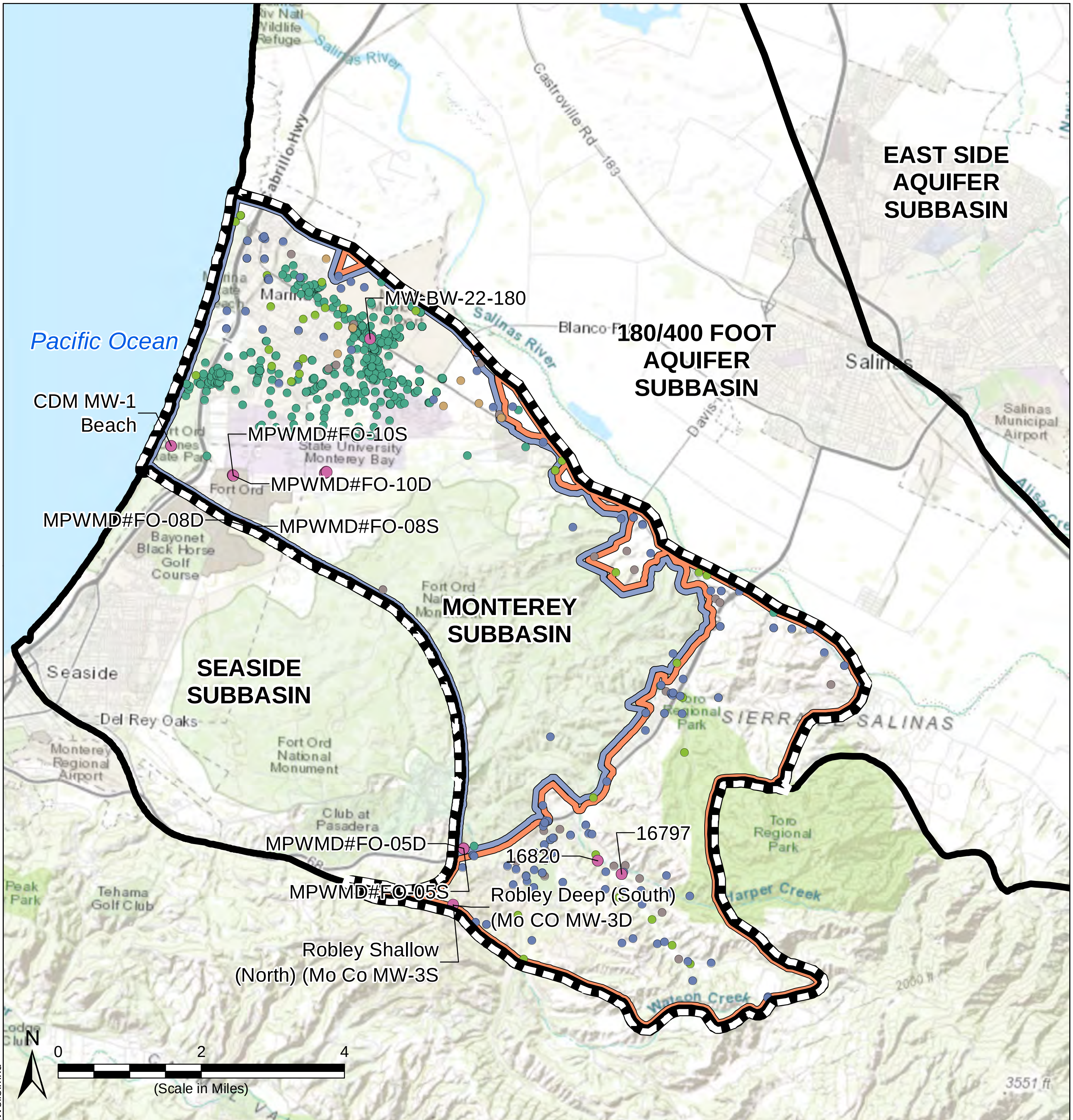
Well locations of the above monitoring programs are shown on Figure 3-9.

Groundwater elevation from CASGEM, USGS, SWRCB, as well as MCWRA, MPWMD, and the Army's monitoring networks, have been used to characterize groundwater level conditions (see Section 5.1 Groundwater Elevations and Flow Direction). Water quality data from MCWRA, MPWMD, and the Army's monitoring networks, in coordination the Airborne Electromagnetic (AEM) Surveys have been used to characterize seawater intrusion and identify water quality concerns (see Section 5.3 Seawater Intrusion and Section 5.4 Groundwater Quality Concerns).

For surface water, there are no surface water inflows beyond those produced from seasonal precipitation in the Subbasin (GeoSyntec, 2007). The USGS monitored streamflows for El Toro Creek at station 11152540 until 2001 (GeoSyntec, 2007). The logarithmic mean of 525 AFY is representative of average flows as shown in Figure 4-24 and Figure 4-25 in Section 4 (GeoSyntec, 2007). As of 2021, there are no active surface gauges in the Corral de Tierra Area.

3.2.1.1 Limits to Operational Flexibility

The existing monitoring networks will be integral to the ongoing monitoring and reporting that will be conducted pursuant to this GSP. For the above-mentioned monitoring programs, the Monterey Subbasin GSP will incorporate the CASGEM program into its monitoring network, as applicable. The MCWD, MCWRA (a member of SVBGSA), and MPWMD also conduct routine groundwater quality monitoring as part of their management efforts. These existing programs will continue and will inform GSP implementation. The Monterey Subbasin Monitoring Network is further described in Section 7 Monitoring Network.



Path: X:\B60094\Maps\2021\09\Fig3-9_LocationsofPublicMonitoringWells.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Public Monitoring Wells

- CASGEM
- Fort Ord
- SWRCB GAMA
- USGS
- MCWD
- MCWRA

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Public monitoring well locations are obtained from respective monitoring agencies.

Locations of Public Monitoring Wells

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-9

3.2.2 Existing Management Programs

The following groundwater management programs exists within the Monterey Subbasin.

3.2.2.1 Integrated Regional Water Management

The majority of the Monterey Subbasin falls within the Greater Monterey County Integrated Regional Water Management Region (Greater Monterey County Region), while a portion of the Subbasin along the southern boundary is within the Monterey Peninsula-Carmel Bay-South Monterey Bay Region (Monterey Peninsula Region). These portions of the Subbasin are therefore included in the Greater Monterey County Integrated Regional Water Management Plan (IWRMP) and the Monterey Peninsula Region IWRMP, respectively.

The Greater Monterey County Region includes the entire Monterey County, excluding the Pajaro River Watershed Region and the Monterey Peninsula Region. The Greater Monterey County IRWMP was adopted in April 2013 and updated in September 2018. The water supply goals for the Greater Monterey County Region, according to the IRWMP (Monterey County, 2018), include the following:

- Improve water supply reliability and protect groundwater and surface water supplies;
- Protect and improve surface, groundwater, estuarine and coast water quality, and ensure the provision of high-quality, potable, affordable drinking water for all communities in the region;
- Develop, fund, and implement integrated watershed approaches to flood management through collaborative and community-supported processes;
- Protect, enhance, and restore the region's ecological resources while respecting the rights of private property owners;
- Promote regional communication, cooperation, and education regarding water resources management;
- Ensure the provision of high-quality, potable, affordable water and healthy conditions for disadvantaged communities (DACs); and
- Adapt the region's water management approach to deal with impacts of climate change using science-based approaches, and minimize the regional causal effects.

The Monterey Peninsula Region consists of approximately 350 square miles along the Monterey Bay and the Carmel River Valley. The Monterey Peninsula IRWMP was adopted in 2014 and was updated to comply with new IRWM Program Guidelines in September 2019. Key goals and priorities for the Monterey Peninsula Region, according to the IRWMP (2019), include the following:

- Meet existing water supply replacement needs for the Carmel River system and Seaside Subbasin;
- Maximize use of recycled water and other reuse and where feasible, expand sewer services to areas with onsite systems to increase sources of water for recycling;

- Develop opportunities for stormwater capture and reuse pursuant to the Stormwater Resource Plan;
- Evaluate, advance, or create water conservation throughout the Region;
- Improve water supply needs to achieve multiple benefits, beneficial uses and environmental flows;
- Seek long-term sustainable supplies for adopted future demand estimates;
- Improve ocean water quality, including Areas of Special Biological Significance (ASBS), by minimizing pollutants in stormwater discharges;
- Improve inland surface water quality for environmental resources (e.g. steelhead), including headwaters and tributaries of streams, and to protect potable water supplies;
- Protect and improve water quality in groundwater basins, especially where at risk from seawater intrusion;
- Develop regional projects and plans necessary to protect critical infrastructure and sensitive habitats from flood damage and sea level rise, in particular, along the Carmel Bay and South Monterey Bay shoreline; Identify cooperative, integrate strategies for protecting both infrastructure and environmental resources, including from climate change impacts; and

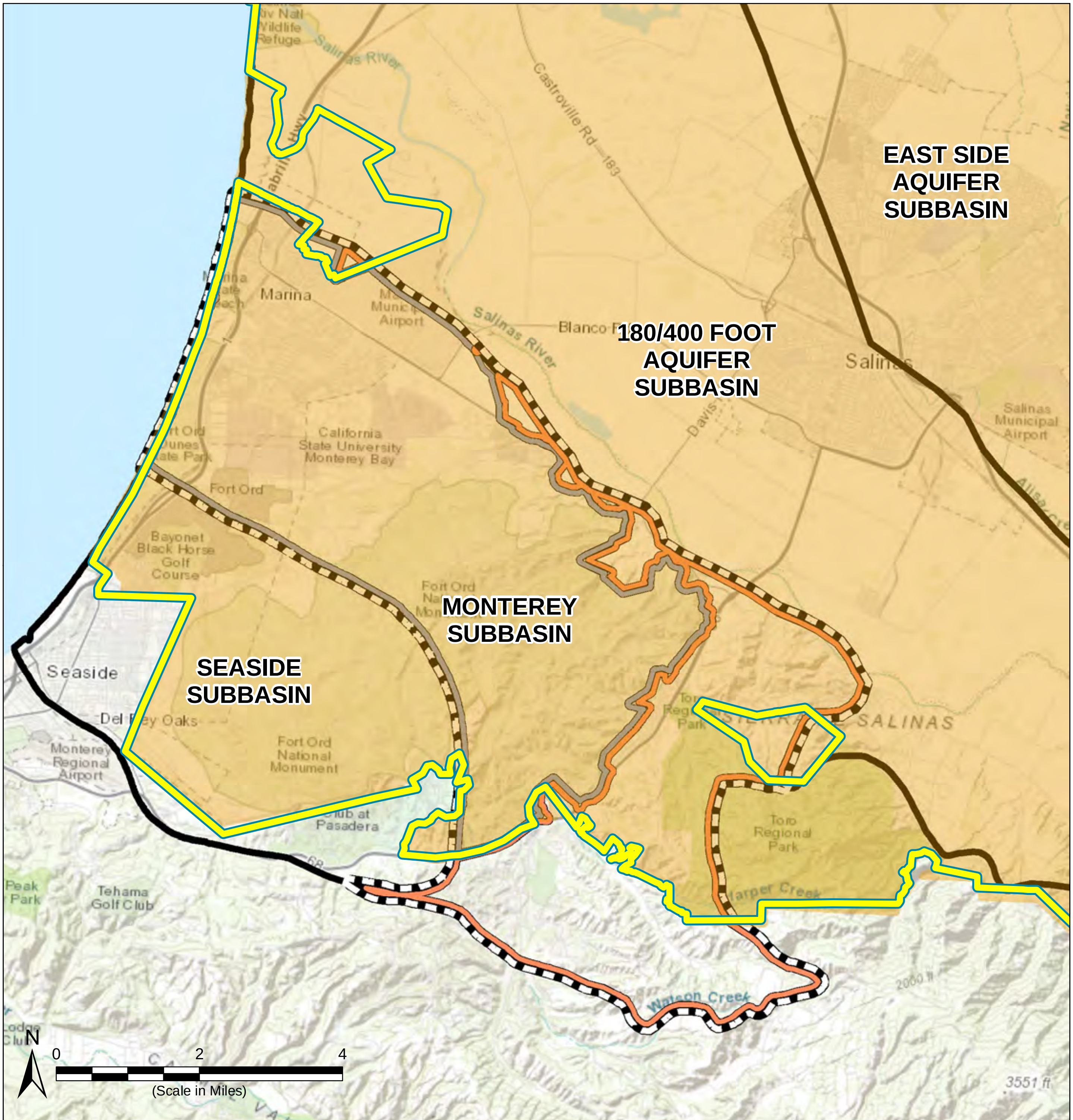
Foster collaboration among regional entities as an alternative to litigation through ongoing meetings of the RWMG and regional data sharing. IRWMP and GSP development are complementary management processes. To the extent that the issues identified for the greater IRWMP regions affect the Subbasin, these issues will be identified in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within the IRWMP regions. The IRWM program is not expected to limit operational flexibility in the Subbasin.

3.2.2.2 MCWRA Management of the Salinas Valley Groundwater Basin

The MCWRA was formed in 1947 by State law, originally as the Monterey County Flood Control and Water Conservation District (MCFCWCD), and established by the Monterey County Flood Control and Water Conservation District Act (District Act). The prevention of seawater intrusion was a principal reason for the enactment of the District Act in 1947. Since then, the MCWRA has developed projects and programs to reduce the adverse impacts from pumping and seawater intrusion within the 180/400-Foot Aquifer Subbasin. As shown on Figure 3-10, Zones 2C, 2Y, and 2Z cover a majority of the Monterey Subbasin, including most of the land north of Harper Canyon. The areas not covered by these zones include a small portion of the City of Marina, and San Benoncio Gulch and Calera Canyon along Corral de Tierra Road up to the intersection with State Route 68. A description of the zones is provided below[6]:

[6] Annexation Zone https://www.co.monterey.ca.us/home/showdocument?id=22209

- Under provisions of the District Act, the MCFCWCD established the Zone 2 and Zone 2A benefit assessment zones to fund the construction of Nacimiento Reservoir and the San Antonio Reservoir, respectively. In 2003, MCWRA created 2C to fund operation and maintenance of the reservoirs and eliminate charges in Zones 2 and 2A.
- Zone 2Y was established to collect assessments for the operation and maintenance of the Castroville Seawater Intrusion Project.
- Zone 2Z was established to collect assessment for the operation and maintenance of the Salinas Valley Reclamation Project.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- MCWRA Zone 2C
- MCWRA Zone 2Y
- MCWRA Zone 2Z

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 10 December 2021.
2. MCWRA Zone 2C boundary obtained from Monterey County Open Data, accessed 10 June 2020.

MCWRA Zones

Marina Coast Water District
Monterey County, CA
November 2021

Figure 3-10

Path: X:\B60094\Maps\2021\09\Fig3-10_MCWRA Zones.mxd

In 1990, the District Act was repealed and replaced by the existing Monterey County Water Resources Agency Act (Agency Act); however, much of the District Act was carried over into the Agency Act. The District Act and then the Agency Act have been the foundation of groundwater management within Monterey County. Additional information on MCWRA monitoring programs and well permitting programs is provided in Sections 3.2.1 and 3.5.4, respectively.

1993 and 1996 Annexation Agreements. MCWRA established annexation zones to institute water supply projects and collect assessments to fund them under various Monterey County Ordinances. The two major historic groundwater users within the Subbasin, the Federal Government and the MCWD, respectively entered into annexation agreements with MCWRA in 1993 and 1996 to be annexed to Zones 2 and 2A[7]. The 1996 Annexation Agreement and Groundwater Mitigation Framework for Marina Area Lands was the fifteenth annexation to Zones 2 and 2A since 1991.[8] In the annexation agreements, the MCWRA recognized that MCWD and the Federal Government had been pumping groundwater for many years and had strong claims to groundwater rights[9] MCWD and the Federal Government agreed that all non-Federal lands within the annexed areas would pay assessments to MCWRA Zones 2 and 2A (later superseded by Zones 2C, 2Y, and 2Z) for regional projects to protect the Salinas Valley Groundwater Basin and reduce seawater intrusion. The Annexation Agreements are attached as Appendix 3-A.

Under the 1993 and 1996 Annexation Agreements, the Federal Government agreed to limit groundwater pumping from the Salinas Valley Groundwater Basin ("Basin") to 6,600 AFY, and MCWD agreed to limit pumping from the Basin to 3,020 AFY, respectively; MCWD's share to be used to serve the City of Marina[10](MCWRA/U.S. Army, 1993; MCWRA/MCWD, 1996). In 2001, the Federal Government transferred ownership of the Fort Ord water system infrastructure to MCWD, including the ability to pump no more than 4,871 AFY[11] of groundwater (of the 6,600 AFY

---

[7] The MCWRA Board of Directors adopted an Annexation Policy dated March 29, 1993, which provided for the process for lands not then included within Zones 2 and 2A to be annexed into both zones subject to the annexation process in Agency Act §43, the preparation of final environmental documents, and the setting of annexation fees.

[8] 1996 Annexation Agreement, Section 3.1.

[9] Section 45 of the Agency Act provided MCWRA to develop a water allocation formula for groundwater users in the County "to preserve agricultural access to an adequate water supply and to preserve agriculture as a mainstay of the Salinas Valley economy". Board of Supervisors Resolution 91-476 adopted September 24, 1991, directed MCWRA staff to prepare information for a water allocation formula for Zone 2 and 2A and bring it back to the Board on or before January 1, 1992, and further directed MCWRA staff to prepare an emergency allocation ordinance for Zones 2 and 2A for consideration by the Board no later than April 1, 1992. While a draft report was prepared, the draft report was never approved by the Board.

[10] In addition, under the 1996 Annexation Agreement, 920 AFY of groundwater was allocated to Armstrong Ranch development, and 500 AFY (of brackish water) to CEMEX in the adjacent 180/400-Foot Aquifer Subbasin.

[11] Under Article 2.a of Amendment No. 1 dated October 23, 2001, to the Memorandum of Agreement between the U.S. Government acting through the Secretary of the Army and FORA, the Army agreed to reserve only 1,691 AFY, or 38 AFY less than the amount actually reserved by the Army in the October 23, 2001 deed. The 38 AFY was to be transferred to FORA and then to MCWD. FORA was to allocate the 38 AFY to the City of Seaside for the benefit of Bay View Mobile Home Park subject to use limitations prescribed in Amendment No. 1 to be administered by the

described in the 1993 Agreement) from the Basin. MCWD is using the 4,871 AFY of groundwater to provide water service to those jurisdictions within the former Fort Ord, which are entitled to water service pursuant to the Fort Ord Base Reuse Plan (Section 3.5.1.4). Under a long-term water service agreement with the Army, MCWD provides water service to all Federal activities within the former Fort Ord utilizing the Army's groundwater pumping rights.

To protect the 180-Foot and 400-Foot aquifers, the 1993 and 1996 Annexation Agreements limit the volume of groundwater that MCWD can extract from the 180-Foot and 400-Foot Aquifers. To offset that limitation, the 1996 Annexation Agreement provides "*…that the '900-foot'*[12] *aquifer should be managed to provide safe, sustained use of the water resource, and to preserve to MCWD the continued availability of water from the '900-foot' aquifer.*"

The 1993 and 1996 Annexation Agreements further provided that MCWRA will seek to develop a replacement potable water supply, such that most groundwater pumping within Fort Ord and Marina Area Lands could be curtailed. However, by Resolution 00-172 adopted on April 25, 2000, the Board of Supervisors of the MCWRA indicated that the MCWRA has no contractual obligation to fund such a system using assessments from MCWRA Zones 2A or 2B (the resolution does not mention other potential sources of funds). MCWD is developing new water supplies to support redevelopment of the former Fort Ord and to supplement its groundwater supplies. These efforts are incorporated in this GSP and discussed further in Section 9.1 Project Descriptions.

MCWRA Groundwater Export Prohibition. The Monterey County Water Resources Agency Act, §52.21 prohibits the export of groundwater from any part of the Salinas Valley Groundwater Basin, including the Monterey Subbasin. In particular, the Act states:

> *For the purpose of preserving [the balance between extraction and recharge], no groundwater from that basin may be exported for any use outside the basin, except that use of water from the basin on any part of Fort Ord shall not be deemed such an export. If any export of water from the basin is attempted, the Agency may obtain from the superior court, and the court shall grant, injunctive relief prohibiting that exportation of groundwater.*

The Agency Act was adopted at a time when the Seaside Subbasin was considered to be hydrologically separate from the Salinas Valley Groundwater Basin, but the above Agency Act section expressly made use of Salinas Valley groundwater within any part of Fort Ord, even though within the Seaside Subbasin, as being exempt from the export prohibition. In 2003, DWR included the Seaside Subbasin within the Salinas Valley Groundwater Basin, which DWR now designates as the Seaside Subbasin.

County Moratorium on Accepting and Processing New Well Permits. On May 22, 2018, the Monterey County Board of Supervisors adopted Ordinance No. 5302 pursuant to Government

City of Seaside pursuant to its land use authority. MCWD has requested FORA and the City of Seaside to correct this oversight with the Army but it has not been yet corrected.

[12] aka the Deep Aquifer. Section 5.3 of the 1996 Annexation Agreement.

Code Section 65858. The ordinance was an Interim Urgency Ordinance, which took effect immediately upon adoption. The ordinance prohibits the acceptance or processing of any applications for new wells in the defined Area of Impact within the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin, with stated exceptions including municipal wells and replacement wells. Pursuant to Section 65858, the ordinance was originally only effective for 45 days to July 5, 2018, but at the June 26, 2018, Board meeting, the Board of Supervisors on a 4-1 vote extended the ordinance to May 21, 2020, by adoption of Ordinance No. 5303. During the moratorium, the County has stated that it will conduct further studies to assess groundwater conditions in the Subbasin. The ordinance expired on May 21, 2020. The County has initiated a planning process to receive input on a possible new ordinance and to address the California Supreme Court's decision in *Protecting Our Water & Environmental Resources v. County of Stanislaus* (2020), 10 Cal. 5th 479, concerning environmental review of new well permits. Well construction applications for the Deep Aquifers are currently being reviewed and permitted on a case-by-case basis.

3.2.2.3 Groundwater Management Plans

MCWRA developed a Groundwater Management Plan (GMP) that is compliant with Assembly Bill 3030 and Senate Bill 1938 legislation (MCWRA, 2006). This GMP exclusively covered the Salinas Valley in Monterey County. As discussed above, the MCWRA was established in 1947 with the responsibility to manage water resources in the Salinas Valley. Therefore prior to 2006, MCWRA has already been implementing a formal groundwater management program including surface water monitoring and groundwater monitoring. The GMP was developed to formalize and extend those ongoing management efforts in the Salinas Valley Groundwater Basin.

The GMP identified three objectives for groundwater management:

- **Objective 1**: Development of Integrated Water Supplies to Meet Existing and Projected Water Requirements. This objective encourages the integrated uses of various water sources, such as surface water, groundwater, recycled water, and possibly desalinated brackish and saline water to meet the water demand.
- **Objective 2**: Determination of Sustainable Yield and Avoidance of Overdraft. This objective is to assess groundwater basin conditions by quantifying basin yield and evaluating historical impacts including seawater intrusion and groundwater storage decline and to implement existing and new management measures to address those issues.
- **Objective 3**: Preservation of Groundwater Quality for Beneficial Use. This objective is to preserve groundwater quality by minimizing seawater intrusion and accumulations of minerals in the groundwater basin.

To meet these three objectives, the plan identified 14 elements that should be implemented by MCWRA:

- **Plan Element 1:** Monitoring of Groundwater Levels, Quality, Production, and Subsidence

- **Plan Element 2:** Monitoring of Surface Water Storage, Flow, and Quality
- **Plan Element 3:** Determination of Basin Yield and Avoidance of Overdraft
- **Plan Element 4:** Development of Regular and Dry Year Water Supply
- **Plan Element 5:** Continuation of Conjunctive Use Operations
- **Plan Element 6:** Short-Term and Long-Term Water Quality Management
- **Plan Element 7:** Continued Integration of Recycled Water
- **Plan Element 8:** Identification and Mitigation of Groundwater Contamination
- **Plan Element 9:** Identification and Management of Recharge Areas and Wellhead Protection Areas
- **Plan Element 10:** Identification of Well Construction, Abandonment, and Destruction Policies
- **Plan Element 11:** Continuation of Local, State and Federal Agency Relationships
- **Plan Element 12:** Continuation of Public Education and Water Conservation Programs
- **Plan Element 13:** Groundwater Management Reports
- **Plan Element 14:** Provisions to Update the Groundwater Management Plan

The GMP and GSP developments are complementary management processes. To the extent that the issues identified for Monterey County affect the Monterey Subbasin, these issues will be identified in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within Monterey County.

3.2.2.4 Urban Water Management Plans

Marina Coast Water District 2020 Urban Water Management Plan

The Marina Coast Water District was formed in 1960. Today MCWD serves municipal and industrial water uses within the City of Marina and the former Fort Ord. The MCWD most recently updated its Urban Water Management Plan (UWMP) in June 2021 (MCWD, 2021). The UWMP describes the service area; reports historical and projected population; identifies historical and projected water demand by category (single-family, multi-family, commercial, industrial, institutional/government, and other); and describes the distribution system and identifies losses.

Water use during 2021 within the MCWD service area was approximately 3,100 AFY. The 2020 UWMP anticipates that projected water demand within the entire District would be 9,584 AFY by 2040, including 2,974 AFY within the City of Marina and 6,610 AFY for the existing and future developments within the Ord Community (i.e., former Fort Ord). This projected water demand by 2035 within the Ord Community is 1,693 AFY short of the 6,600 AFY groundwater supply outlined in the 1993 Annexation Agreement (MCWRA/U.S. Army, 1993; see Section 3.2.2.2)[13].

Additional water supplies such as recycled water will be used to meet this potential shortfall within the Ord Community. In 2021, MCWD takes delivery of the first 600 AFY of advanced treated water from the Pure Water Monterey (PWM) Project out of MCWD's total 1,427 AFY PWM entitlement (see discussion of the PWM Project in Section 9.1 Project Descriptions). Prior to the development of the 2020 UWMP, MCWD conducted a joint-study with FORA and Monterey One Water (M1W) that identified a new indirect potable reuse project to develop an additional 927 AFY water supply for implementation of the Fort Ord Base Reuse Plan (EKI, 2020). The project is further described in Section 9.1.

MCWD is also a key potable and recycled water transmission hub owner connecting the North Marina and North Ord areas with the yet to be developed South Ord area, which includes portions of the Cities of Seaside, Del Rey Oaks, and Monterey. MCWD owns the potable water transmission pipeline, which MCWD will use to serve the South Ord area. The pipeline is currently being used by California American Water (Cal Am) for its Carmel River Aquifer Storage and Recovery (ASR) Project to convey injection water and to convey recovered water to its Monterey District, but MCWD has the first priority of use as the pipeline's owner. It is anticipated that this potable pipeline will also be used to convey recovered PWM water for direct use in California American Water's Monterey District although no agreement for such use has been negotiated. MCWD also owns the new 10-mile transmission pipeline for the PWM Project, which will deliver advanced treated water to MCWD recycled water customers and to the PWM injection wells in the Seaside Subbasin.

In addition, the MCWD UWMP includes a number of demand management measures including:

- Water Waste Prevention Ordinances
- Metering
- Conservation Pricing
- Public Education and Outreach
- Programs to Assess and Manage Distribution System Real Loss
- Water Conservation Program Coordination and Staffing Support
- Water Survey Programs for Residential Customers
- Residential Plumbing Retrofits
- Residential Ultra-Low Flow Toilet Replacement Programs

[13] The 6,600 AFY of groundwater supply for MCWD's Ord Community service area was further allocated by FORA to each land use jurisdiction within the area. The 2015 UWMP further compared projected water demand by 2035 with groundwater supply allocation for each jurisdiction. Considering only the jurisdictions with shortfalls, the sum of jurisdictional shortfalls is anticipated to be 2,901 AFY by 2035.

- High-Efficiency Washing Machine Rebate Programs
- Commercial, Industrial, and Institutional Accounts
- Landscape Conservation Programs and Incentives

MCWD's implementation of demand management measures resulted in MCWD receiving state-wide recognition of its water conservation achievements during the last drought.

California Water Service – Salinas District 2020 Urban Water Management Plan

A portion of the California Water Service area extends into the area located along the northern portion of State Route 68 in the Corral de Tierra Area of the Subbasin. Its 2020 Urban Water Management Plan (UWMP) (California Water Service, 2016) describes the service area; reports historic and projected population; identifies historical and projected water demand by category such as single-family, multi-family, commercial, industrial, institutional/government, and other; and describes the distribution system and identifies system losses.

The California Water Service UWMP also includes a number of demand management measures including:

- Water Waste Prevention Ordinances
- Metering
- Conservation Pricing
- Public Education and Outreach
- Programs to Assess and Manage Distribution System Real Loss
- Water Conservation Program Coordination and Staffing Support
- Rebates and give-aways
- Plumbing fixture replacement and Direct Installation Programs
- Irrigation equipment and landscape efficiency improvements

California Water Service's UWMP notes that groundwater will remain its sole supply due to uncertainties regarding the cost and implementation of other options, such as surface water diversion or desalination. However, the UWMP recognizes that it would be beneficial for California Water Service to diversify its supply portfolio. There is currently one active production well and four inactive production wells within the Subbasin.

3.2.2.5 CCRWQCB Agricultural Order

In 2017, the Central Coast Regional Water Quality Control Board (CCRWQCB) issued Agricultural Order No. R3-2017-0002, a Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (CCRWQCB, 2017). The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve receiving water quality. Specific requirements for individual growers are structured into three tiers based on the relative risk their operations pose to water quality.

Growers must enroll, pay fees, and meet various monitoring and reporting requirements according to the tier to which they are assigned. All growers are required to implement groundwater monitoring, either individually or as part of a cooperative regional monitoring program. Growers electing to implement individual monitoring and not participate in the regional monitoring program implemented by the Central Coast Groundwater Coalition (CCGC) are required to test all on-farm domestic wells and the primary irrigation supply well for nitrate or nitrate plus nitrite, and general minerals; including, but not limited to, TDS, sodium, chloride and sulfate.

In April 2021, the CCRWQCB issued Agricultural Order No. R3-2021-0040 included new Irrigated Lands Regulatory Program (ILRP) Waste Discharge Requirements (WDR) for farming operations in the Salinas Valley Groundwater Basin area. The permit requires that growers implement practices to reduce nitrate leaching into groundwater and improve receiving water quality. Under the new Ag Order on-farm domestic wells will be monitored for 1,2,3-trichloropropane among the other constituents that were monitored under Ag Order 3.0. Specific requirements for individual growers are structured into 3 phases based on the relative risk their operations pose to water quality. Each of the 3 phases encompasses a different area of the Central Coast Basin. Monitoring under Ag Order 4.0 will start in 2027 in the Monterey Subbasin.

3.2.2.6 Water Quality Control Plan for the Central Coast Basins

The Water Quality Control Plan for the Central Coastal Basin (Basin Plan) was most recently updated in June 2019 (SWRCB, 2019). The objective of the Basin Plan is to outline how the quality of the surface water and groundwater in the Central Coast Region should be managed to provide the highest water quality reasonably possible. Water Quality Objectives for both groundwater (drinking water and irrigation) and surface water are provided in the Basin Plan.

The Basin Plan lists beneficial users, describes the water quality which must be maintained to allow those uses, provides an implementation plan, details SWRCB and CCRWQCB plans and policies to protect water quality and a statewide surveillance and monitoring program, as well as regional surveillance and monitoring programs. The SWRCB's Sources of Drinking Water Policy, adopted in Resolution No. 88-63 and incorporated in its entirety in the CCRWQCB's Basin Plan, provides that water with TDS less than or equal to 3,000 mg/L is considered suitable or potentially suitable for drinking water beneficial uses.

Present and potential future beneficial uses for inland waters in the Basin are: surface water and groundwater as municipal supply; agricultural; groundwater recharge; recreational water; sport fishing; warm fresh water habitat; wildlife habitat; rare, threatened or endangered species; and, spawning, reproduction, and/or early development of fish.

3.2.2.7 Title 22 Drinking Water Program

The SWRCB Division of Drinking Water (DDW) regulates public water systems in the State to ensure the delivery of safe drinking water to the public. A public water system is defined as a system for the provision of water for human consumption that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. Private domestic wells, wells associated with drinking water systems with less than 15 residential service connections, industrial, and irrigation wells are not regulated by the DDW.

The DDW enforces the monitoring requirements established in Title 22 of the California Code of Regulations (CCR) for public water system wells, and all the data collected must be reported to the DDW. Title 22 also designates the Maximum Contaminant Levels (MCLs) for various waterborne contaminants, including volatile organic compounds, non-volatile synthetic organic compounds, inorganic chemicals, radionuclides, disinfection byproducts, general physical constituents, and other parameters.

3.2.2.8 Limits to Operational Flexibility

This GSP has been developed to be coordinated with the requirements, management plans and monitoring programs administered by other jurisdictions in the area, including SVBGSA, MCWRA, MCWD GSA, CCRWQCB, and the Federal Government. For example:

- The IRWMP and GSP development are complementary management processes. To the extent that the issues identified for the greater IRWMP region affect the Subbasin, these issues will be discussed in the following sections of this GSP. The implementation of this GSP will contribute to the sustainable use of water supplies within the IRWMP region and the IRWMP is not expected to limit operational flexibility in the Subbasin.
- The purpose and objective of MCWRA's groundwater management of the Subbasin, which focuses on providing regional solutions to protection of the Subbasin and preventing seawater intrusion, aligns with the goals of this GSP. The GSP will augment and integrate with MCWRA's historical management of the Subbasin.

Some of the existing management and regulatory programs include well registration, extraction monitoring, new well restrictions, pumping allowances and restrictions, recharge requirements and/or water quality protection standards that will limit operational flexibility. These limits to operational flexibility have already been incorporated into the projects and programs included in this GSP. Examples of limits on operational flexibility include:

- Pumping allowances in the MCWRA annexation agreements with MCWD and the Federal Government may restrict groundwater use. However, current groundwater use by MCWD within the City of Marina and the former Fort Ord is well below the annexation agreement pumping allowances. These agreements are not expected to adversely affect the Subbasin's ability to reach sustainability.

- The groundwater export prohibition included in the Agency Act prevents export of water out of the Subbasin. This prohibition is not expected to adversely affect the Subbasin's ability to reach sustainability.
- The Basin Plan and the Title 22 Drinking Water Program restrict the quality of water that can be recharged into the Subbasin as well as the location of groundwater recharge.
- Well construction restrictions within the Former Fort Ord (see Section 3.5.4.2) as well as the County's Interim Urgency Ordinance[14], which imposes a temporary moratorium on wells in the Area of Impact (see Section 3.5.4.3), may limit certain activities and the Subbasin GSAs' ability to access certain sources of water. However, the moratorium is not expected to adversely affect the Subbasin's ability to reach sustainability.

3.3 Conjunctive Use Programs

There is no existing conjunctive use program within the Monterey Subbasin. The Pure Water Monterey Project is an advanced water recycling project with a conjunctive use component under development by MPWMD, M1W, and MCWD. The project is discussed in Section 9.1 Project Descriptions.

3.4 Groundwater Cleanup at the Former Fort Ord

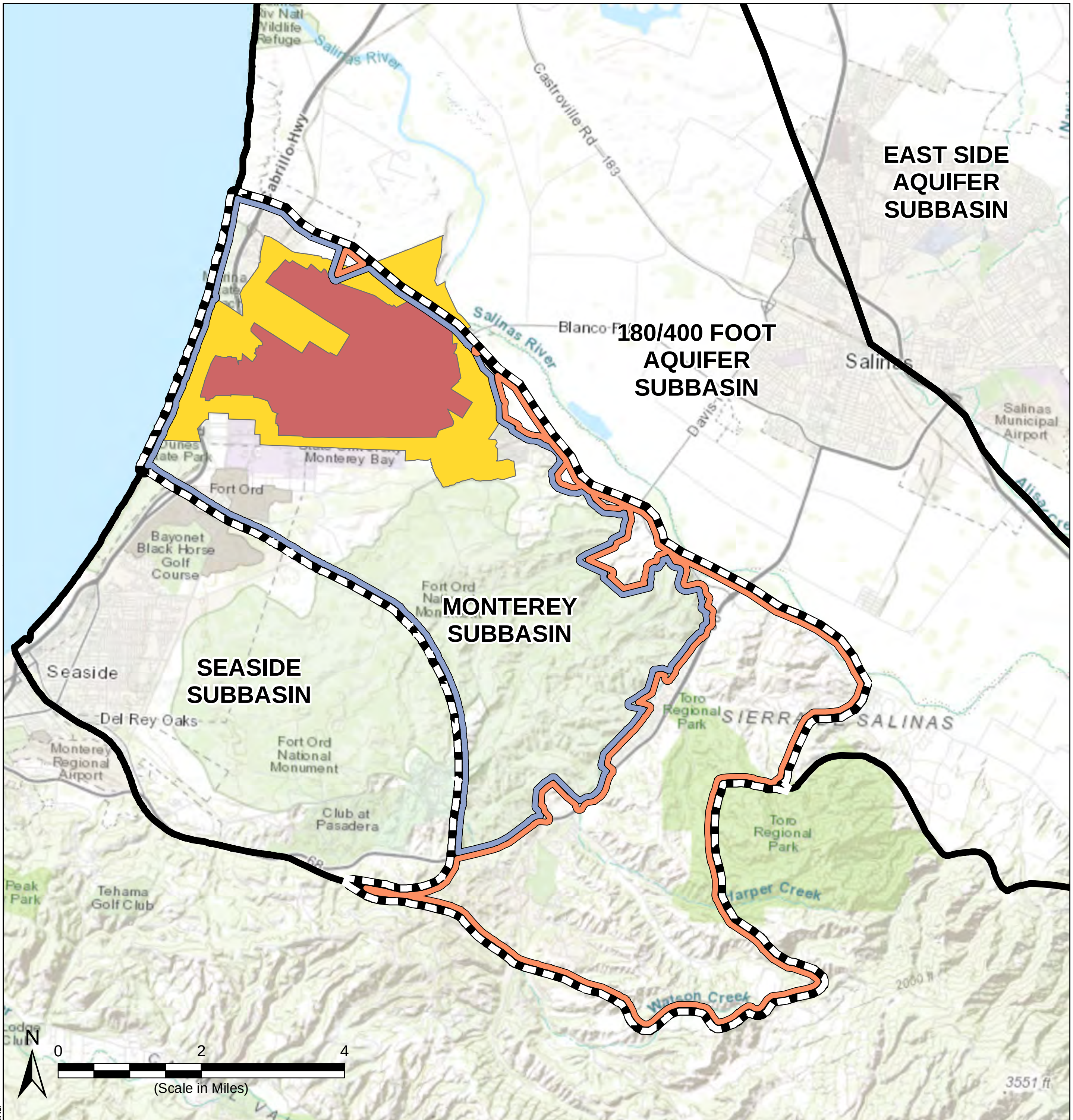
The former Fort Ord military base consists of 27,827 acres across the Monterey, 180/400-Foot Aquifer, and Seaside Subbasins. Within the Monterey Subbasin, the former Fort Ord encompasses more than half of the Subbasin's area. The Fort Ord military base was established in 1917 by the U.S. Army as a maneuver area and field artillery target range. The base was officially closed in 1994.

Remedial investigation and cleanup action at Fort Ord led by the Army began in 1986. The cleanup activities at Fort Ord have included groundwater and soil remediation associated with industrial and waste disposal activities, and later included munitions cleanup. The site was added to the National Priorities List on February 21, 1990. The Army was designated as the lead agency and the U.S. Environmental Protection Agency (EPA) was designated as the lead regulatory agency for the Superfund process at Fort Ord. A Federal Facility Agreement was signed by the Army, U.S. EPA, the California Department of Toxic Substances Control, and the CCRWQCB in 1990.

As of 2021, groundwater remediation is ongoing at three sites: Operable Unit (OU) 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume (OUCTP), for volatile organic compound (VOC) constituents of concern.

[14] The Interim Urgency Ordinance expired in May 2021.

Activity and use limitations are in place at the former Fort Ord such as zoning restrictions, deed or access restrictions, and well installation restrictions. County Ordinance No. 04011 of 2005 was adopted to prohibit and/or regulate new water wells in areas within the former Fort Ord due to groundwater contamination constraints. Well construction is prohibited in areas overlying or adjacent to the contamination plumes in the former Fort Ord (i.e., Prohibition Zone) and is subject to special review in areas that may be impacted by the contamination plumes (i.e., Consultation Zone). The Prohibition and Consultation Zones were last updated in 2016 and are shown on Figure 3-11.



Path: X:\B60094\Maps\2021\09\Fig3-11_FortOrdProhibitionZones.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra

Fort Ord Special Groundwater Protection Zones

Prohibition Zone

Consultation Zone

Notes

1. All locations are approximate.
2. Monterey County Ordinance No. 04001 (Monterey County Code Title 15, Chapter 15.08.140) prohibits and/or regulates contruction of new water wells within the Fort Ord groundwater protection zones shown herein, which overlay or are adjacent to the contamination plumes on the former Fort Ord. Current groundwater protection zone are obtained from Source 2.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. U.S. Department of the Army, 2017. Final 4th Five-Year Review Report for Fort Ord Superfund Site, Monterey County, California, prepared by the Fort Ord Base Realignment and Closure Office, dated September 2017.

Fort Ord Special Groundwater Protection (Contamination) Zones

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-11

3.5 Land Use Elements or Topic Categories of Applicable General Plans

Monterey County and the cities of Marina and Seaside have land use authority over all or portions of the Monterey Subbasin. Additionally, the Fort Ord Reuse Authority oversees reuse of the former Fort Ord army base within the Subbasin. Land use is an important factor in water management, as described below. The following sections provide a general description of these land use plans and how implementation may affect groundwater in the Monterey Subbasin. The following descriptions were taken from publicly available general plans at the time of the GSP preparation.

3.5.1 General Plans and Other Land Use Plans

This section identifies relevant policies in the current General Plans that could: (1) affect water demands in the Monterey Subbasin (e.g., due to population growth and development of the built environment), (2) influence the GSP's ability to achieve sustainable groundwater use, and (3) affect implementation of General Plan land use policies.

3.5.1.1 Monterey County General Plan

Relevant elements of the Monterey County General Plan (Monterey County 2010) are summarized in Table 3-2.

Table 3-2. Monterey County General Plan Summary

Element	Goal / Policy	
Land Use	LU-1.4	Growth areas shall be designated only where an adequate level of services and facilities such as water, sewerage, fire and police protection, transportation, and schools exist or can be assured concurrent with growth and development. Phasing of development shall be required as necessary in growth areas in order to provide a basis for long-range services and facilities planning.
Open Space	OS-3.8	The County shall cooperate with appropriate regional, state and federal agencies to provide public education/outreach and technical assistance programs on erosion and sediment control, efficient water use, water conservation and re-use, and groundwater management. This cooperative effort shall be centered through the Monterey County Water Resources Agency.
et. seq. Public Services	GOAL PS-2	Assure an adequate and safe water supply to meet the county's current and long-term needs.
	PS-2.1	Coordination among, and consolidation with, those public water service providers drawing from a common water table to prevent overdrawing the water table is encouraged.

Element	Goal / Policy	
	PS-2.2	The County of Monterey shall assure adequate monitoring of wells in those areas experiencing rapid growth provided adequate funding mechanisms for monitoring are established in the CIFP.
	PS-2.3	New development shall be required to connect to existing water service providers where feasible. Connection to public utilities is preferable to other providers.
	PS-2.4	Regulations for installing any new domestic well located in consolidated materials (e.g., hard rock areas) shall be enacted by the County.
	PS-2.5	Regulations shall be developed for water quality testing for new individual domestic wells on a single lot of record to identify: a) Water quality testing parameters for a one-time required water quality test for individual wells at the time of well construction. b) A process that allows the required one-time water quality test results to be available to future owners of the well. Regulations pursuant to this policy shall not establish criteria that will prevent the use of the well in the development of the property. Agricultural wells shall be exempt from the regulation.
	GOAL PS-3	Ensure that new development is assured a long-term sustainable water supply.
	PS-3.1	Except as specifically set forth below, new development for which a discretionary permit is required, and that will use or require the use of water, shall be prohibited without proof, based on specific findings and supported by evidence, that there is a long-term, sustainable water supply, both in quality and quantity to serve the development [see Plan for list].
	PS-3.2	Specific criteria for proof of a Long-Term Sustainable Water Supply and an Adequate Water Supply System for new development requiring a discretionary permit, including but not limited to residential or commercial subdivisions, shall be developed by ordinance with the advice of the General Manager of the Water Resources Agency and the Director of the Environmental Health Bureau. A determination of a Long-Term Sustainable Water Supply shall be made upon the advice of the General Manager of the Water Resources Agency. The following factors shall be used in developing the criteria for proof of a long-term sustainable water supply and an adequate water supply system: [see Plan for list]
	PS-3.3	Specific criteria shall be developed by ordinance for use in the evaluation and approval of adequacy of all domestic wells. The following factors shall be used in developing criteria for both water quality and quantity including, but not limited to: [see Plan for list]
	PS-3.4	The County shall request an assessment of impacts on adjacent wells and instream flows for new high-capacity wells, including high-capacity urban and

Element	Goal / Policy	
		agricultural production wells, where there may be a potential to affect existing adjacent domestic or water system wells adversely or in-stream flows, as determined by the Monterey County Water Resources Agency. In the case of new high-capacity wells for which an assessment shows the potential for significant adverse well interference, the County shall require that the proposed well site be relocated or otherwise mitigated to avoid significant interference. The following factors shall be used in developing criteria by ordinance for use in the evaluation and approval of adequacy of all such high-capacity wells, including but not limited to: a) Effect on wells in the immediate vicinity as required by the Monterey County Water Resources Agency or Environmental Health Bureau. b) Effects of additional extractions or diversion of water on in-stream flows necessary to support riparian vegetation, wetlands, fish, and other aquatic life including migration potential for steelhead, for the purpose of minimizing impacts to those resources and species. This policy is not intended to apply to replacement wells.
	PS-3.5	The Monterey County Health Department shall not allow construction of any new wells in known areas of saltwater intrusion as identified by Monterey County Water Resources Agency or other applicable water management agencies: a) Until such time as a program has been approved and funded that will minimize or avoid expansion of salt water intrusion into useable groundwater supplies in that area; or b) Unless approved by the applicable water resource agency. This policy shall not apply to deepening or replacement of existing wells, or wells used in conjunction with a desalination project.
	PS-3.6	The County shall coordinate and collaborate with all agencies responsible for the management of existing and new water resources.
	PS-3.7	A program to eliminate overdraft of water basins shall be developed as part of the Capital Improvement and Financing Plan (CIFP) for this Plan using a variety of strategies, which may include but are not limited to: a) Water banking; b) Groundwater and aquifer recharge and recovery; c) Desalination; d) Pipelines to new supplies; and/or e) A variety of conjunctive use techniques. The CIFP shall be reviewed every five years in order to evaluate the effectiveness of meeting the strategies noted in this policy. Areas identified to be at or near overdraft shall be a high priority for funding.
	PS-3.8	Developments that use gray water and cisterns for multi-family residential and commercial landscaping shall be encouraged, subject to a discretionary permit.

Element	Goal / Policy	
	PS-3.9	A tentative subdivision map and/or vesting tentative subdivision map application for either a standard or minor subdivision shall not be approved until the applicant provides evidence of a long-term sustainable water supply in terms of yield and quality for all lots that are to be created through subdivision.
	PS-3.10	In order to maximize agricultural water conservation measures to improve water use efficiency and reduce overall water demand, the County shall establish an ordinance identifying conservation measures that reduce agricultural water demand.
	PS-3.11	In order to maximize urban water conservation measures to improve water use efficiency and reduce overall water demand, the County shall establish an ordinance identifying conservation measures that reduce potable water demand
	PS-3.12	The County shall maximize the use of recycled water as a potable water offset to manage water demands and meet regulatory requirements for wastewater discharge, by employing strategies including, but not limited to, the following: a) Increase the use of treated water where the quality of recycled water is maintained, meets all applicable regulatory standards, is appropriate for the intended use, and re-use will not significantly impact beneficial uses of other water resources. b) Work with the agricultural community to develop new uses for tertiary recycled water and increase the use of tertiary recycled water for irrigation of lands currently being irrigated by groundwater pumping. c) Work with urban water providers to emphasize use of tertiary recycled water for irrigation of parks, playfields, schools, golf courses, and other landscape areas to reduce potable water demand. d) Work with urban water providers to convert existing potable water customers to tertiary recycled water as infrastructure and water supply become available.
	PS-3.13	To ensure accuracy and consistency in the evaluation of water supply availability, the Monterey County Health Department, in coordination with the MCWRA, shall develop guidelines and procedures for conducting water supply assessments and determining water availability. Adequate availability and provision of water supply, treatment, and conveyance facilities shall be assured to the satisfaction of the County prior to approval of final subdivision maps or any changes in the General Plan Land Use or Zoning designations.
	PS-3.14	The County will participate in regional coalitions for the purpose of identifying and supporting a variety of new water supply projects, water management programs, and multiple agency agreements that will provide additional domestic water supplies for the Monterey Peninsula and Seaside Subbasin, while continuing to protect the Salinas and Pajaro River groundwater basins from saltwater intrusion. The County will also participate in regional groups including representatives of the Pajaro Valley Water Management Agency and the County of Santa Cruz to identify and support a variety of new water supply,

Element	Goal / Policy	
		water management and multiple agency agreement that will provide additional domestic water supplies for the Pajaro Groundwater Basin. The County's general objective, while recognizing that timeframes will be dependent on the dynamics of each of the regional groups, will be to complete the cooperative planning of these water supply alternatives within five years of the adoption of the General Plan and to implement the selected alternatives within five years after that time.
	PS-3.15	The County will pursue expansion of the Salinas Valley Water Project (SVWP) by investigating expansion of the capacity for the Salinas River water storage and distribution system. This shall also include, but not be limited to, investigations of expanded conjunctive use, use of recycled water for groundwater recharge and seawater intrusion barrier, and changes in operations of the reservoirs. The County's overall objective is to have an expansion planned and in service by the date that the extractions from the Salinas Valley groundwater basin are predicted to reach the levels estimated for 2030 in the EIR for the Salinas Valley Water Project. The County shall review these extraction data trends at five-year intervals. The County shall also assess the degree to which the Salinas Valley Groundwater Basin (Zone 2C) has responded with respect to water supply and the reversal of seawater intrusion based upon the modeling protocol utilized in the Salinas Valley Water Project EIR. If the examination indicates that the growth in extractions predicted for 2030 are likely to be attained within ten years of the date of the review, or the groundwater basin has not responded with respect to water supply and reversal of seawater intrusion as predicted by the model, then the County shall convene and coordinate a working group made up of the Salinas Valley cities, the MCWRA, and other affected entities. The purpose will be to identify new water supply projects, water management programs, and multiple agency agreements that will provide additional domestic water supplies for the Salinas Valley. These may include, but not be limited to, expanded conjunctive use programs, further improvements to the upriver reservoirs, additional pipelines to provide more efficient distribution, and expanded use of recycled water to reinforce the hydraulic barrier against seawater intrusion. The county's objective will be to complete the cooperative planning of these water supply alternatives within five years and to have the projects on-line five years following identification of water supply alternatives.

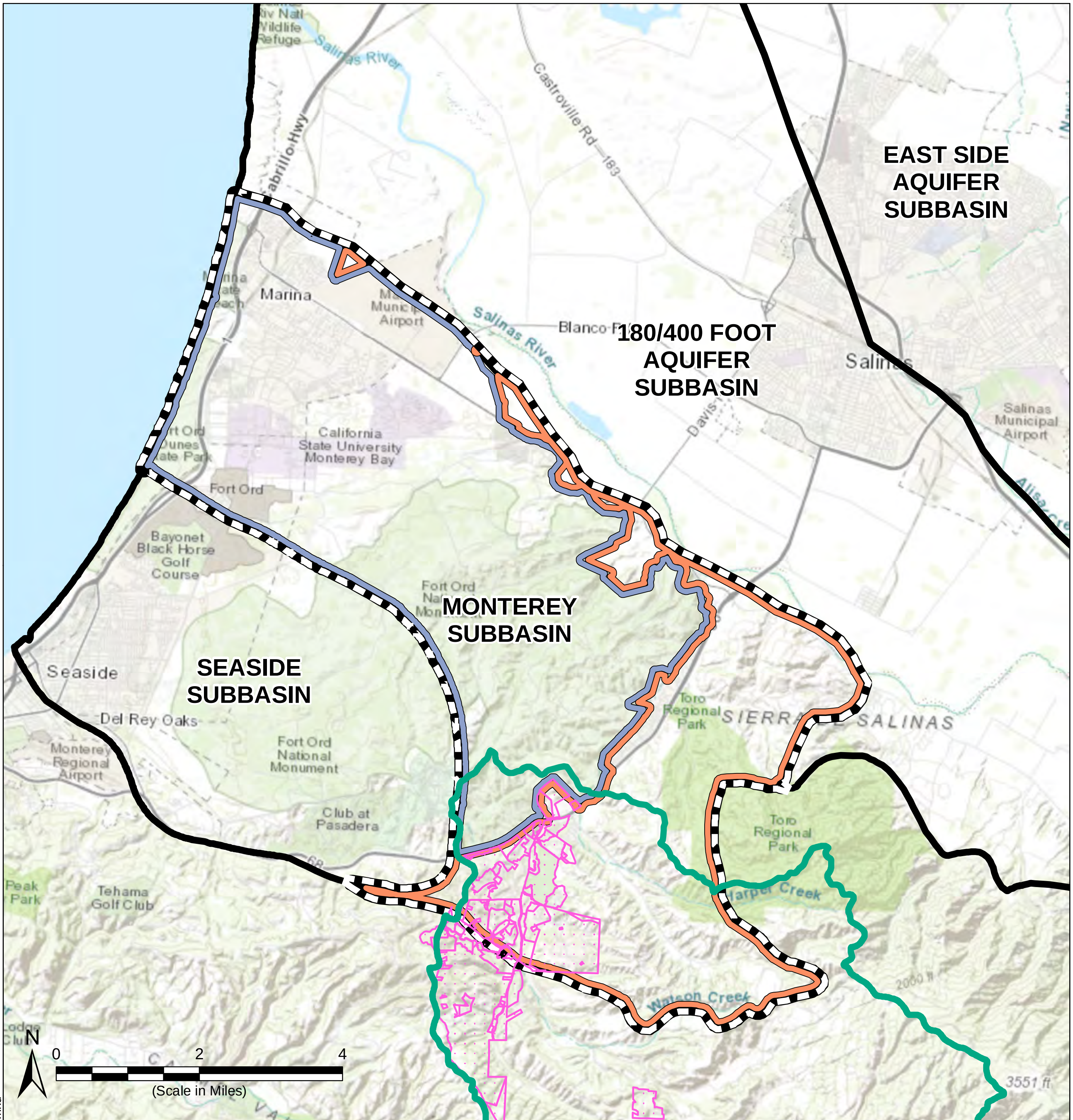
The Monterey County General Plan does not include population projections; however, the Association of Monterey Bay Area Governments (AMBAG) has developed population projections through 2050, as shown in Table 3-3.

The County imposed a B-8 Zoning overlay in 1992 to the western portions of the El Toro Planning area due to declining groundwater elevations and the concern for build-out demand negatively impacting future supplies. This overlay is shown in Figure 3-12. This zoning limits any development to single-family homes on lots that existed before 1991. This zoning overlay only covers a small portion of the Corral de Tierra Management area.

Table 3-3. Monterey County Population Projections (AMBAG, 2018)

Geography	2015	2020	2025	2030	2035	2040	Change 2015-2040 Numeric	Change 2015-2040 Percent
AMBAG Region	**762,676**	**791,600**	**816,900**	**840,100**	**862,200**	**883,300**	**120,624**	**16%**
Monterey County	**432,637**	**448,211**	**462,678**	**476,588**	**489,451**	**501,751**	**69,114**	**16%**
Carmel-By-The-Sea	3,824	3,833	3,843	3,857	3,869	3,876	52	1%
Del Rey Oaks	1,655	1,949	2,268	2,591	2,835	2,987	1,332	80%
Gonzales	8,411	8,827	10,592	13,006	15,942	18,756	10,345	123%
Greenfield	16,947	18,192	19,425	20,424	21,362	22,327	5,380	32%
King City	14,008	14,957	15,574	15,806	15,959	16,063	2,055	15%
Marina	20,496	23,470	26,188	28,515	29,554	30,510	10,014	49%
Marina balance	19,476	20,957	22,205	22,957	23,621	24,202	4,726	24%
CSUMB (portion)	1,020	2,513	3,983	5,558	5,933	6,308	5,288	518%
Monterey	28,576	28,726	29,328	29,881	30,460	30,976	2,400	8%
Monterey balance	24,572	24,722	25,324	25,877	26,456	26,972	2,400	10%
DLI & Naval Postgrad	4,004	4,004	4,004	4,004	4,004	4,004	0	0%
Pacific Grove	15,251	15,349	15,468	15,598	15,808	16,138	887	6%
Salinas	159,486	166,303	170,824	175,442	180,072	184,599	25,113	16%
Sand City	376	544	710	891	1,190	1,494	1,118	297%
Seaside	34,185	34,301	35,242	36,285	37,056	37,802	3,617	11%
Seaside balance	26,799	27,003	27,264	27,632	28,078	28,529	1,730	6%
Fort Ord (portion)	4,450	4,290	4,340	4,490	4,690	4,860	410	9%
CSUMB (portion)	2,936	3,008	3,638	4,163	4,288	4,413	1,477	86%
Soledad	24,809	26,399	27,534	28,285	29,021	29,805	4,996	20%
Soledad balance	16,510	18,100	19,235	19,986	20,722	21,506	4,996	30%
SVSP & CTF	8,299	8,299	8,299	8,299	8,299	8,299	0	0%
Balance Of County	104,613	105,361	105,682	106,007	106,323	106,418	1,805	2%
San Benito County	**56,445**	**62,242**	**66,522**	**69,274**	**72,064**	**74,668**	**18,223**	**32%**
Hollister	36,291	39,862	41,685	43,247	44,747	46,222	9,931	27%
San Juan Bautista	1,846	2,020	2,092	2,148	2,201	2,251	405	22%
Balance Of County	18,308	20,360	22,745	23,879	25,116	26,195	7,887	43%
Santa Cruz County	**273,594**	**281,147**	**287,700**	**294,238**	**300,685**	**306,881**	**33,287**	**12%**
Capitola	10,087	10,194	10,312	10,451	10,622	10,809	722	7%
Santa Cruz	63,830	68,381	72,091	75,571	79,027	82,266	18,436	29%
Santa Cruz balance	46,554	49,331	51,091	52,571	54,027	55,266	8,712	19%
UCSC	17,276	19,050	21,000	23,000	25,000	27,000	9,724	56%
Scotts Valley	12,073	12,145	12,214	12,282	12,348	12,418	345	3%
Watsonville	52,562	53,536	55,187	56,829	58,332	59,743	7,181	14%
Balance Of County	135,042	136,891	137,896	139,105	140,356	141,645	6,603	5%

Sources: Data for 2015 are from the U.S. Census Bureau and California Department of Finance. Forecast years were prepared by AMBAG and PRB.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

El Toro B8 Planning Zone

El Toro Planning Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. Monterey County El Toro Planning Area and Zoning Information obtained from Monterey County Open Data, accessed 10 June 2020.

Monterey County B-8 Zoning Areas

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-12

Path: X:\B60094\Maps\2021\09\Fig3-12_MontereyCountyB8Zoning.mxd

3.5.1.2 City of Marina General Plan

The City of Marina was founded in 1915 and incorporated in 1975. The first General Plan was adopted in 1978. The overall goal of the Marina General Plan is “the creation of a community which provides a high quality of life for all its residents; which offers a broad range of housing, transportation, and recreation choices; and which conserves irreplaceable natural resources” (City of Marina, 2010).

The General Plan recognizes that future water demands will require changes in the management of water resources in the area. Water conservation, reclamation, and reuse will constitute major components of future water management efforts. The policies and programs of the General Plan are designed to promote water conservation, the use of recycled water to protect water quality, and to ensure that the demand of future community development does not exceed the capacity to provide water in an environmentally acceptable way [3.42].

The General Plan includes the following measures related to water-supply planning:

- New developments must have identified water sources [3.45].
- A 15% reserve will be maintained between demand and supply. When demand exceeds 85% of the available supply, no new development will be allowed until supplemental water sources are identified [3.47].

The primary responsibility for water resource management in Marina rests with MCWD as the water purveyor, and MCWRA as the entity responsible for managing the surface water and groundwater resources of the Salinas Valley Groundwater Basin.

3.5.1.3 City of Seaside General Plan

The City of Seaside is in the process of updating its general plan to a planning horizon of 2040. The plan “seeks to protect the coastal system and preserve the natural habitat that extends beyond the City’s boundaries in balance with Seaside’s desire to be developed as a well-rounded mixed-use community. Equity, sustainability, collaboration, and innovation are centrally embedded in the General Plan goals, policies, and actions to achieve a mixed use urbanscape.” (Seaside, 2019)

The primary responsibility for water resource management in the City of Seaside within the Monterey Subbasin rests with MCWD, the water purveyor, and MCWRA, which is the entity responsible for managing the surface water and groundwater resources of the Salinas Valley Groundwater Basin. The plan acknowledges an inadequate supply of water on the Monterey Peninsula as a constraint for new developments and establishes programs to work with MCWD to develop water conservation methods and secure water supply for both existing and proposed uses within the city.

The Seaside General Plan includes the following goals, policies, and implementation measures that are related to groundwater or land use management, and that could potentially influence the implementation of this GSP.

- **Goal HSC-8**: Buildings and landscapes that promote water conservation, efficiency, and the increased use of recycled water.
- **Goal HSC-11**: New construction that meets a high-level of environmental performance.
- **Goal CFI-2:** A sustainable water supply that supports existing community needs and long-term growth.
- **Goal CFI-3:** Clean and sustainable groundwater.

3.5.1.4 Fort Ord Base Reuse Plan

The former Fort Ord, which covers more than half of the Subbasin's area, is currently under redevelopment. Redevelopment of the former Fort Ord was under the oversight of the Fort Ord Reuse Authority (FORA), established in 1994 and recently terminated in June 2020. Prior to its termination, FORA allocated assets/liabilities and transitioned land use planning within former Fort Ord to each of the local jurisdictions, including the Cities of Marina and Seaside, the City of Monterey, and the County of Monterey. The governing document of Fort Ord's redevelopment, the Fort Ord Base Reuse Plan, was incorporated into each individual jurisdictional area's land use plans, which are then incorporated into MCWD's UWMP as described in Section 3.2.2.4.

The Fort Ord Base Reuse Plan, Final Reassessment Report (EMC, 2012), projected a total water demand of 9,000 AFY at buildout. This projected water demand is an additional 2,400 AFY over and above the 6,600 AFY groundwater supply described under the 1993 Annexation Agreement (MCWRA/U.S. Army, 1993; see Section 3.2.2.2). Development of the 2,400 AFY of additional water supply was identified as one of the mitigation measures for redevelopment of the former Fort Ord. As described in Section 3.4 above, within the former Fort Ord, MCWD has been designated as the exclusive (1) water and sewer collection service provider and (2) developer and implementer of all new water supplies for all non-Federal lands. Under an exclusive contract with the Army, MCWD is responsible for providing water and sewer collection services for the Army and other Federal agencies within the former Fort Ord. Water demand projections associated with implementation of the Fort Ord Base Reuse Plan are included in MCWD's UWMP (Section 3.2.2.4).

The following efforts have been conducted by FORA and MCWD to support implementation of the Fort Ord Base Reuse Plan:

In 2005, the FORA and MCWD Boards of Directors both approved the Regional Urban Water Augmentation Project (RUWAP) Hybrid Alternative, which included recycled water and desalination supply components providing 1,200 AFY each. FORA and MCWD then agreed upon a modified RUWAP Hybrid Alternative that would provide 1,427 AFY of recycled water to the former Fort Ord (via the *Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse* project described in Section 9.4.6). The FORA Board Resolution No. 07-10 (May 2007) allocated the 1,427 AFY of RUWAP recycled water to the various land use jurisdictions (EMC, 2012).

In 2015, the FORA Board of Directors endorsed a joint water supply planning process between FORA, M1W, and MCWD to identify the “Additional Water Augmentation Component.” In 2016, MCWD, M1W, and FORA entered into an agreement to fund an analysis to identify alternatives to supply the additional 973 AFY of Water Augmentation (i.e., the total of 2,400 AFY required by the EIR subtracted by 1,427 AFY to be provided by the RUWAP). The Three Parties (FORA, MCWD, and M1W) recognize there may be a number of options to meet the 973 AFY “Additional Water Augmentation Component,” and through this Water Supply Augmentation Study, aim to systematically identify and evaluate the potential supply augmentation alternatives, and select a preferred option. The three-party Water Supply Augmentation Study began in 2018 and was completed in June 2020. Water supply options being evaluated include brackish water and seawater desalination, increased water conservation measures, additional advanced treatment water (ATW), and indirect potable reuse/groundwater recharge and replenishment (IPR). IPR was selected by the study as the water supply alternative and is discussed further in Section 9.4.2.

3.5.1.5 California Coastal Act and Local Coastal Programs

The Subbasin consists of approximately three miles of Monterey Bay coastline that are within the California Coastal Zone.

The California Coastal Act requires that local governments in the Coastal Zone create and implement Local Coastal Programs (LCPs) to conserve coastal-dependent land use. The Cities of Marina and Seaside have approved LCPs for Coastal Zones within their respective incorporated limits. The LCPs each consists of a Local Coastal Land Use Plan (LCLUP) and a Local Coastal Implementation Plan (LCIP) (City of Marina 2013a, 2013b; City of Seaside 2013a, 2013b). Additionally, a portion of the Subbasin’s Coastal Zone consists of the Fort Ord Dunes State Park managed by the California Department of Parks and Recreation which is located west of Highway 1 and south of the City of Marina.

This GSP has been developed to be coordinated with the goals, policies, and requirements administered by the Marina and Seaside LCLUPs as well as the California Coastal Commission. Policies in the local LCLUPs related to habitat management have been incorporated into the sustainable management criteria included in this GSP. Requirements to obtain and comply with coastal development permits have been incorporated into the projects and management actions included in this GSP.

3.5.2 Effects of Land Use Plan Implementation on Water Demand

The general plans detailed above guide future growth and development within their jurisdictional areas. This additional growth, particularly with redevelopment of the former Fort Ord, may place additional demands on groundwater resources within the Subbasin. However, the goals, policies, and implementation measures established by the existing land use plans are complementary to sustainable groundwater management of the Subbasin relative to future land use development and conservation. For example:

- The Monterey County General Plan encourages the growth areas to be designated only where adequate level of services and facilities such as water exists or can be ensured concurrent with growth and development. The plan initiates a program to eliminate overdraft of water basins as part of the Capital Improvement and Financing Plan (CIFP). The program includes various strategies such as water banking, groundwater and aquifer recharge as well as looking for new water sources such as expansion of the Salinas Valley Water Project (SVWP). The Monterey County General Plan aligns with the GSP.
- The City of Marina General Plan prohibits any new development that requires water allocation in excess of the available supply or in excess of its designated water allocation for that portion of former Fort Ord within the City. The plan encourages the City to work closely with MCWD to supply water to the current infrastructures prior to or concurrent with new developments while the existing or new developments should utilize water more efficiently.
- The City of Seaside plans to remove water supply constraints for development and redevelopment of the City by working with regional water suppliers. The plan also encourages coordination with regional and local water suppliers and participation in water conservation programs.
- The Fort Ord Reuse Plan relies on the nearby cities, such as City of Seaside and City of Marina, and Monterey County to manage the former Ford Ord area. Implementation of former Fort Ord's redevelopment will be pursuant to these local jurisdictions' land use plans and policies.

3.5.3 Effects of GSP Implementation on Water Supply Assumptions

Successful implementation of this GSP will help to ensure that the Subbasin groundwater supply is sustainably managed as set forth by SGMA. Therefore, implementation of this GSP is not anticipated to significantly affect the current water supply assumptions or land use plans.

Within the Marina-Ord Area, implementation of this GSP may induce management and project costs to be funded by MCWD to secure water supply for future development within the former Fort Ord, which will be supported by fees levied on such new developments for new water supplies. Within the Corral de Tierra Area, implementation of this GSP will induce management and project costs, and may include allocations and/or a water charges framework. Therefore, implementation of this GSP may induce changes in the cost of groundwater, and as a result, changes in land use changes based on financial decisions by individual development within this area. However, there is no direct impact from GSP implementation on land use management.

3.5.4 Well Permitting Process

The Monterey County Well Program[15] is responsible for well permitting within the Subbasin, including the construction, destruction, and repairs or modifications of domestic, irrigation, agricultural, cathodic protection, monitoring or heat exchange wells.

The Public Service element of the Monterey County General Plan addresses permitting of individual wells in rural or suburban areas. New residential or commercial lots in rural or suburban areas with limited utility services must be a minimum area of 2.5 acres if a well is the water source. Existing lots (of any size) can use an onsite well if they are outside of a water system service area. Existing lots within an established water system service area can use wells if they are greater than 2.5 acres or have a connection to a public sewage system. Table 3-4 summarizes the Monterey County General Plan's water supply guidelines for new lots (Monterey County, 2010, Table PS-1). Table 3-5 depicts the decision matrix from the Monterey County General Plan for permitting new wells for existing lots (Monterey County, 2010, Table 3-2).

Table 3-4. Monterey County Water Supply Guidelines for New Lots

Major Land Groups	Water Well Guidelines
Public Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Agriculture Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Rural Lands	Individual Wells Permitted in Areas with Proven Long-Term Water Supply
Rural Centers	Public System; Individual Wells Allowed in limited situations
Community Areas	Public System

Table 3-5. Monterey County Well Permitting Guidelines for Existing Lots

Characteristics of Property	Water Connection Existing or Available from the Water System	Not Within a Water System or a Water Connection Unavailable
Greater than or equal to 2.5 Acres connected to a Public Sewage System or an onsite wastewater treatment system	Process Water Well Permit	Process Water Well Permit
Less than 2.5 Acres and connected to a Public Sewage System	Process Water Well Permit	Process Water Well Permit
Less than 2.5 Acres and connected to an onsite wastewater treatment system	Do not Process Water Well Permit	Process Water Well Permit

On August 29, 2018, the State Third Appellate District Court of Appeal published an opinion in *Environmental Law Foundation v. State Water Resources Control Board* (No. C083239), a case that has the potential to impact future permitting of wells near navigable surface waters to which

15 https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/wells

they may be hydrologically connected. The Court of Appeal found that while groundwater itself is not protected by the public trust doctrine, the doctrine does protect navigable waters from harm caused by extraction of groundwater if it adversely affects public trust uses. Further, it found that the County (Siskiyou County in this case), as a subdivision of the State, shares responsibility for administering the public trust. Monterey County is responsible for well permitting. Therefore, it has a responsibility to consider the potential impacts of groundwater withdrawals on public trust resources when permitting wells near areas where groundwater may be interconnected with navigable surface waters.

Moreover, California Supreme Court's decision in *Protecting Our Water and Environmental Resources v. County of Stanislaus* (2020) held that Stanislaus County could not categorically classify its issuance of groundwater well construction permits as ministerial decisions exempt from environmental review under the CEQA. Chapter 15.08 of the Monterey County Code sets forth the application and decision-making process for the County in considering applications for well construction permits. The Chapter sets forth certain technical requirements that appear to be purely ministerial in their application; however, the Chapter also gives the Health Officer discretion to impose unspecified conditions on a permit, grant variances, and deny an application if in his/her judgment it would defeat the purposes of the Chapter. The Monterey County Code has not yet been amended, so permits are currently issued according to Chapter 15.08 and the 2010 General Plan, as applicable. The Monterey County Health Department, Environmental Health Bureau issues well permits and receives input from the County of Monterey Housing and Community Development to determine what, if any, level of CEQA review is necessary. Additional prohibitions and restrictions on well drilling within the Monterey Subbasin area described below.

3.5.4.1 Marina Coast Water District Ordinance No. 31

MCWD Ordinance No. 31 (codified as Chapter 3.32 of the MCWD Code and Ordinances) prohibits water wells to be constructed or reconstructed within the boundary of MCWD, except wells constructed by MCWD. Exceptions apply to shallow wells that are less than one-hundred feet deep for non-potable purposes and wells that predate the ordinance.

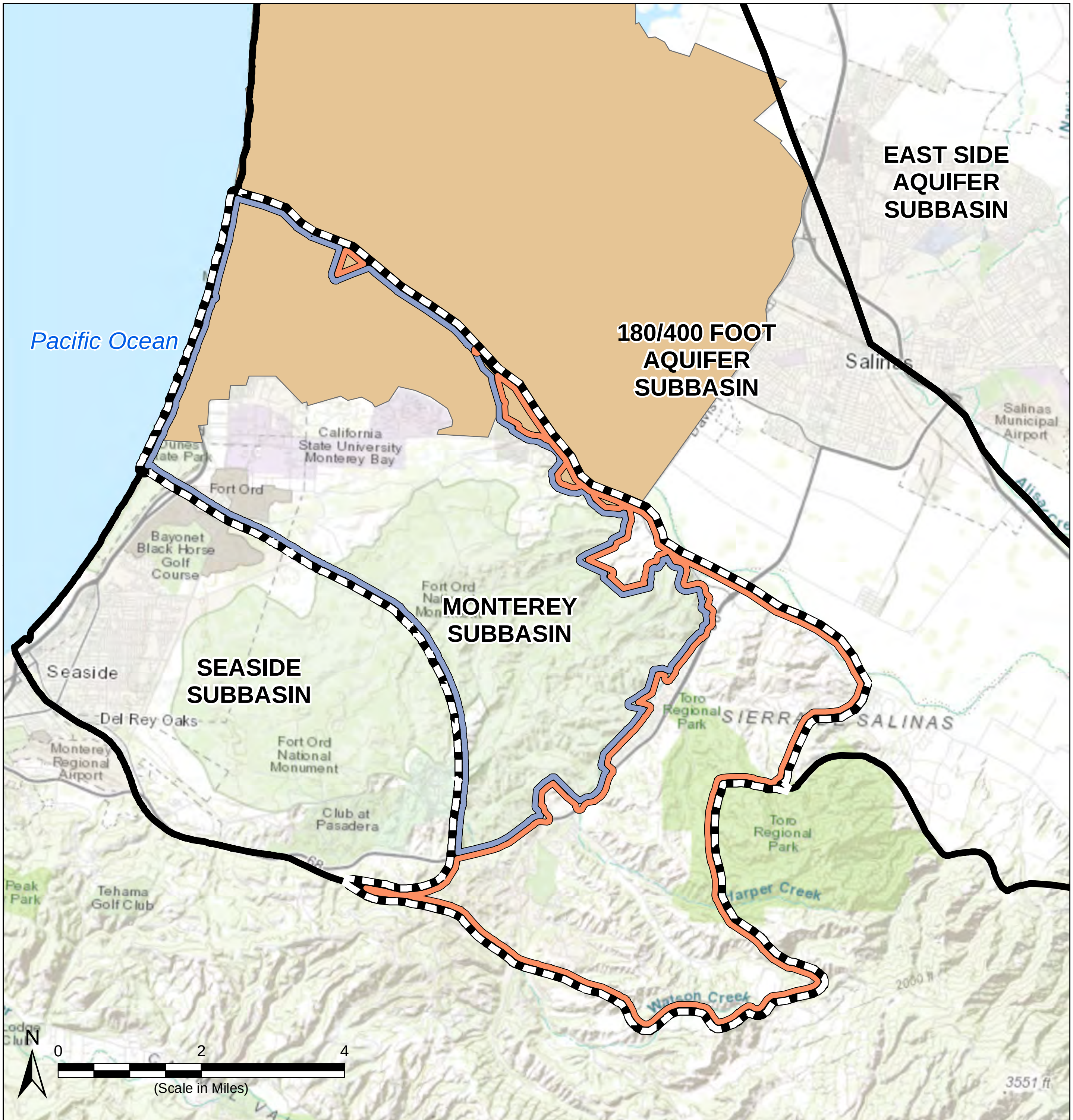
3.5.4.2 Well Construction Restrictions within the Former Fort Ord

County Ordinance No. 04011 of 2005 was adopted to prohibit and/or regulate new water wells in areas within the former Fort Ord due to groundwater contamination constraints. Well construction is prohibited in areas overlying or adjacent to the contamination plumes in the former Fort Ord (i.e., Prohibition Zone) and is subject to special review in areas that may be impacted by the contamination plumes (i.e., Consultation Zone). The Prohibition Zone and Consultation Zone within the former Fort Ord are shown on Figure 3-11 above**.**

3.5.4.3 Interim Moratorium on New Well Permits within Area of Impact (Expired)

On May 22, 2018, the Monterey County Board of Supervisors adopted Ordinance No. 5302 pursuant to Government Code Section 65858. The interim ordinance was an urgency measure to prohibit approval of wells in a defined, seawater intruded "Area of Impact" and in the Deep

Aquifers of the Salinas Valley Groundwater Basin in the unincorporated area of Monterey County, due to the immediate threat to the public health, safety, and welfare posed by new wells in these areas. The ordinance imposed a moratorium on the County Health Department accepting and processing new well permits; it was not a moratorium on additional groundwater pumping from existing wells. It also had stated exceptions, including municipal wells and replacement wells. The ordinance was an Interim Urgency Ordinance which took effect immediately upon adoption. Pursuant to Section 65858, the ordinance was originally only effective for 45 days to July 5, 2018, but at the June 26 Board meeting, the Board of Supervisors on a 4-1 vote extended the ordinance to May 21, 2020, by adoption of Ordinance No. 5303. The “Area of Impact” overlaps with the northern third of the Subbasin, as shown on Figure 3-13. The County has not yet completed proposed modifications to the well construction ordinance and the moratorium on well construction permit applications has expired since May 2021. Well construction applications for the Deep Aquifers are currently being reviewed and permitted on a case-by-case basis.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Area of Impact

Management Areas

Marina-Ord Area

Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Area of impact obtained from Exhibit B of Monterey County Urgency Ordinance No. 5302.

Path: X:\B60094\Maps\2021\09\Fig3-13 Area of Impact.mxd

Monterey County Ordinance No. 5303 Area of Impact

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 3-13

4 HYDROGEOLOGIC CONCEPTUAL MODEL

This section presents the hydrogeologic conceptual model (HCM) for the Subbasin. As described in the Hydrogeological Conceptual Model Best Management Practices (BMP) document (DWR, 2016), an HCM provides, through descriptive and graphical means, an understanding of the physical characteristics of an area that affect the occurrence and movement of groundwater, including geology, hydrology, land use, aquifers and aquitards, and water quality. This HCM serves as a foundation for subsequent Basin Setting analysis, including water budgets (Chapter 6), numerical models, monitoring network development (Chapter 7), and the development of sustainable management criteria (Chapter 8).

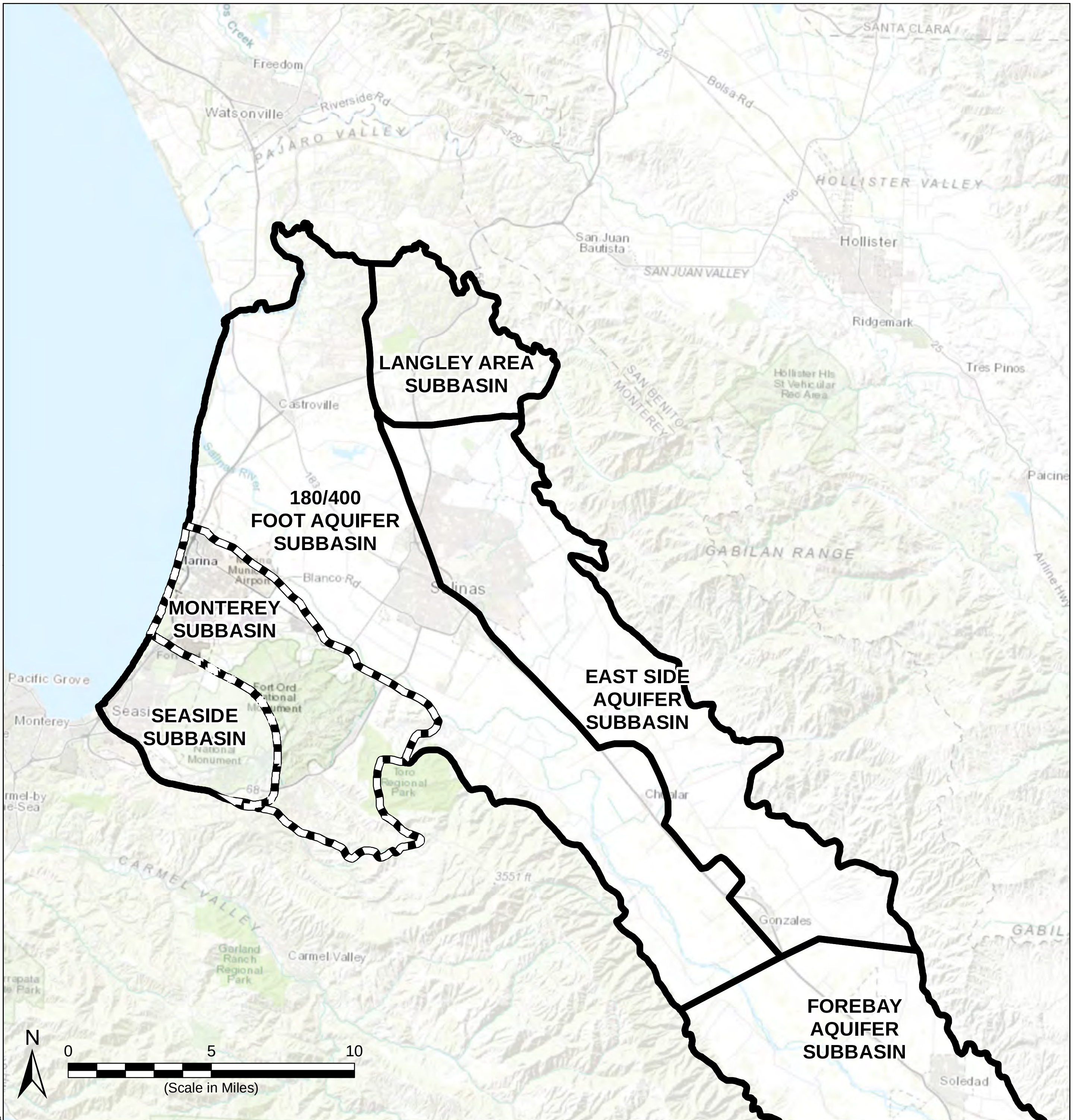
4.1 General Description

The Monterey Subbasin (Subbasin; DWR Basin No. 3-004.10) is located at the northwestern end of the Salinas Valley Groundwater Basin, an approximately 90-mile long alluvial basin underlying the elongated, intermountain valley of the Salinas River. The Subbasin includes the portions of the Monterey Bay coastal plain, south of the approximate location of the Reliz Fault, as well as upland areas to the southeast of the coastal plain. The Subbasin is bordered by the 180/400-Foot Aquifer Subbasin to the northeast and by the adjudicated Seaside Subbasin to the southwest (Figure 4-1 and Figure 4-2).

4.1.1 Geological and Structural Setting

The Subbasin geology forms the physical framework in which groundwater occurs and moves. The geology described here is based on previously published scientific reports from investigations conducted by the USGS, State of California, other consulting firms, and academic institutions.

The Salinas Valley was formed through periods of structural deformation and periods of marine and terrestrial sedimentation in a tectonically active area on the eastern edge of the Pacific Plate. The water-bearing sediments of the Salinas Valley are over 2,000 feet thick in places and are composed of unconsolidated marine and alluvial sediments of Pliocene and younger age (Brown & Caldwell, 2015). Within the Monterey Subbasin, the water-bearing strata include river and sand dune deposits of Holocene and Pleistocene age, the Aromas Sand and Paso Robles Formation of Plio-Pleistocene age, the Purisima Formation of Pliocene age, and the Santa Margarita Formation of Miocene age (Greene, 1970; Harding ESE, 2001; Geosyntec, 2007). The Monterey Formation of Miocene age represents the relatively non-water-bearing bedrock that underlies the Subbasin (see Section 4.1.2.2, Bottom of the Basin).



Legend
- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

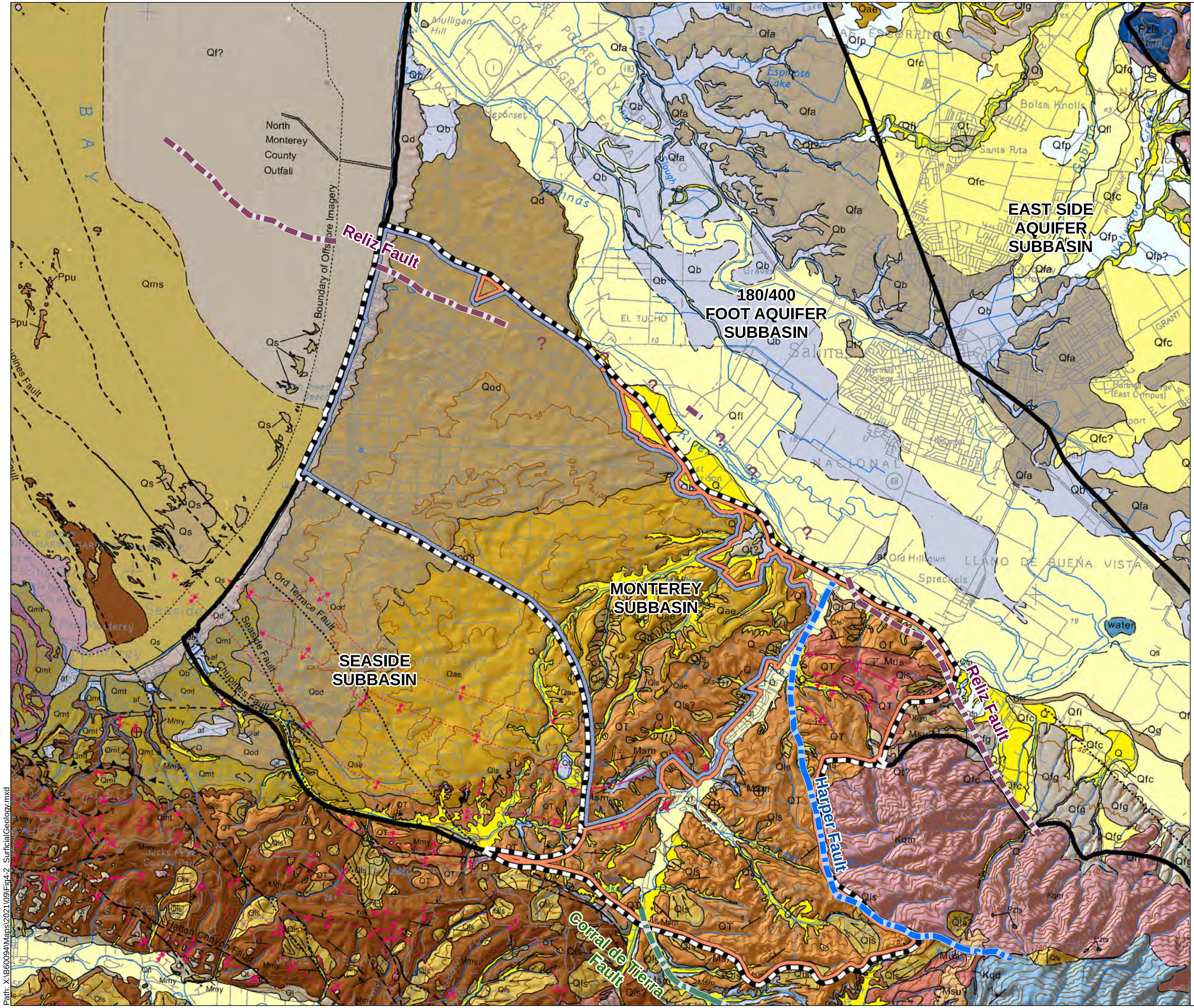
Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Salinas Valley Subbasins

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-1

Path: X:\B60094\Maps\2021\09\Fig4-1_SalinasValleySubbasins.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

Estimated Fault Locations

Corral de Tierra Fault

Harper Fault

Reliz Fault

Anticlinal fold; solid where well located; dashed where inferred; dotted where concealed; queried where existence or continuation is uncertain.

Synclinal fold; solid where well located; dashed where inferred; dotted where concealed; queried where existence or continuation is uncertain.

Surficial Geology Units

- Q Alluvium
- Qd Dune sand
- Qb Basin deposits
- Qo Older alluvium
- Qt Terrace deposits
- Qfl Flood plain deposits
- Qar Aromas Sand (undivided)
- Qae Eolian facies
- Qaf Fluvial facies
- QT Plio-Pleistocene continental deposits
- Qls Landslide deposits
- Qod Older Dune Sand
- Ppu Purisima Formation
- Msm Santa Margarita Sandstone (Mv-Basalt interbed)
- Mmy Monterey Formation
- Msu Unnamed Miocene sedimentary rocks
- Mus Unnamed Miocene sandstone
- Kqm Quartz monzonite

Sources

1. Basemap layers obtained from Department of Conservation, California of Geological Survey, "Geological Map of the Monterey 30'X60' Quadrangle and Adjacent Areas".
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Surficial Geology

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-2

Path: X:\B60094\Maps\2021\09\Fig4-2_SurficialGeology.mxd

4.1.1.1 Geologic Formations

Major geologic units of the Monterey Subbasin are described below, starting at the ground surface and moving downwards through the strata from youngest to oldest. The corresponding designation on Figure 4-2 Surficial Geology is provided in parenthesis.

- *Alluvium, Flood Plain Deposits, Landslide Deposits (Q, Qfl, Qls)* – Holocene Alluvium consists of unconsolidated stream and basin deposits that occur at the base of eastern Subbasin hillslopes. These deposits have gradational contacts with the Floodplain Deposits (Qfl) that occur along El Toro Creek and its tributaries. The Floodplain Deposits consist predominately of unconsolidated layers of mixed sand, gravel, silt, and clay that were deposited in a fluvial environment by the Salinas River and its tributaries. Numerous landslides are present in upland portions of the Subbasin such as San Benancio, Harper, and Corral de Tierra Canyons.
- *Older Dune Sand (Qod)* – This Pleistocene unit blankets most of the northwestern portions of the Subbasin and is the predominant surface deposit present in approximately one-third of the Subbasin. This unit only exists southwest of the Salinas River and is up to 250 feet thick. This sand is predominately fine- to medium-grained, with thin, gentle to moderate cross-bedding (Harding ESE, 2001).
- *Older Alluvium (Qo)* – This Pleistocene unit comprises alternating, interconnected beds of fine-grained and coarse-grained deposits, predominately associated with alluvial fan depositional environments. The Older Alluvium underlies the coastal Marina-Ord Area but is not exposed at the ground surface. This unit underlies the Older Dune Sand, and in the Marina-Ord Area has been referred to in some reports as Valley Fill Deposits, which is described as including an estuarine clay layer (Salinas Valley Aquitard) and underlying sand and gravel fluvial sequence (Harding ESE, 2001).
- *Aromas Sand (Qae)* – This Pleistocene unit is composed of cross-bedded sands containing some clayey layers (Harding ESE, 2001). This unit was deposited predominately in an eolian, high-energy alluvial, alluvial fan, and shoreline environments, with the predominant deposition environment being eolian (Harding ESE, 2001; Greene, 1970; Dupre, 1990). The Aromas Sand likely extends into the northern portion of the 180/400-Foot Aquifer Subbasin (MCWRA, 2017). The Aromas Sand is exposed throughout the ridge and hilltops in the southeastern portion of the Subbasin, while the unit is buried beneath Older Dune Sand and Alluvium in the vicinity of the City of Marina. The thickness of the Aromas Sand varies within the Subbasin and is up to 300 feet thick (Harding ESE, 2001; Muir, 1982). Although a clayey or hard red bed is often observed at the basal contact with the underlying Paso Robles Formation, the stratigraphic relationship between the Aromas Sand and the Paso Robles Formation is difficult to discern due to lithologic similarities and the complex interface between them (Harding ESE, 2001; Dupre, 1990)

- *Paso Robles Formation (QT)* – This Pliocene to lower Pleistocene unit is composed of lenticular beds of sand, gravel, silt, and clay from terrestrial deposition (Thorup, 1976; Durbin *et al*, 1978). The depositional environment is largely fluvial but also includes alluvial fan, lake, and floodplain deposition (Durbin, 1974; Harding ESE, 2001; Thorup, 1976; Greene, 1970). The individual beds of fine and coarse materials typically have thicknesses of 20 to 60 feet (Durbin *et al*, 1978). Durham (1974) reports that the thickness of the Paso Robles Formation is variable due to erosion of the upper part of the unit. Varying thicknesses ranging from 500 feet to 1,000 feet are found within the Subbasin. Outcrops of the Paso Robles Formation occur in the central and southern portions of the Subbasin.
- *Purisima Formation (Ppu)* – This Pliocene unit consists of interbedded siltstone, sandstone, conglomerate, clay and shale deposited in a shallow marine environment (Greene, 1977; Harding ESE, 2001). The Purisima Formation has been found in boreholes near the cities of Marina and Seaside; however, the unit is missing from the more inland portions of the Monterey and Seaside Subbasins (Harding ESE, 2001; HydroMetrics, 2009; Geosyntec, 2007). The Purisima Formation ranges in thickness from 500 to 1,000 feet (Feeney and Rosenberg, 2003).
- *Santa Margarita Sandstone (Msm)* –The Miocene Santa Margarita Sandstone is a friable, arkosic sandstone. In the northern portion of the Subbasin, the Paso Robles Formation conformably overlays the Purisima Formation, which interfingers with the Santa Margarita Sandstone (Durbin, 2007; Hydrometrics, 2009). Towards the boundaries with the Seaside Subbasin and the Corral de Tierra Area, the Paso Robles unconformably overlays over the Santa Margarita Sandstone. Outcrops of the Santa Margarita Sandstone are found in the Corral de Tierra Area.
- *Monterey Formation (Mmy)* – The Monterey Formation (Miocene) is a shale or mudstone deposited in a shallow marine environment (Harding ESE, 2001; Greene, 1977). As discussed below, the Monterey Formation is relatively impervious. The top of the Monterey Formation is defined as the bottom of the Subbasin (Section 4.1.2.2).
- *Unnamed Miocene Sandstone (Mus)* – An unnamed Miocene sandstone unit (Mus) underlies the Monterey Formation. The Mus unit consists of an upper part of marine arkosic sandstone and conglomerate; and a lower part of continental sandstone and conglomerate (Wagner, et al. 2002). This unit is exposed in the Corral de Tierra Area near the eastern and southern Subbasin boundaries. This unit is sometimes referred to as the Basal Sandstone in other reports (GeoSyntec, 2007).
- *Unnamed Miocene Sedimentary Rocks (Msu)* – Miocene metamorphic sedimentary rocks (Msu) are deposited on granitic rocks of the Galiban Range (Kqm). The Msu unit is comprised of granitic conglomerate and arkosic sandstone of marine and non-marine sources (Wagner, et al. 2002). This unit is exposed in the Corral de Tierra Area near the eastern Subbasin boundary. These unnamed Miocene units (i.e., Mus and Msu) are approximately 250 feet thick (Geosyntec, 2007).

4.1.1.2 Surface Geology

As shown on Figure 4-2, the predominant surficial geologic unit covering the coastal plain portion of the Subbasin is "Qod" (i.e., Older Dune Sand [Pleistocene]). South of the coastal plain area, the Eolian facies of Aroma Sand “Qae” (Pleistocene) comprises the hills of the Fort Ord area. Further south near Highway 68 and in the Corral de Tierra Area, the predominant surficial geologic unit is “QT” (Paso Robles Formation [Plio-Pleistocene]). Other minor units in the area include "Q” (Alluvium [Holocene]), and “Qls” (Landslide Deposits [Pleisto-Holocene]), found in thin strips along the intermittent tributaries to El Toro Creek, which is a tributary to the Salinas River (as discussed above); and "Qls" (landslide deposits) that exist in pockets in the upland areas.

4.1.2 Subbasin Extent

4.1.2.1 Lateral Basin Boundaries

The Monterey Subbasin is bounded by the following combination of Subbasin boundaries and physical boundaries of the Salinas Valley Basin:

Two subbasins are adjacent to the Monterey Subbasin.

1. The 180/400-Foot Aquifer Subbasin. The northeastern boundary with the 180/400-Foot Aquifer Subbasin is divided into two parts: the northern part coincides with a buried trace of the Reliz Fault (DWR, 2016); the southern part follows the contact between Aromas Sand / Paso Robles Formations (Qae/QT) and alluvium (Q). The Reliz Fault does not appear to be a barrier to groundwater flow between these subbasins (see Section 4.2.2.3).
2. The Seaside Subbasin. The southwestern boundary with the Seaside Subbasin is based on an inferred groundwater divide. The boundary with the Seaside Subbasin was formally established in the Seaside Basin Adjudication Amended Decision (Superior Court of California, 2007).

Two additional physical features bound the Monterey Subbasin.

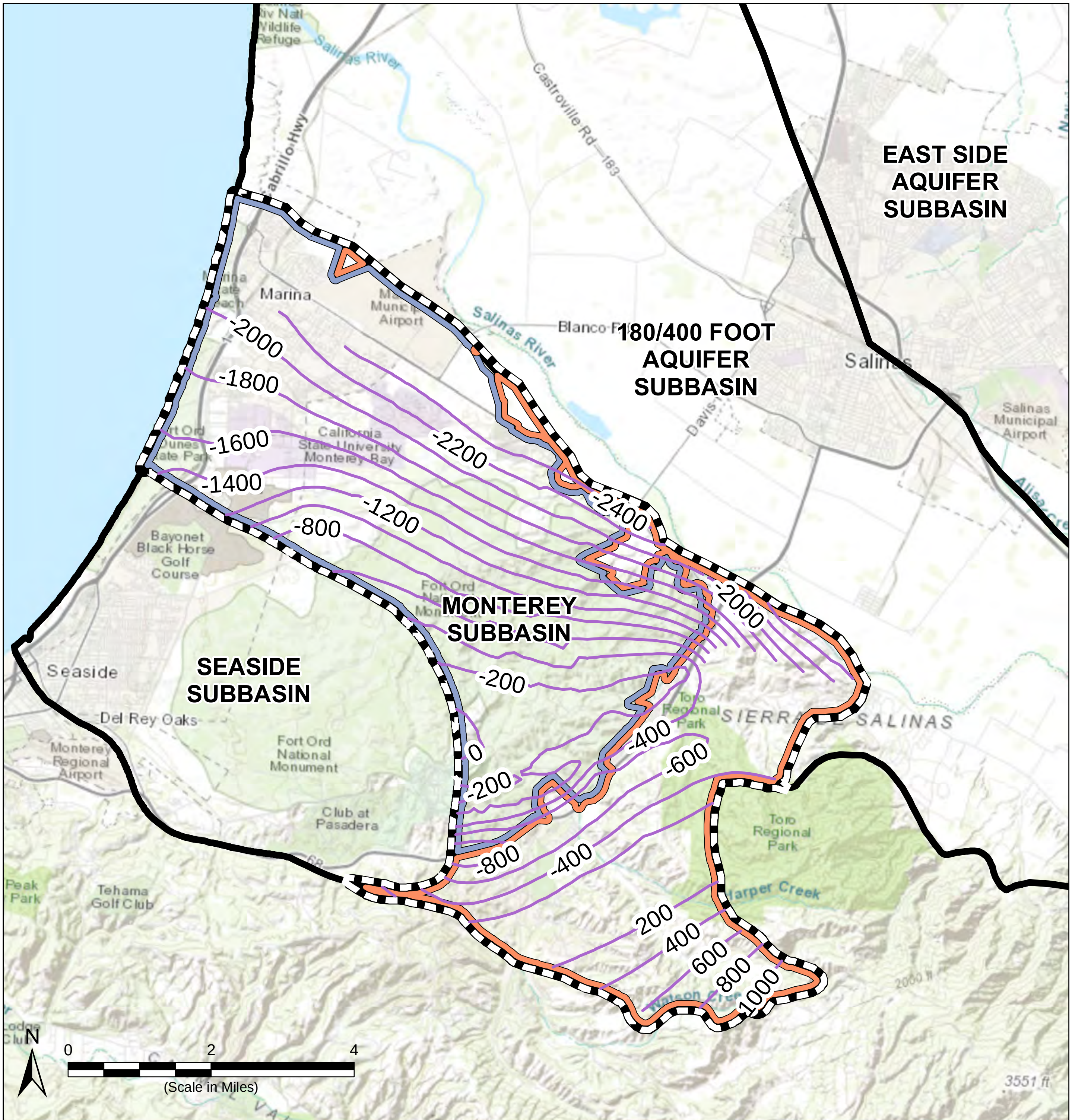
1. The Monterey Bay shoreline bounds the northwestern edge of the Subbasin.
2. The Sierra de Salinas bound the eastern and southern edge of the Subbasin. One part of this boundary follows the contact between Pleistocene units and the Cretaceous quartz monzonite, and another part of this boundary generally follows the contact between Pleistocene units and Miocene rocks as shown on Figure 4-2.

4.1.2.2 Bottom of the Basin

The bottom of the Monterey Subbasin is defined herein as the top of Monterey Formation. The Monterey Formation has low hydraulic conductivity as it is comprised of shale and diatomite (Yates, 2002) and yields water that is generally of low water quality (Geosyntec, 2007). Figure 4-3 shows contours that define the top elevation of the Monterey Formation for most of the Monterey Subbasin.

The deepest groundwater production wells in the Subbasin generally extend to depths within the Purisima or Santa Margarita Formations above the Monterey Formation, and are found closer to the coast. Along the northeastern boundary of the Subbasin, where the Monterey Formation is overlain by the Purisima Formation (Durbin 2007, Yates and others 2005, Greene 1970, Greene 1977), the deepest groundwater extractions are from MCWD wells MCWD-10, -11, and -12, which are screened across Paso Robles and Purisima Formations from 780 ft bgs to 1,840 ft bgs. In the Corral de Tierra Area, many wells are screened in the Aromas Sand and Paso Robles Formation continental deposits as well as the Santa Margarita Sandstone. Slightly south of the Corral de Tierra Area, outside of the Subbasin, a number of wells tap both the Monterey Formation and the unnamed sandstone and conglomerate unit (GeoSyntec, 2007; Feeney, 2003).

The top of the Monterey Formation ranges from an elevation of 1,000 feet in the Corral de Tierra Area to -2,400 feet near the coast, or from approximately 700 feet below land surface in the Corral de Tierra Area to over 2,000 feet below land surface near the coast. As shown on Figure 4-3 and Figure 4-4, there is a set of an east/northeast trending highs and lows on the surface of the Monterey Formation near the Ord-Corral de Tierra boundary. This reflects the mapped structural deformation of the unit in this area illustrated by the pink anticline and synclines in Figure 4-2. Additionally, the depth to the Monterey Formation can illustrate the structural, depositional, and erosional complexity which defines this hydrostratigraphic setting (Figure 4-4).



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Top of Monterey Fm. ft MSL

Management Areas

Marina-Ord Area

Corral de Tierra Area

Abbreviations

Fm. = formation

Ft MSL = feet mean sea level

Notes

1. All locations are approximate.

Sources

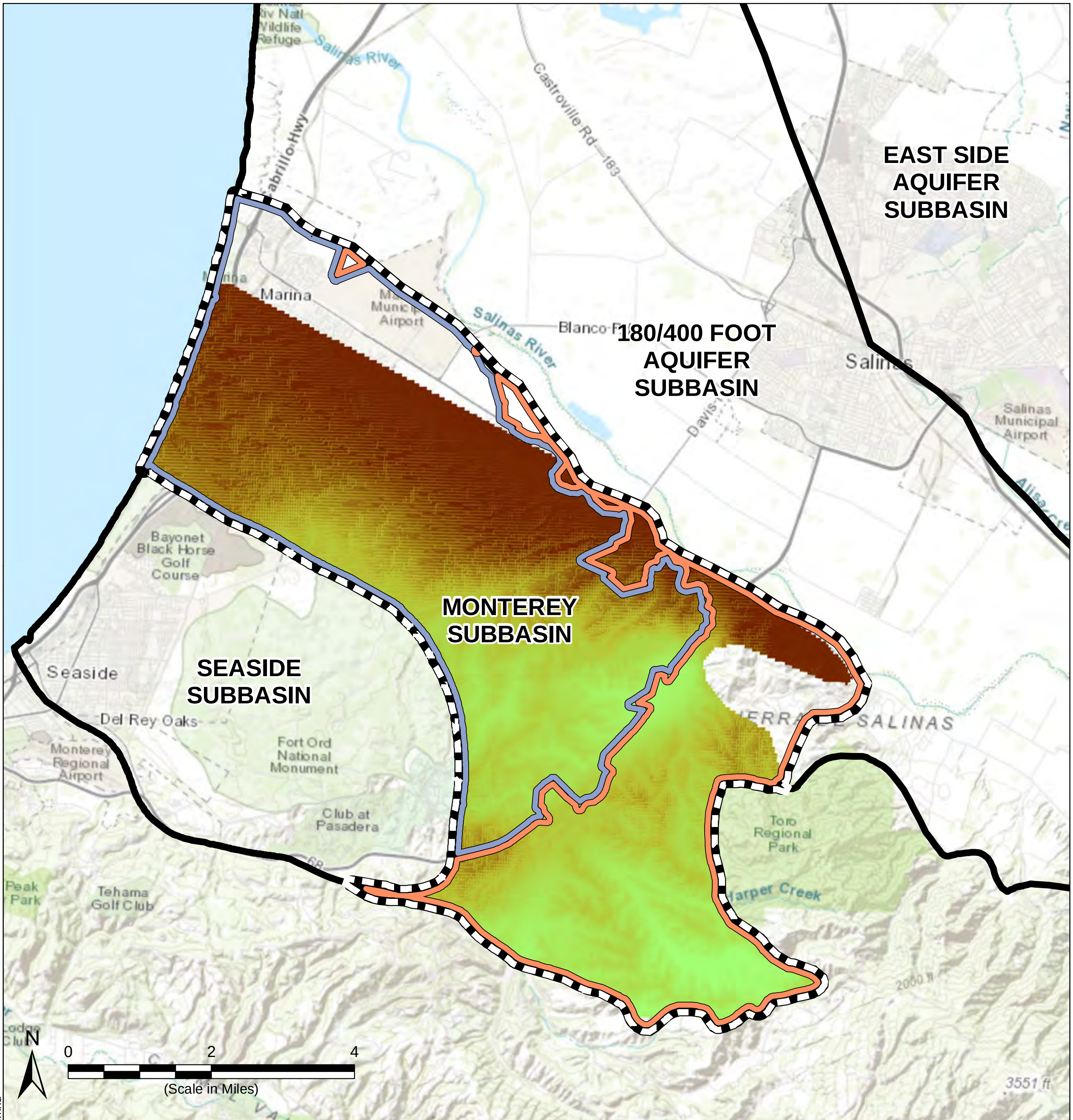
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. The elevations of the top of Monterey Fm. are obtained from the sources below:
   - Rosenberg (2001, 2009)
   - Staal. Gardner and Dunne (1987)
   - Feeney and Rosenberg (2003)

Bottom of the Basin – Top of the Monterey Formation

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-3

Path: X:\B60094\Maps\2021\09\Fig4-3_Top_of_Monterey.mxd



Path: X:\B60094\Maps\2021\09\Fig4-4 Depth to Top of Monterey.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra

Depth to Top of Monterey Formation (ft bgs)

133

2735

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. The depth to the top of the Monterey Formation are obtained from subracting the elevation of the top of the Monterey Formation (Figure 4-3) from ground surface elevation.

Abbreviations

DEM = digital elevation model

Fm. = formation

Ft bgs = feet below ground surface

Notes

1. All locations are approximate.

Depth to Top of the Monterey Formation

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-4

4.1.3 Physical Characteristics

4.1.3.1 Topographic Information

Figure 4-5 shows the topography within the Monterey Subbasin. Topography generally slopes down to the northwest towards Monterey Bay, ranging from sea level at the shoreline to 1,900 ft msl in the southeastern corner of the Subbasin.

In the coastal area of the Subbasin, the topography is shaped by active coastal sand dunes, followed by coastal plain and older stabilized sand dunes. Coastal sand dunes are present along a narrow quarter-mile-wide stretch of land where the Subbasin meets the bay. These coastal dunes rise to approximately 100 feet in elevation and grade eastward into a narrow coastal plain varying in width from one to two miles. Older sand dunes dominate the topography in the northwestern portion of the Subbasin and the majority of the Marina-Ord Area (CH2M, 2004).

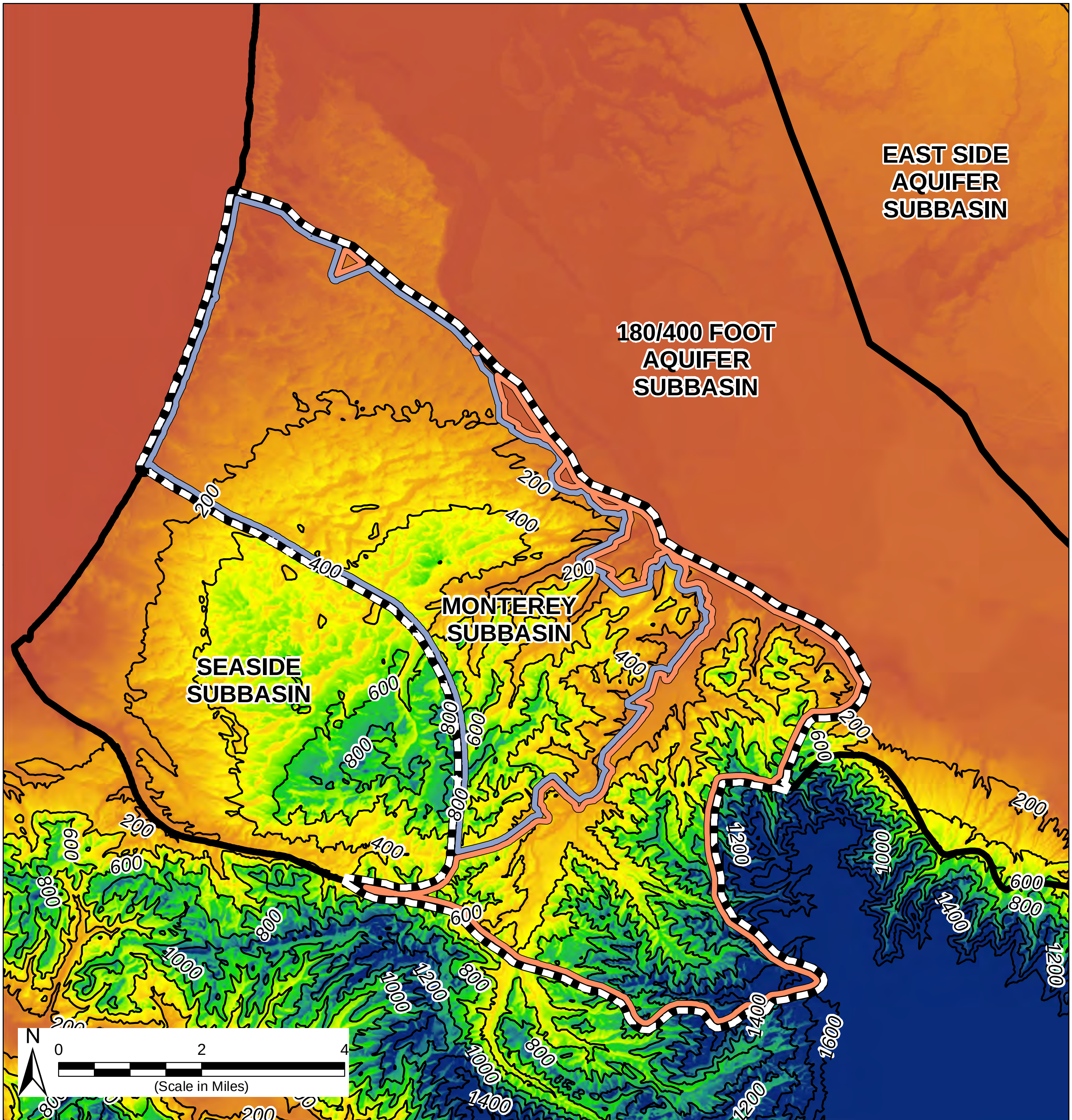
The topography of the southeastern uplands area is characterized by low hills and small sub-watersheds with well-defined drainages. Runoff from these areas is northeastward towards the Salinas River Valley by way of El Toro Creek or other smaller tributaries.

4.1.3.2 Soil Characteristics

The soils of the Subbasin are derived from the underlying geologic formations and influenced by the historical and current patterns of climate and hydrology. Soil types can influence groundwater recharge and are an important consideration for the siting of potential artificial recharge projects.

Soils within the Subbasin are shown on Figure 4-6, and are based on the U.S Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Soil Survey Geographic Database (SSURGO). Soils within the Subbasin are relatively coarse in texture, with the predominant types being sand, loamy sand, and fine sandy loam. Textures are generally coarser near the coast and finer to the south.

Figure 4-7 shows the infiltration potential of soils based on SSURGO's Hydrologic Soil Group designations. Soils within the Subbasin are predominantly of Hydrologic Soil Group A in the coastal plain area, indicating high infiltration rates and low runoff potential. In the Fort Ord hills area, soils predominately belong to Hydrologic Soil Groups C and D, with below-average and low infiltration rates, respectively, and moderately high and high runoff potential, respectively. A mix of Hydrologic Soil Groups A through D exist in the Corral de Tierra Area east of El Toro Creek.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Elevation Contour (200-ft interval)

Land Surface Elevation (ft msl)

High : 1500

1200

900

600

300

Low : 0

Management Areas

Marina-Ord Area

Corral de Tierra Area

Sources

1. Surface elevation data obtained from USGS NED (https://viewer.nationalmap.gov/basic/).

Abbreviations

ft = feet

ft MSL = feet mean sea level

Notes

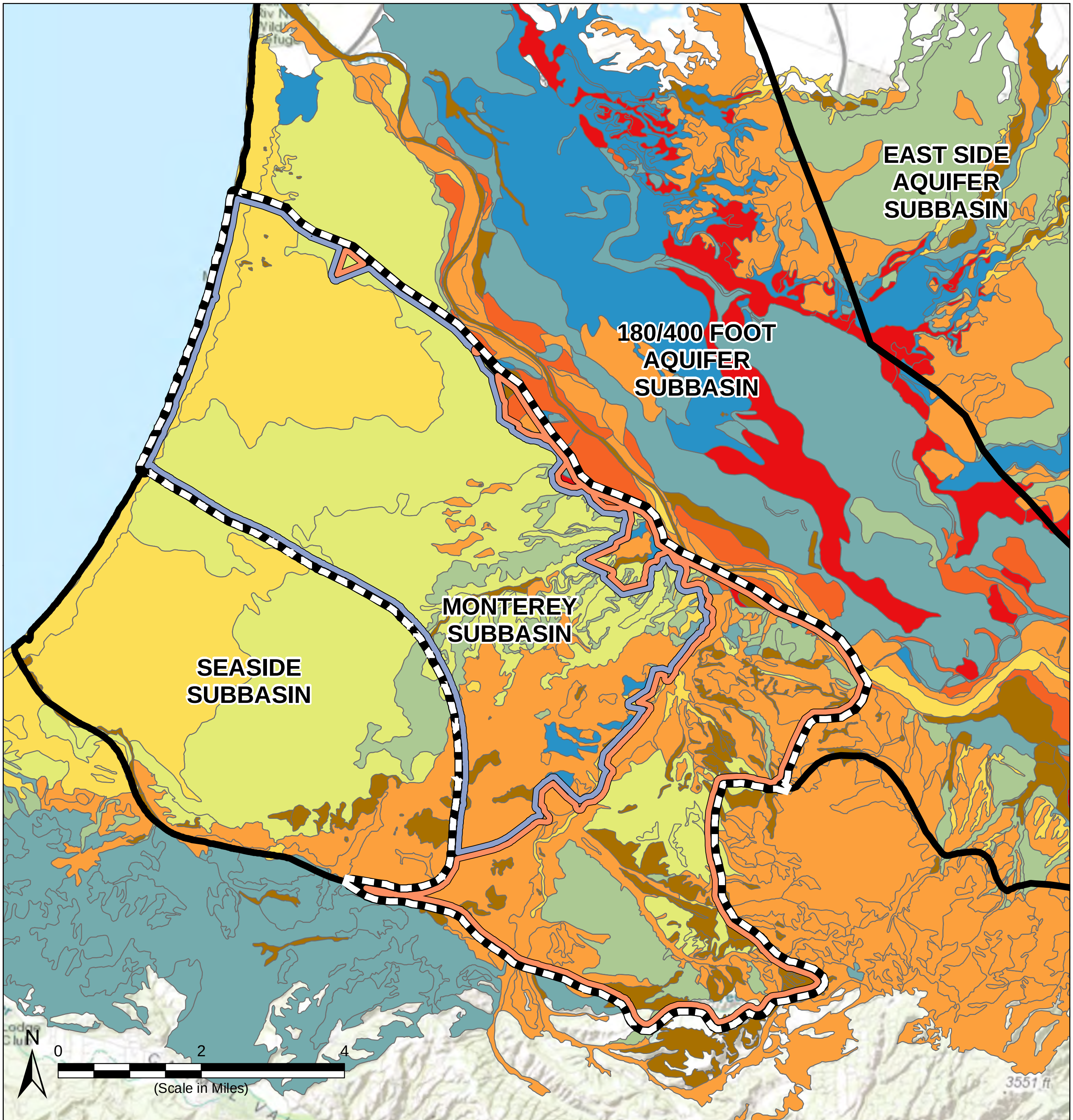
1. All locations are approximate.

Topography

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-5

Path: X:\B60094\Maps\2021\09\Fig4-5_Topography.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

Soil Texture

Other

Clay

Clay Loam

Loam

Loamy Sand

Sand

Sandy Loam

Silt Loam

Silty Clay

Abbreviations

DWR	= California Department of Water Resources
MCWD	= Marina Coast Water District
SSURGO	= Soil Survey Geographic Database

Notes

1. All locations are approximate.
2. Soil textures are based on map units extracted from SSURGO database (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) and generalized into soil texture categories. Only the soil units of greatest extent are included in their own category. Additonal soil units grouped as "Other".

Sources

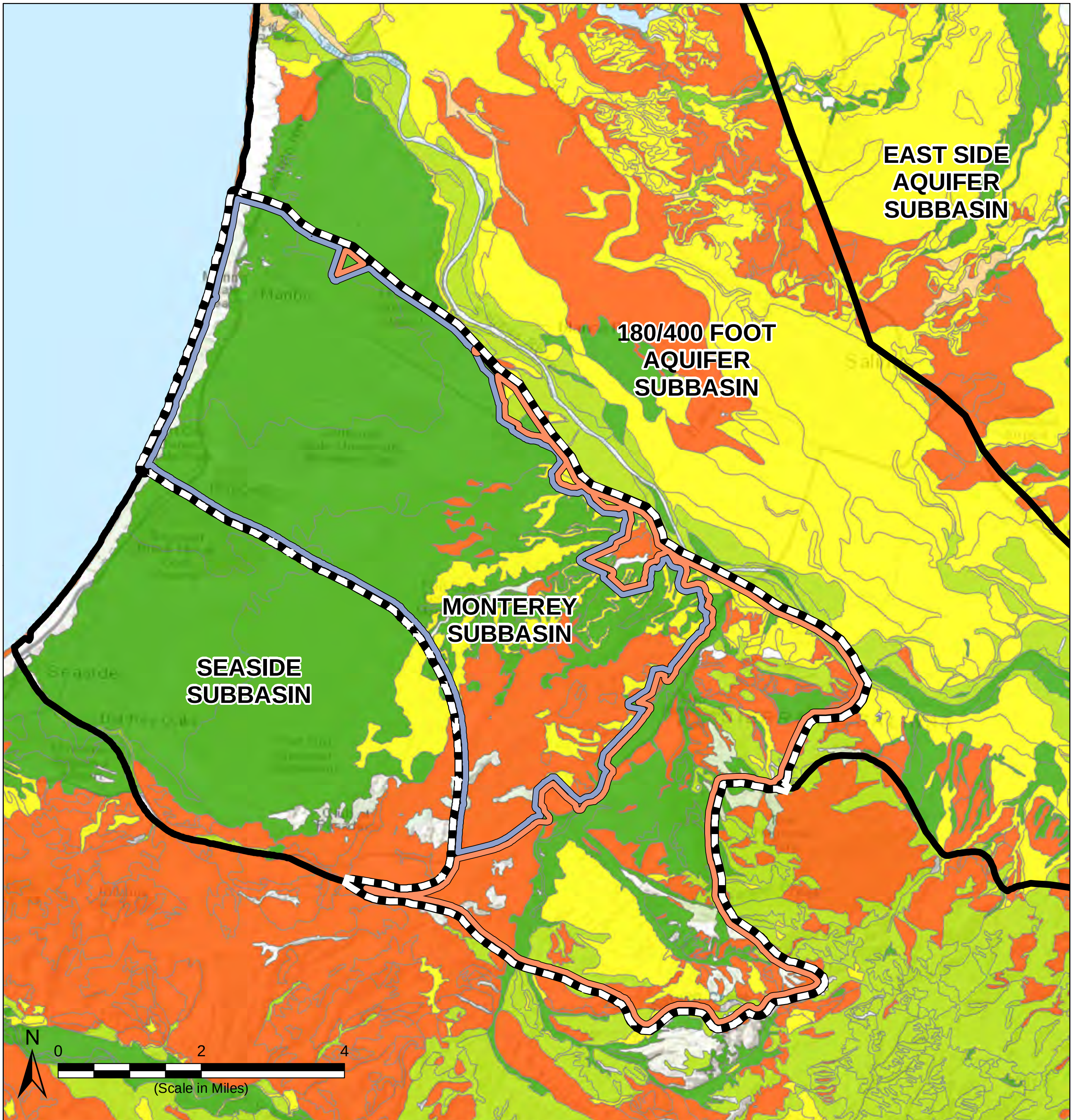
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Soil data is obtained from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).

Soil Map Units

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-6

Path: X:\B60094\Maps\2021\09\Fig4-6_SoilMapUnit.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra

Hydrologic Soil Groups

A: High Infiltration Rate

B: Moderate Infiltration Rate

C: Slow Infiltration Rate

D: Very Slow Infiltration Rate

Abbreviations

SSURGO = Soil Survey Geographic Database

Notes

1. All locations are approximate.
2. Hydrologic soil groups are per Source 2.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Soil data is obtained from SSURGO (https://gdg.sc.egov.usda.gov/GDGOrder.aspx#).

Hydrologic Soil Groups

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-7

Path: X:\B60094\Maps\2021\09\Fig4-7_HydroSoilGroup.mxd

4.1.3.3 Recharge and Discharge Areas

Most of the Marina-Ord Area has good recharge potential for the Dune Sand Aquifer, which subsequently recharges the underlying 180-Foot and 400-Foot Aquifers due to the high infiltration potential of the soils. This recharge is discussed further below in the general water quality section. There is uncertainty regarding the location and recharge mechanism for the Deep Aquifers (see discussion for each aquifer in Section 4.2.2). Additionally, due to the prevailing hydraulic gradient, the Subbasin currently receives an inflow of seawater across the coastal northwestern boundary. Return flow from urban irrigation is not likely a significant source of recharge, and there are currently no artificial recharge projects within the Subbasin. Discharge of groundwater from the Subbasin is predominantly through groundwater pumping from private and municipal supply wells and groundwater remediation extraction wells.

Soils of varying infiltration potential exist in the Corral de Tierra Area. Recharge from precipitation to the Aromas Sand/Paso Robles continental deposits and the Santa Margarita Sandstone in the southern Corral de Tierra Area is approximately 2 to 3 inches of the total annual precipitation (GeoSyntec, 2007; Fugro, 1996). This equals around 10 to 20 percent of average precipitation, which is approximately 16 inches of rain per year (Fugro, 1996). There is also a minimal volume of recharge from septic systems, and it is assumed that this recharge is to the shallow alluvial sediments (Yates, 2002). Recharge to the unnamed sandstone and conglomerate likely occurs in areas of higher elevation in the Sierra de Salinas south of the Monterey Subbasin (GeoSyntec, 2007).

According to several previous investigations, groundwater discharge to El Toro Creek causes the creek to flow perennially starting at a location below the Corral de Tierra Country Club. Streamflow data for the period 1961 to 2002 from USGS gage 11152540, located north of San Benancio Road, indicate a mean annual streamflow of 1,590 AFY (GeoSyntec, 2007). It has not been determined what portion of this mean annual streamflow is attributable to groundwater discharge and what portion is attributable to runoff.

4.2 Subbasin Hydrogeology

The Monterey Subbasin is hydrostratigraphically complex and represents a transition zone between the more defined, laterally continuous aquifer system along the central axis of the Salinas Valley and the less continuous aquifer systems towards the Sierra de Salinas. Past hydrostratigraphic analyses of the Subbasin have generally focused on areas where groundwater production and remediation activities have occurred, i.e., in the vicinity of the City of Marina, in the eastern portion of the former Fort Ord, and within the southern Corral de Tierra Area. Limited subsurface information exists in the central portion of the Subbasin (i.e., the BLM-managed Federal Land area). The description of the hydrogeology presented herein is based on the best available information for the Subbasin. Hydrogeologic information for the Marina-Ord Area and the Corral de Tierra Area are described independently given the uncertainty regarding the connections between the different aquifers and strata identified in these areas.

4.2.1 Cross Sections

4.2.1.1 Cross Sections in the Marina-Ord Area

Figure 4-8 through Figure 4-12 present cross-sections that illustrate the geologic setting and hydrostratigraphy beneath the Marina-Ord Area. These cross-sections are derived from *Hydrogeologic Investigation of the Salina Valley Basin in the Vicinity of the Fort Ord and Marina* (Harding ESE, 2001).

Legend

Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area
Corral de Tierra

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap adapted from Plate 2 of Harding ESE, 2001.

Notes

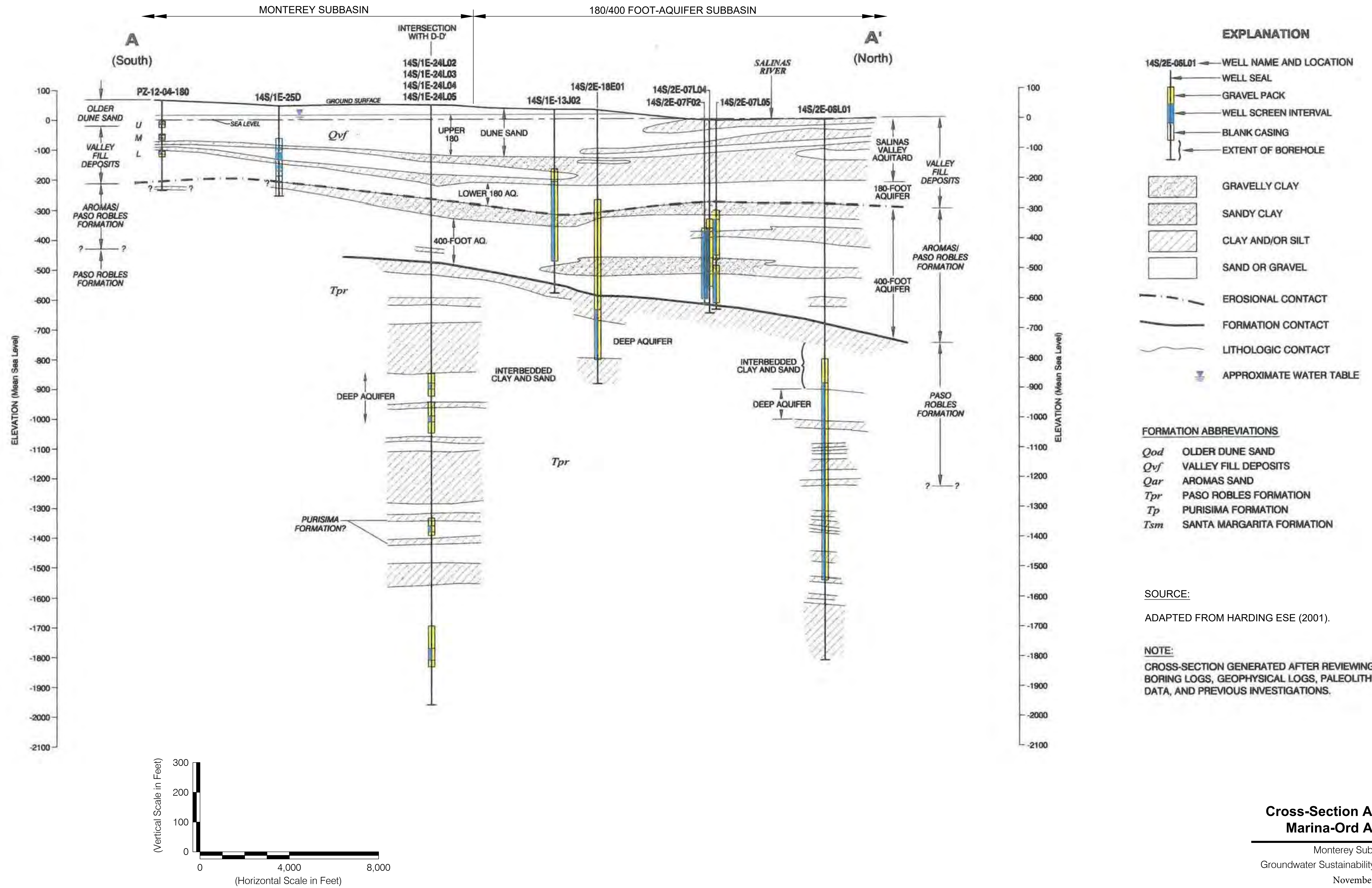
1. All locations are approximate.

Cross-Section Locations

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-8

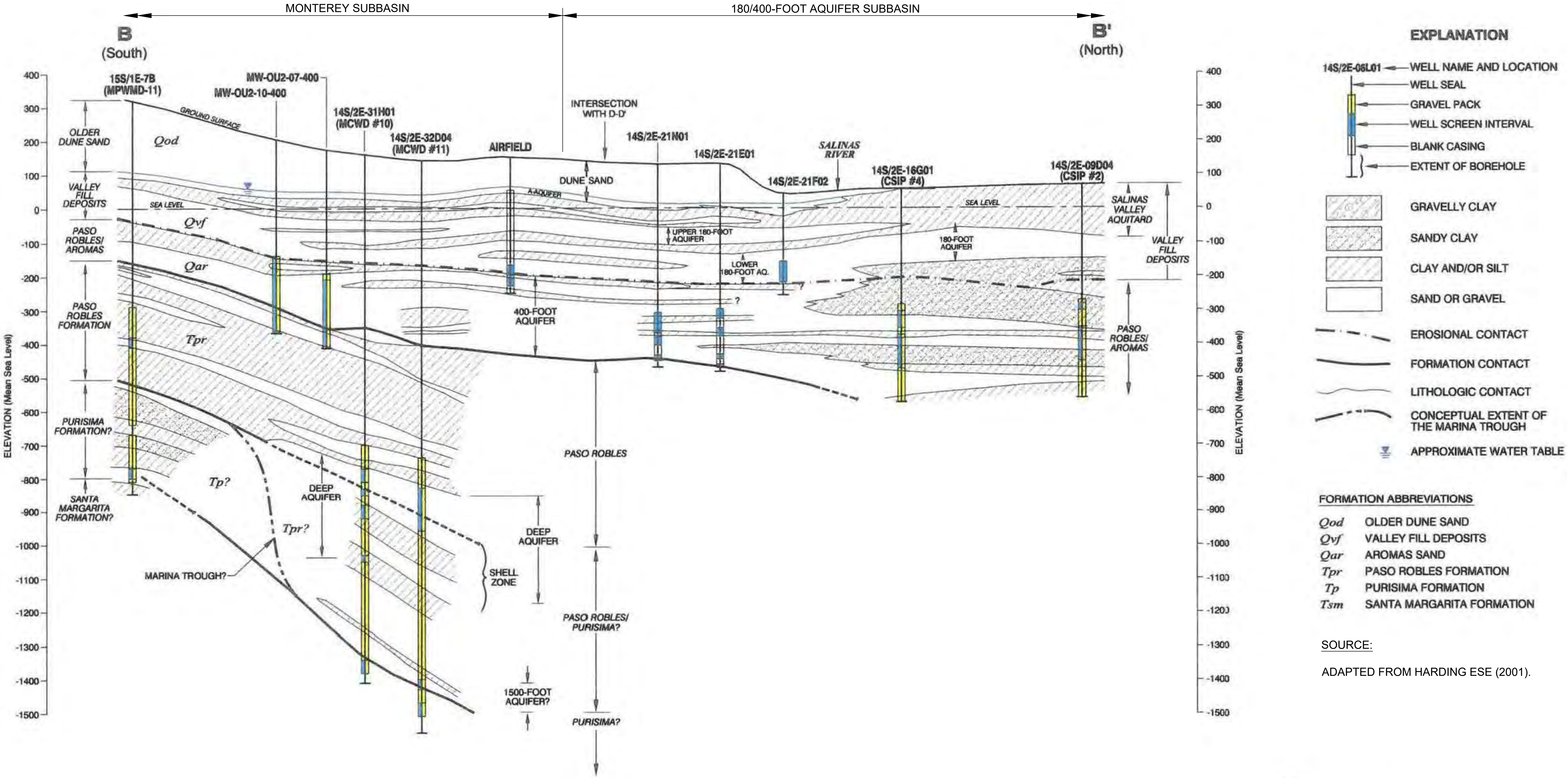
Path: X:\B60094\Maps\2021\09\Fig4-8_CrossSectLocations.mxd



Cross-Section A-A', Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-9

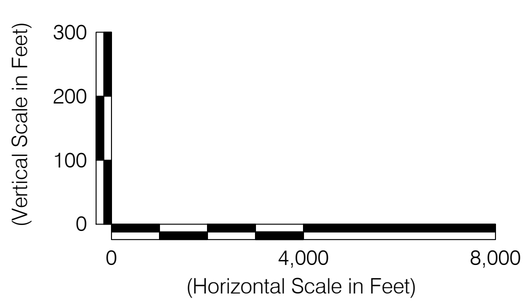


SOURCE:

ADAPTED FROM HARDING ESE (2001).

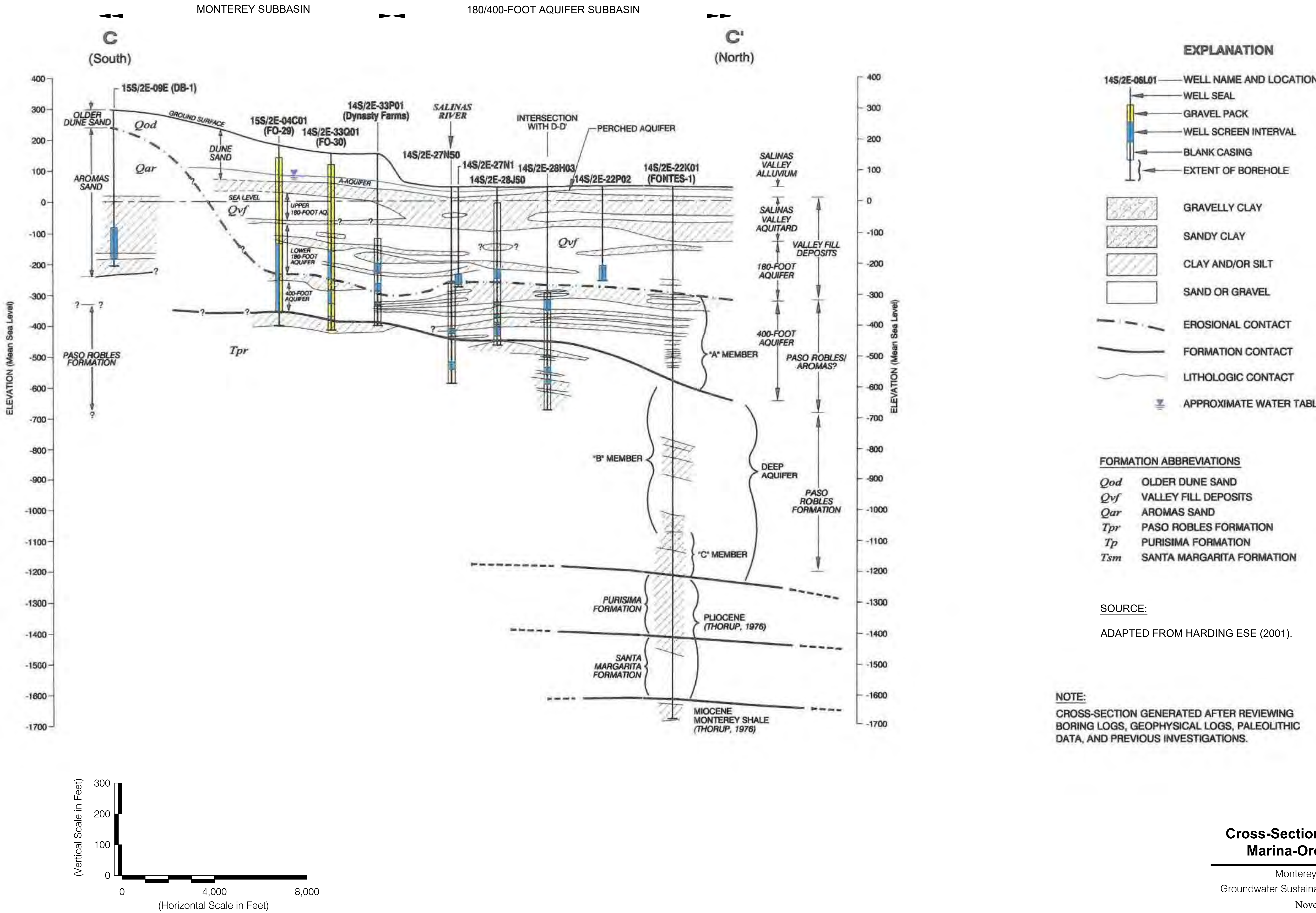
NOTE:

CROSS-SECTION GENERATED AFTER REVIEWING BORING LOGS, GEOPHYSICAL LOGS, PALEOLITHIC DATA, AND PREVIOUS INVESTIGATIONS.



Cross-Section B-B', Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021
Figure 4-10

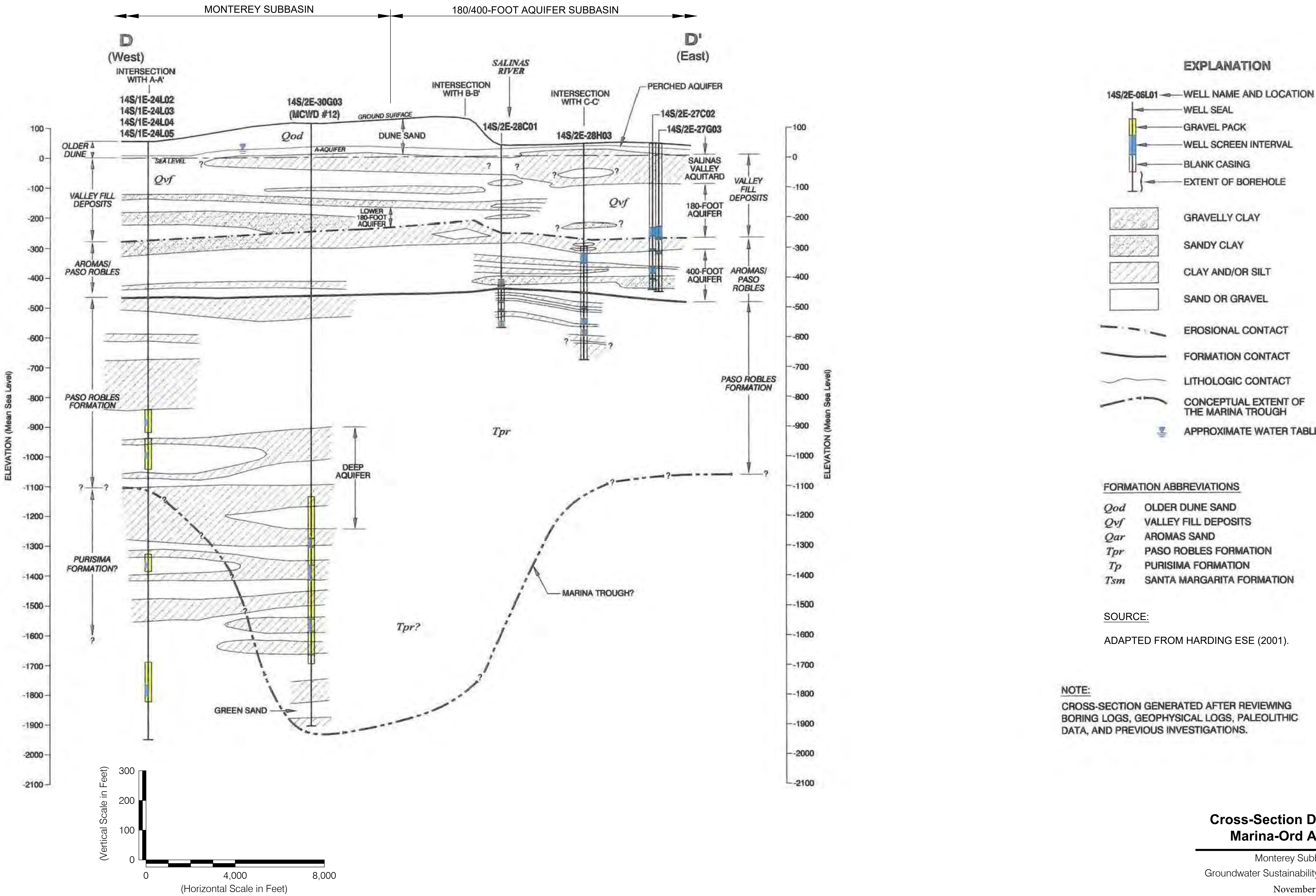


Cross-Section C-C', Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-11

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Cross-Section D-D', Marina-Ord Area

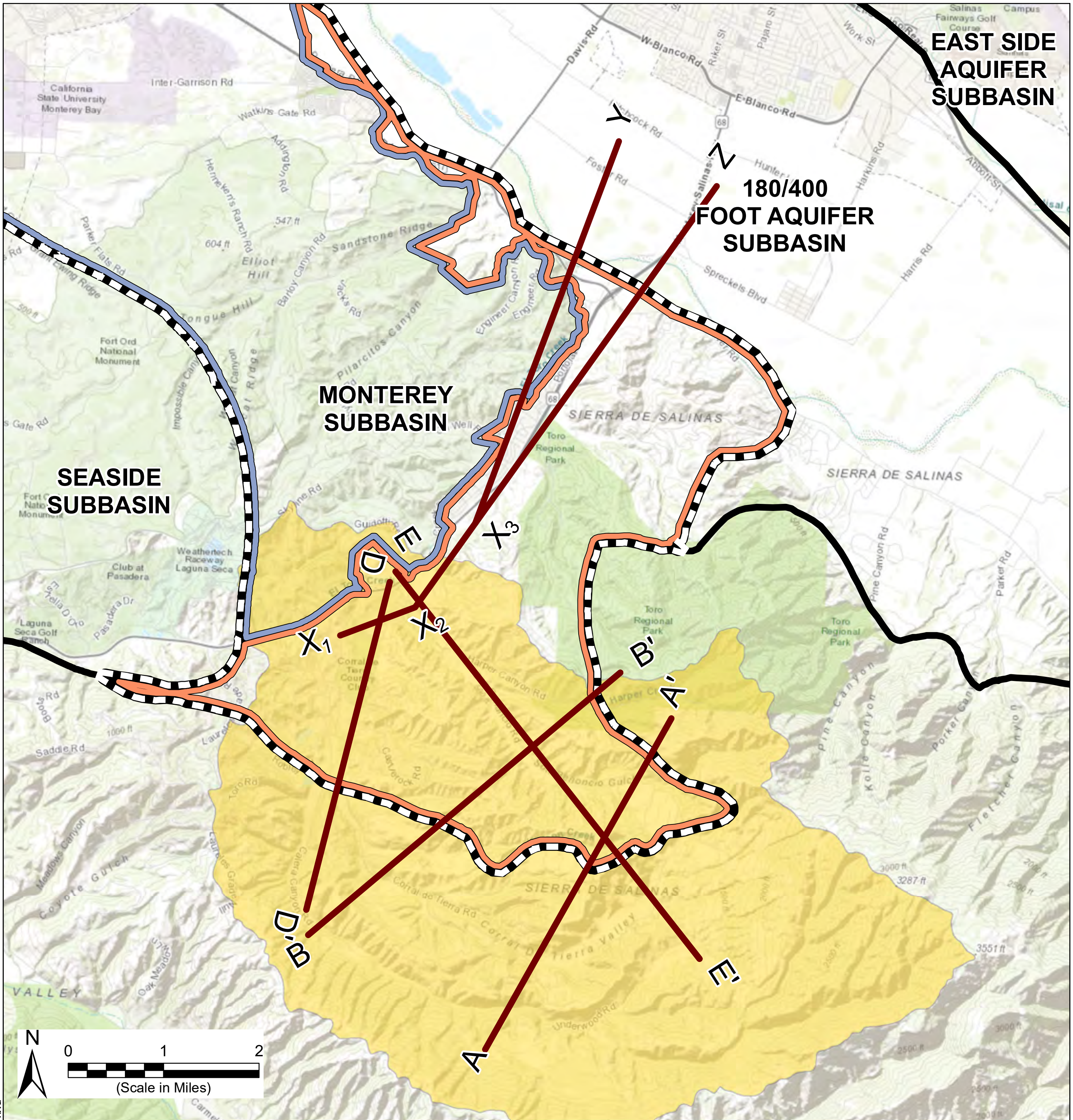
Monterey Subbasin
Groundwater Sustainability Plan
November 2021
Figure 4-12

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

4.2.1.2 Cross Sections in the Corral de Tierra Area

Figure 4-13 through Figure 4-18 present cross-sections that illustrate the geologic setting beneath the Corral de Tierra Area as well as a geologic map of the area that shows the geologic formations present at the ground surface. The legends in each of the figures present the age sequence of the geologic materials from the youngest unconsolidated Quaternary sediments to the oldest pre-Cretaceous basement rock where it may be present.

The cross-sections for the Corral de Tierra Area are derived from the *El Toro Groundwater Study* (GeoSyntec, 2007) and the *Supplement to the El Toro Study* (GeoSyntec, 2010). These cross-sections illustrate the faulted and warped geologic features of the area.



Path: X:\B60094\Maps\2021\09\Fig4-13_CrossSectLocations_CDT.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Cross-Section Locations
- El Toro Planning Area (Note

Management

- Marina-Ord Area
- Corral de Tierra Area

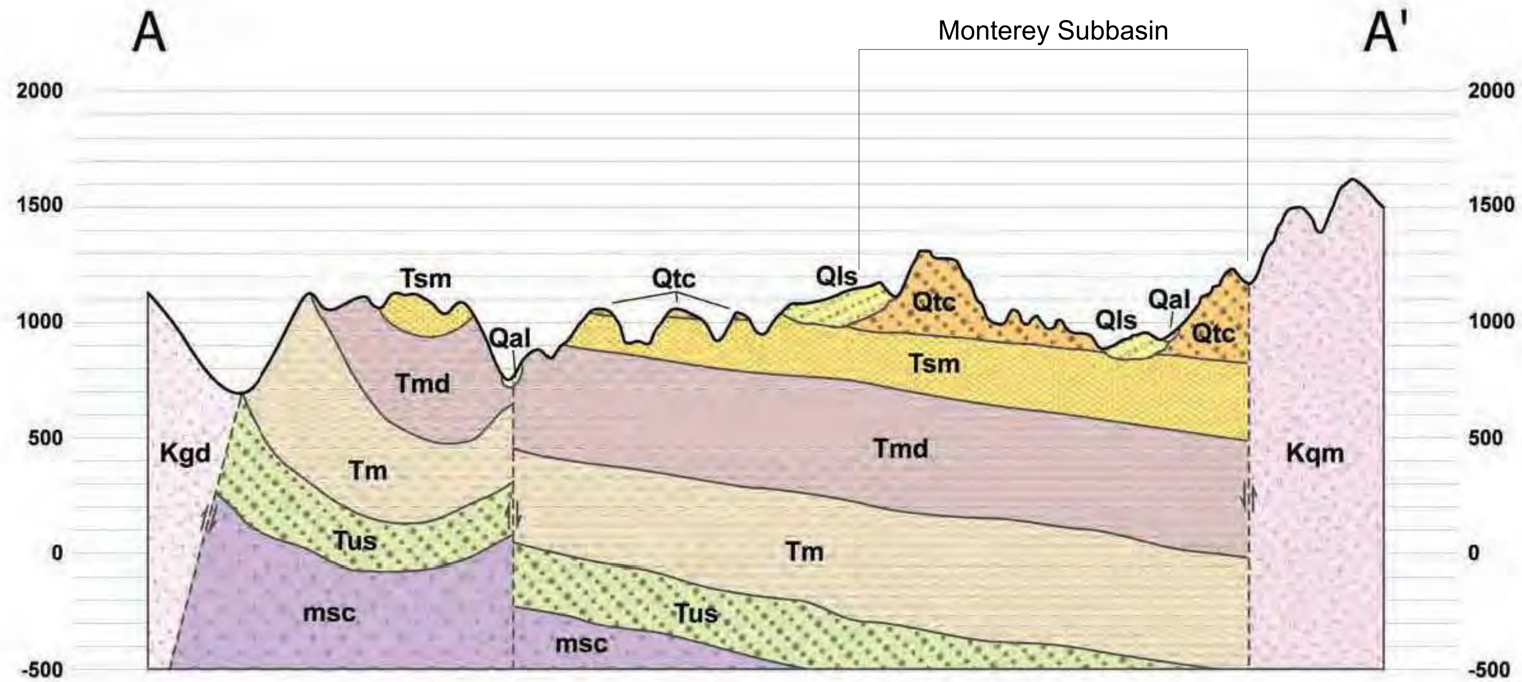
Notes
1. All locations are approximate.
2. Area of interest of the 2007 El Toro Groundwater Study (Geosyntec, 2007).

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap adapted from Plate 2 of Harding ESE, 2001.

Cross-Section Locations
Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

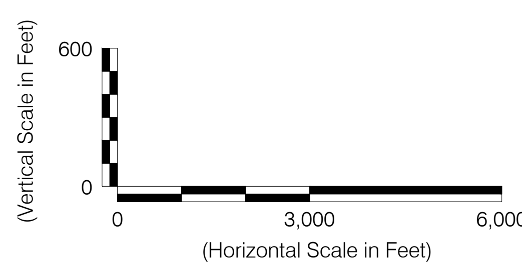
Figure 4-13



Legend:

- Qal - Alluvial Deposits
- Qls - Landslide Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)
- Tsm - Santa Margarita*
- Tmd - Monterey Formation (Upper Formation)
- Tm - Monterey Formation (Lower Formation)
- Tus - Basal Sands
- Kgd - Granodiorite
- Kqm - Garnetiferous Quartz Monzonite
- msu - Schist

* El Toro Primary Aquifer System



Source:

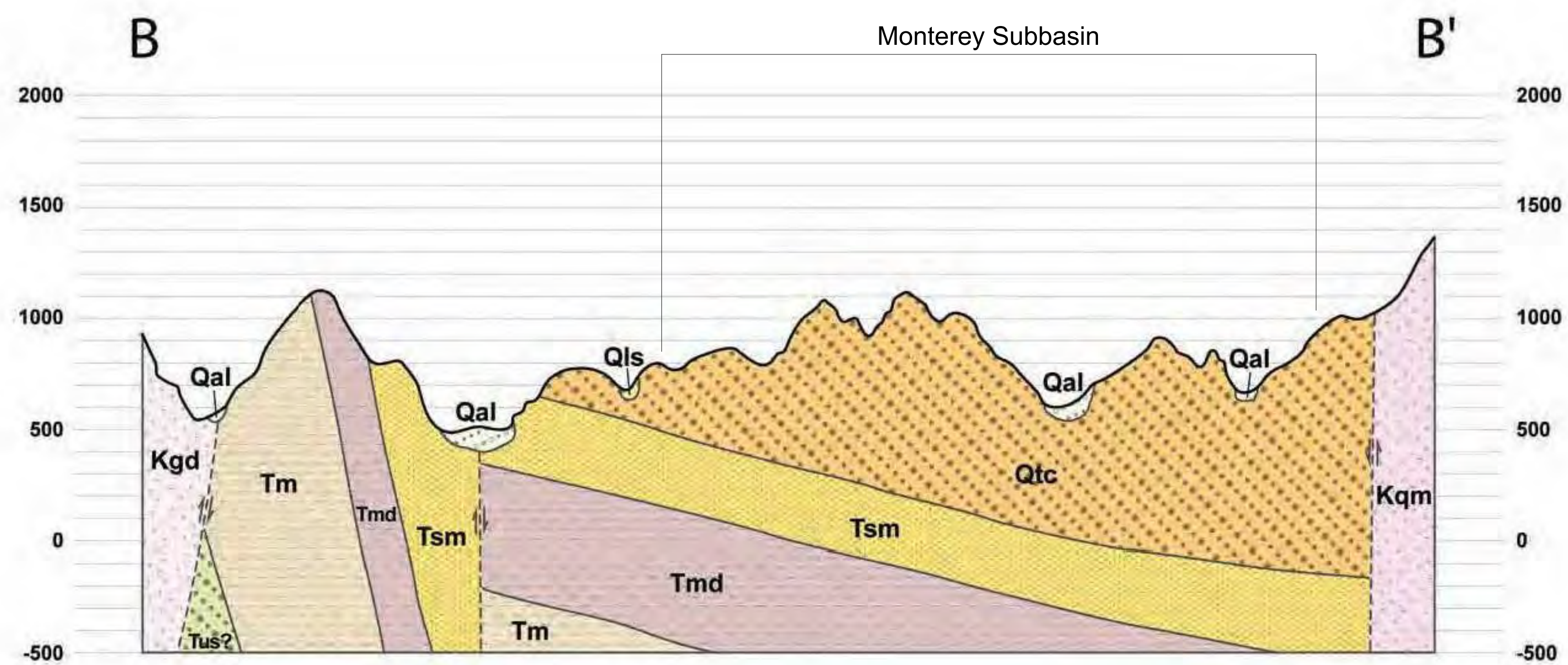
Adapted from GeoSyntec (2007).

Cross-Section A-A', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-14

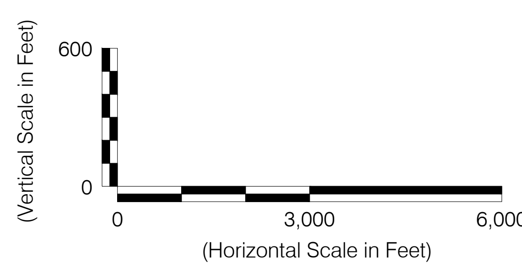
20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend:

- Qal - Alluvial Deposits
- Qls - Landslide Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)
- Tsm - Santa Margarita*
- Tmd - Monterey Formation (Upper Formation)
- Tm - Monterey Formation (Lower Formation)
- Tus - Basal Sands
- Kgd - Granodiorite
- Kqm - Garnetiferous Quartz Monzonite
- msu - Schist

* El Toro Primary Aquifer System



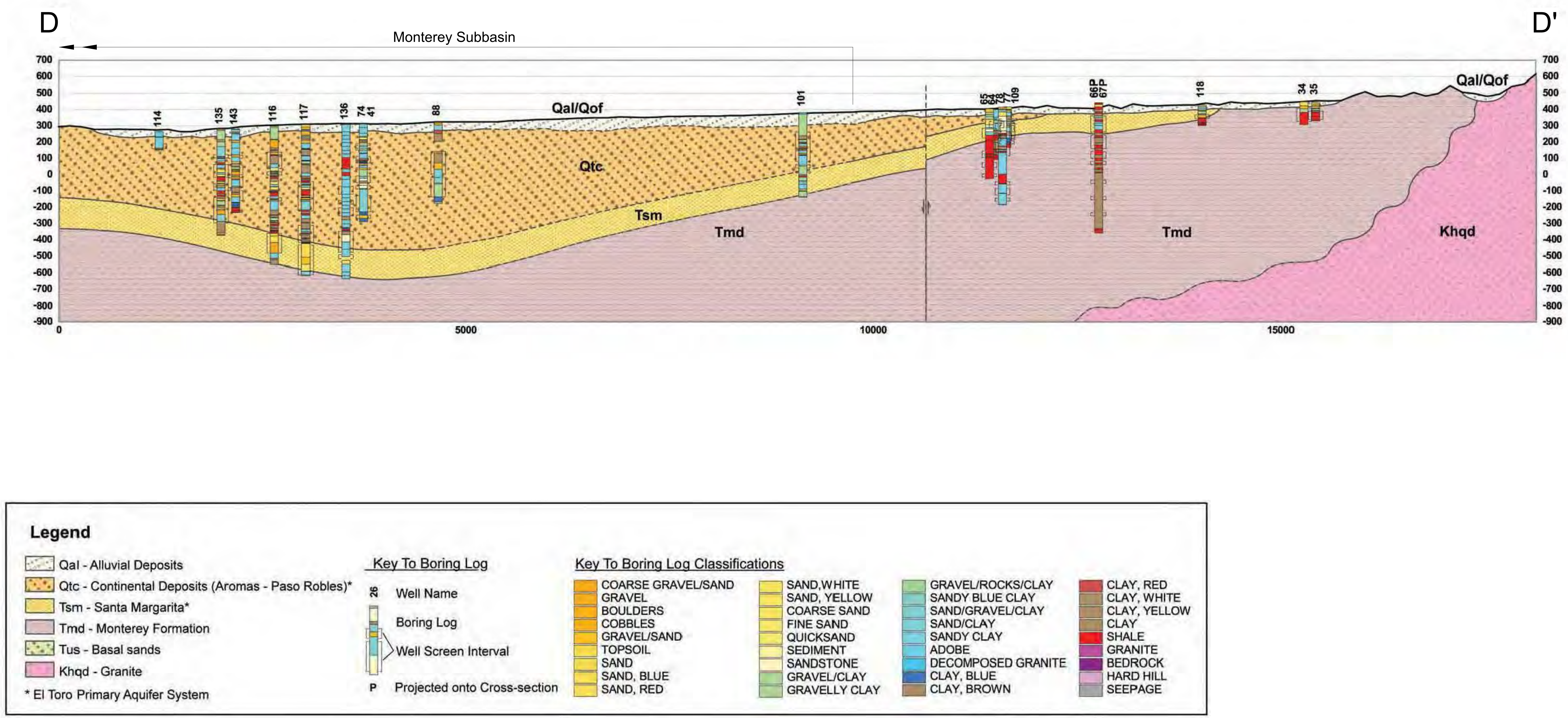
Source:

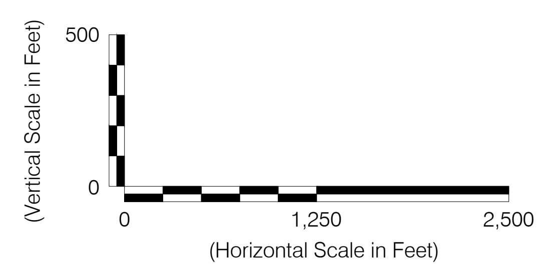
Adapted from GeoSyntec (2007).

Cross-Section B-B', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-15





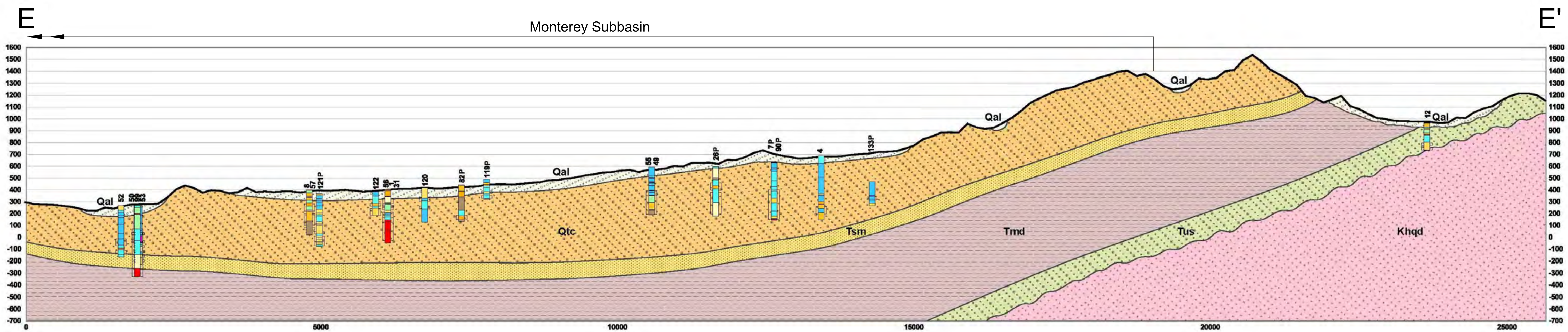
Source:

Adapted from GeoSyntec (2007).

Cross-Section D-D', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-16



Legend

- Qal - Alluvial Deposits
- Qtc - Continental Deposits (Aromas - Paso Robles)*
- Tsm - Santa Margarita*
- Tmd - Monterey Formation
- Tus - Basal sands
- Khqd - Granite

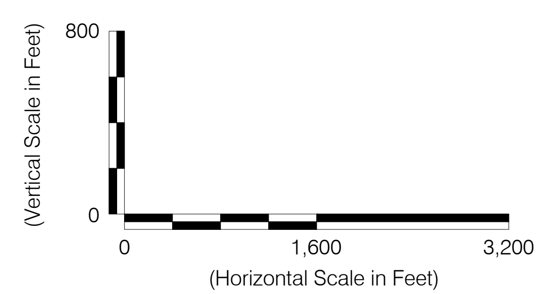
* El Toro Primary Aquifer System

Key To Boring Log

- 26 Well Name
- Boring Log
- Well Screen Interval
- P Projected onto Cross-section

Key To Boring Log Classifications

COARSE GRAVEL/SAND	SAND,WHITE	GRAVEL/ROCKS/CLAY	CLAY, RED
GRAVEL	SAND, YELLOW	SANDY BLUE CLAY	CLAY, WHITE
BOULDERS	COARSE SAND	SAND/GRAVEL/CLAY	CLAY, YELLOW
COBBLES	FINE SAND	SAND/CLAY	CLAY
GRAVEL/SAND	QUICKSAND	SANDY CLAY	SHALE
TOPSOIL	SEDIMENT	ADOBE	GRANITE
SAND	SANDSTONE	DECOMPOSED GRANITE	BEDROCK
SAND, BLUE	GRAVEL/CLAY	CLAY, BLUE	HARD HILL
SAND, RED	GRAVELLY CLAY	CLAY, BROWN	SEEPAGE



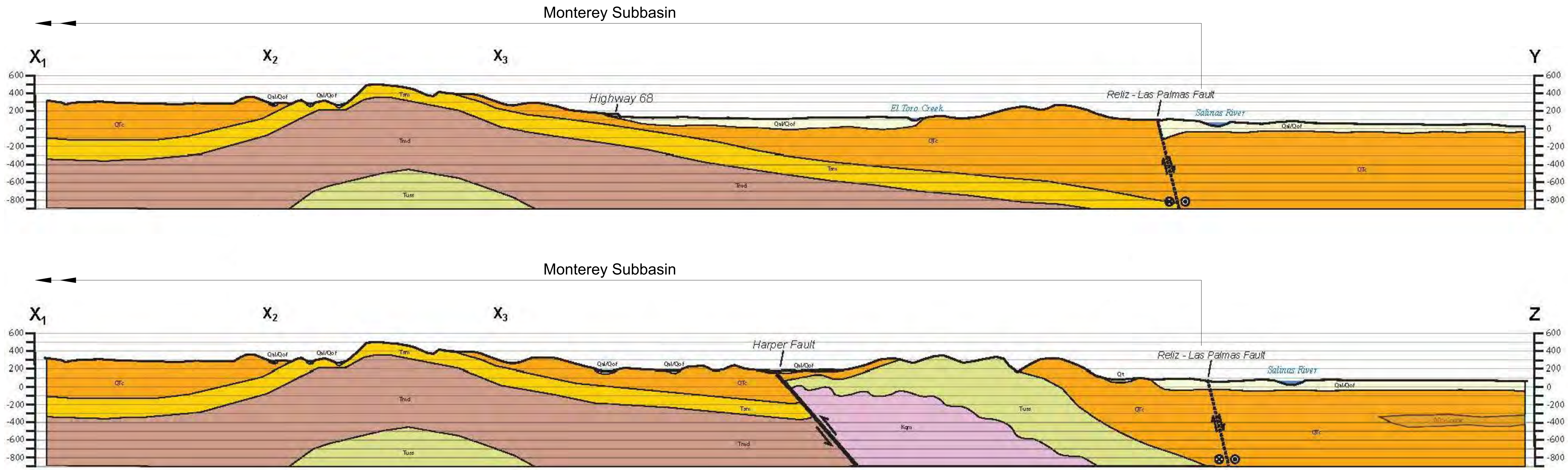
Source:

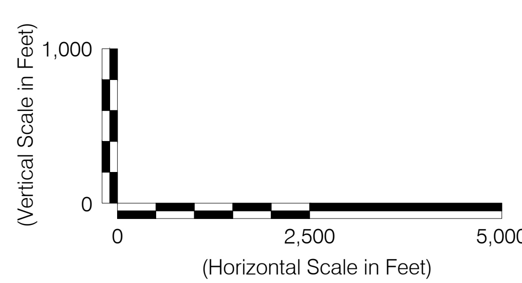
Adapted from GeoSyntec (2007).

Cross-Section E-E', Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-17





Source:

Adapted from GeoSyntec (2010).

Cross-Sections X-Y and X-Z
Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-18

4.2.2 Principal Aquifers and Aquitards

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The aquifers that have historically been identified in the Marina-Ord Area in previous reports include the unconfined Dune Sand Aquifer and the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifers. Within the southern Corral de Tierra Area, the aquifers have historically been described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). Based on the best available information, these geologic formations are grouped together to form the El Toro Primary Aquifer System for the Corral de Tierra Area, which is described in more detail below. These geologic formations also comprise portions of the 400-Foot Aquifer and the Deep Aquifers in the northern Salinas Valley including the Marina-Ord Area. Even though the geology is the foundation for the principal aquifers of the Subbasin, the principal aquifers are not solely determined by the geologic formations. These relationships will be described in more detail in the sections below.

The following set of principal aquifers and aquitards are defined in the Monterey Subbasin:

- Dune Sand Aquifer
- Fort-Ord/Salinas Valley Aquitard
- 180-Foot Aquifer
- 180/400-Foot Aquitard
- 400-Foot Aquifer
- 400-Foot/Deep Aquitard
- Deep Aquifers
- El Toro Primary Aquifer System

The principal aquifer and aquitard designations and relationships to geologic formations are illustrated in Table 4-1. This table is based on the 2017 Monterey County Water Resources Agency's *Recommendations to address the expansion of seawater intrusion in the Salinas Valley groundwater basin* report, but has been modified to reflect specific hydrogeologic conditions and relationships within the Subbasin (Harding ESE, 2001; Rosenberg & Feeney, 2003).

Table 4-1. Generalized Geologic-Hydrogeologic Relationships

<table>
<tr><th>Period/Epoch</th><th>Geological Unit</th><th>Principal Aquifers and Aquitards
Corral de Tierra Area</th><th>Principal Aquifers and Aquitards
Marina Ord Area</th></tr>
<tr><td>Holocene</td><td>Recent Dune Sand (Qd)
Older Dune Sand (Qod)</td><td rowspan="6">N/A</td><td>Dune Sand Aquifer</td></tr>
<tr><td rowspan="8">Pleistocene</td><td rowspan="2">Old Alluvium / Valley Fill Deposits (Qo/Qvf)</td><td>Fort Ord-Salinas Valley Aquitard</td></tr>
<tr><td rowspan="2">180-Foot Aquifer</td></tr>
<tr><td rowspan="3">Aromas Sand (Qae)</td></tr>
<tr><td>180/400-Foot Aquitard</td></tr>
<tr><td rowspan="2">400-Foot Aquifer</td></tr>
<tr><td rowspan="3">Paso Robles Formation (QT)</td><td rowspan="6">El Toro Primary Aquifer System</td></tr>
<tr><td>400-Foot/Deep Aquitard</td></tr>
<tr><td rowspan="4">Deep Aquifers</td></tr>
<tr><td rowspan="2">Pliocene</td><td>Purisima Formation (Ppu)</td></tr>
<tr><td rowspan="2">Santa Margarita Formation (Msm)</td></tr>
<tr><td rowspan="2">Miocene</td></tr>
<tr><td>Monterey Formation (Mmy)</td><td>N/A
(Minimally Water-Bearing)</td><td>N/A
(Minimally Water-Bearing)</td></tr>
</table>

Not all of these principal aquifers occur across the entire Monterey Subbasin due to the complex geologic setting present. The Dune Sand and 180-Foot Aquifers are generally not present in the Corral de Tierra Area, although they are present in the Marina-Ord area. The Paso Robles, Santa Margarita, and Purisima Formations are generally present across the whole subbasin, even though the correlated principal aquifers are not.

These formations and correlated principal aquifers are also in connection with the equivalent principal aquifers in the 180/400-Foot and Seaside Subbasins. Groundwater connection between the Marina-Ord Area and the 180/400-Foot Aquifer Subbasin is relatively well established based on water levels observed in the 180-Foot, 400-Foot, and Deep Aquifers as well seawater migration between subbasins in the 180-Foot and 400-Foot Aquifers. As discussed below, the 400-Foot Aquifer is comprised of the top 200 feet of the Paso Robles Formation and the Aromas Sand, while the Deep Aquifers are comprised of the remainder of the Paso Robles Formation, the Purisima Formation and the Santa Margarita Formation. Due to its geologic composition, the 400-Foot Aquifer has been believed to be connected to the shallow Paso Robles Aquifer and the Deep

Aquifers have been believed to be connected to the deep Santa Margarita Aquifer in the Seaside Subbasin (Yates, 2005).

The Paso Robles and Santa Margarita Formations comprise the El Toro Primary Aquifer System in the Corral de Tierra Area. In the Seaside Subbasin, these same geologic formations that form the Seaside Subbasin's shallow Paso Robles Aquifer and deep Santa Margarita Aquifer. They are grouped together in the Corral de Tierra Area as many wells are screened across both formations and local geochemistry of groundwater indicates they generally act as a single aquifer in this locale. Groundwater connection between the Corral de Tierra Area and the Seaside Subbasin's Laguna Seca Area is relatively well established with production wells screened in the Paso Robles and Santa Margarita Formations. However, the geologic and hydrostratigraphic transition between Corral de Tierra Area and the Marina-Ord Area through the former Fort Ord or the transition between the Corral de Tierra Area and the 180/400-Foot Aquifer Subbasin is not as well studied or understood.

4.2.2.1 <u>Marina-Ord Area</u>

Water-bearing geologic units in the Marina-Ord Area include the Dune Sands, the Old Alluvium / Valley Fill Deposits, the Aromas Sands, the Paso Robles Formation, the Purisima Formation, and the Santa Margarita Sandstone. These geologic units form a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The following set of principal aquifers and aquitards are defined in the Marina-Ord Area:

- Dune Sand Aquifer
- Fort-Ord/Salinas Valley Aquitard
- 180-Foot Aquifer
- 180/400-Foot Aquitard
- 400-Foot Aquifer
- 400-Foot/Deep Aquitard
- Deep Aquifers

4.2.2.1.1 <u>Dune Sand Aquifer</u>

The Dune Sand Aquifer is composed of fine to medium, well-sorted dune sands of Holocene age (Ahtna Engineering, 2013). The Dune Sand Aquifer is also sometimes referred to as the "A-Aquifer" beneath Fort Ord (Harding Lawson Associates (HLA, 1994; Jordan et al., 2005; Harding ESE, 2001). Groundwater in the Dune Sand Aquifer is unconfined. The aquifer is perched away from the coast, in areas where the Fort Ord-Salinas Valley Aquitard (FO-SVA) exists and groundwater in the 180-Foot Aquifer has fallen below the bottom elevation of the FO-SVA. It is hydraulically connected to the underlying 180-Foot Aquifer in areas nearer to the coast. The average saturated thickness of the Dune Sand Aquifer is approximately 50 feet. As shown on Figure 4-7, the sandy soils of this aquifer have high infiltration potential.

A north-south trending groundwater divide exists in the Dune Sand Aquifer. West of the groundwater divide, groundwater in the Dune Sand Aquifer flows westward, and both recharge the 180-Foot Aquifer and flow to the Pacific Ocean near the edge of the FO-SVA. Water from the Dune Sand Aquifer that recharges the 180-Foot Aquifer flows in response to gradients in the 180-Foot Aquifer, which is currently eastward (i.e., inland). East of the groundwater divide, groundwater in the Dune Sand Aquifer flows northeastward towards the Salinas River. A conceptual model of this groundwater flow is shown on Figure 4-19 below.

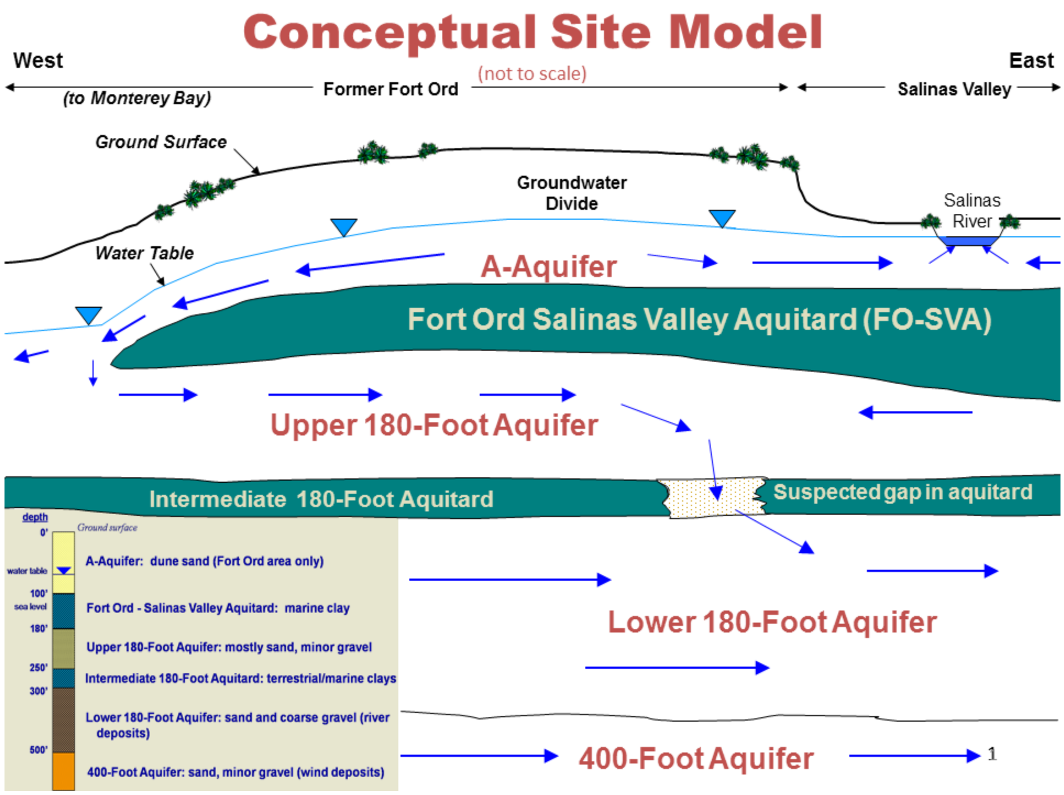


Figure 4-19. Conceptual Model of Principal Aquifers in the Marina-Ord Area

This aquifer is recharged primarily by rainfall infiltration and in turn provides a source of deep percolation into the upper 180-Foot aquifer and eventually into the lower 180-Foot and 400-Foot Aquifers in the Monterey Subbasin (HLA, 1994).

Extraction and infiltration activities associated with remediation in the former Fort Ord take place within the Dune Sand Aquifer.

4.2.2.1.2 <u>Fort Ord-Salinas Valley Aquitard</u>

The Fort Ord-Salinas Valley Aquitard (FO-SVA) is composed of laterally extensive blue or yellow sandy clay layers with minor interbedded sand layers (Harding ESE, 2001; DWR, 2003). The FO-SVA generally correlates to the Pleistocene Older Alluvium stratigraphic unit, which is shown as

Valley Fill. The FO-SVA was deposited in a shallow sea during a period of relatively high sea level. Harding ESE noted that the FO-SVA beneath the former Fort Ord might be formed under a different depositional event than the Salinas Valley Aquitard (SVA) unit beneath the Salinas Valley (e.g., estuarine deposits vs. flood plain deposits). However, the two clay units are hydraulically equivalent (Harding ESE, 2001).

The FO-SVA is generally encountered at depths of less than 150 feet. While this clay layer is relatively continuous in the northern portion of the Valley, it is not monolithic across the Subbasin. The clay layer is missing in some areas and pinches out in certain areas.

Within the Subbasin, the FO-SVA is continuous beneath the City of Marina and most of Fort Ord (Harding ESE, 2001; Kennedy/Jenks, 2004; Ahtna Engineering, 2013; MACTEC, 2006). The extent of the FO-SVA is illustrated on Figure 4-20. The FO-SVA thins towards the Monterey Subbasin/Seaside Subbasin boundary as well as toward the coast, where it appears to pinch out near Highway 1 (Harding ESE, 2001). The thinning and pinching out of the FO-SVA in these locations increases the vertical hydraulic connection between the Dune Sand Aquifer and underlying 180-Foot Aquifer.

4.2.2.1.3 180-Foot Aquifer

The FO-SVA generally overlies and confines the 180-Foot Aquifer. The 180-Foot Aquifer consists of interconnected sand and gravel beds that are from 50 to 150 feet thick. The sand and gravel layers of this aquifer are interlayered with clay lenses (Ahtna Engineering, 2013). This aquifer is correlated to the Older Alluvium (Valley Fill) or upper Aromas Sand formations (Harding ESE, 2001; Kennedy-Jenks, 2004; Ahtna Engineering, 2013).

The gravels, sands, and interspersed clays of the 180-Foot Aquifer are found in the vicinity of the City of Marina and extend a short distance southwest beyond the extent of the FO-SVA (HLA, 1994). Beneath the ocean, the sediments "extend to submarine outcrops on the floor and canyon walls of Monterey Bay (Harding ESE, 2001; Todd Engineers, 1989; Greene, 1977; DWR, 1946). As discussed above, the aquifer is confined where overlain by the FO-SVA. It may become unsaturated where groundwater elevation is lower than the bottom elevation of the FO-SVA, or unconfined where the FO-SVA pinches out. The 180-Foot Aquifer is found generally at depths between 100 and 400 ft bgs beneath the Marina-Ord Area, with varying thickness.

South of the City of Marina, in a portion of the former Fort Ord, the 180-Foot Aquifer is separated into an "upper" zone of sandy deposits with some gravel and a "lower" zone of gravel with sand and clay lenses; the two zones are separated by a thin clay layer (Ahtna Engineering, 2013). Data collected within the former Fort Ord show that significant head differences exist between the upper and lower zones of the 180-Foot Aquifer.

The 180-Foot Aquifer receives recharge from the overlying Dune Sand Aquifer as well as percolation through the FO-SVA, and rainfall and surface water infiltration in areas where the FO-SVA does not exist. This recharge mechanism is also supported by the similar geochemistry between the Dune Sand Aquifer and the 180-Foot Aquifer (Section 4.2.4.1). Subsurface inflows and outflows to the 180-Foot Aquifer also occur from 180-Foot Aquifer of the 180/400-Foot

Aquifer Subbasin and from the Aromas Sand southeast of the former Fort Ord where there may be a hydrologic connection (HLA, 1994).

The primary uses of the 180-Foot Aquifer are for municipal water supply in the lower 180-Foot Aquifer. Extraction and infiltration activities associated with remediation in the former Fort Ord also take place within the 180-Foot Aquifer.

4.2.2.1.4 180/400-Foot Aquitard

The base of the 180-Foot Aquifer is the 180/400-Foot Aquitard. This aquitard consists of interlayered clay and sand layers, including a marine blue clay layer (DWR, 2003). The 180/400-Foot aquitard varies in thickness and quality across the Subbasin, and "varies laterally throughout the Fort Ord area" (MACTEC, 2006). Therefore, areas of hydrologic connection between the 400-Foot and 180-Foot Aquifers exist, and Fort Ord is one of several locations where this aquitard is thin or discontinuous (Kennedy-Jenks, 2004).

4.2.2.1.5 400-Foot Aquifer

The 400-Foot Aquifer is comprised of fine to medium-grained sand with varying degrees of interbedded clay lenses (Ahtna Engineering, 2013). The 400-Foot Aquifer appears to be composed of portions of the Aromas Sand near the coast, and the upper 200 feet of the Paso Robles Formation (HLA, 1994; Harding ESE, 2001), although it is sometimes difficult to delineate the transition between the two formations (Harding ESE, 2001). It is usually encountered between 270 and 470 feet below ground surface in the Marina-Ord area. The upper portion of the 400-Foot Aquifer merges and interfingers with the 180-Foot Aquifer in some areas where the 180/400-Foot Aquitard is missing (DWR, 1973).

Due to its geologic composition, the 400-Foot Aquifer has been believed to be connected to the shallow Paso Robles aquifer in Seaside Subbasin (Yates, 2005). In the Seaside Subbasin, this aquifer consists of several continuous water-producing zones and unconfined zones where granular materials of the Paso Robles Formation are in contact with surficial deposits.

Recharge to this aquifer likely occurs from both the overlying 180-Foot Aquifer and outcrops of the Aromas Sand and Paso Robles Formations in and near the Corral de Tierra Area. Groundwater flow direction in the 400-Foot Aquifer is influenced by groundwater pumping and the connection with neighboring Subbasins.

The primary uses of the 400-Foot Aquifer are for municipal supply in the Marina-Ord Area.

4.2.2.1.6 400-Foot/Deep Aquitard

The base of the 400-Foot Aquifer is the 400-Foot/Deep Aquitard. In some areas of the Salinas Valley Basin, this aquitard can be several hundred feet thick (Kennedy-Jenks, 2004). However, boring logs in the Marina-Ord Area indicate that a series of aquitards underly the 400-Foot Aquifer and extend into the Deep Aquifers. There is no analysis available for the spatial occurrence or geologic composition of the 400-Foot/Deep Aquitard. It is likely comprised of Paso Robles Formation deposits.

4.2.2.1.7 Deep Aquifers

The Deep Aquifers are also collectively referred to as the 900-Foot Aquifer or 900-Foot and 1500-Foot Aquifers in the northern Salinas Valley. The Deep Aquifers are up to 900 feet thick and have alternating sandy-gravel layers and clay layers which do not differentiate into distinct aquifer and aquitard units (DWR, 2003). The Deep Aquifers may also refer to all the water-bearing sediments beneath the 400-Foot Aquifer.

Within the Monterey Subbasin, the Deep Aquifers comprise the middle and lower portions of the Paso Robles Formation, the Purisima Formation, and the Santa Margarita Sandstone (Hanson et al., 2002; Yates, 2005). The Deep Aquifers are also likely connected to the deep Santa Margarita aquifer in Seaside Subbasin (Yates, 2005). The Deep Aquifers overlie the low permeability Monterey Formation, which is the bottom of the Subbasin.

Due to the geologic formations' depositional environments, the Deep Aquifers consist of alternating layers of sand and gravel mixtures with discontinuous clays rather than distinct, coherent aquifers and aquitards (Brown and Caldwell, 2015). There is a strong likelihood of flow through these confining layers (MCWRA, 2018).

The recharge mechanisms for the Deep Aquifers are not well known. There is likely some recharge from overlying aquifers, as downward vertical gradients exist (Thorup, 1976; Feeney and Rosenberg, 2003). Additional recharge may come from outcrops of Santa Margarita Sandstone or Paso Robles Formation in the Corral de Tierra Area. There are no known recharge mechanisms or pathways for the Purisima Formation other than from leakage from overlying aquifers, and there are no surficial outcrops of the Purisima Formation in the Salinas Valley Basin (Feeney and Rosenberg, 2003). Some extractions may be supported by depletion of groundwater storage (Feeney and Rosenberg, 2003). Specific storage was calculated at 0.000013, which suggests that the volume of groundwater that can be removed from storage is not large (Feeney and Rosenberg, 2003).

Oxygen and deuterium analyses of water from the Deep Aquifers suggest that, unlike the upper aquifer system (i.e., 180-Foot and 400-Foot Aquifers), water in the Deep Aquifers was not recharged under current climatic conditions (MCWRA, 2017). Additionally, tritium and carbon-14 analyses of Deep Aquifers water indicate that it was recharged thousands of years before present (Hanson et al., 2002). Age dating of groundwater by USGS indicates that groundwater in the Deep Aquifers near the Monterey Coast maybe 25,000 to 30,000 years old (Hanson et al., 2002).

The Deep Aquifers are used primarily for municipal water supply in the Marina-Ord Area.

4.2.2.2 Corral de Tierra Area

There is one single principal aquifer in the Corral de Tierra Area called the El Toro Primary Aquifer System. Groundwater is produced from the following water-bearing geologic units: the Aromas Sands, the Paso Robles Formation, and the Santa Margarita Sandstone. These water-bearing geologic units are grouped together to form the El Toro Primary Aquifer System (GeoSyntec, 2007). These formations are grouped into one functional primary aquifer due to many wells being screened across more than one formation in this area. The longer screen lengths allow for better well yields as this design accesses more saturated thickness of the aquifer.

The shallowest water-bearing sediments within the Corral de Tierra Area are thin and occur along stream corridors. These sediments range from 0 to 120 feet thick and are a part of the Holocene alluvium unit (GeoSyntec, 2007). The geologic map in Figure 4-2 shows this unit as Q; the cross-sections in Figure 4-14 through Figure 4-18 show this unit as Qal and Qof. Several small domestic wells draw groundwater from these local alluvial aquifers, but these volumes of groundwater are minimal (GeoSyntec, 2007). Since this volume of groundwater is neither economic nor significant, these shallow sediments are not considered a principal aquifer, nor are they included in the El Toro Primary Aquifer System. Groundwater in these sediments is hydraulically connected to both the small streams found in the area and the principal aquifer due to a lack of continuous or regional aquitard to interrupt infiltration and percolation (El Toro Creek, San Benancio Gulch, Watson Creek, and Calera Creek; see Section 4.3) (GeoSyntec, 2007).

Beneath the shallow sediments, the following principal aquifer is recognized as the distinguishing hydrostratigraphic feature of this area:

- El Toro Primary Aquifer System

Immediately outside the southern end of the Subbasin, small amounts of groundwater are also produced from the Monterey Formation and the unnamed sandstone, which underlies the Monterey Formation (Anderson-Nichols and Co., 1981). Additional information regarding hydrogeology of these formations can be found in the *El Toro Groundwater Study* and the *Seaside Groundwater Basin Modeling and Protective Groundwater Elevations* report (Geosyntec, 2007; HydroMetrics, 2009). This volume of groundwater is neither economic nor significant; there is no known extraction from the unnamed sandstone within the Corral de Tierra Area. Additionally, the Monterey Formation is defined as the bottom of the Subbasin. As such, neither the Monterey Formation nor the unnamed sandstone is considered a principal aquifer, nor are they included in the El Toro Primary Aquifer System.

4.2.2.2.1 El Toro Primary Aquifer System

The El Toro Primary Aquifer System is comprised of the Aromas Sands, the Paso Robles Formation, and the Santa Margarita Sandstone together. Many production wells are screened across more than one unit in the Corral de Tierra Area, thereby causing the hydrostratigraphy to effectively function as one aquifer.

Within the Corral de Tierra Area, the eolian Aromas Sands deposits are up to 200 feet thick and comprise the hills in the Area. The Paso Robles Formation comprises a series of nonmarine, semi-consolidated continental deposits that consist of fine to coarse-grained sands and gravels of Plio-Pleistocene age. Due to local variations of conformability and similarity of sediments, these units are sometimes referred to collectively as continental deposits (GeoSyntec, 2007). The geologic map in Figure 4-2 shows the Aromas Sand and Paso Robles Formation units as Qae and QT, respectively. The Aromas Sand and Paso Robles units are grouped together and shown on the cross-sections as undifferentiated Qtc.

The Paso Robles Formation is frequently found at the surface in the Corral de Tierra Area. The uppermost 200 feet of the Paso Robles Formation deposits are recognized as forming much of the 400-Foot Aquifer in the greater Salinas Valley Groundwater Basin (Harding ESE, 2001). The remaining portions of the Paso Robles Formation form portions of the Deep Aquifers closer to the coast. Erosion has impacted the available thickness of the Paso Robles Formation. The transition between the outcropped locations in the Corral de Tierra Area to the subterranean portions in the Marina-Ord area is not well understood due to the lack of available data through the Fort Ord area. Subsequently, the relationship to the 400-Foot Aquifer through this area is not yet defined.

The Santa Margarita Sandstone is a Miocene-aged, marine, white, thick and locally cross-bedded, very fine to coarse-grained sandstone with an average thickness of 100 to 300 feet in the Subbasin. The geologic map in Figure 4-2 shows this unit as Msm. In the geologic cross-sections, this unit is shown as Tsm. The Santa Margarita Sandstone correlated with the Deep Aquifers closer to the coast, and where it is encountered at significant depth from the surface. However, there are portions of the Santa Margarita Sandstone that crop out in the hills northwest of highway 68, which is more northwest than the cross-sections shown in Figure 4-27 and Figure 4-28. This exemplifies the extent to which structural deformation has shaped this region's hydrostratigraphy and added complexity to understanding the principal aquifers across the Subbasin.

Recharge to the El Toro Principal Aquifer System is through precipitation and through the streambeds and alluvial sediments. Groundwater flow direction is generally northward and towards heavy pumping centers like the Laguna Seca region and the lower Corral de Tierra Canyon region.

The primary use of groundwater from the El Toro Primary Aquifer System is urban (municipal and domestic), with minimal agricultural supply.

4.2.2.3 Interconnectivity

Hydrostratigraphy in the Marina-Ord Area consists of a series of laterally continuous aquifers consistent with the aquifers that form the distinguishing features of the northern Salinas Valley. The aquifers that have historically been identified in the Marina-Ord Area in previous reports include the unconfined Dune Sand Aquifer and the confined aquifers known as the 180-Foot Aquifer, the 400-Foot Aquifer, and the Deep Aquifers. Within the southern Corral de Tierra Area, the aquifers have historically been described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (Geosyntec, 2007; Yates 2005). Based on the best available information, these geologic formations are grouped together to form the El Toro Primary Aquifer System for the Corral de Tierra Area, which is described in more detail below. These geologic formations also comprise portions of the 400-Foot Aquifer and the Deep Aquifers in the northern Salinas Valley including the Marina-Ord Area. Even though the geology is the foundation for the principal aquifers of the Subbasin, the principal aquifers are not solely determined by the geologic formations. These relationships will be described in more detail in the sections below.

4.2.3 Structural Restrictions to Flow

There are no known structural restrictions to flow beneath the Marina-Ord Area.

A buried trace of the Reliz Fault (also known as the Reliz-King City Fault or King City Fault) has been said to generally align with the boundary between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin. However, the location of this fault is poorly constrained or defined. Beneath the bottom of the Subbasin, the Monterey Formation is displaced downward on the northeast side of the Reliz Fault by as much as 1,000 ft (Durbin, 2007). There is no sign of the fault affecting "late Pleistocene or younger sediments" (HLA, 1994; Feeney and Rosenberg, 2003). This fault does not appear to impede groundwater flow in the Dune Sand Aquifer, the 180-Foot Aquifer, or the 400-Foot Aquifer, based on observed groundwater elevation and seawater intrusion conditions across the Subbasin boundary (see Chapter 5).

The Corral de Tierra Area is surrounded by several structural features. It is bounded on the east by the Reliz Fault and the Corral de Tierra Fault to the southwest (GeoSyntec, 2007). The Harper Fault is between these two other faults, closer to the Reliz Fault (GeoSyntec, 2007). All of these faults strike to the northwest and steeply dip to the northeast. A northeast striking syncline occurs roughly along Highway 68. A deeper anticlinal feature is shown in Figure 4-2 near San Benancio Creek and appears to be orthogonal to the syncline, which parallels Highway 68 (GeoSyntec, 2010). Additional east-trending anticlines are shown near the boundary between the Seaside Subbasin and the Corral de Tierra Area. Despite all structural features which bound and deform the Corral de Tierra Area, none seem to indicate any barrier to flow to the rest of the Monterey Subbasin, or to the neighboring Seaside or 180/400-Foot Aquifer Subbasins. Rather, the corner of the Seaside and Corral de Tierra boundary seems to be a location of divergence of groundwater flow, where some groundwater continues to the Seaside Subbasin by way of the Laguna Seca area, and some groundwater continues to the Marina-Ord Area by way of the Fort Ord National Monument, as shown in Chapter 5. This corner features a dip-rise-dip appearance on the surface of the Monterey Formation.

4.2.4 General Water Quality

This section presents a general discussion of the natural fresh groundwater quality in the Monterey Subbasin, focusing on general geochemistry. The distribution and concentrations of specific constituents of concern, including seawater intrusion, are discussed further in Chapter 5. This discussion is based on data from previous reports. Key diagrams are included in Appendix 4-A.

4.2.4.1 Marina-Ord Area

Dune Sand Aquifer

Groundwater in the Dune Sand Aquifer has a sodium-chloride chemical character. Groundwater in this aquifer is primarily fresh; minimal seawater intrusion has occurred in this aquifer.

180-Foot Aquifer

Water quality in the 180-Foot Aquifer beneath the Marina-Ord Area is distinct from the water quality in the Salinas Valley and has a more sodium-chloride chemical character (i.e., a higher proportion of sodium and chloride) (HLA, 1994). West of the SVA, groundwater quality is similar throughout the combined Dune Sand Aquifer and 180-Foot Aquifer (HLA, 1994). Groundwater in both aquifers is likely recharged from precipitation infiltrating through similar geologic materials.

The Dune Sand Aquifer contributes recharge to the 180-Foot Aquifer, as groundwater from this aquifer flows westward until it reaches the SVA, after which it turns eastward within the 180-Foot aquifer. While seawater intrusion has occurred in the lower 180-Foot Aquifer in the northern portion of the Subbasin, groundwater in the upper 180-Foot Aquifer remains fresh.

400-Foot Aquifer

Water quality in the 400-Foot Aquifer is chemically distinct from the water quality of the overlying Dune Sand and 180-Foot Aquifer. The 400-Foot Aquifer has a calcium-bicarbonate chemical character (HLA, 1994). However, some wells have higher concentrations of chloride, which is indicative of seawater intrusion. Wells screened in the gravel layers of the 400-Foot Aquifer have elevated concentrations of sodium. This characteristic is similar to that of wells screened in the gravel layers of the 180-Foot Aquifer and those in the Salinas Valley (HLA, 1994).

Seawater intrusion has occurred in the 400-Foot Aquifer in the northern portion of the Subbasin.

Deep Aquifers

Groundwater in the Deep Aquifer system is distinct from the overlying aquifers, having a sodium-bicarbonate chemical character with relatively low concentrations of calcium (Harding ESE, 2001; Hanson et al., 2002). Water quality generally worsens (i.e., increasing chloride concentrations) with depth (Feeney and Rosenberg, 2003). Ratios of chloride-to-boron and isotope analysis (18O, 2H, 3H, 14C) were used to infer the sources and age of groundwater (Hanson et al., 2002). Groundwater in the upper portions of the Deep Aquifers had similar chloride-to-boron ratios to groundwater in the overlying aquifers, which suggests a similar source of recharge. Groundwater in the deepest sections of the Deep Aquifers is enriched in chloride with respect to surface waters in the Salinas Valley, and isotope analysis indicated the Deep Aquifers were not recharged under recent climatic conditions. Isotope analysis also revealed that the groundwater in the Deep Aquifers might have been recharged thousands of years ago (Hanson et al., 2002).

No seawater intrusion has been observed in the Deep Aquifers.

4.2.4.2 Corral de Tierra Area

Groundwater in the El Toro Primary Aquifer System has an intermediate chemical character (no dominant cation or anion) but the chemical composition varies slightly between lithologic units. Uniform moderate to high TDS concentrations were found throughout the El Toro Primary Aquifer System, which supports the hydraulically connected geologic units. Isotope analysis further indicates that groundwater throughout the El Toro Primary Aquifer System has similar recharge sources (Geosyntec, 2007).

4.2.5 Aquifer Properties

4.2.5.1 Marina-Ord Area

Hydraulic conductivity information of the aquifers underlying the Marina-Ord Area is obtained from previous reports and presented below. Transmissivity information is included in Appendix 4-A.

Dune Sand Aquifer

The measured horizontal hydraulic conductivity of the Dune Sand Aquifer ranges from 0.14 to 120 feet per day (ft/d), and vertical conductivity ranges from 0.6 to 4.0 ft/d (HLA, 1994; HLA, 1999; MACTEC, 2006; HydroGeoLogic, Inc., 2006; Jordan et al., 2005). Measured horizontal hydraulic conductivity of the Dune Sand Aquifer is shown on Figure 4-20.

180-Foot Aquifer

Measured horizontal hydraulic conductivities in the 180-Foot Aquifer in the Fort Ord area range from 1.7 to 390 ft/d (HLA, 1994; HLA, 1999; MACTEC, 2006; HydroGeoLogic, Inc., 2006; Jordan et al., 2005). Measured horizontal hydraulic conductivities of the 180-Foot and 400-Foot Aquifers are shown on Figure 4-21.

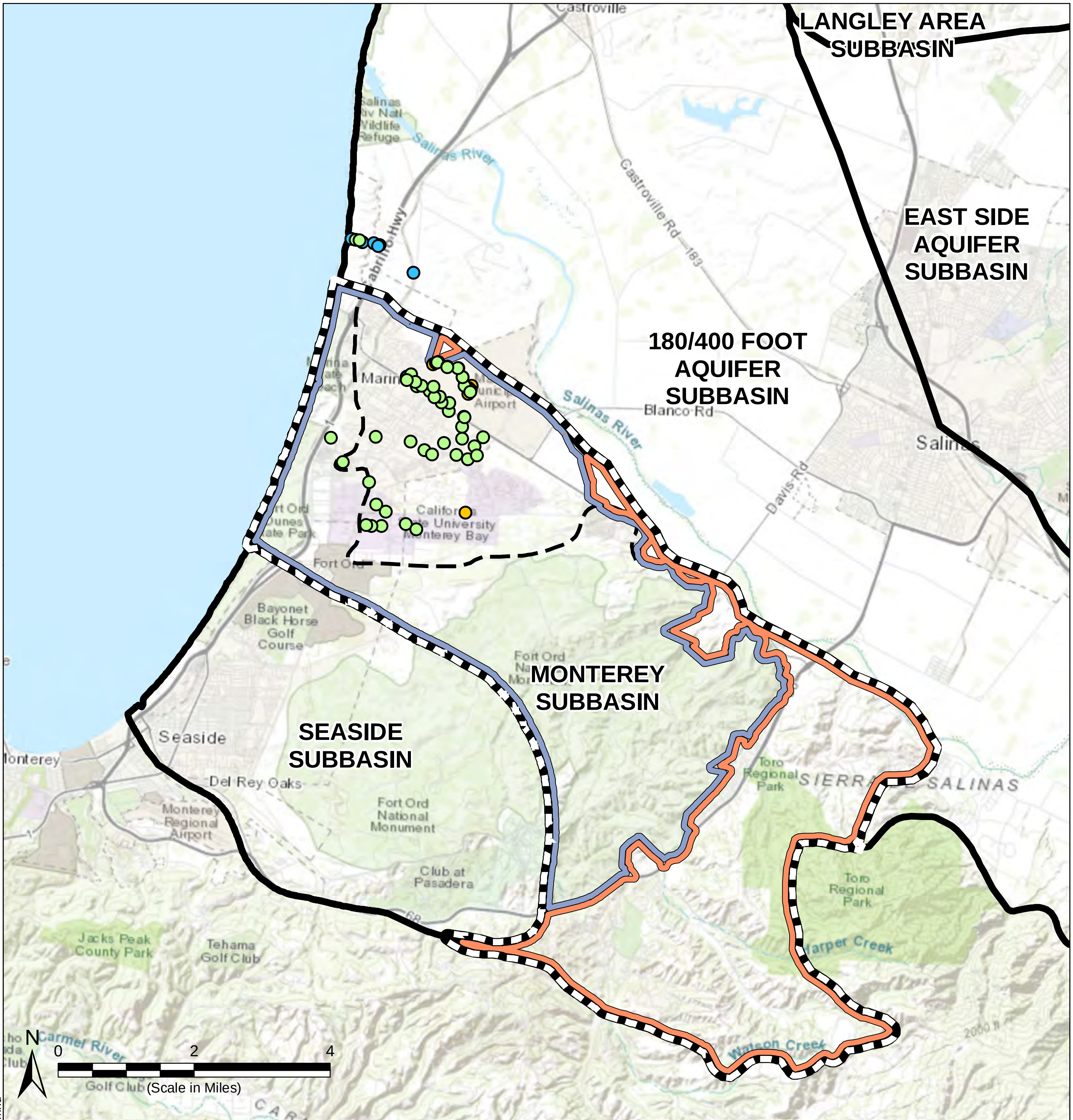
400-Foot Aquifer

Measured horizontal hydraulic conductivities in the 400-Foot Aquifer in the Fort Ord area range from 33 to 237 ft/d. MCWD's production wells MCWD-29, MCWD-30, and MCWD-31 have specific capacities ranging from 70 gallons per minute per foot (gpm/ft) to 127.3 gpm/ft (MCWD, 2019).

Deep Aquifers

Measured horizontal hydraulic conductivities in the Deep Aquifers are generally lower than the overlying 180-Foot and 400-Foot Aquifers. The measured horizontal hydraulic conductivity in Deep Aquifers ranges from 2.2 to 37 ft/d (Figure 4-22). Specific capacities of MCWD's Deep Aquifer wells range from 10.8 gpm/ft to 22.5 gpm/ft (MCWD, 2019).

Age dating of groundwater by USGS indicates that groundwater in the Deep Aquifers near the Monterey Coast may be 25,000 to 30,000 years old (Hanson et al., 2002). An interval with dated marine water was found at approximately 1,000 ft bgs in this area. A study to assess the potential recharge to this aquifer zone is in progress, and a request of Statements of Qualifications (RFQ) was released in September 2021(SVBGSA, 2021).



Path: X:\B60094\Maps\2021\09\Fig4-20 HydraulicConduct_Shallow.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Extent of FO-SVA (Harding ESE, 2001)

Hydraulic Conductivity (ft/d)

- Less than 1
- 1-10
- 10-100
- 100-1,000
- Greater than 1,000

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft/d = feet per day

Notes

1. All locations are approximate.

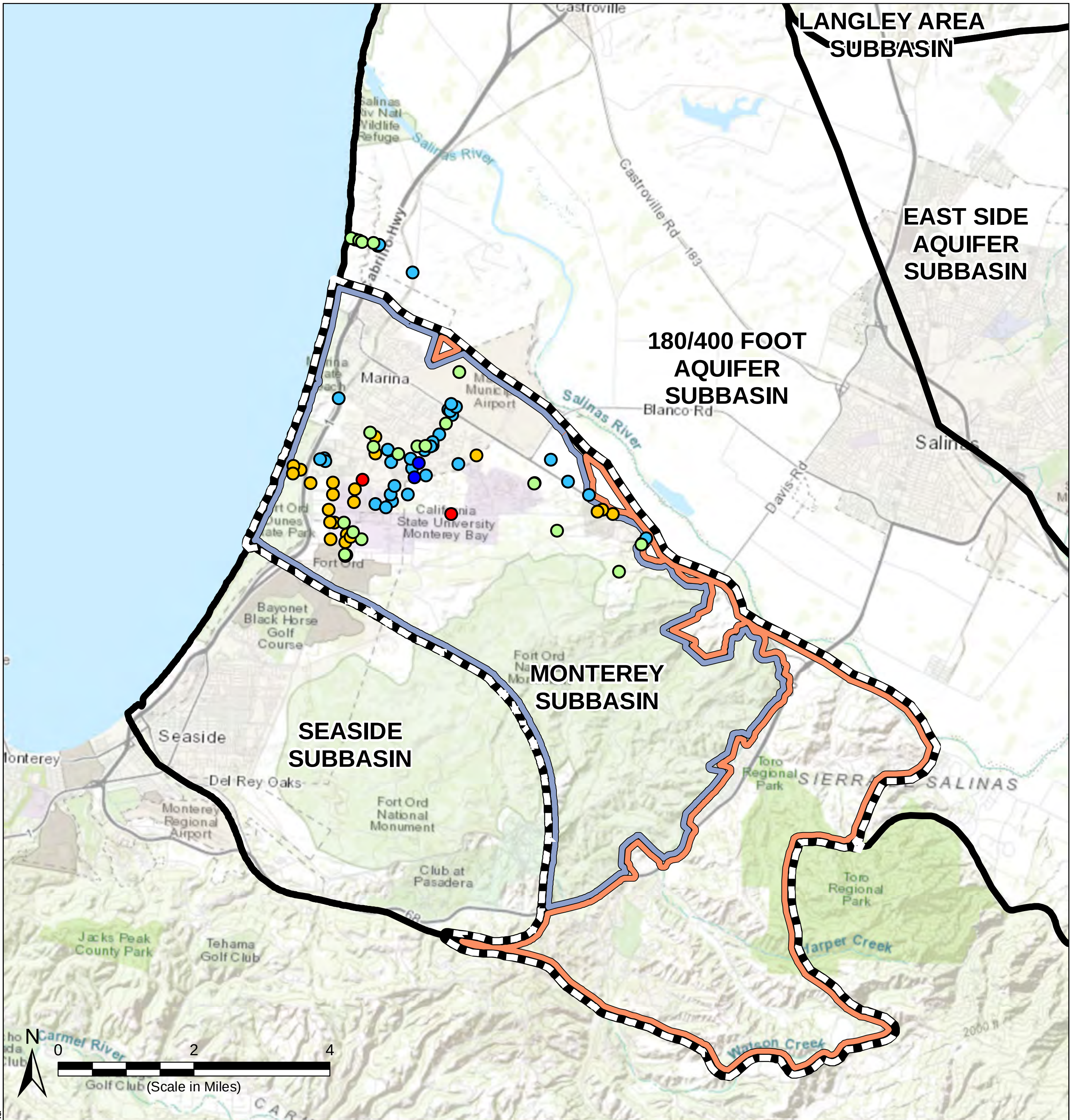
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Hydraulic conductivies are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   GeoScience, 2014
   GeoScience, 2016
   Jordan et al., 2005
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Hydraulic Conductivities in the Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-20



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Hydraulic Conductivity (ft/d)

- Less than 1
- 1-10
- 10-100
- 100-1,000
- Greater than 1,000

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft/d = feet per day

Notes

1. All locations are approximate.

Sources

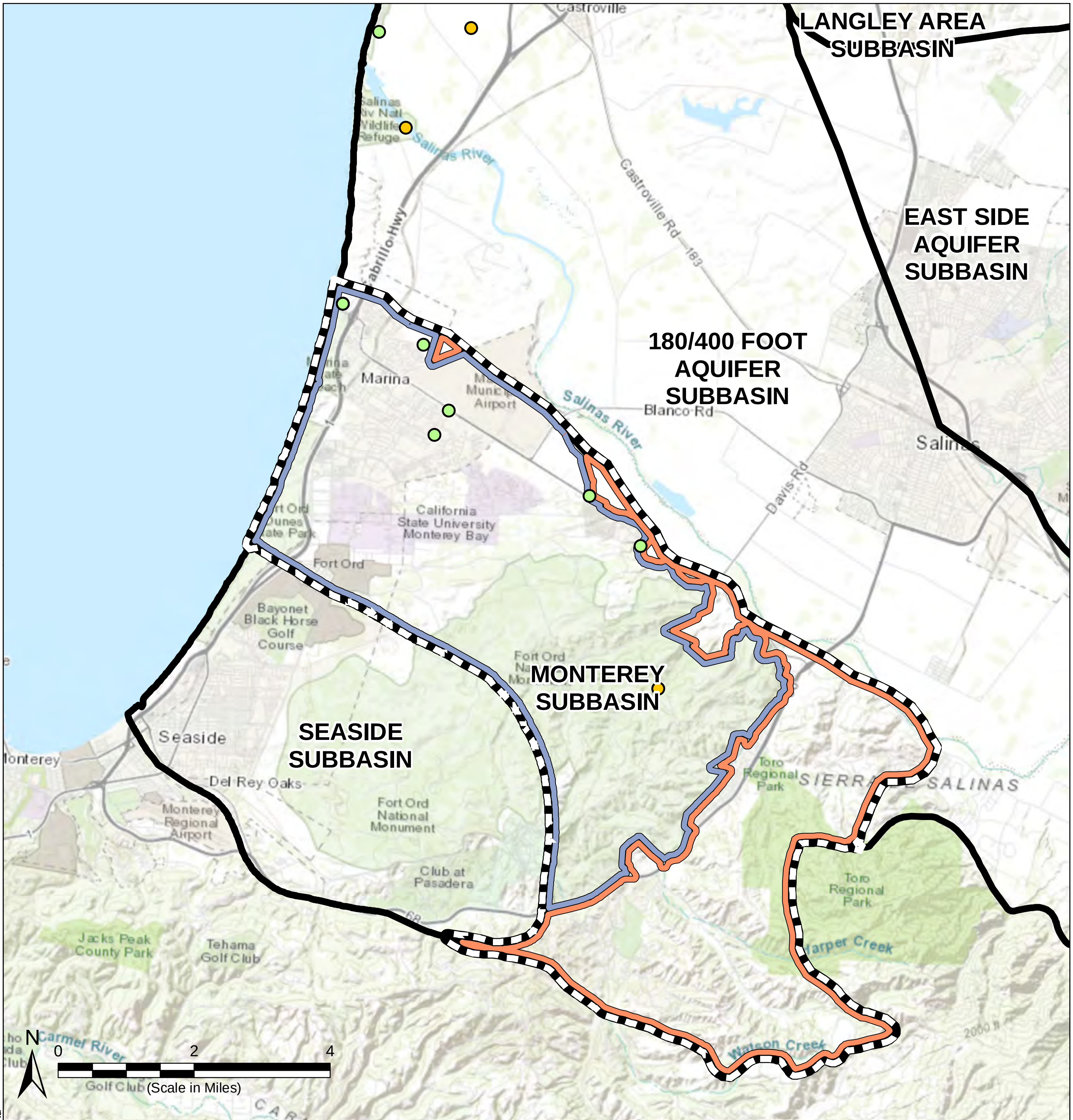
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Hydraulic conductivies are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   GeoScience, 2014
   GeoScience, 2016
   Jordan et al., 2005
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Hydraulic Conductivities in the 180-Foot Aquifer and 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-21

Path: X:\B60094\Maps\2021\09\Fig4-21 HydraulicConduct 400ft.mxd



Path: X:\B60094\Maps\2021\09\Fig4-22 HydraulicConduct_Deep.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Hydraulic Conductivity (ft/d)

- Less than 1
- 1-10
- 10-100
- 100-1,000
- Greater than 1,000

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft/d = feet per day

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Hydraulic conductivies are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   GeoScience, 2014
   GeoScience, 2016
   Jordan et al., 2005
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Hydraulic Conductivities in the Deep Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-22

4.2.5.2 Corral de Tierra Area

The most comprehensive compilation of hydraulic conductivities in the Corral de Tierra Area comes from the *Seaside Groundwater Basin Modeling and Protective Groundwater Elevations* (HydroMetrics, 2009). This study describes a model that covers the adjudicated Seaside Subbasin and the Monterey Subbasin. This study collected previously published hydraulic conductivity values for the geologic units encountered in the region. The model separates the aquifer by geologic formation, and Table 4-2 shows hydraulic conductivity estimated for the Paso Robles Formation and the Santa Margarita Sandstone.

The study also estimated storage coefficients, which relate to an aquifer's ability to store groundwater for each of the principal aquifers. These include specific yield (set at a value of 0.08 for the unconfined aquifers) and specific storage (set at a value of 0.0006 for the confined aquifers) (HydroMetrics, 2009). These values were selected for the Seaside model. Specific storage values range from 5×10^{-5} to 5×10^{-3} for confined aquifers, and specific yield values may range from 0.1 to 0.01 in unconfined aquifers (Todd, 1980).

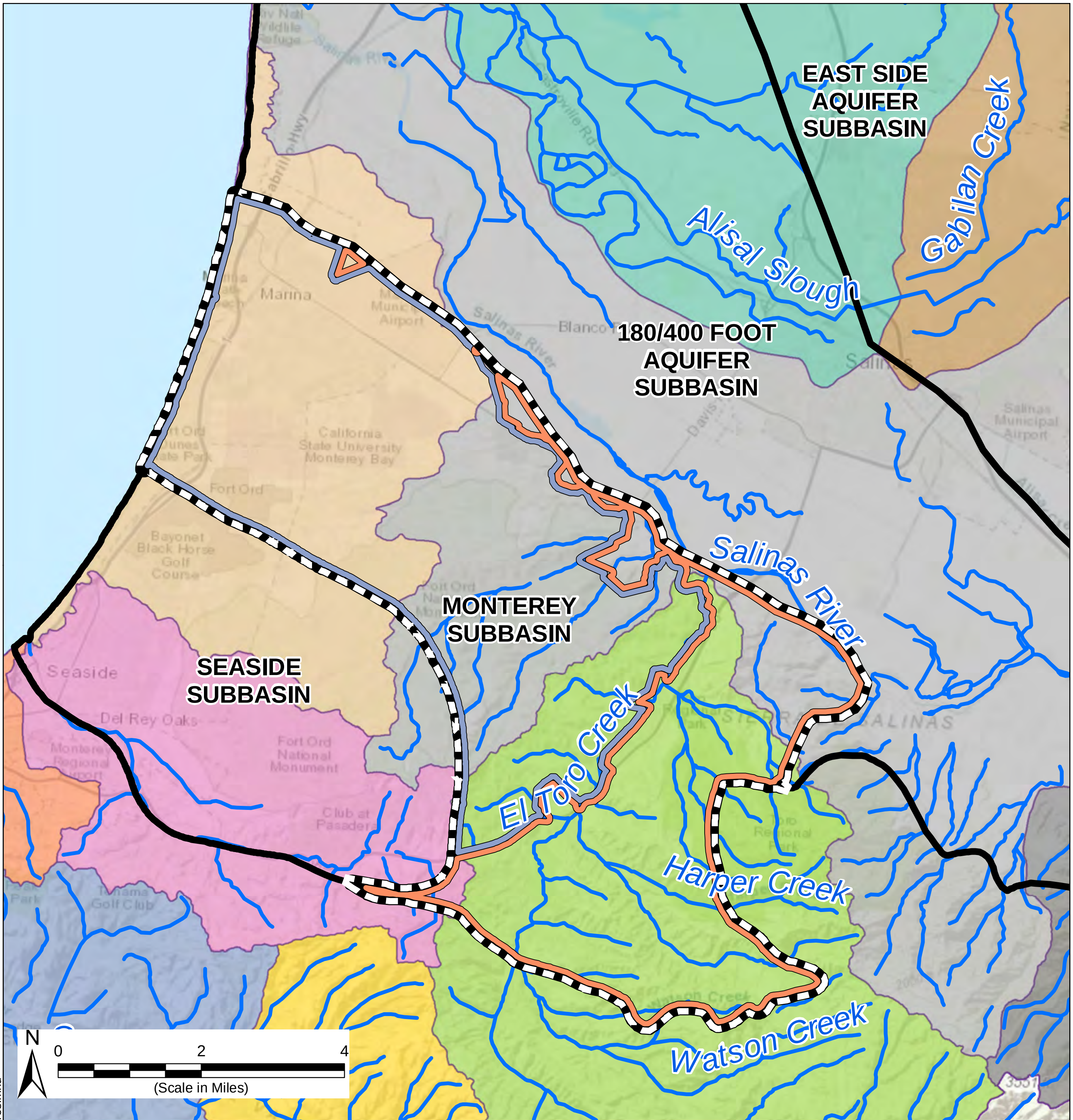
Table 4-2. El Toro Primary Aquifer Hydraulic Conductivity Values (modified from HydroMetrics WRI, 2009)

Principal Aquifer	Geologic Formation	Hydraulic Conductivity (feet per day)	Source	Reference
El Toro Primary Aquifer System	Paso Robles	20	Pump Test	Fugro West, Inc., 1997
		2	Model Calibration	Yates et al., 2005
	Santa Margarita	63	Pump Test	Fugro West, Inc., 1997
		3-5	Model Calibration	Yates et al., 2005

Since many wells are screened across both the Paso Robles Formation and the Santa Margarita Sandstone, aquifer properties for the El Toro Primary Aquifer System reflect a composite of properties (GeoSyntec, 2007). The saturated thickness of the El Toro Primary Aquifer System is greatest near highway 68, as shown by high well yields and significant storage (GeoSyntec, 2007).

4.3 Surface Water Bodies

Surface water features and subwatersheds at the 12-digit Hydrological Code (HUC-12) level within the Subbasin are shown on Figure 4-23.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Natural Surface Water Features

- Stream/River

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Watersheds (HUC 12)

- 180600051507
- Alisal Creek-Salinas River
- Alisal Slough-Tembladero Slough
- Canyon Del Rey
- El Toro Creek
- Las Gazas Creek-Carmel River
- Nativdad Creek-Gabilan Creek
- Parker Flats-Frontal Monterey Bay
- Potrero Canyon-Carmel River
- Seal Rock Creek-Frontal Monterey Bay

Notes

1. Watersheds with a 12-digit hydrologic unit code (HUC 12) are shown. HUC 12 is generally a local sub-watershed level that captures tributary systems.

Sources

1. Surface water features and watersheds from NHD website: (https://viewer.nationalmap.gov/basic/).

Abbreviations

HUC = Hydrologic Unit Code
NHD = National Hydrography Dataset

Natural Surface Water Features

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 4-23

Path: X:\B60094\Maps\2021\09\Fig4-23_NaturalSurfaceWaterFeatures.mxd

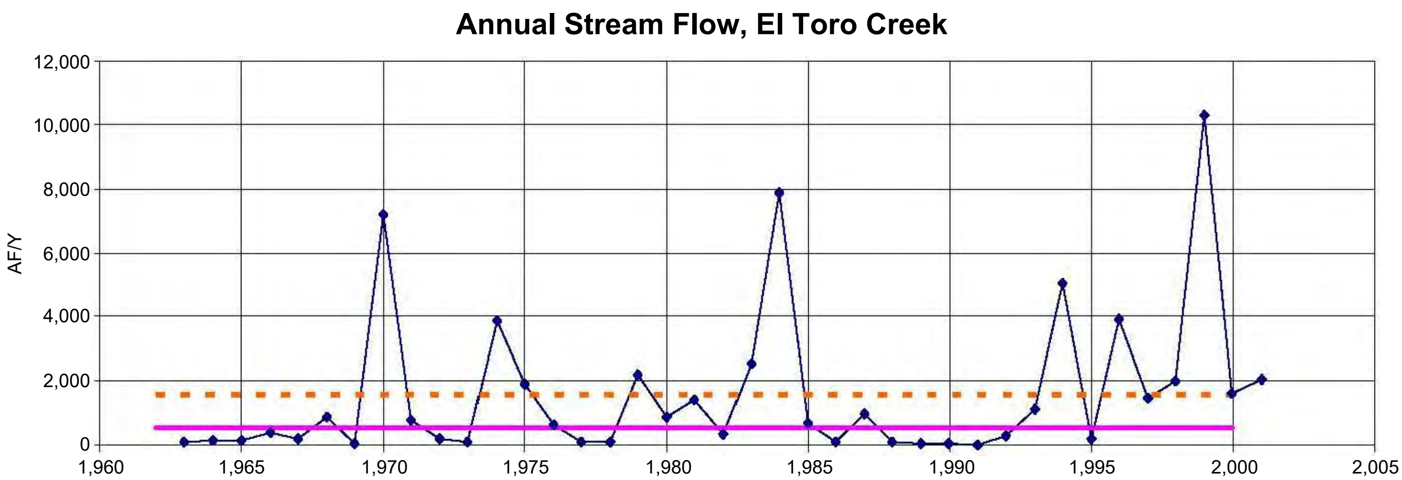
Coastal areas of the Subbasin drain toward Monterey Bay. Runoff is minimal due to the high rate of surface water infiltration into the permeable dune sand. Consequently, well-developed natural drainages are absent throughout much of this area (Harding, 2004).

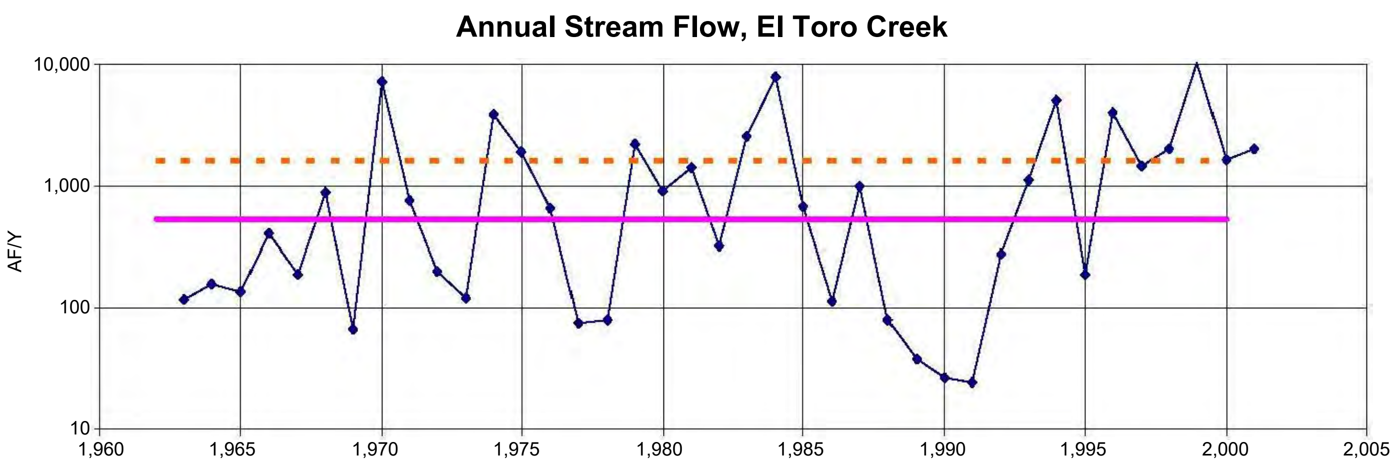
Small intermittent streams found in the Subbasin include the San Benancio Gulch, Watson Creek, and Calera Creek (GeoSyntec, 2007). These streams generally flow northeastward and are tributaries to the Salinas River. Flows in these creeks respond rapidly to rainfall, and they are usually dry in the summer months. These creeks have a “flashy” nature and readily lose water to streambed seepage. (Hydrometrics, 2009). These streams flow less than 25 percent of the year (GeoSyntec, 2007).

El Toro Creek is a perennial stream below the confluence with Watson Creek below the Corral de Tierra golf course (Feikert, 2001). Recorded streamflows at USGS gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 AFY (GeoSyntec, 2007). This means annual streamflow was calculated for the entire record from 1961 to 2001. However, El Toro Creek did not record flow every year, with notable dry periods from 1985 to 1992 (Figure 4-24).

Yates and others (2005) concluded that local streams (i.e., El Toro Creek and smaller streams) contribute insignificantly to groundwater recharge. Along limited reaches, these streams gain streamflow from groundwater discharge. However, the stream-aquifer exchanges are not thought to be significant to either the groundwater budget or to the response of the groundwater basin to pumping (Durbin, 2007).

Due to the intermittent nature and minimal amount of streamflow, there are no surface water rights registered with the SWRCB within the Subbasin.





Legend:

- Mean Annual Flow (AF/Y)
- Mean Annual Log Q = 525 AF/Y
- Mean Annual Q = 1,590 AF/Y

Source:

Adapted from GeoSyntec (2007).

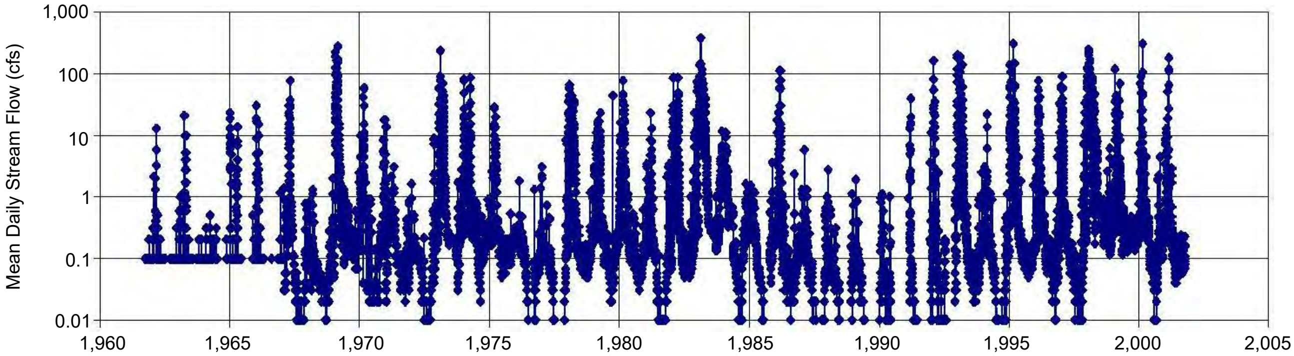
Annual Stream Flow, El Toro Creek

Monterey Subbasin Groundwater Sustainability Plan

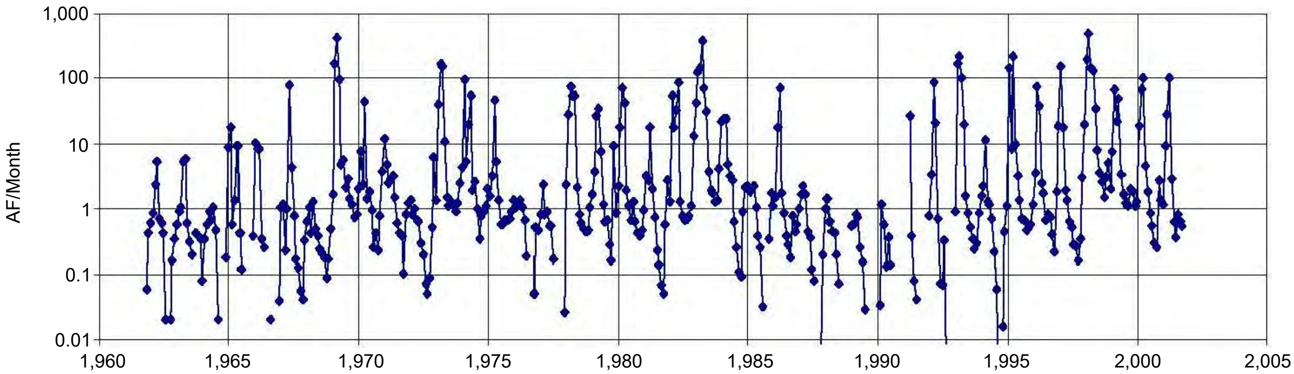
November 2021

Figure 4-24

Mean Daily Stream Flow, El Toro Creek



Monthly Stream Flow, El Toro Creek



Legend:

Mean Daily and Monthly Flow

Source:

Adapted from GeoSyntec (2007).

Daily and Monthly Stream Flow, El Toro Creek

Monterey Subbasin

Groundwater Sustainability Plan

November 2021

Figure 4-25

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18

4.3.1 Source and Point of Delivery for Imported Water Supplies

There are no known sources of imported water for this subbasin. Groundwater is the only source of water for this subbasin.

4.4 Data Gaps

A significant portion of the Subbasin remains undeveloped to date, which includes federal lands located in the Fort Ord hills area and lands in the lower El Toro Creek area (i.e., northern portion of the Corral de Tierra Area). As such, limited to no subsurface information is available in these areas. Regardless, many comprehensive studies have been conducted in areas where groundwater development has been active; and the hydrogeologic conceptual model for those areas is well developed.

One significant data gap exists in the hydrogeologic conceptual model for the Subbasin. This data gap relates to the location and magnitude of recharge to the Marina-Ord Area Deep Aquifers, one of the major production aquifers within the Subbasin and within other subbasins of the Salinas Valley Groundwater Basin. As described in Chapters 7, the GSP will include ongoing data collection and monitoring that will allow continued refinement and quantification of the groundwater system. Chapter 10 includes activities to address the identified data gaps and improve the hydrogeologic conceptual model.

5 CURRENT AND HISTORICAL GROUNDWATER CONDITIONS

This section presents information on historical and current groundwater conditions within the Subbasin based on available data. The Groundwater Sustainability Agencies (GSAs) gathered information from multiple monitoring agencies within the Subbasin to establish the best comprehensive understanding of the Subbasin's groundwater conditions. Source of data used to inform this assessment includes data from Marina Coast Water District (MCWD), Monterey County Water Resources Agency (MCWRA), Fort Ord, Monterey Peninsula Water Management District (MPWMD), California Department of Water Resources (DWR), United States Geological Survey (USGS), Monterey Peninsula Landfill, and Seaside Groundwater Basin Watermaster records, various state and federal databases, and other reports.

For the purpose of this Chapter:

(a) "Current Conditions" or "Current Period" refers to third-quarter 2017 and second-quarter 2018.

(b) "Historical Conditions" or "Historical Period" refers to Water Years (WY) 2004 through 2018 (i.e., October 2003 through September 2018).

The 15-year Historical Conditions period is used to develop the historical water budget as well as assess groundwater elevation and water quality trends. As discussed further below, this period is climatically close to normal/average rainfall conditions measured in the vicinity of the Subbasin since 1895. It includes a significant drought period between 2012 and 2015, as well as other drier and wetter than normal years. In some cases, other periods of record are also discussed in this section when either (a) the discussion is constrained by the time periods of available datasets (e.g., for land subsidence), or (b) characterization of groundwater conditions is improved by incorporation of data from other time periods.

This chapter summarizes information related to the six sustainability indicators defined under the Sustainable Groundwater Management Act (SGMA), including:

1. Chronic lowering of groundwater levels;
2. Changes in groundwater storage;
3. Seawater intrusion;
4. Groundwater quality;
5. Subsidence; and
6. Depletion of interconnected surface waters.

In addition, the chapter discusses groundwater dependent ecosystems (GDEs). GDEs are not a SGMA-defined sustainability indicator but are an important part of Groundwater Sustainability Plans (GSPs).

As discussed in the Hydrogeological Conceptual Model (HCM), the principal aquifers of the Marina-Ord Area are mostly the same as the layered principal aquifers in the 180/400-Foot

Aquifer Subbasin. The principal aquifer in the Corral de Tierra Area is the El Toro Primary Aquifer System, which combines the water-bearing geologic units into one functional aquifer. These geologic formations are present across the Subbasin and include the Aromas Sands, Paso Robles Formation, and the Santa Margarita Sandstone. However, the Dune Sands and 180-Foot Aquifers, and their unique geology are not present in the Corral de Tierra Area. The hydrologic connection between the Management Areas is undefined with the best available data and information, but the presence of the same geologic units indicates some connection. The groundwater conditions outlined below are the best attempt to describe both the unique areas as well as the connection despite the uncertainty and with the understanding that implementation actions will begin to address these data gaps.

5.1 Groundwater Elevations and Flow Direction

Subbasin groundwater elevations are presented using the following methodologies:

- Maps of groundwater elevation contours that show the geographic distribution of groundwater elevations at a specific time. The contours represent lines of equal groundwater elevation in feet above the NAVD88 vertical datum.
- Hydrographs of individual wells that show the variations in groundwater elevation at individual wells over an extended period.
- Vertical hydraulic gradients in a single location that assess the potential for vertical groundwater flow direction.

5.1.1 Data Sources

Groundwater elevations have been assessed based on data collected and compiled from various agencies, including MCWD, MCWRA, Fort Ord, MPWMD, DWR's California Statewide Groundwater Elevation Monitoring (CASGEM) database, USGS, Monterey Peninsula Landfill, and Seaside Groundwater Basin Watermaster. Multiple datasets were reconciled and processed for quality assurance/quality control prior to analysis of groundwater conditions. These "data cleaning" efforts included the identification and removal of potentially erroneous data points through examination of hydrographs and information recorded based on the quality of the measurement. For the purposes of this analysis, the periods of Fall 2017 and Spring 2018 and are used to represent seasonal low and high conditions during the Current Period. They are also considered representative of current land and water use conditions.

5.1.2 Groundwater Elevation Contours and Horizontal Groundwater Gradients

Groundwater elevation contours for each principal aquifer during Fall 2017 and Spring 2018[16] are presented on Figure 5-1 to Figure 5-10. Groundwater flow directions and groundwater levels observed during these periods in the Marina-Ord Area and Corral de Tierra Area are summarized below.

5.1.2.1 Marina-Ord Area

The Principal Aquifers in the Marina Ord Area include: the Dune Sand Aquifer, 180-Foot Aquifer, 400-Foot Aquifer, and Deep Aquifers. In the Marina-Ord Area, the 180-Foot Aquifer contains two distinct layers, known as the upper- and lower- 180-Foot Aquifer. Conditions in both layers of the 180-Foot Aquifer are described herein. Both layers are hydraulically connected to the Principal Aquifer known also known as the 180-Foot Aquifer in the adjacent 180/400-Foot Aquifer Subbasin.

Dune Sand Aquifer

As discussed in Chapter 4 and shown in Figure 5-1 and Figure 5-5, the Dune Sand Aquifer only exists in the Marina-Ord Area within the dune sand deposits located in the western portion of the Subbasin.

- Groundwater elevations in the Dune Sand Aquifer range from 90 ft NAVD88 in the central portion of the Marina-Ord Area to approximately 5 ft NAVD88 near the coast where the Dune Sand Aquifer merges with the upper 180-Foot Aquifer, west of the SVA. Groundwater level data for the Dune Sand Aquifer are limited in the southern portion of the Marina-Ord Area near the Monterey-Seaside Subbasin boundary and at the eastern extent of the dune sands.
- A groundwater divide exists in the Dune Sand Aquifer within the Marina-Ord Area. West of the groundwater divide, groundwater in the Dune Sand Aquifer flows westward towards the Pacific Ocean and recharges the 180-Foot Aquifer where the SVA pinches out. Upon entering the 180-Foot Aquifer, groundwater abruptly reverses direction and flows eastward (i.e., inland). East of the groundwater divide, groundwater in the Dune Sand Aquifer flows to the northeast toward the 180/400-Foot Aquifer Subbasin and the Salinas River.
- During the Current Period, the average magnitude of the horizontal gradient in the Dune Sand Aquifer was approximately 0.011 ft/ft west of the groundwater divide and 0.007 ft/ft east of the groundwater divide.

---

[16] Data between August 15, 2017 and December 15, 2017, are used to develop groundwater contours for the Fall 2017 season. For wells that have multiple measurements during this period, priority was given to measurements taken closer to August 27, 2017. Data between January 15, 2018 and April 15, 2018, are used to develop groundwater contours for the Spring 2018 season, with priority given to measurements taken closer to March 5, 2018.

180-Foot Aquifer

The 180-Foot Aquifer is subdivided into the upper 180-Foot Aquifer and the lower 180-Foot Aquifer in the Marina-Ord Area, based on the stratigraphy described in multiple studies focused on this area (Ahtna Engineering, 2013; Harding ESE, 2001; detailed in Chapter 4). Groundwater elevations and gradients observed in these two zones of the 180-Foot Aquifer are described below.

Upper 180-Foot Aquifer

- Groundwater elevations in the upper 180-Foot Aquifer are highest at the coastline and generally decrease inland to the east/northeast. Flow directions are generally to the northeast toward the 180/400-Foot Aquifer Subbasin.
- In Fall 2017 (Figure 5-2), groundwater elevations range from 5 ft NAVD88 along the coast to -20 ft NAVD88 at the Monterey- 180/400-Foot Aquifer Subbasin boundary. Groundwater elevations are generally higher in Spring 2018. This increase is likely the result of increased recharge and reductions in pumping in the Salinas Valley Basin.
- Groundwater elevations are near sea level at the coastline and are below sea level further inland. This inland gradient allows high salinity water to flow into the Subbasin (see Section 5.3 Seawater Intrusion). However, inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion.
- During the current period, the average horizontal gradient in the 180-Foot Aquifer was 0.0012 ft/ft in Fall 2017 and 0.0008 ft/ft in Spring 2018 (Figure 5-6).

Lower 180-Foot Aquifer

As discussed in Chapter 4, the lower 180-Foot Aquifer is hydraulically connected to the 400-Foot Aquifer in the Marina-Ord Area due to the discontinuous nature of the 180/400-Foot Aquitard within this region. As such, groundwater elevations and gradients in the lower 180-Foot Aquifer are similar to those in the 400-Foot Aquifer in the Marina Ord Area of the Subbasin, which is further described below.

400-Foot Aquifer

Figure 5-3 and Figure 5-7 show groundwater elevation contours within the 400-Foot Aquifer in the Marina-Ord Area. These groundwater elevations and gradients are consistent with those observed in the lower-180 Foot Aquifer. Groundwater elevations in the 400-Foot Aquifer have been plotted in combination with groundwater elevations within the Paso Robles Aquifer identified in the adjacent Seaside Subbasin. Available data indicates that these aquifers are potentially hydraulically connected. However, there is also a possible connection between the Seaside Subbasin Paso Robles Aquifer with the upper portion of the Deep Aquifers in the Monterey Subbasin.

- Groundwater elevations in the 400-Foot Aquifer are highest in the southern portion of the Monterey Subbasin and generally decrease to the north and east. Flow directions are generally toward the northeast and the 180/400-Foot Aquifer Subbasin. A flow divide occurs along the Monterey-Seaside Subbasin boundary.

- A local groundwater depression exists just north of the Monterey-Seaside Subbasin boundary, where a potential connection between the 400-Foot Aquifer and the Deep Aquifers may be located (see Section 5.1.3).
- In Fall 2017, groundwater elevations in the Marina-Ord Area ranged from 0 ft NAVD88 at the coast to -40 ft NAVD88 at the Monterey- 180/400-Foot Aquifer Subbasin boundary. Groundwater elevations were generally higher in Spring 2018. This increase is likely the result of increased recharge and reductions in pumping in the Salinas Valley Basin.
- Groundwater elevations are near sea level at the coastline and below sea level further inland. Based on available cross-sections (e.g., Harding ESE, 2001; see Chapter 4), the formations that make up this aquifer extend offshore and likely outcrop beneath a veneer of Pleistocene or Holocene marina sediments that is thin (i.e., less than 5 meters) across much of the offshore shelf but thicker (i.e., up to 32 meters) near the Salinas River Delta (Johnson et al., 2016). These conditions allow high salinity water to flow into this aquifer in the northern portion of the Subbasin.
- During the Current Period, the average magnitude of the horizontal gradient in the 400-Foot Aquifer was 0.0011 ft/ft in Fall 2017 and 0.0006 ft/ft in Spring 2018.

Deep Aquifers

As discussed in Chapter 4, the Deep Aquifers consist of multiple aquifers and aquitards that appear to be somewhat hydraulically connected. Given the absence of data for the multiple layers that make up this aquifer, this assessment generally describes conditions in the Deep Aquifers as a whole.

Figure 5-4 and Figure 5-8 show groundwater elevation contours within the Deep Aquifers in combination with groundwater elevation contours within the Santa Margarita Aquifer in the Seaside Subbasin. Available data indicate that these aquifers are potentially hydraulically connected.

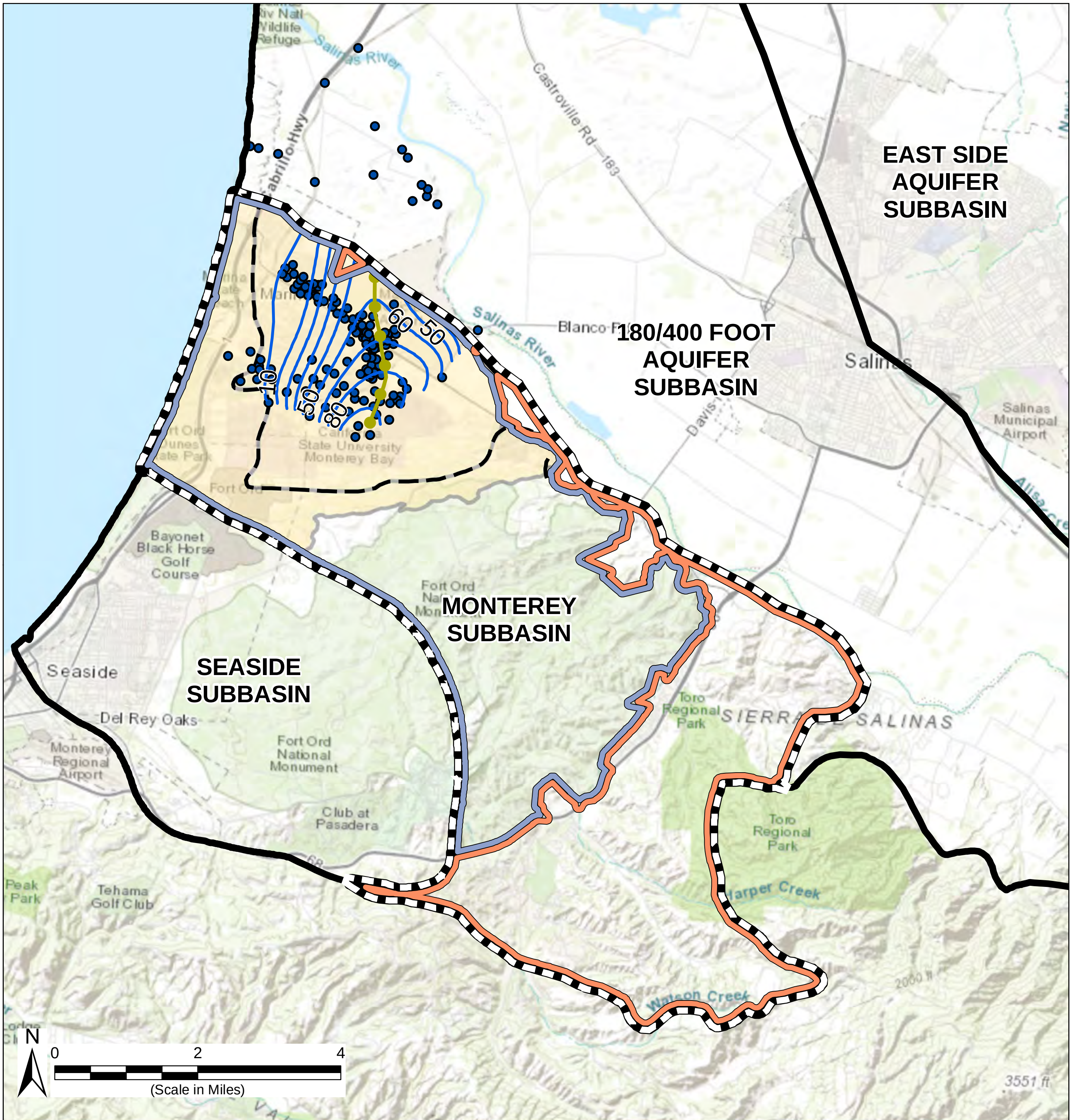
- Groundwater elevations in the Deep Aquifers are highest in the southeastern portion of the Marina-Ord Area and generally decrease toward the northwest. Flow directions are generally toward the north, suggesting some recharge from mountain ranges south of the Subbasin and flow into a pumping trough just north of the Monterey-180/400-Foot Aquifer Subbasin boundary near West Blanco Road and Nashua Road. A local groundwater high exists just north of the Monterey-Seaside Subbasin boundary between the Seaside Subbasin and Monterey-180/400-Foot Aquifer Subbasin pumping centers.
- In Fall 2017, groundwater elevations ranged from 160 ft NAVD88 near the southeastern Subbasin boundary to -60 ft NAVD88 in the north near the Monterey/180/400-Foot Aquifer Subbasin boundary. Groundwater elevations were generally higher in Spring 2018.
- During the Current Period, the average magnitude of horizontal gradients in the Deep

Aquifers, identified on the basis of contours shown on Figures 5-1 and 5-2, ranged between 0.0006 ft/ft in Fall 2017 to 0.0004 ft/ft in Spring 2018 in the Marina Ord Area. However, since groundwater elevations shown on these figures may represent multiple aquifers within the Deep Aquifers due to varying screen lengths and depths, the direction and magnitude of these gradients may not accurately represent conditions throughout the Deep Aquifers.

- Groundwater elevations in the Deep Aquifers are significantly lower than those in the 400-Foot Aquifer and have been consistently below sea level since the late 1980s. These data suggest that the Deep Aquifers are at risk of seawater intrusion from locations where these formations outcrop on the ocean floor near the rim of the Monterey Canyon (Hartwell et al., 2015; Johnson et al., 2016) and from leakage from the overlying seawater intruded aquifers.

5.1.2.2 Corral de Tierra Area

Figure 5-9 through Figure 5-10 show groundwater elevation contours within the El Toro Primary Aquifer System in the Corral de Tierra Area. Groundwater in the El Toro Primary Aquifer System generally flows from the south toward the north, northwest, and northeast with a potential groundwater flow divide occurring near the Monterey-Seaside Subbasin boundary in the Laguna Seca area. There may be localized depressions around pumping centers, but there is not sufficient data to show them in the groundwater elevation contours in the following figures. Additionally, the Monterey Formation, which is the bottom of the Subbasin, is uplifted in this locale due to structural deformation and may impact some flow direction. In Fall 2017, the groundwater elevations in the El Toro Primary Aquifer System ranged from approximately 800 ft to -40 ft NAVD88 from south to north.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Dune Sand Groundwater Divide
- Extent of Dune Sand Geologic Unit
- 2017 Fall Groundwater Elevation Contours in the Dune Sand Aquifer (ft NAVD 88)
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Groundwater Level Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Fall 2017. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

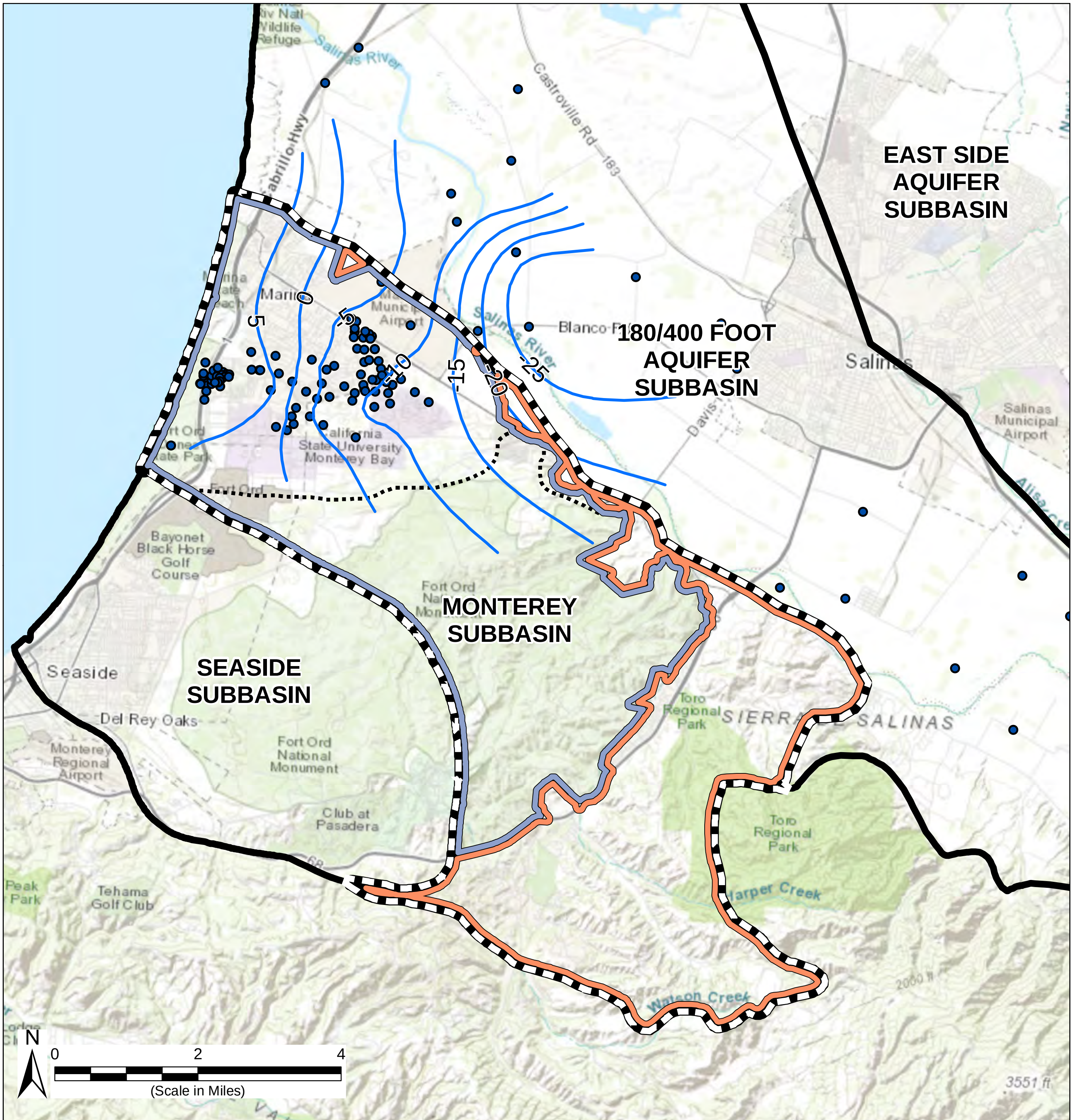
1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Groundwater Level Contours in the Dune Sand Aquifer - Fall 2017

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-1

Path: X:\B60094\Maps\2021\09\Fig5-1-DuneSand_Fall2017.mxd



Path: X:\B60094\Maps\2021\09\Fig5-2-Upper-180-ft_Fall2017.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- 2017 Fall Groundwater Contours in the Upper 180-Foot Aquifer (NAVD 88)
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)
- Groundwater Level Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Groundwater contours are drawn using minimum curvature method with groundwater elevation measurements collected during Fall 2017. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

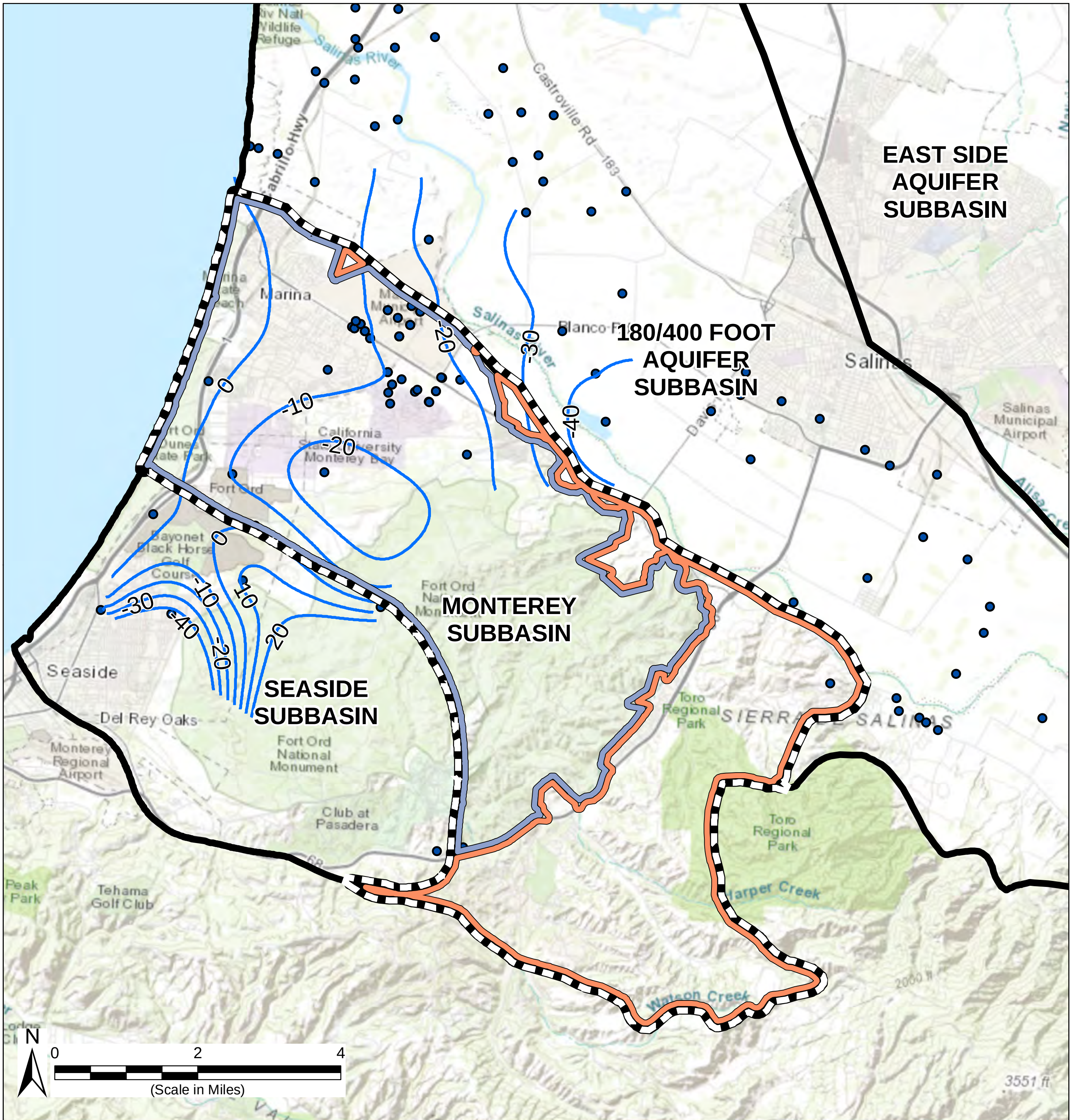
Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. The contours herein presents conditions in the upper 180-Foot Aquifer.

Groundwater Level Contours in the 180-Foot Aquifer - Fall 2017

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-2



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- 2017 Fall Groundwater Contours in the Lower 180-Foot, 400-Foot Aquifer (NAVD 88)
- Groundwater Level Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. Conditions in the lower 180-Foot Aquifer are consistent with those observed in the 400-Foot Aquifer.
4. MPWMD#FO-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer.

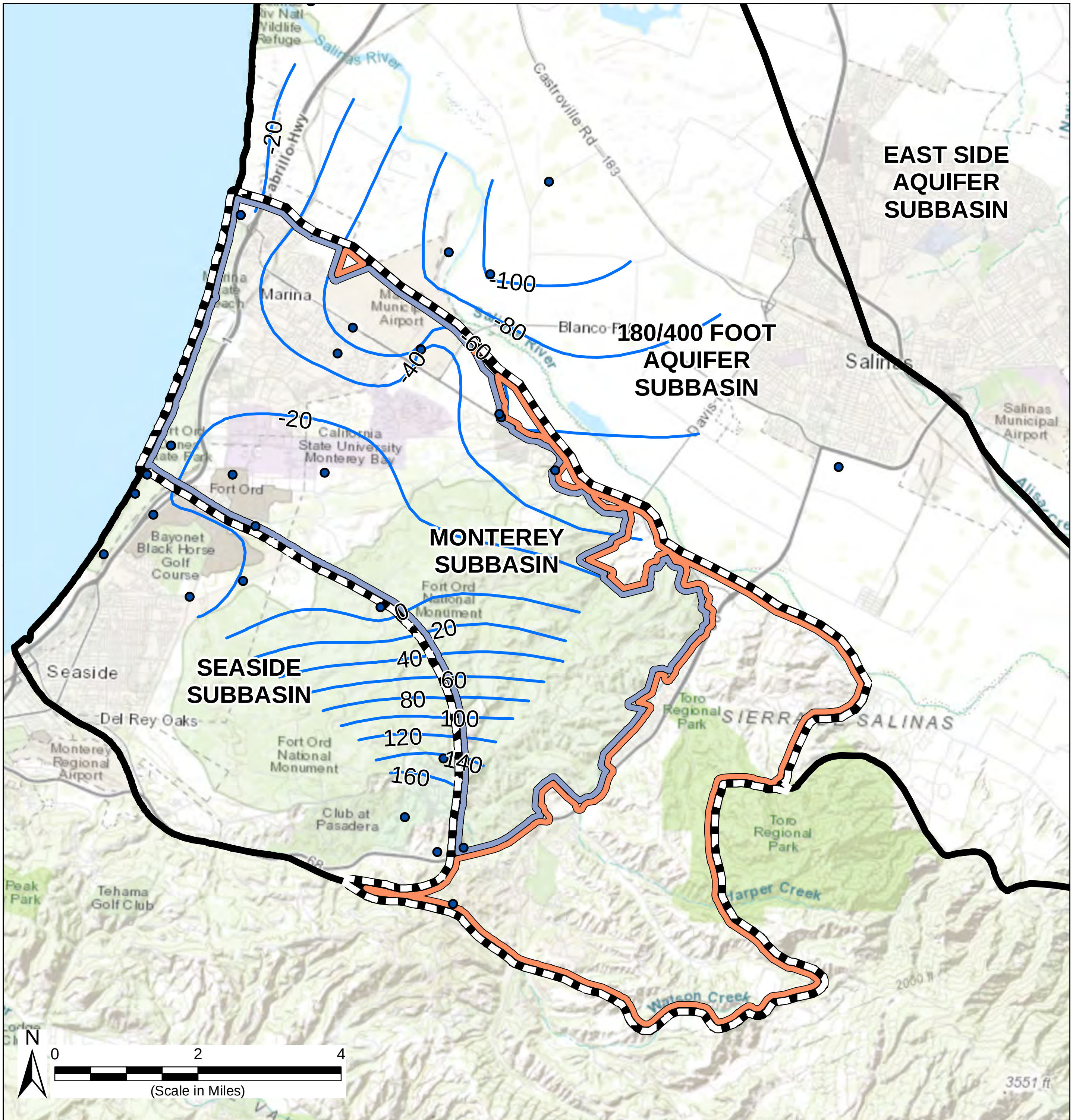
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 29 November 2021.
2. Groundwater contours are drawn using minimum curvature method with groundwater elevation measurements collected during Fall 2017. Only static water levels are plotted.

Groundwater Level Contours in the 400-Foot Aquifer - Fall 2017

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-3



Path: X:\B60094\Maps\2021\09\Fig5-4-Deep_Fall2017.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

2017 Fall Groundwater Contours in the Deep Aquifers (NAVD 88)

Groundwater Level Measurement Locations

Management Areas

Marina-Ord Area

Corral de Tierra

Abbreviations

ft = foot

NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

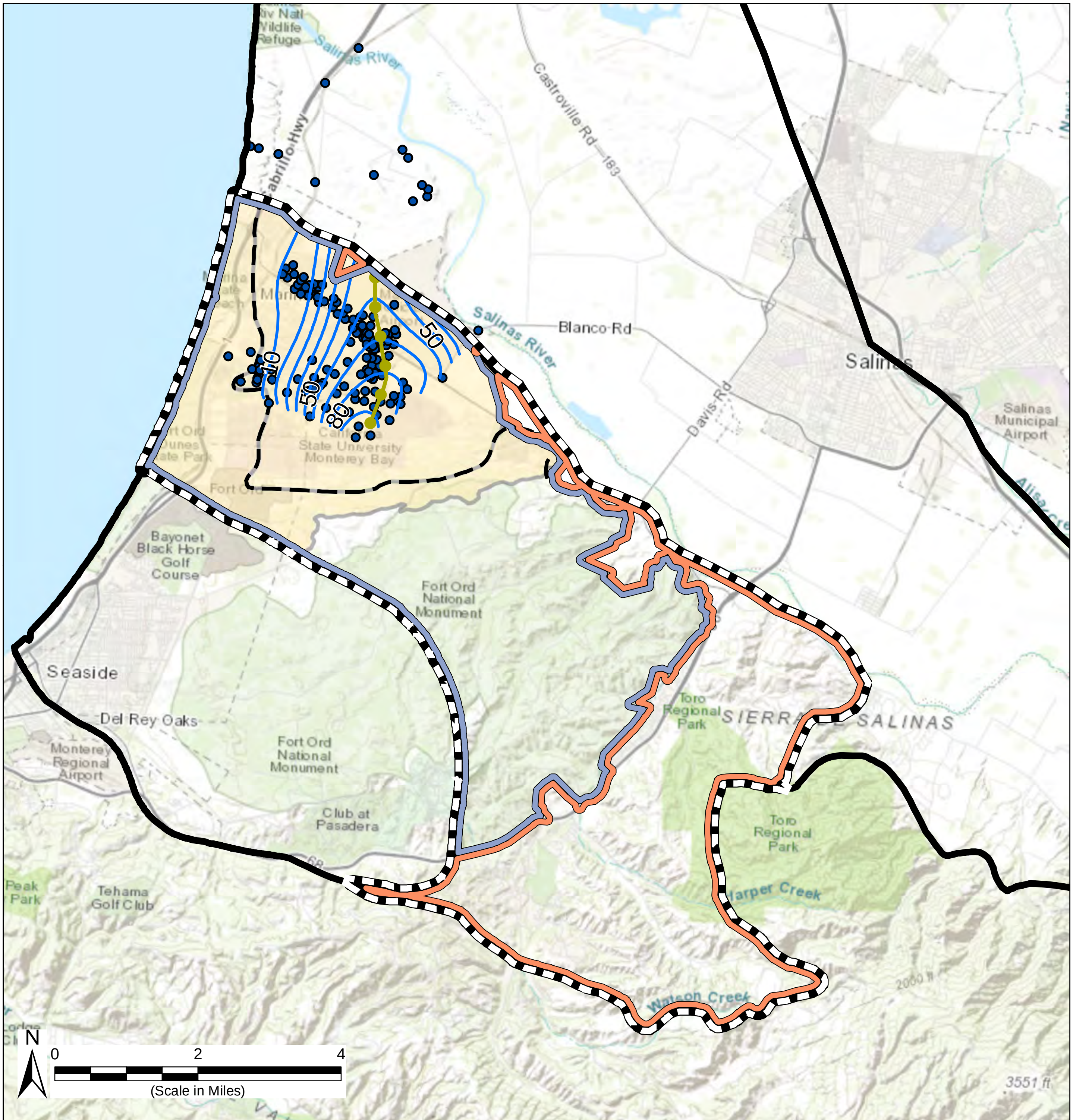
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 29 November 2021.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Fall 2017. Only static water levels are plotted.

Groundwater Level Contours in the Deep Aquifers - Fall 2017

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-4



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Dune Sand Groundwater Divide
- Extent of Dune Sand Geologic Unit
- 2018 Spring Groundwater Elevation Contours in the Dune Sand Aquifer (ft NAVD 88)
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Groundwater Level Measurement Locations

Management Areas

- Marina-Ord
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Spring 2018. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

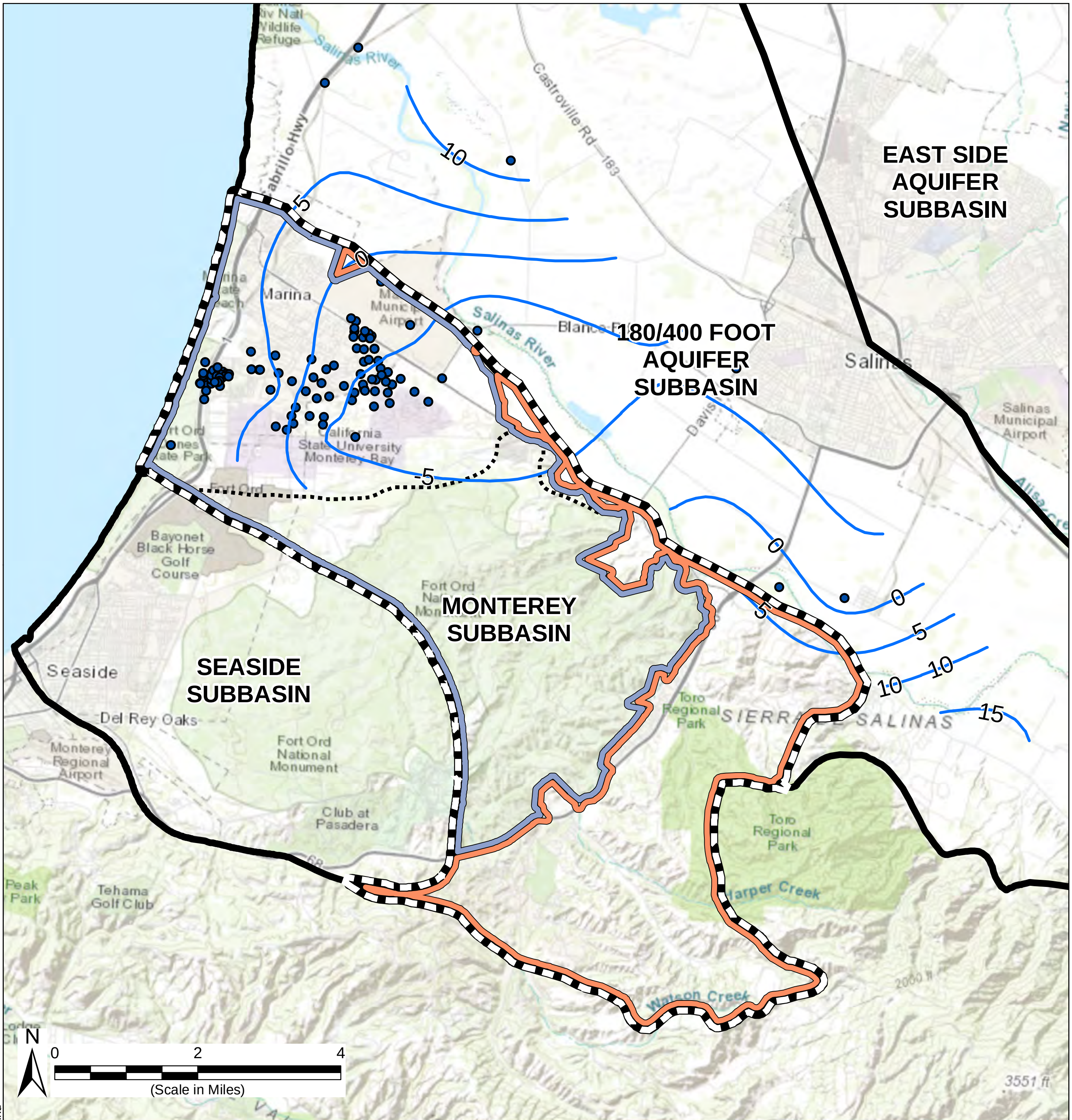
1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Groundwater Level Contours in the Dune Sand Aquifer - Spring 2018

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-5

Path: X:\B60094\Maps\2021\09\Fig5-5-DuneSand_Spring2018.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- 2018 Spring Groundwater Contours in the Upper 180-Foot Aquifer (NAVD 88)
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)
- Groundwater Level Measurement Locations

Management

- Marina-Ord
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Groundwater contours are drawn using minimum curvature method with groundwater elevation measurements collected during Spring 2018. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

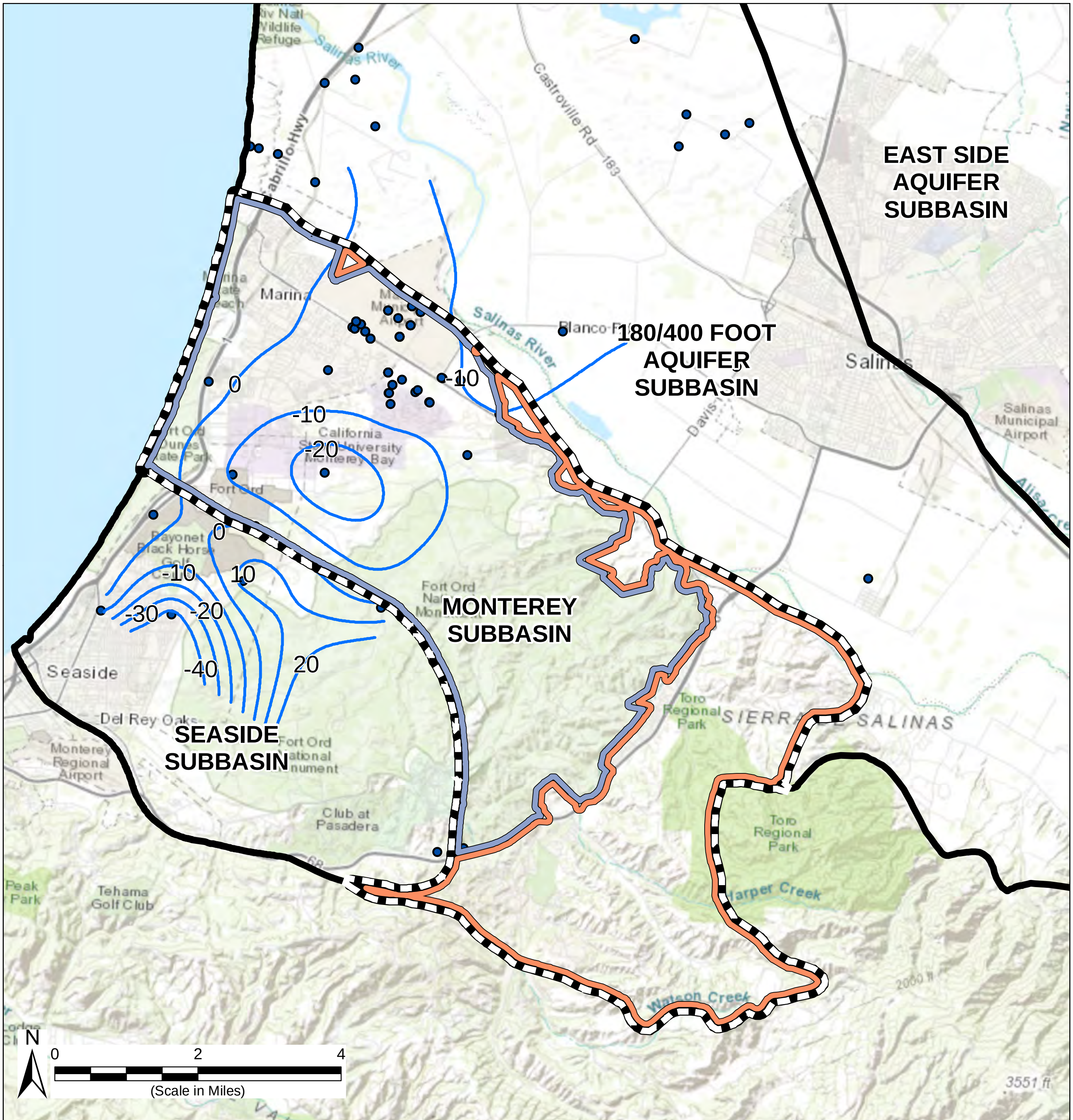
1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. The contours herein presents conditions in the upper 180-Foot Aquifer.

Groundwater Level Contours in the 180-Foot Aquifer - Spring 2018

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-6

Path: X:\B60094\Maps\2021\09\Fig5-6-Upper180-FT_Spring2018.mxd



Path: X:\B60094\Maps\2021\09\Fig5-7-400-FT_Spring2018.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

2018 Spring Groundwater Contours in the Lower 180-Foot, 400-Foot Aquifer (NAVD 88)

Groundwater Level Measurement Locations

Management Areas

Marina-Ord Area

Corral de Tierra Area

Abbreviations

ft = foot

NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. Conditions in the lower 180-Foot Aquifer are consistent with those observed in the 400-Foot Aquifer.
4. MPWMD#FO-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer.

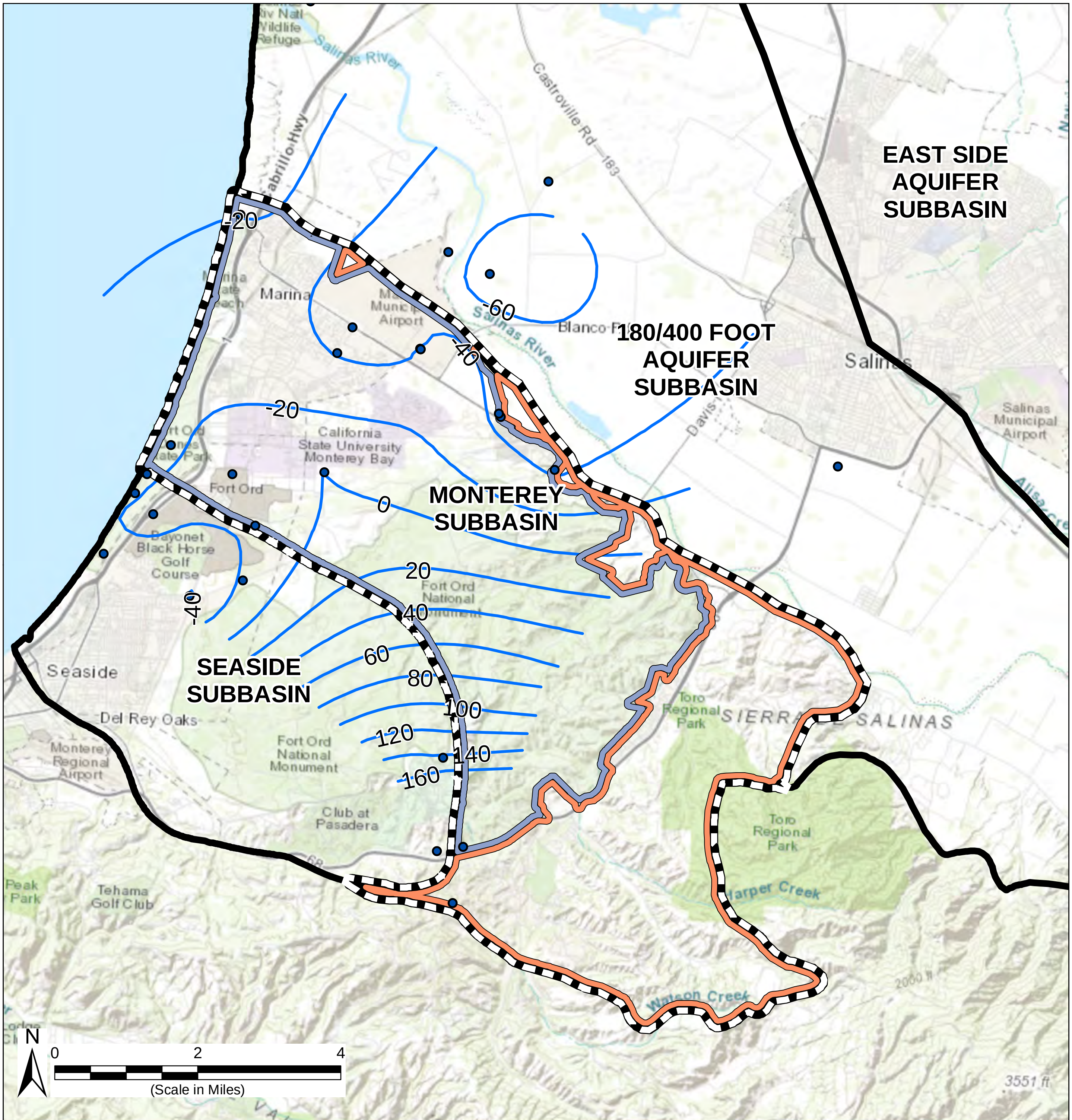
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 29 November 2021.
2. Groundwater contours are drawn using minimum curvature method with groundwater elevation measurements collected during Spring 2018. Only static water levels are plotted.

Groundwater Level Contours in the 400-Foot Aquifer - Spring 2018

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-7



Path: X:\B60094\Maps\2021\09\Fig5-8-Deep_Spring2018.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- 2018 Spring Groundwater Contours in the Deep Aquifers (NAVD 88)
- Groundwater Level Measurement Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 29 November 2021.
2. Groundwater contours are drawn using kriging method with groundwater elevation measurements collected during Spring 2018. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

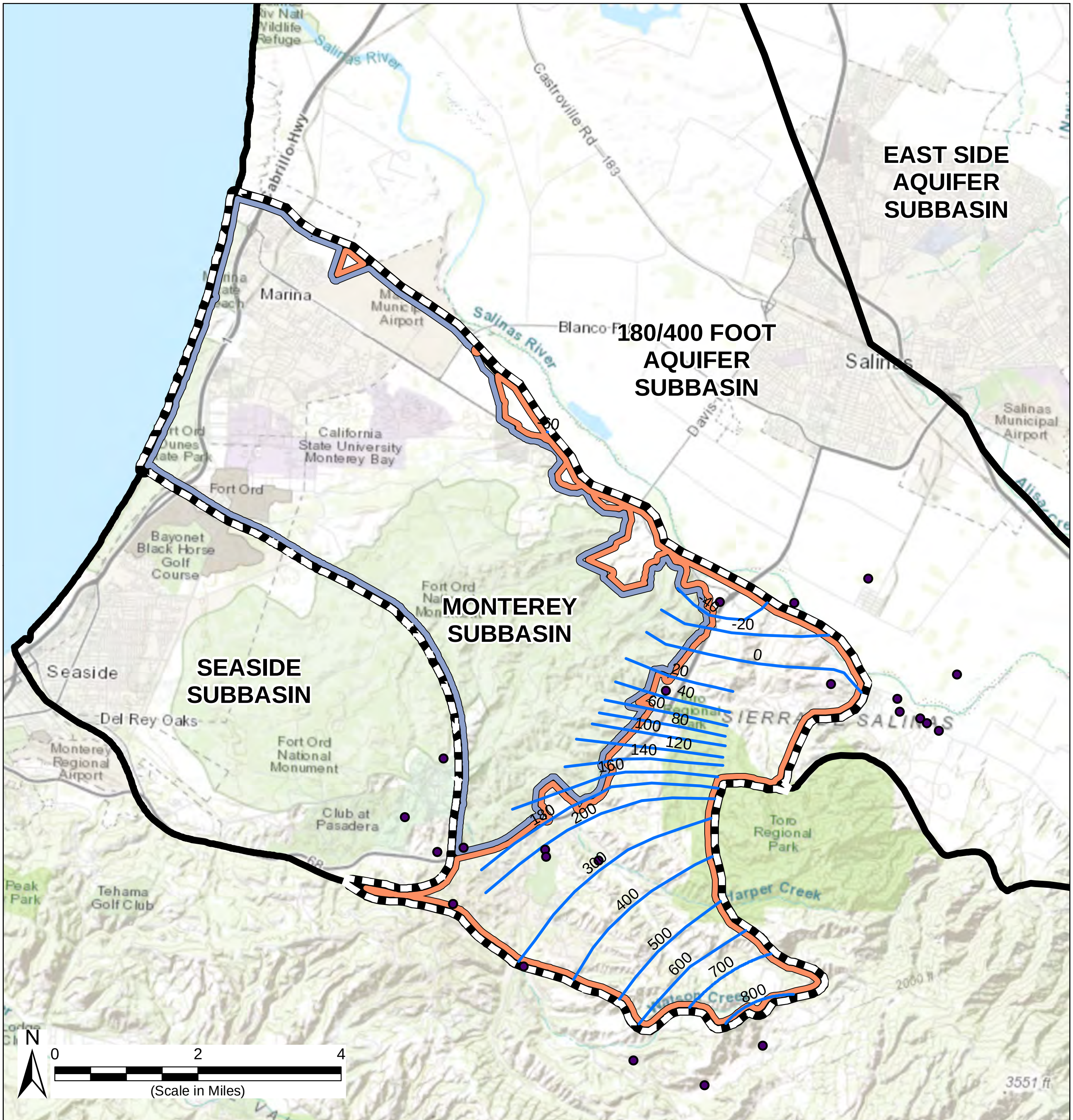
Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.
3. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Groundwater Level Contours in the Deep Aquifers - Spring 2018

Monterey Subbasin
Groundwater Sustainability Plan
May 2020

Figure 5-8



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management

Marina-Ord

Corral de Tierra

Groundwater Level Measurement Locations

2017 Fall Groundwater Contours in the El Toro Primary Aquifer (ft NAVD 88)

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 December 2021.
2. Groundwater contours are drawn with groundwater elevation measurements collected during Fall 2017. Only static water levels are plotted.

Abbreviations

ft = feet

NAVD 88 = North American Vertical Datum of 1988

Notes

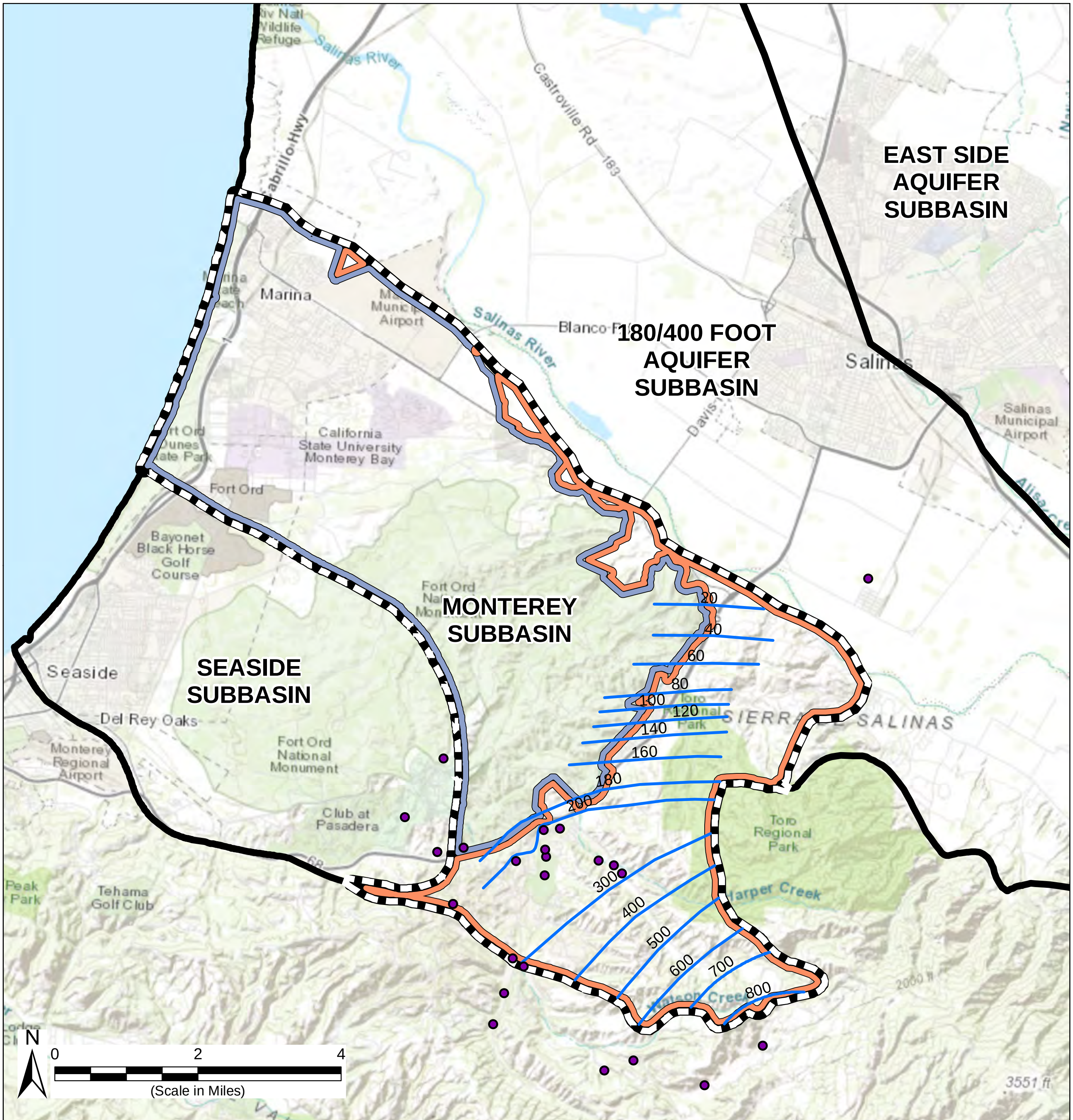
1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Groundwater Level Contours in the El Toro Primary Aquifer - Fall 2017

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-9

Path: X:\B60094\Maps\2021\09\Fig5-9-El_Toro_Fall2017.mxd



Path: X:\B60094\Maps\2021\09\Fig5-10-El_Toro_Spring 2018.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra Area
- Groundwater Level Measurement Locations
- 2018 Spring Groundwater Contours in the El Toro Primary Aquifer (ft NAVD 88)

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 December 2021.
2. Groundwater contours are drawn with groundwater elevation measurements collected during Spring 2018. Only static water levels are plotted.

Abbreviations

ft = foot
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Groundwater Level Contours in the El Toro Primary Aquifer - Spring 2018

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-10

5.1.3 Long-Term Groundwater Elevation Trends

Representative temporal trends in groundwater elevations can be assessed with hydrographs that plot changes over time. Wells were selected for hydrograph analysis based on their length of record and location. Wells believed to be representative of conditions across various areas of the Subbasin were selected. Additionally, a linear regression of the water level data over a 15-year period (i.e., 2004 through 2018) was used to evaluate long-term groundwater elevation trends for selected wells.

Figure 5-11 through Figure 5-15, and Figure 5-17 depict the locations and hydrographs of representative wells within each principal aquifer and their hydrographs. The large versions of the hydrographs for these wells, as well as other representative monitoring wells, are included in Appendix 8-A. The following sections summarize trends in groundwater elevations within each principal aquifer within the Marina-Ord Area and the Corral de Tierra Area.

5.1.3.1 Marina-Ord Area

Dune Sand Aquifer

- Groundwater elevations in the Dune Sand Aquifer have been generally stable for over three decades and do not show large seasonal variations, unlike the groundwater elevations in the 180-Foot, 400-Foot and Deep Aquifers which show large seasonal variations due to agricultural pumping in the neighboring Salinas Valley groundwater subbasins. Consistent with most shallow unconfined aquifers that receive direct recharge from rainfall, water levels in the Dune Sand Aquifer increase and decrease during extended wet and dry periods. Most wells in this aquifer show slightly decreasing trends during the past 15 years following a prior period of increasing water levels. Linear trendline slopes over this period ranged from -0.761 feet per year (ft/yr) to 0.0222 ft/yr (Figure 5-11).

180-Foot Aquifer

Upper 180-Foot Aquifer

- Groundwater elevations have been stable in the upper 180-Foot Aquifer in the past thirty years. During the past 15 years, wells in this aquifer have shown no significant trend. Linear trendline slopes over this period ranged from -0.0363 ft/yr to 0.0161 ft/yr (Figure 5-12). Seasonal fluctuations in this aquifer have been as large as 10 ft.

Lower 180-Foot Aquifer

- Groundwater elevations in the lower 180-Foot Aquifer are generally equivalent to those observed in the 400-Foot Aquifer, which is described below.

400-Foot Aquifer

- Groundwater elevations have been stable over the past thirty years in wells in this aquifer in the northern Marina-Ord Area. During the past 15 years, groundwater elevation trends in wells screened in the 400-Foot aquifer in this area have been generally flat. Linear trendline slopes over the last 15-year period ranged from -2.02 ft/yr to 0.108 ft/yr (Figure 5-13). Seasonal fluctuations in this aquifer have been as large as 30 ft.

Two CASGEM wells in the southwestern portion of the Marina-Ord Area, MPWMD#FO-10 and MPWMD#FO-11, show consistent decreasing trends over the past 15-years. Additionally, groundwater elevations in these wells are significantly lower than those to the north near the City of Marina and the south in the Seaside Subbasin. When water levels in these wells are plotted in conjunction with other 400-Foot Aquifer wells in the Marina Ord Area, they indicate the presence of a localized depression in the groundwater potentiometric surface of the 400-Foot Aquifer. However, there is no known extraction in the Monterey Subbasin in the vicinity of these wells, and groundwater elevation trends observed in these wells are similar to those measured in the Deep Aquifers. These data suggest that (1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells.

Deep Aquifers

- Groundwater production from the Deep Aquifers in the 180/400-Foot Aquifer Subbasin began in the mid-1970s. Within the Monterey Subbasin, MCWD's production in the Deep Aquifers began in 1985. At this time, groundwater elevations were close to sea level in the Deep Aquifers within the Marina-Ord Area of the Monterey Subbasin (Feeney and Rosenberg, 2003).
- Groundwater elevations in the Deep Aquifers within the Marina-Ord Area declined rapidly in the first few years of MCWD's extraction from the Deep Aquifers, but stabilized beginning in the early 1990s, and stayed stable through the mid-2000s. During this time period, rates of groundwater extraction from the Deep Aquifers ranged from 2,000 AFY to 2,300 AFY from MCWD wells. Rates of groundwater extraction from agricultural production wells screen in the Deep Aquifers in the 180/400-Foot Aquifer Subbasin were approximate 2,000 AFY during this period, resulting in a combined production rate of approximately 4,000 AFY from the Deep Aquifers (Figure 5-16)[17].
- Groundwater elevations in the Deep Aquifers have shown a consistent decline since the mid-2000s. Linear trendline slopes in representative wells within the Marina-Ord area over the past 15 years have ranged from -2.84 ft/yr to 0.749 ft/yr (Figure 5-14 and Figure 5-15).
- The USGS multi-completion well (014S001E24L) near the Monterey Coast shows varying potentiometric heads between screen intervals with similar long-term trends. These data indicate that the Deep Aquifers are comprised of a series of aquifer zones and aquitards that are influenced by groundwater production within these zones. As evidenced by

[17] During this period, MCWD and MCWRA entered into the 1996 Annexation Agreement (see Section 3.2.2.2) where the parties agreed *"… that the '900-foot' aquifer* (aka the Deep Aquifers) *should be managed to provide safe, sustained use of the water resource, and to preserve to MCWD the continued availability of water from the '900-foot' aquifer."*

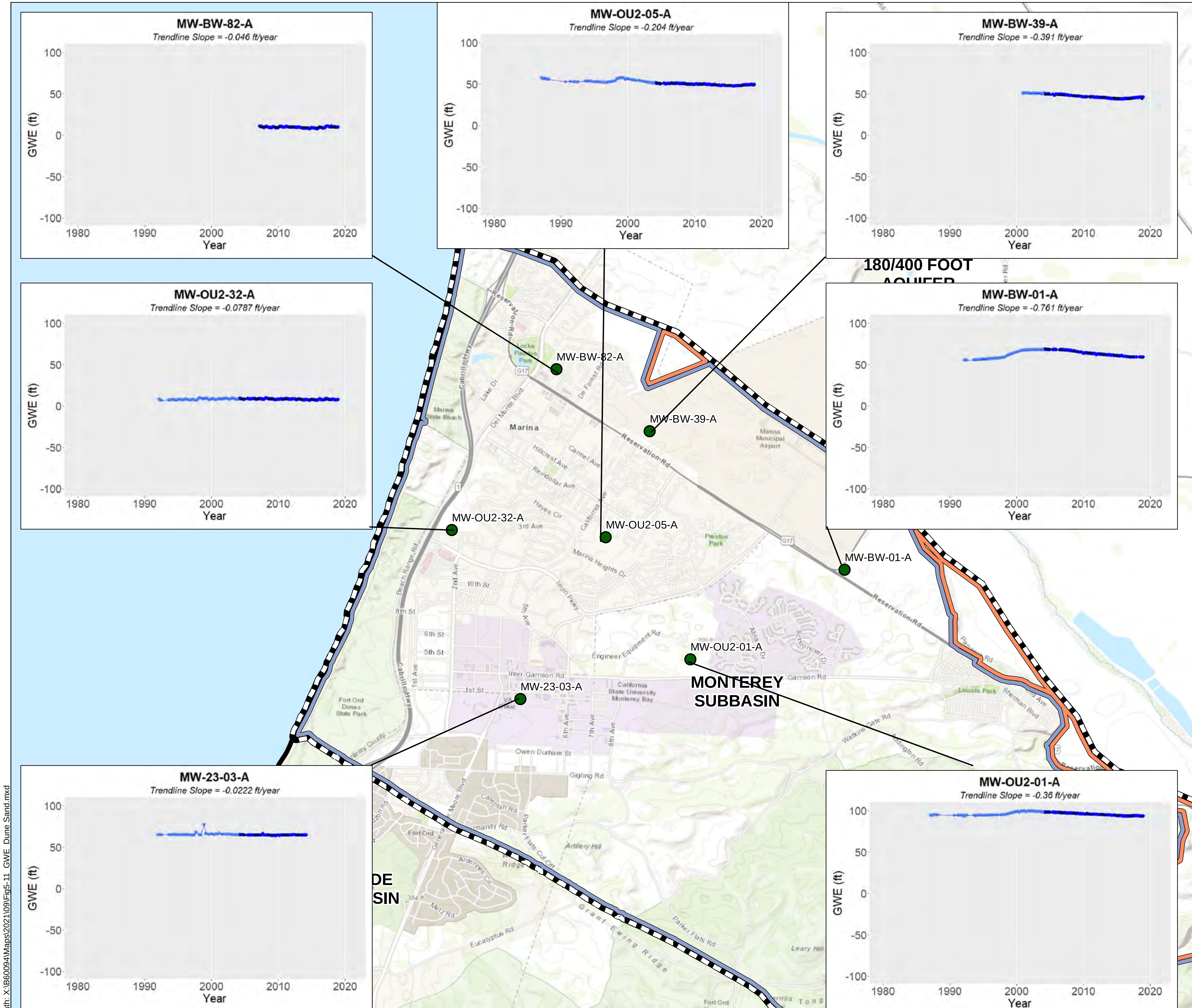
groundwater elevations measured in 014S001E24L and 14S02E33E, groundwater elevations in the upper portion of the Deep Aquifers (approximately 900 ft bgs) are lower than those in the lower portion of the Deep Aquifers (approximately 1,500 ft bgs). Groundwater elevation trends in the upper portion of the Deep Aquifers have also shown a steeper decreasing trend than the lower portion of the Deep Aquifers over the past 15 years.

- Similar declines in groundwater elevations are observed in Deep Aquifers wells located in the adjacent 180/400-Foot Aquifer Subbasin near Cooper Road and Blanco Road. Figure 5-15 shows long-term hydrographs for wells located near the Monterey-180/400-Foot Aquifer Subbasin boundary. As shown on these hydrographs, groundwater elevations in wells located near Cooper Road and Blanco Road have declined more than 5 ft/year over the past 15 years.
- The observed decline in groundwater elevations in the Deep Aquifers is the result of increased groundwater production from the Deep Aquifers. 180/400-Foot Aquifer Subbasin Information collected by the MCWRA (Figure 5-16) shows that groundwater production from the Deep Aquifers increased from approximately 2,500 AFY in 2008 to over 10,000 AFY in 2019 (MCWRA, 2020). Approximately 30 new Deep Aquifers production wells were permitted and constructed within the 180/400-Foot Aquifer Subbasin during this period (MCWRA, 2020). Groundwater pumping from the Deep Aquifers within the Monterey Subbasin is limited to MCWD's municipal production, which has been relatively stable at quantities ranging from 2,000 AFY to 2,500 AFY since 1990 and is well within the limit established within the Annexation Agreements with MCWRA as detailed in Chapter 3. Increases in groundwater production from the Deep Aquifers are primarily occurring in the 180/400-Foot Aquifer Subbasin immediately north of the Monterey Subbasin. The 180-Foot and 400-Foot Aquifers are seawater intruded in this area and no alternative water source is available, i.e., it is outside the existing Castroville Seawater Intrusion Project (CSIP) service area.

5.1.3.2 Corral de Tierra Area

Groundwater elevations have been monitored since the 1960s in several wells, which are screened in the El Toro Primary Aquifer System in the Corral de Tierra Area. Of these wells, a few wells show groundwater elevation declines of up to 60 to 80 feet. On average, long-term groundwater elevations declines are 40-50 feet (Figure 5-17) (GeoSyntec, 2007).

According to the 2007 *El Toro Groundwater Study* report, the majority of long-term hydrographs exhibit a downward trend in groundwater elevations with an average rate of decline of -0.6 ft/yr (GeoSyntec, 2007). Since 1999, some hydrographs show larger rates of groundwater elevation decline, averaging 1.8 feet per year (GeoSyntec, 2007). The Laguna Seca area, which is in the Seaside Subbasin west of the Corral de Tierra Area, shows similar groundwater elevation declines and has been demonstrated to be hydrogeologically connected to the El Toro area (GeoSyntec, 2007; Hydrometrics, 2009).



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Dune Sand Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Single Completion Wells

- GWE Measurements Between 2004 and 2018 (15 Years)
- GWE Measurements Before 2004
- Trendline (Note 1)

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
ft/year	= foot per year
GWE	= groundwater elevation
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

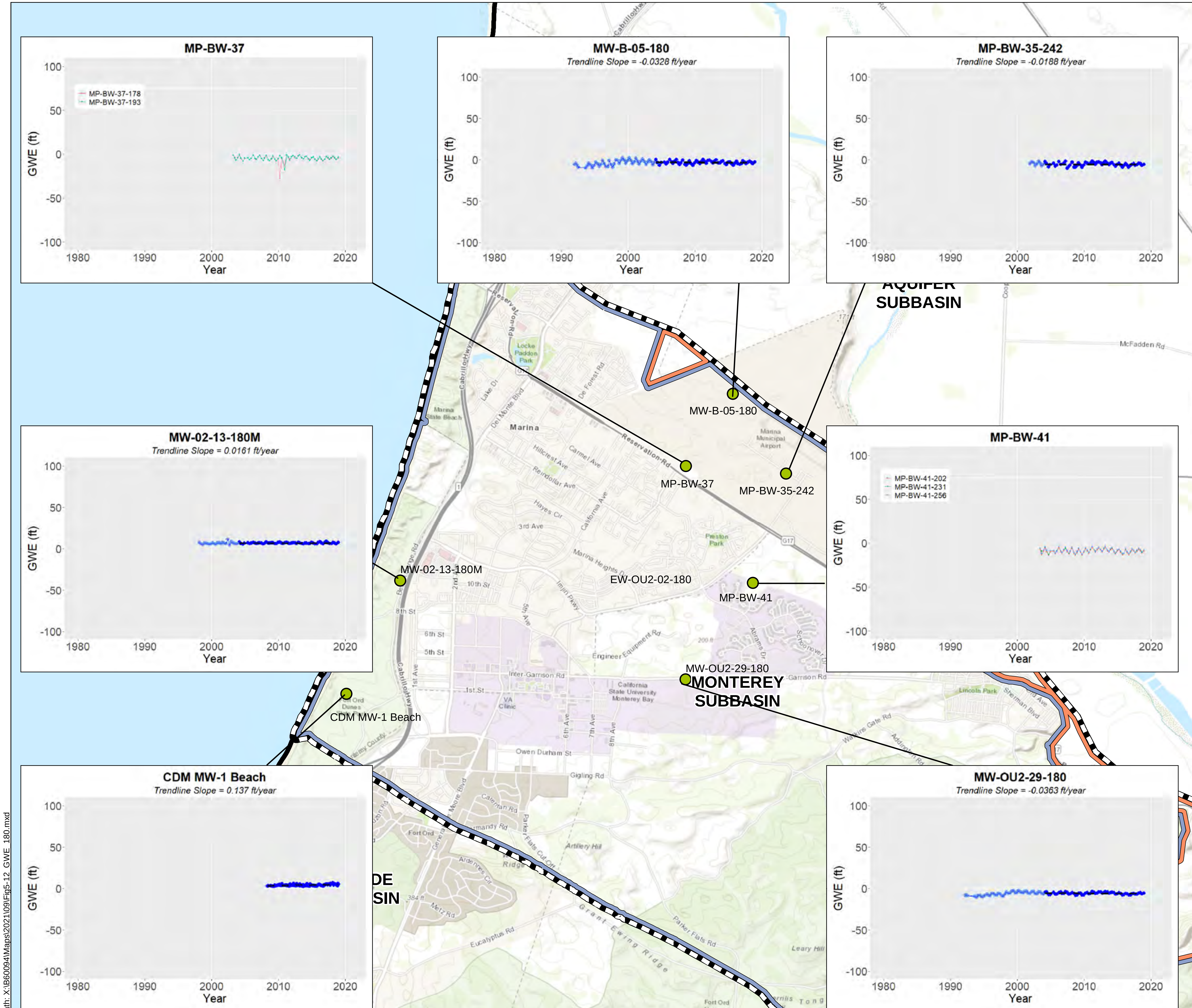
N 0 0.75 1.5 (Scale in Miles)

Representative Groundwater Elevation Hydrographs in the Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-11

Path: X:\B60094\Maps\2021\09\Fig5-11_GWE_Dune Sand.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Upper 180-Foot Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Single Completion Wells

- GWE Measurements Between 2004 and 2018 (15 Years)
- GWE Measurements Before 2004
- Trendline (Note 1)

Multi-Completion Monitoring Wells

- GWE Measurements (Note 2)

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
ft/year	= foot per year
GWE	= groundwater elevation
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period.
2. GWE measurements are shown in different colors for multi-completion wells, and no trendline analysis was performed for these wells.
3. Groundwater elevations are in ft NAVD 88.
4. Hydrographs herein present conditions in the upper 180-Foot Aquifer.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

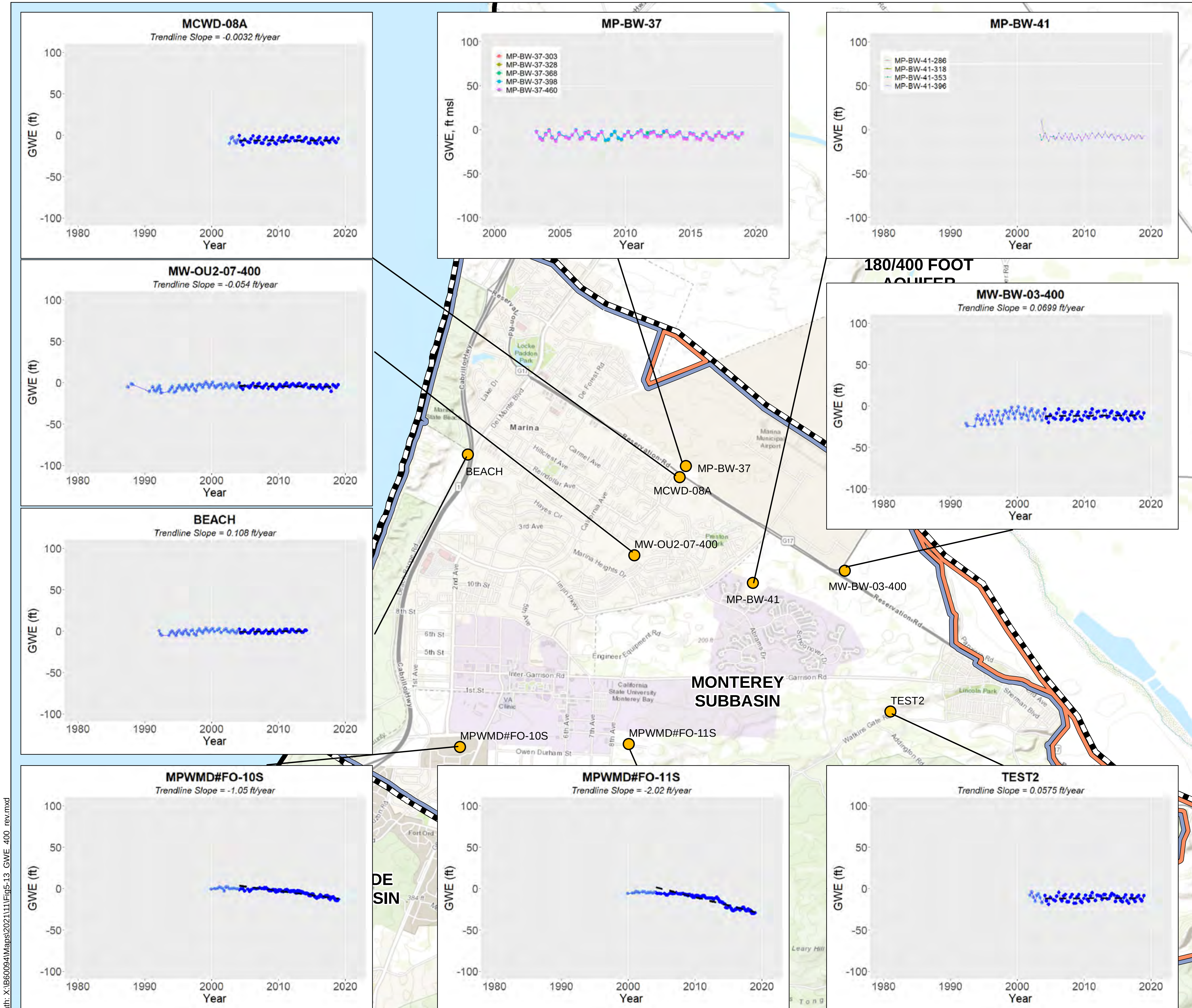
N 0 0.75 1.5 (Scale in Miles)

Representative Groundwater Elevation Hydrographs in the 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-12

Path: X:\B60094\Maps\2021\09\Fig5-12_GWE_180.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Lower 180-Foot, 400-Foot Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Single Completion Wells

- GWE Measurements Between 2004 and 2018 (15 Years)
- GWE Measurements Before 2004
- Trendline (Note 1)

Multi-Completion Monitoring Wells

- GWE Measurements (Note 2)

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
ft/year	= foot per year
GWE	= groundwater elevation
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period.
2. GWE measurements are shown in different colors for multi-completion wells, and no trendline analysis was performed for these wells.
3. Groundwater elevations are in ft NAVD 88.
4. Conditions in the lower 180-Foot Aquifer are consistent with those observed in the 400-Foot Aquifer.

Sources

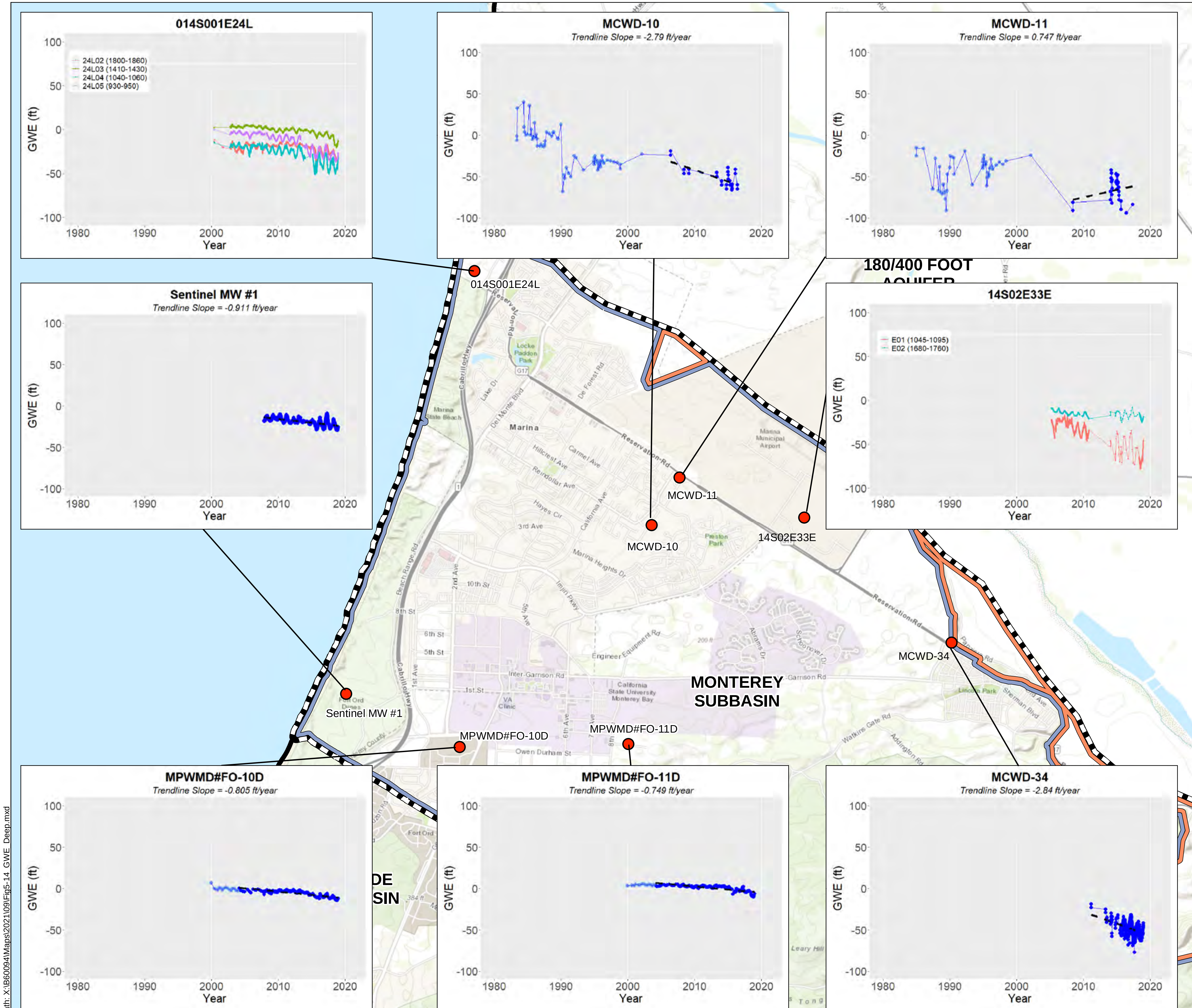
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Representative Groundwater Elevation Hydrographs in the 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-13

Path: X:\B60094\Maps\2021\11\Fig5-13_GWE_400_rev.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Deep Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Single Completion Wells

- GWE Measurements Between 2004 and 2018 (15 Years)
- GWE Measurements Before 2004
- Trendline (Note 1)

Multi-Completion Monitoring Wells

- GWE Measurements (Note 2)

Abbreviations

DWR = California Department of Water Resources
ft = foot
ft/year = foot per year
GWE = groundwater elevation
NAVD 88 = North American Vertical Datum of 1988

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period.
2. GWE measurements are shown in different colors for multi-completion wells, and no trendline analysis was performed for these wells.
3. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

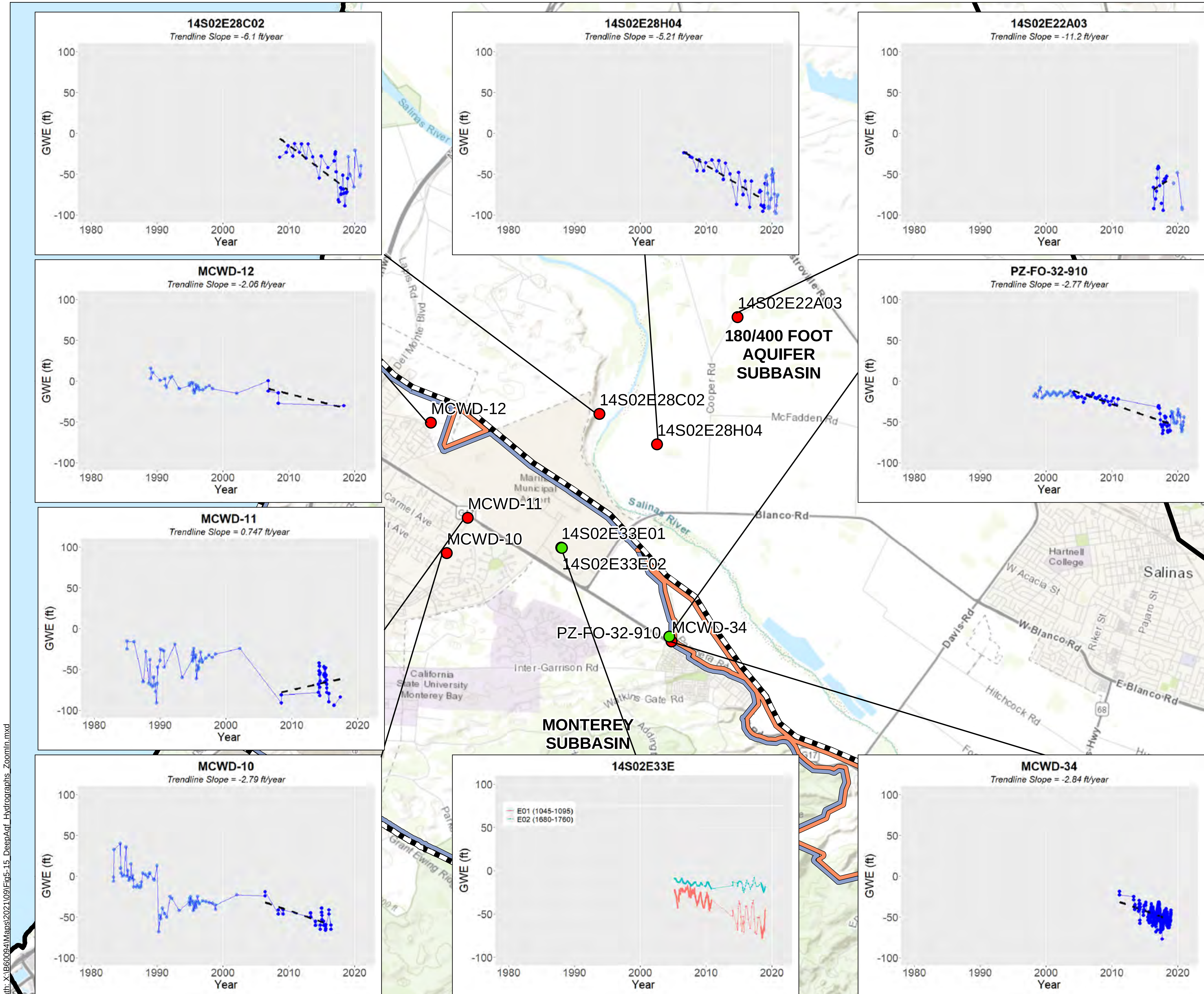
N 0 0.75 1.5 (Scale in Miles)

Representative Groundwater Elevation Hydrographs in the Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-14

Path: X:\B60094\Maps\2021\09\Fig5-14_GWE_Deep.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord Area

Corral de Tierra Area

Deep Aquifer Wells with Hydrographs

Production / Public Supply Well

Monitoring Well

Single Completion Wells

GWE Measurements Between 2004 and 2018 (15 Years)

GWE Measurements Before 2004 or after 2018

Trendline (Note 1)

Multi-Completion Monitoring Wells

GWE Measurements (Note 2)

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
ft/year	= foot per year
GWE	= groundwater elevation
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period.
2. GWE measurements are shown in different colors for multi-completion wells, and no trendline analysis was performed for these wells.
3. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

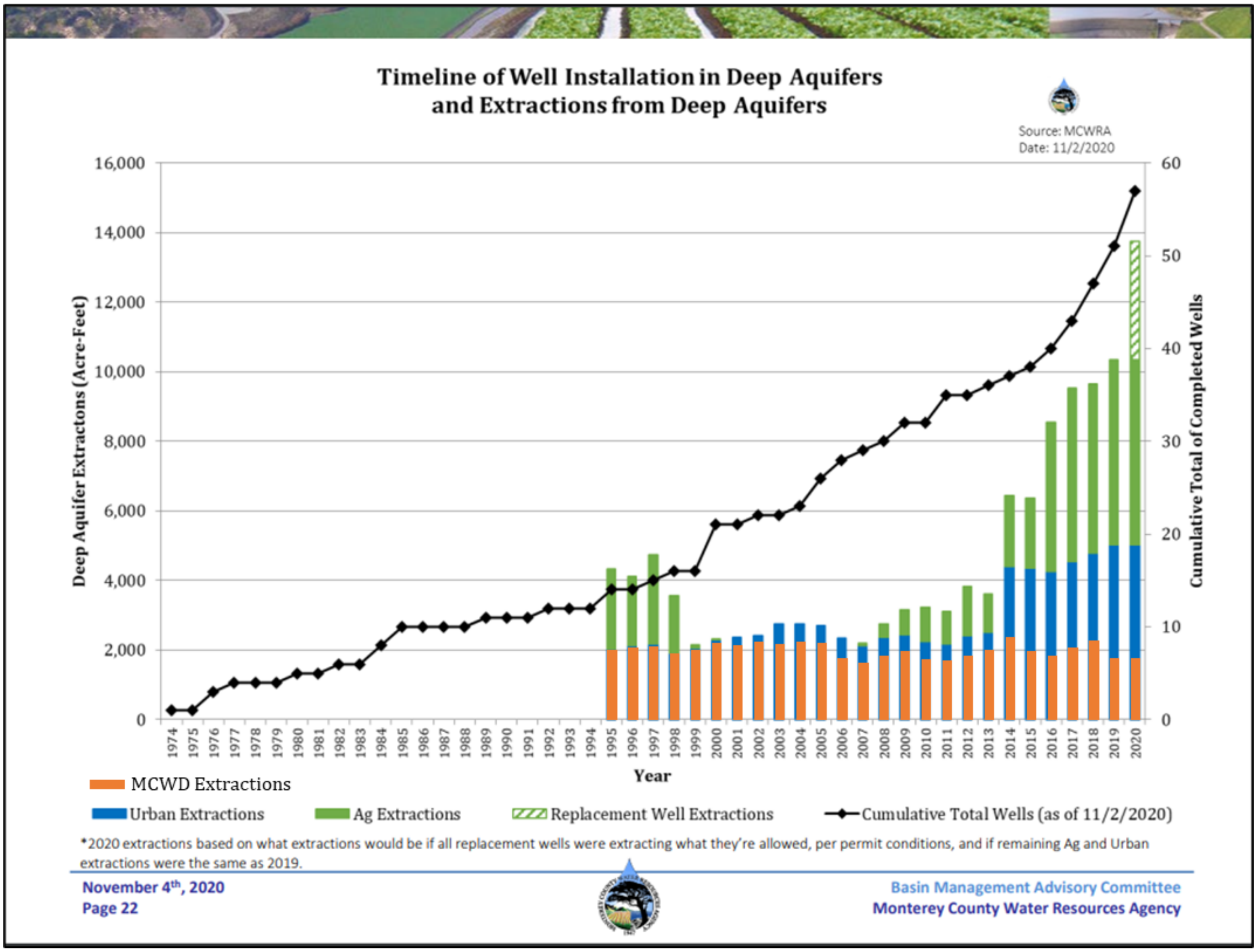
N 0 1 2 (Scale in Miles)

Representative Groundwater Elevation Hydrographs in the Deep Aquifers near Subbasin Boundary

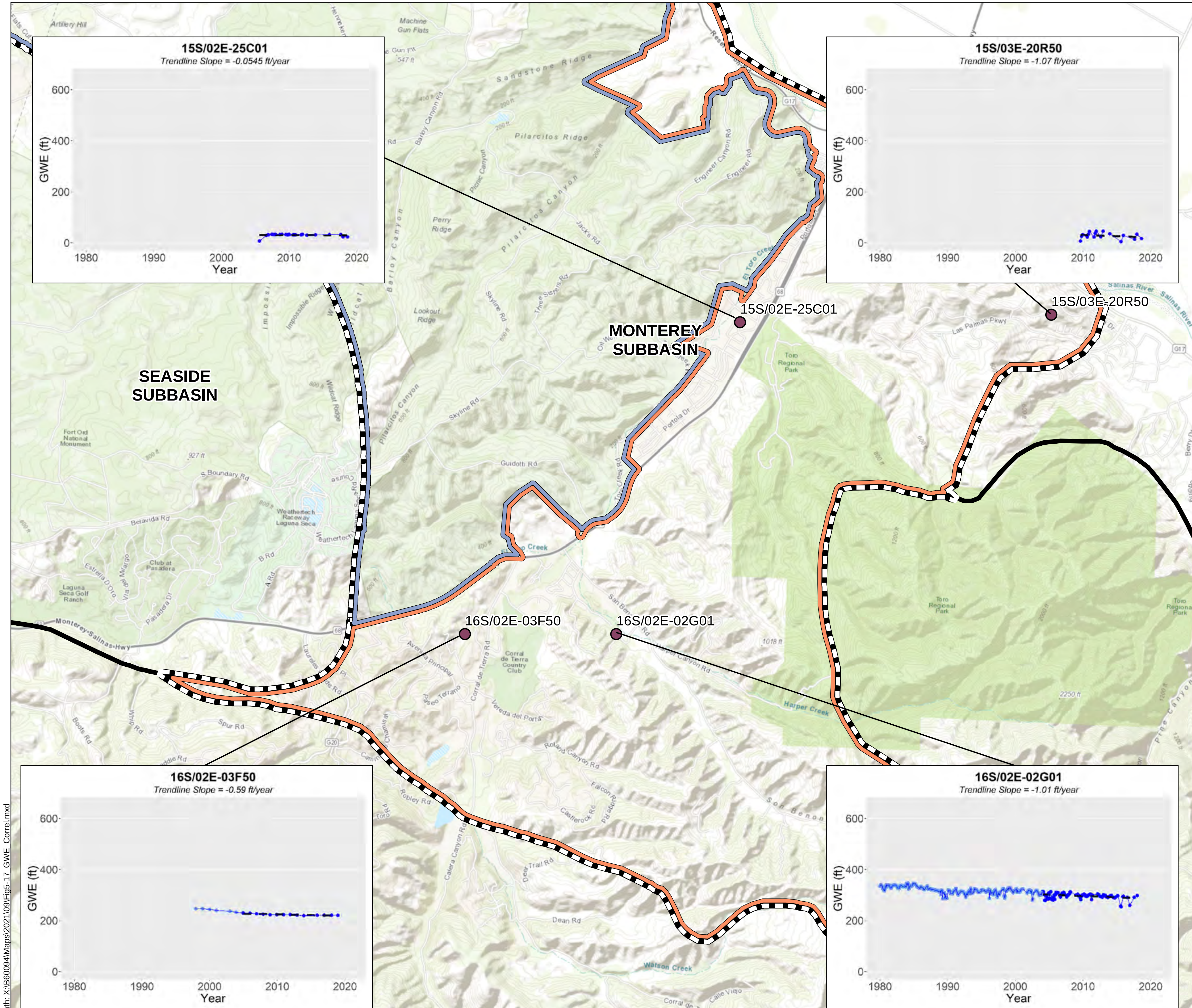
Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-15

Figure 5-16. Timeline of Well Installation in Deep Aquifer and Extraction from Deep Aquifers



Note: This figure is adapted from MCWRA's Basin Management Advisory Committee presentation on November 4, 2020. This figure represents groundwater extraction from the Deep Aquifers within the area defined by the Groundwater Extraction Management System (GEMS) ordinance. The figure was adapted to show the portion of Deep Aquifers extraction within the Monterey Subbasin, which is primarily by MCWD (orange) vs. other agricultural and urban Deep Aquifers extraction (blue and green) located in the 180/400-Foot Aquifer Subbasin.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Well Locations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Single Completion Wells

- GWE Measurements Between 2004 and 2018 (15 Years)
- GWE Measurements Before 2004
- Trendline (Note 1)

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
NAVD 88	= North American Vertical Datum of 1988
ft/year	= feet per year
GWE	= groundwater elevation

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more GWE measurements during that period..
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 December 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Representative Groundwater Elevation Hydrographs in the El Toro Primary Aquifer

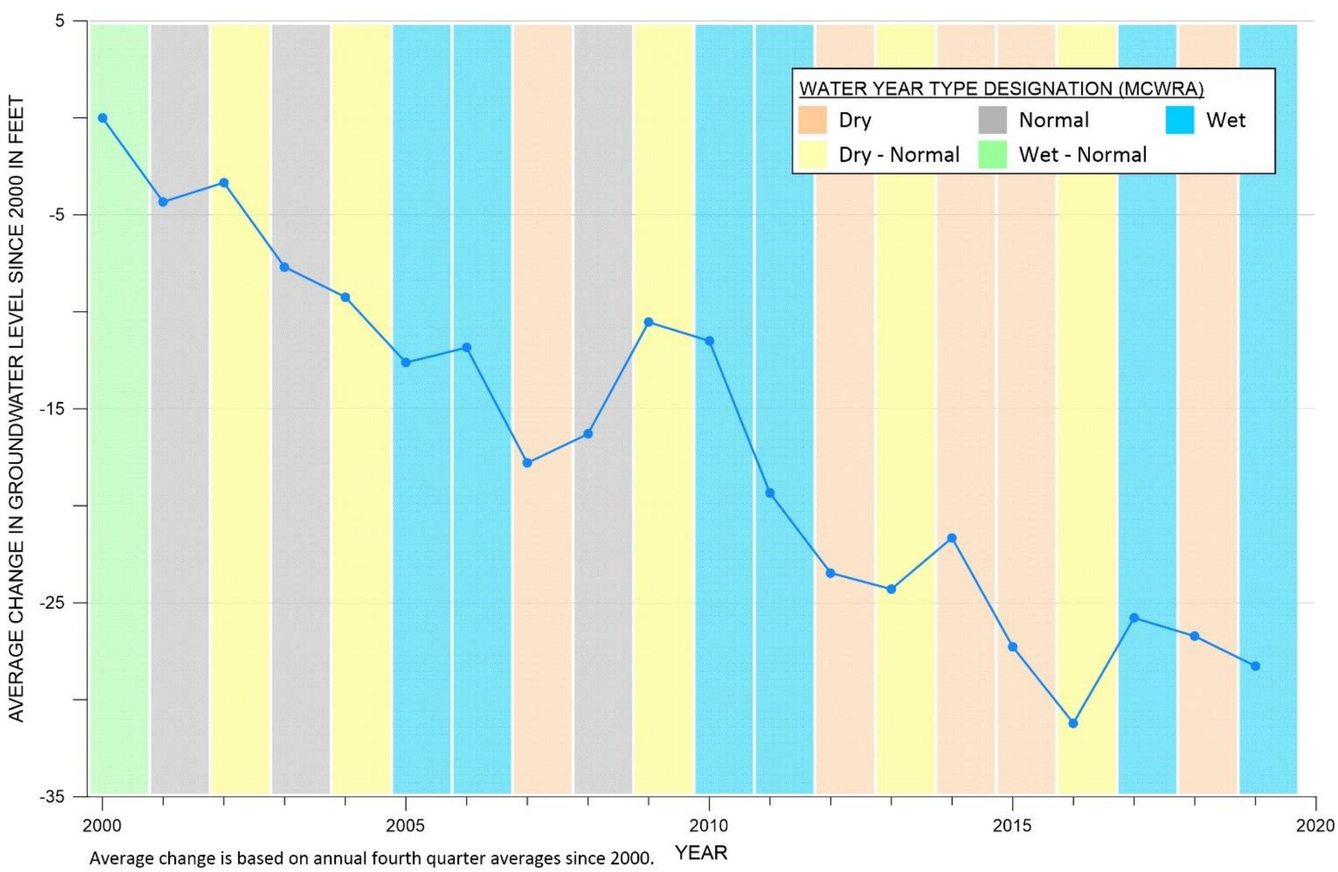
Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-17

Another way of looking at temporal groundwater elevation trends is shown on Figure 5-18, which presents a graph of cumulative groundwater elevation change for the El Toro Primary Aquifer System. The graph of cumulative change in groundwater elevation is based on the average change in Fall groundwater elevations for designated wells in the subarea each year. The average decline since 2000 is approximately -27 feet. MCWRA uses Fall groundwater elevations because these measurements are taken after the end of the irrigation season and before seasonal recharge from winter precipitation increases in groundwater levels. The cumulative groundwater elevation change plot is therefore an estimated average hydrograph for wells in the subarea. Although this plot does not reflect the groundwater elevation change at any specific location, it provides a general illustration of how the average groundwater elevation in the subarea changes in response to climatic cycles, groundwater extraction, and water-resources management at the Subbasin scale.

The graph of cumulative elevation change and the specific hydrographs presented in Appendix 8-B show a long-term decline in groundwater elevations in the Subbasin over time.

Figure 5-18. Cumulative Groundwater Elevation Change for the Corral de Tierra Area



5.1.4 Vertical Hydraulic Groundwater Gradients

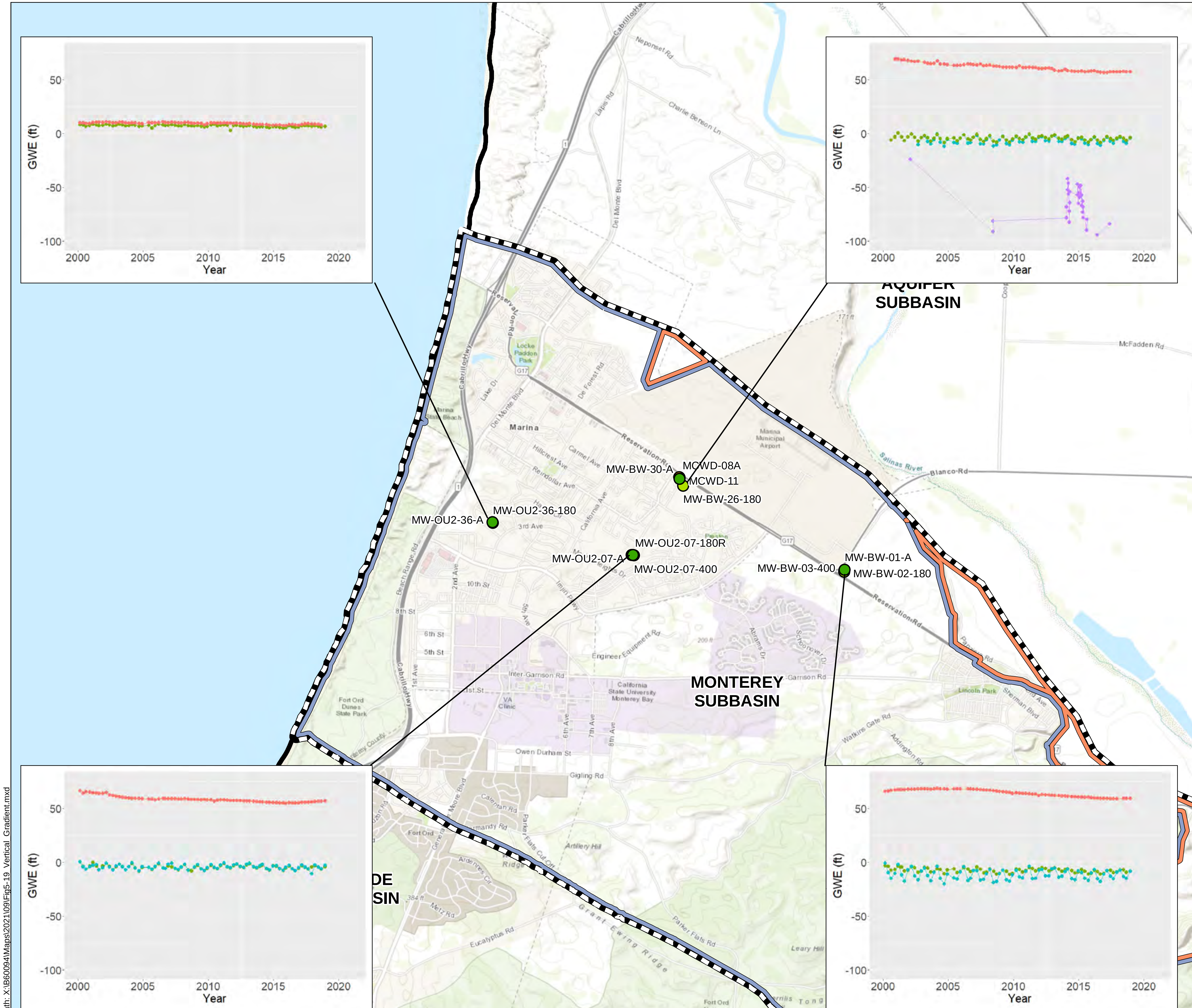
Downward vertical hydraulic gradients exist in many portions of the Subbasin. These downward vertical gradients are caused by areal surface recharge, groundwater extraction from deeper Aquifers, and laterally extensive aquitards, which exist in the Marina-Ord Area. These vertical hydraulic gradients can impact the magnitude and direction of groundwater flow between principal aquifers and increase the potential for downward migration of highly saline water in seawater intruded areas, if pathways exist between aquifers.

Evaluation of vertical gradients can be accomplished by examination of groundwater elevations measured in collocated wells screened in different aquifers. This approach requires water level information from wells that: (a) have known well construction information, (b) are only screened in one Principal Aquifer, (c) have contemporaneous measurements (i.e., water levels measured at least in the same year and season), and (d) are in close spatial proximity to each other. It is important to note that a difference in groundwater elevation between principal aquifers does not, in and of itself, establish a vertical flow.

Figure 5-19 shows four sets of wells located in the central portion of the Marina-Ord Area and one set of wells located near the coast that meet the identified criteria. The hydrographs for each set of wells illustrate the difference in groundwater elevations between Principal Aquifers. In the central Marina-Ord Area, groundwater elevations are approximately 70 ft lower in the 180-Foot Aquifer and 400-Foot Aquifer than in the Dune Sand Aquifer. Groundwater elevations are approximately 60 ft lower in Deep Aquifers than in the 180-Foot and 400-Foot Aquifers. Near the Monterey Coast, there is no appreciable groundwater elevation difference between the Dune Sand Aquifer and the 180-Foot Aquifer.

Figure 5-20 shows estimated vertical gradients between the 400-Foot Aquifer and the Deep Aquifers in the Fall of 2017. These estimated vertical gradients are calculated based on the difference groundwater elevation contours for the 400-Foot Aquifer and Deep Aquifers shown on Figure 5-3 and Figure 5-4, respectively. As shown on Figure 5-20, groundwater elevations in the Deep Aquifers are 20 to 60 ft lower than those in the 400-Foot Aquifer in the northwestern portion of the Subbasin where the lower 180-Foot/400-Foot Aquifer is seawater intruded.

While many wells in the Corral de Tierra Area are screened in both the Paso Robles Formation and the Santa Margarita Sandstone, some wells are screened more in the Paso Robles Formation and some are screened more in the Santa Margarita Sandstone. Downward vertical hydraulic gradients have been recorded in the Laguna Seca subarea of the adjacent Seaside Subbasin (Yates, 2002). Therefore, there is an expectation that downward vertical gradients exist between the Paso Robles Formation and the Santa Margarita Sandstone within the El Toro Primary Aquifer System (GeoSyntec, 2007). Figure 5-21shows hydrographs between wells screened exclusively in the Paso Robles Formation (shallow) and the Santa Margarita Sandstone (deep) in the Corral de Tierra Area near the Laguna Seca region. There is an approximate 75-foot difference in the water levels between the two water-bearing formations. Due to the sediments that comprise these water-bearing formations, there is likely downward vertical flow between the formations as a result of these gradients.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Dune Sand Aquifer Wells
- Upper 180-Foot Aquifer Wells
- Lower 180-Foot, 400-Foot Aquifer Wells
- Deep Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Groundwater Levels in ft NAVD 88

- Dune Sand Aquifer
- Upper 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer
- Deep Aquifers

Abbreviations

DWR = California Department of Water Resources
ft = foot
GWE = groundwater elevation
NAVD 88 = North American Vertical Datum of 1988

Notes

1. Groundwater elevations are in ft NAVD 88.

Sources

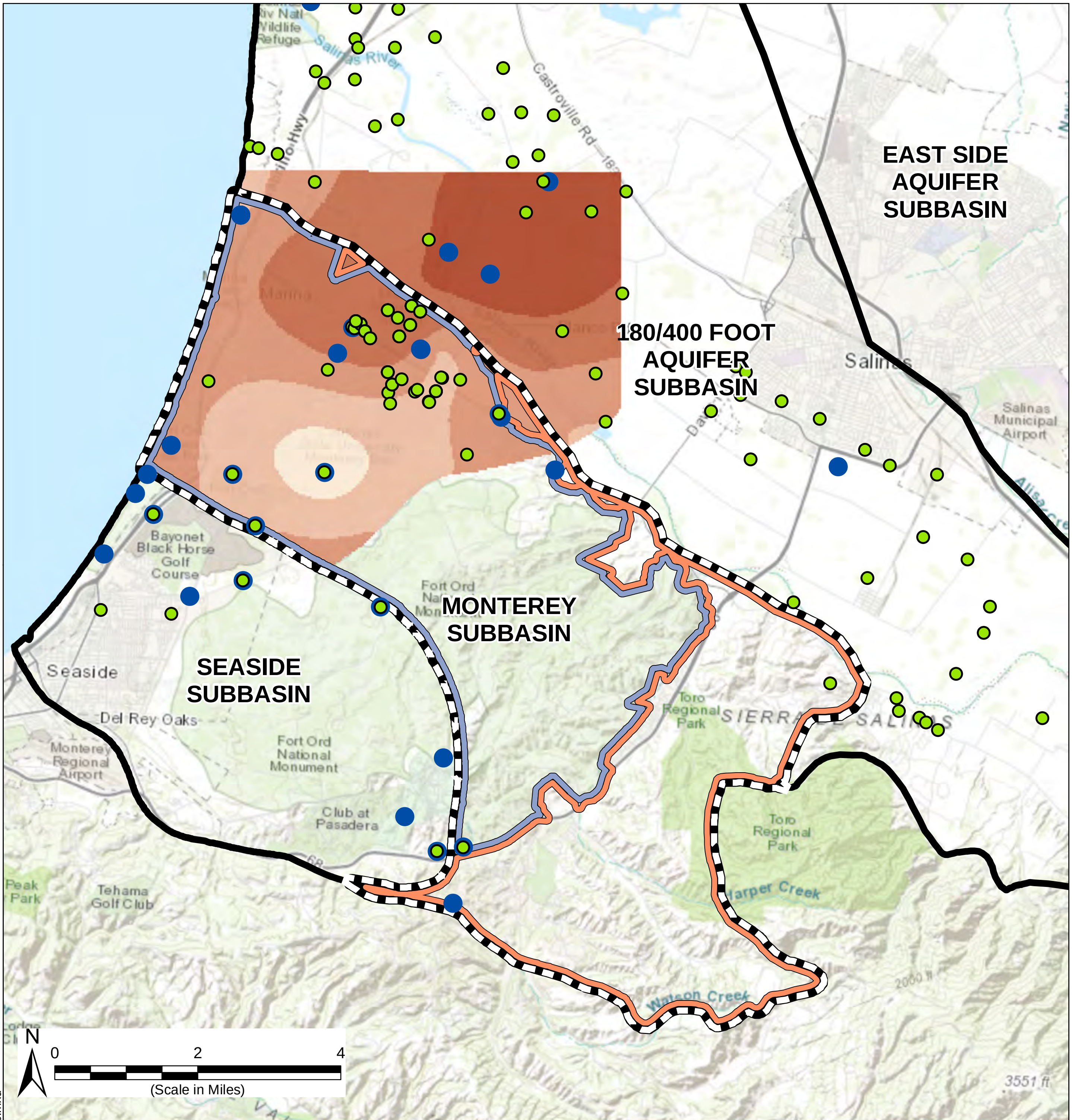
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 0.75 1.5 (Scale in Miles)

Vertical Gradients Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-19



Path: X:\B60094\Maps\2021\09\Fig5-20_Vertical Gradient 400-Deep.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Groundwater Level Measurement Locations (400-Foot Aquifer)
- Groundwater Level Measurement Locations (Deep Aquifers)

Management Areas

- Marina-Ord Area
- Corral de Tierra

Vertical Gradients between the 400-Foot Aquifer and Deep Aquifer (ft)

- -20 - 0
- 1 - 20
- 21 - 40
- 41 - 60
- 61 - 75

Abbreviations

ft = foot

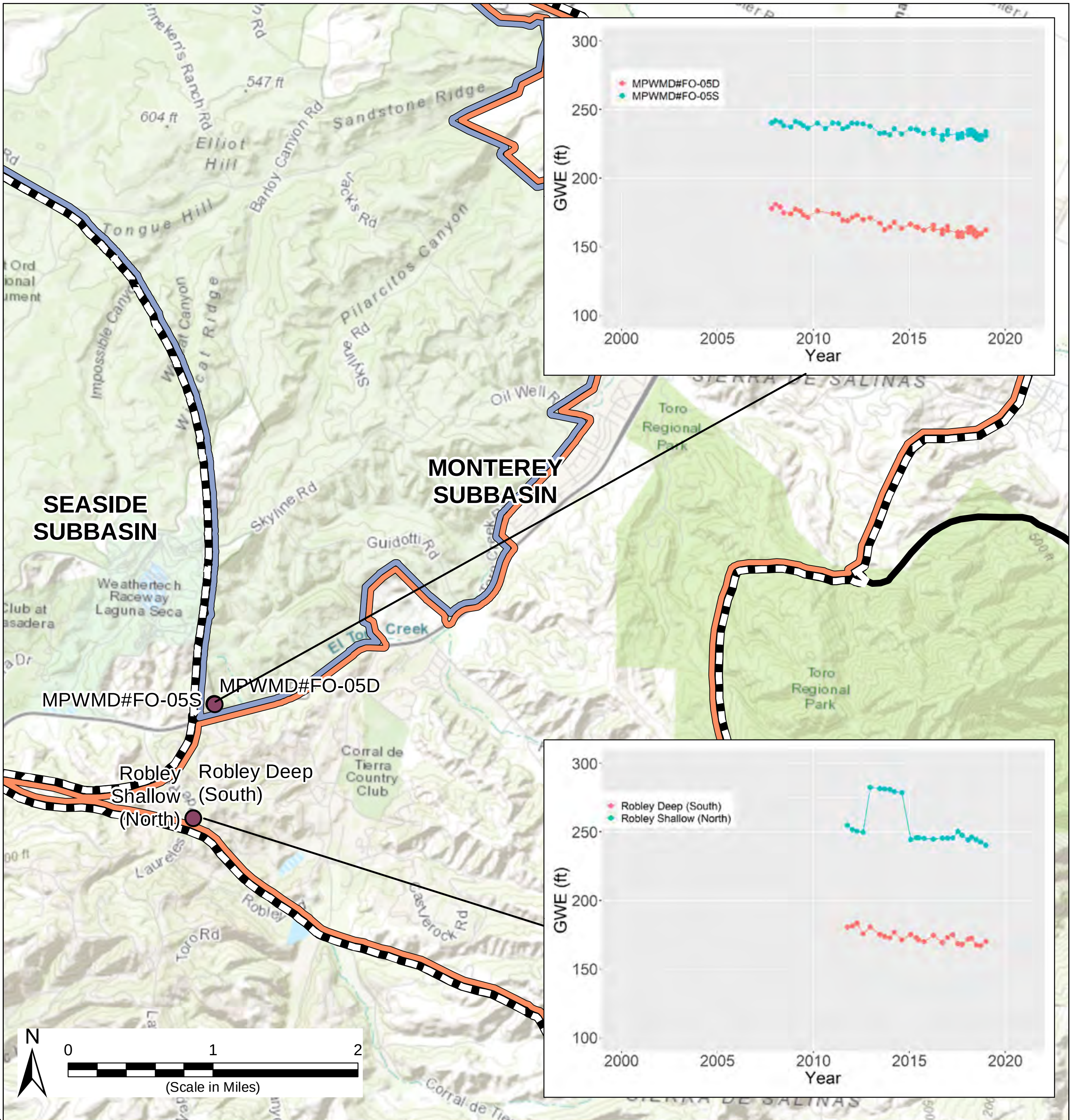
Sources

1. Verticial gradients are calculated by subtracting the Lower 180-Foot, 400-Foot Aquifer Contours in 2017 Fall from the Deep Aquifer Contours in 2017 Fall. Negative gradients may be due to missing 400-Foot Aquifer contours.

Fall 2017 Vertical Gradients Between 400-Foot Aquifer and Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-20



Legend

Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Well Locations

Management Areas

Marina-Ord Area
Corral de Tierra Area

Groundwater Levels in ft msl

GWE in Paso Robles Formation
GWE in Santa Margarita Sandstone

Abbreviations

DWR = California Department of Water Resources
ft = foot
NAVD 88 = North American Vertical Datum of 1988
GWE = groundwater level elevation

Notes

1. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 December 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Vertical Gradients between the Paso Robles Formation and the Santa Margarita Sandstone, near the Laguna Seca Subarea

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-21

Path: X:\B60094\Maps\2021\09\Fig5-21_CDT_VerticalGradient.mxd

5.2 Change in Groundwater Storage

Estimate change in storage for the Monterey Subbasin was simulated for the historical period (i.e., WY 2004-2018) using the numerical model developed for the Monterey Subbasin. A description of the numerical model and results are detailed in Chapter 6. Changes of storage estimates for the historical period are detailed in Appendix 6-A and summarized below.

Annual average change in storage within the Monterey Subbasin was estimated to be -4,434 AFY during WY 2004-2018. The cumulative change in storage over this 15-year period was estimated to be -66,517 AF. Seawater inflow to the Monterey Subbasin across the ocean boundary during the historical period is presumed to leave the Subbasin across the 180/400-Foot Aquifer Subbasin boundary, given that there has been negligible expansion of the seawater intrusion front during the historical period (Section 5.3.4).

Change of storage estimates were additionally calculated for each of the management area water budget zones (WBZs)[18]. Within the Marina-Ord Area WBZ, the annual average change in storage over the historical period was estimated at -1,632 AFY for a cumulative change in storage of -24,478 AF. The majority of this loss occurred within the 400-Foot and Deep Aquifers, consistent with recent groundwater elevation trends described in Section 5.1.3 above. Within the Corral de Tierra Area WBZ, the annual average change in storage over the historical period was estimated to be -2,803 AFY for a cumulative change in storage of -42,039 AF.

There are inherent uncertainties using numerical models as they can only approximate physical systems and have limitations in how they compute data. The uncertainty associated with the model estimates is explored further in Section 6.7. However, the groundwater model selected to perform this analysis represents the best available tool for estimating water budget and change in storage. A detailed discussion of data input and assumptions into the Monterey Subbasin Groundwater Flow Model (MBGWFM) is included in Sections 6.1 and 6.2 and Appendix 6-B. As additional groundwater elevation, aquifer properties, and groundwater extraction data become available, they will be used to refine the representation of these aquifers as part of future modeling efforts.

5.3 Seawater Intrusion

Groundwater overdraft in the larger Salinas Valley Basin has resulted in landward groundwater gradients near the coast and created an influx of highly saline water in the coastal aquifers. Seawater intrusion has been documented in the Salinas Valley Basin since the 1940s (DWR, 1946). Within the Monterey Subbasin, seawater intrusion has been documented in the northern portion of the lower 180-Foot and 400-Foot Aquifers.

---

[18] As described in Chapter 6, the Marina-Ord Area WBZ includes the Marina-Ord Area as well as well as the Reservation Road portion of the Corral de Tierra Area, as they share the same principal aquifers; the Corral de Tierra Area WBZ includes the main portion of the Corral de Tierra Area underlain by the El Toro Primary Aquifer System.

The negative impact of seawater intrusion on local water resources and the agricultural economy has been the primary motivation for many studies dating back to 1946 (DWR, 1946). MCWRA and others have implemented a series of engineering and management projects, including well construction moratoriums, developing the Castroville Seawater Intrusion Project (CSIP) system, and implementing the Salinas Valley Water Project (SVWP), among other actions to halt seawater intrusion. Although those actions have managed to slow the advance of intrusion and reduce its impacts, seawater intrusion remains an ongoing threat.

5.3.1 Data Sources

Water quality data discussed in this section was obtained from various local monitoring agencies, including MCWD, MCWRA, Fort Ord, MPWMD, and the Seaside Groundwater Basin Watermaster. These data are augmented by results from two airborne electromagnetic (AEM) surveys conducted by MCWD in 2017 and 2019.

5.3.1.1 Water Quality Data

The extent and advancement of seawater intrusion within the Subbasin have been monitored by local monitoring agencies. The following TDS, chloride, as well as specific conductivity data are analyzed herein:

- Water quality data collected by MCWRA, MPWMD, and the Seaside Basin Watermaster;
- Water quality data collected by MCWD in December 2018 from MCWD wells and Fort Ord monitoring wells (EKI, 2019).

These water quality data are shown on Figure 5-24 and discussed in detail in Section 5.3.3.

5.3.1.2 Geophysical Data

Geophysical data considered in this GSP include AEM data obtained for the northern Salinas Valley and induction logging data obtained from Sentinel Wells installed along the Monterey and Seaside Subbasin coastline.

In 2017 and 2019, MCWD retained geophysical consultants (Aqua Geo Frameworks; AGF) and Stanford University researchers to obtain and analyze AEM data within the northern Salinas Valley Basin (Stanford/Aqua Geo Frameworks; Aqua Geo Frameworks, 2019). During these surveys, a helicopter carrying electronic geophysical equipment surveyed resistivity of subsurface geology over an approximately 15-mile by 7-mile area along the coastal 180/400-Foot Aquifer and Monterey Subbasins. The studies' goal was to evaluate the understanding of the hydrostratigraphy in the study area and to interpret the distribution of groundwater quality indicated by available well data. A first round of AEM data were collected in April 2017, shortly after the 2014-2016 drought. A second round of AEM data were collected in May 2019, which is more representative of a wetter hydrologic condition. The data collected during each round of AEM were "inverted" to develop a three-dimensional picture of the distribution of electrical resistivity.

The AEM survey measures the resistivity of a volume of subsurface material composed of sediments containing air and/or water (Stanford/Aqua Geo Frameworks, 2018). While measurement of the electrical resistivity of the water alone (typically reported as the inverse parameter, electrical conductivity) can be a direct indicator of the salinity of the water (i.e., the more salts in the water, the lower the electrical resistivity), the electrical resistivity of a volume of subsurface material is determined not just by the salinity of the water, but is also affected by the texture and mineralogy of the sediments and the volume of water present. Very simply, increasing the amount of clay, the amount of water, and/or the salinity of the water all decrease the electrical resistivity.

A part of the studies' scope was to investigate the relationship between inverted AEM data and water quality. The following interpretation of AEM data has been experimentally developed for the study area.

Table 5-1. Experimental Interpretation of AEM Resistivity Data in the Northern Salinas Valley

TDS Concentration in Groundwater	AEM Resistivity Within general or unknown aquifer materials (Stanford/Aqua Geo Frameworks, 2018)	AEM Resistivity Within the sandy/gravelly 180-Foot and 400-Foot Aquifers (Aqua Geo Frameworks, 2019)
Greater than 10,000 mg/L	Less than 5 ohm/cm	Less than 7.2 ohm/cm
Less than 3,000 mg/L	Greater than 25 ohm/cm	Greater than 13.2 ohm/cm

The Stanford study found that very high resistivity (greater than 25 ohm/cm) or very low resistivity (smaller than 5 ohm/cm) are indicative of fresh groundwater and high salinity groundwater, respectively. Moderate AEM resistively in the range of 5 to 25 ohm/cm can be indicative of either higher salinity or higher amount of clay in subsurface materials, thus the exact water quality associated with these resistivity values is more difficult to discern. In the known extents of sandy and gravelly 180-Foot and 400-Foot Aquifers, AGF has developed an experimental relationship whereby AEM resistivity of greater than 13.2 ohm/cm and less than 7.2 ohm/cm are indicative of fresh groundwater and high salinity groundwater, respectively.

The AEM surveys have found that high salinity groundwater as a result of seawater intrusion exists within the lower 180-Foot Aquifer and 400-Foot Aquifers of the Monterey Subbasin. This volume of high salinity groundwater is overlain by fresh groundwater in the Dune Sand and upper 180-Foot Aquifers. The results of the AEM study are consistent with water quality data collected within the Subbasin (EKI, 2019). No significant difference was found between seawater intrusion conditions in 2017 and 2019 within the Subbasin.

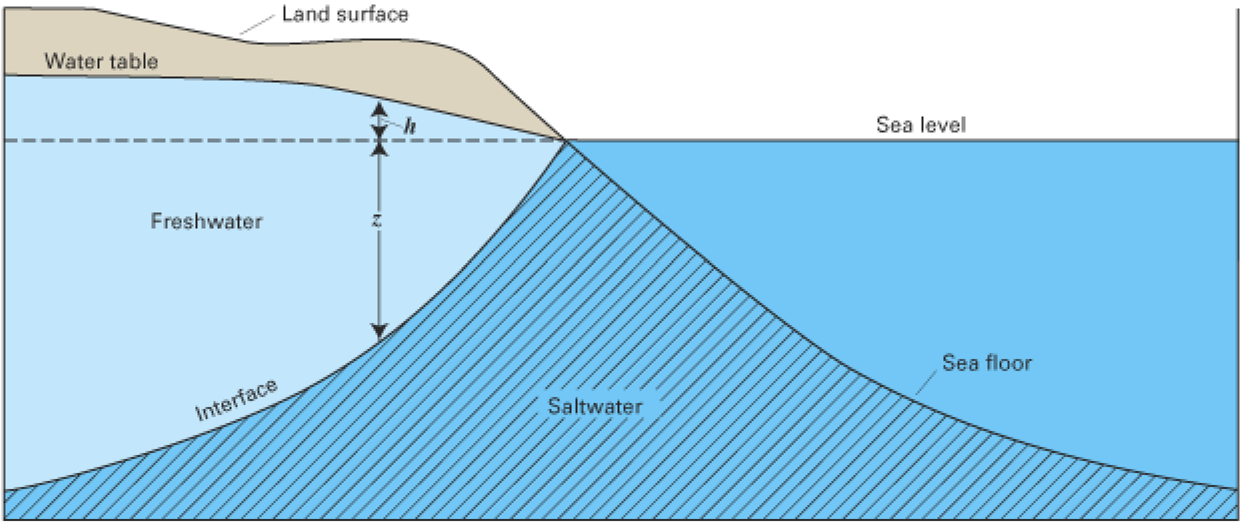
Induction logging within a well measures the fluid conductivity within the adjacent formation. Although this method does not provide exact measurements of water quality, it can be used to monitor changes in conductivity (i.e., groundwater salinity) over time. The Seaside Basin Watermaster constructed and maintains four Sentinel Wells along the coast to detect potential seawater intrusion. The northern-most well, SBMW-1, is located within the Monterey Subbasin. The Watermaster conducts semi-annual induction logging within these wells. During baseline monitoring of SBMW-1 in 2007, it has been documented that very high conductivities indicative of saline groundwater were observed in depths from 125 feet to approximately 350-400 feet (Feeney, 2007). There has been no significant change in salinity observed in this well since 2007 (Montgomery & Associates, 2019).

5.3.2 Defining Seawater Intrusion

Coastal aquifers usually contain two sets of flow going into opposite directions: lower density freshwater flowing seaward and higher density seawater flowing inland. When groundwater levels in aquifers connected to the ocean fall to near or below sea level, flows across the ocean/land boundary become predominantly onshore flows (Barlow, 2003). As higher density seawater flows inland, it forms a seawater wedge beneath the less dense fresh groundwater until the water table achieves equilibrium, as shown on Figure 5-22.

The freshwater depth above sea level and the freshwater depth below the sea level in the wedge are related to each other through the Ghyben-Herzberg Relation, which states that for every foot of freshwater above sea level there is approximately 40 feet of freshwater below sea level (Barlow, 2003). For a given depth within the subsurface, therefore, the potentiometric head must be at least 1/40 of that depth above sea level in order for freshwater to be present at that depth. For example, for freshwater to be present within the 180-Foot Aquifer and 400-Foot Aquifer (i.e., with bottom depths of approximately -250 ft NAVD88 and -500 ft NVAD88, respectively), the potentiometric surface in those aquifers needs to be maintained at an elevation of at least 6.3 ft NVAD88 and 12.5 ft NAVD88, respectively. In a complexly layered aquifer system like the Salinas Valley Basin, each aquifer may have its own seawater wedge, with a seawater front at different horizontal distances from the shoreline, depending on each aquifer' relative hydraulic connection to pumping wells and the Pacific Ocean (Yates and Wiese, 1988).

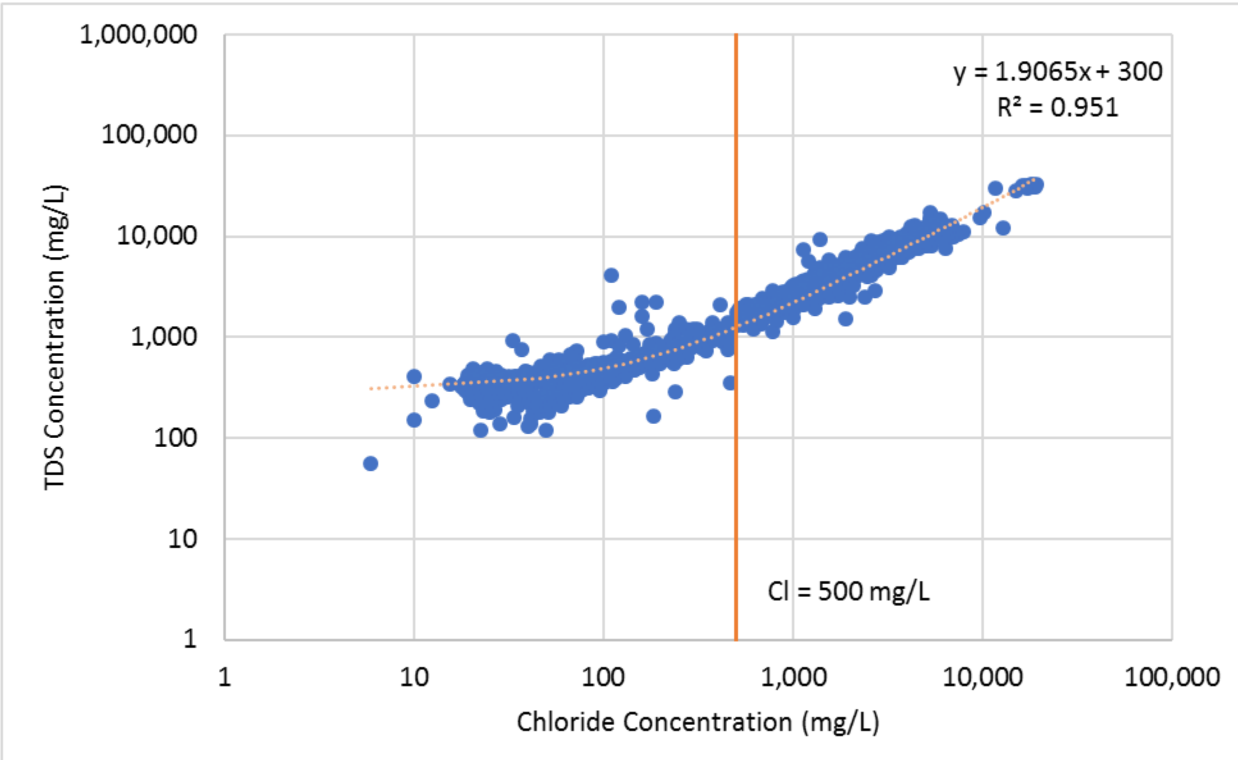
Figure 5-22. Ghyben-Herzberg Relation (Barlow, 2003)



The definition of seawater intrusion is generally based on a TDS or chloride concentration threshold and is dependent on local beneficial uses and groundwater protection strategies. In the larger Salinas Valley Basin, MCWRA has defined the seawater intrusion threshold as 500 mg/L of chloride. This chloride concentration is significantly lower than the 19,000 mg/L chloride concentration typical of seawater, but it represents a concentration that impact use of the water. Additionally, groundwater in the Marina-Ord aquifers has low natural TDS generally less than 500 mg/L, and the primary source of salinity in this area is seawater intrusion. Therefore, this GSP adopts the seawater intrusion threshold as 500 mg/L of chloride, or 1,000 mg/L of TDS as a surrogate where chloride data are unavailable.

TDS has been identified as a surrogate for chloride to define seawater intrusion due to the scarcity of actual chloride measurements within the Subbasin and the excellent correlation between these two parameters in the Marina-Ord aquifers. Groundwater in the Marina-Ord aquifers has low natural TDS generally less than 500 mg/L and the primary source of salinity in this area is seawater intrusion. The strong correlation between these water quality parameters within the seawater intruded lower 180-Foot/400-Foot Aquifer is shown on Figure 5-23 below. Appendix 5-A further examines this correlation and establishes a quantitative relationship to allow conversion between TDS and chloride concentrations detected in this aquifer.

Figure 5-23. Relationship Between TDS and Chloride Concentrations in the Lower 180-Foot, 400-Foot Aquifer



It should be noted that the seawater-affected groundwater quality may well be sufficient for many beneficial uses. In other words, while the definition of seawater intrusion front as the 500 mg/L chloride threshold (or 1,000 mg/L of TDS as a surrogate) is a useful guideline for identifying when some seawater intrusion effect may be detected, this does not necessarily mean that the groundwater within the affected region is no longer suitable for current or potential beneficial uses. Specifically, the following beneficial use standards on TDS apply to groundwater within the seawater intruded area of the Subbasin:

- The State of California has adopted an upper Secondary Maximum Contaminant Level (SMCL) for TDS of 1,000 mg/L, and a short-term maximum SMCL of 1,500 mg/L for drinking water.
- Under SWRCB Resolution 88-63, the state considers all groundwater containing TDS at concentrations less than 3,000 mg/L as having potential beneficial use as a domestic and municipal supply. This Resolution is adopted as part of the RWQCB's Water Quality Protection Plan for the region.
- The Federal Clean Water Act defines groundwater containing less than 10,000 mg/L TDS as an Underground Source of Drinking Water.

- SWRCB Resolution 68-16, also known as the Antidegradation Policy, requires that the existing high quality of waters be maintained to the maximum extent possible, and allows degradation only if it is consistent with maximum benefit to the people of the state, will not unreasonably affect present and potential beneficial uses, and will not result in water quality lower than applicable standards.

5.3.3 Seawater Intrusion Maps and Cross-sections

Figure 5-24 shows recent (post-2015) TDS concentrations in each of the coastal aquifers. As shown on Figure 5-24, TDS concentrations measured in the Dune Sand, upper 180-Foot, and Deep Aquifers monitoring locations are generally below 1,000 mg/L, indicating that there is no or minimal seawater intrusion in these aquifers. In the lower 180-Foot and 400-Foot Aquifers, TDS concentrations of over 10,000 mg/L are observed up to four miles inland near the northern Monterey Subbasin boundary.

As shown on Figure 5-25, cross-sections A-A’ and B-B’ (Figure 5-26 and Figure 5-27) run perpendicular to the coastline and show relevant TDS data (measured at designed well screen intervals) and 2019 AEM survey data along these transects. Cross-section B-B’ is located within the Monterey Subbasin; however, AEM data along this cross-section are sporadic due to the absence of AEM data in urban areas where high density of utilities interferes with AEM data collection. Cross-section A-A’ runs immediately north of the Monterey Subbasin, and provides insight regarding the vertical delineation of seawater intrusion within the coastal areas of the Monterey Subbasin.

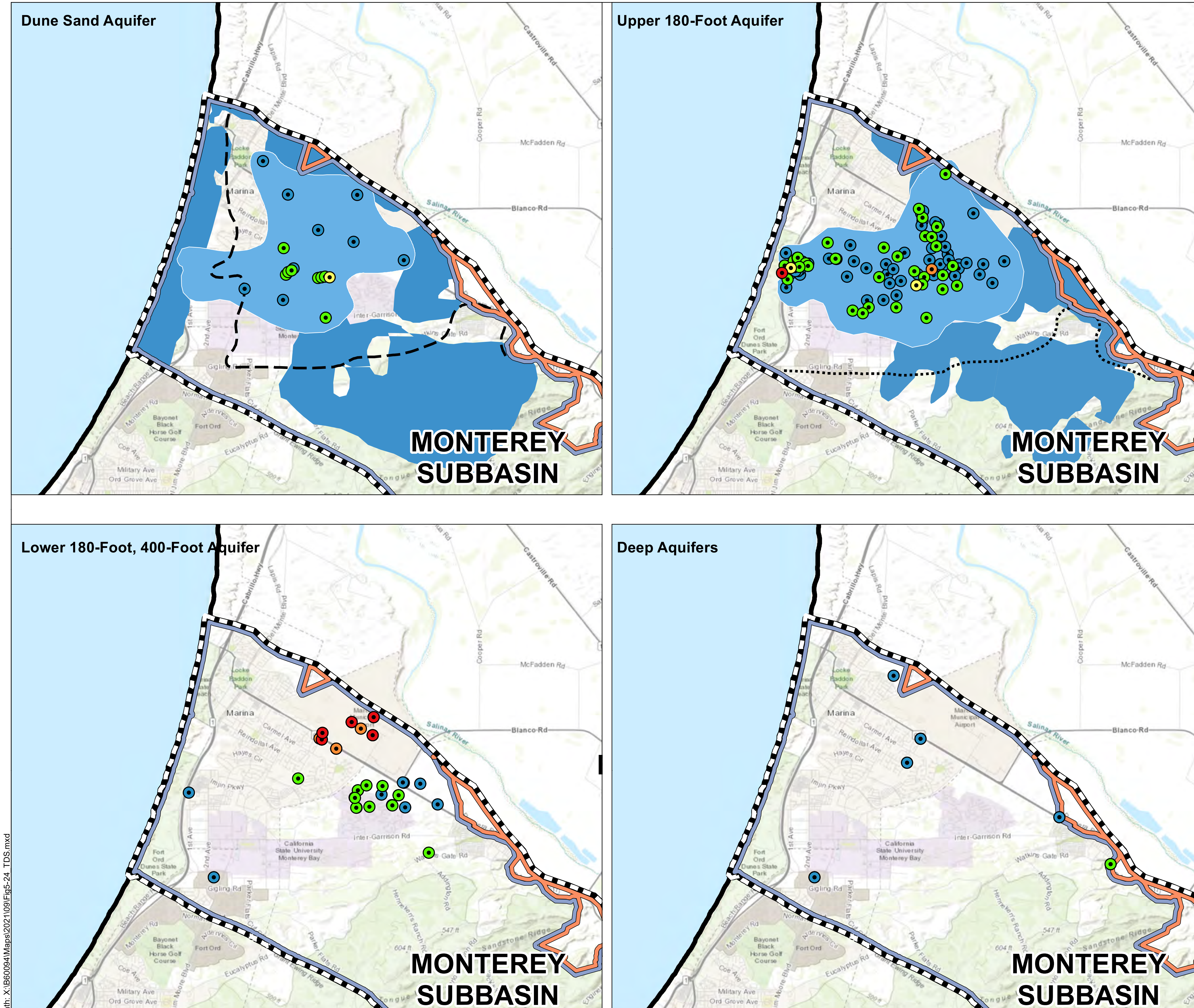
TDS and AEM data shown on these cross-sections confirm that seawater intrusion in the Monterey Subbasin primarily exists in the lower 180-Foot Aquifer and 400-Foot Aquifer, whereas groundwater in the Dune Sand and upper 180-Foot Aquifers remains fresh. TDS concentrations are dramatically different in different depths of the multi-completion wells (e.g., MP-BW-37), and the highest TDS concentration occurs in approximately 360 to 400 feet below ground surface (ft bgs). It appears that seawater intrusion in these two aquifers forms a unified intrusion wedge due to the discontinuity of the 180/400-Foot Aquitard near the coast. The data are consistent with the Ghyben-Herzberg Relation, which accounts for the downward movement of high-density seawater, overlain by lighter freshwater.

Based on available TDS and AEM data, Figure 5-28 depicts the estimated extent of seawater intrusion within the Monterey Subbasin. As shown on Figure 5-28, seawater intrusion within the Monterey Subbasin extends as far as four miles inland. This estimated extent of seawater intrusion is consistent with available chloride data, which only exist for non-seawater intruded areas. No additional data exist between MCWD production well MCWD-30 and the cluster of wells located northwest of MCWD’s production wells, where TDS concentrations exceed 10,000 mg/L. Therefore, the actual location of the seawater intrusion front where groundwater TDS concentrations exceed 1,000 mg/L and/or chloride concentrations exceed 500 mg/L is unknown. The location of the seawater intrusion front in the vicinity of these wells has been identified as a data gap.

The estimated extent of sweater intrusion shown on Figure 5-28 is generally consistent with MCWRA's mapped extent of the current (2019) seawater intrusion front in the 400-Foot Aquifer (see Appendix 5-B). MCWRA also maps a similar seawater intrusion front in the 180-Foot Aquifer in the Monterey Subbasin. However, as discussed Chapter 4 and shown above, the 180-Foot Aquifer in the Subbasin is divided by an intermediate aquitard into an upper zone and a lower zone. There is no observed seawater intrusion in the upper portion of the 180-Foot Aquifer. Therefore, MCWRA's maps are only consistent with data collected from the lower 180-Foot Aquifer.

Figure 5-28 also presents the mapped Fall 2017 groundwater elevations for the lower 180-Foot Aquifer and the 400-Foot Aquifer. The figure shows that depressed groundwater elevations in the 180/400-Foot Aquifer Subbasin are creating inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin. This observed inland gradient is generally parallel to the current seawater intrusion front.

Since groundwater elevations in the Deep Aquifers are lower than sea level and also lower than groundwater elevations within the 400-Foot Aquifer, there is a significant risk that seawater intrusion will occur in this aquifer. Such seawater intrusion could either occur from lateral migration of seawater within the Deep Aquifers from subsea outcrops located further off-shore or and/or downward vertical migration from the intruded 400-Foot Aquifer. However, the locations and mechanisms of the Deep Aquifers recharge are not well understood. Therefore, the likelihood of and potential timeframe for seawater intrusion in this aquifer is unknown.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley
- Freshwater Extent Identified by AEM Survey (Stanford/Aqua Geo Frameworks, 2018)
- Groundwater with TDS <1,000 mg/L (Note 2)
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Post 2015 TDS Concentrations

- ≤ 500 mg/L
- 500 - 1,000 mg/L
- 1,000 - 3,000 mg/L
- 3,000 - 10,000 mg/L
- >10,000 mg/L

Abbreviations

AEM = airborne electromagnetic
mg/L = miligram per liter
TDS = total dissolved solids

Notes

1. All locations are approximate.
2. Results of TDS and specific conductance are shown herein. Specific conductance to TDS conversion is based on a derived slope of 0.7025 mg/L per uS /cm from a linear regression model with existing data.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. TDS and specific conductance concentration measurements are obtained from various public agencies.

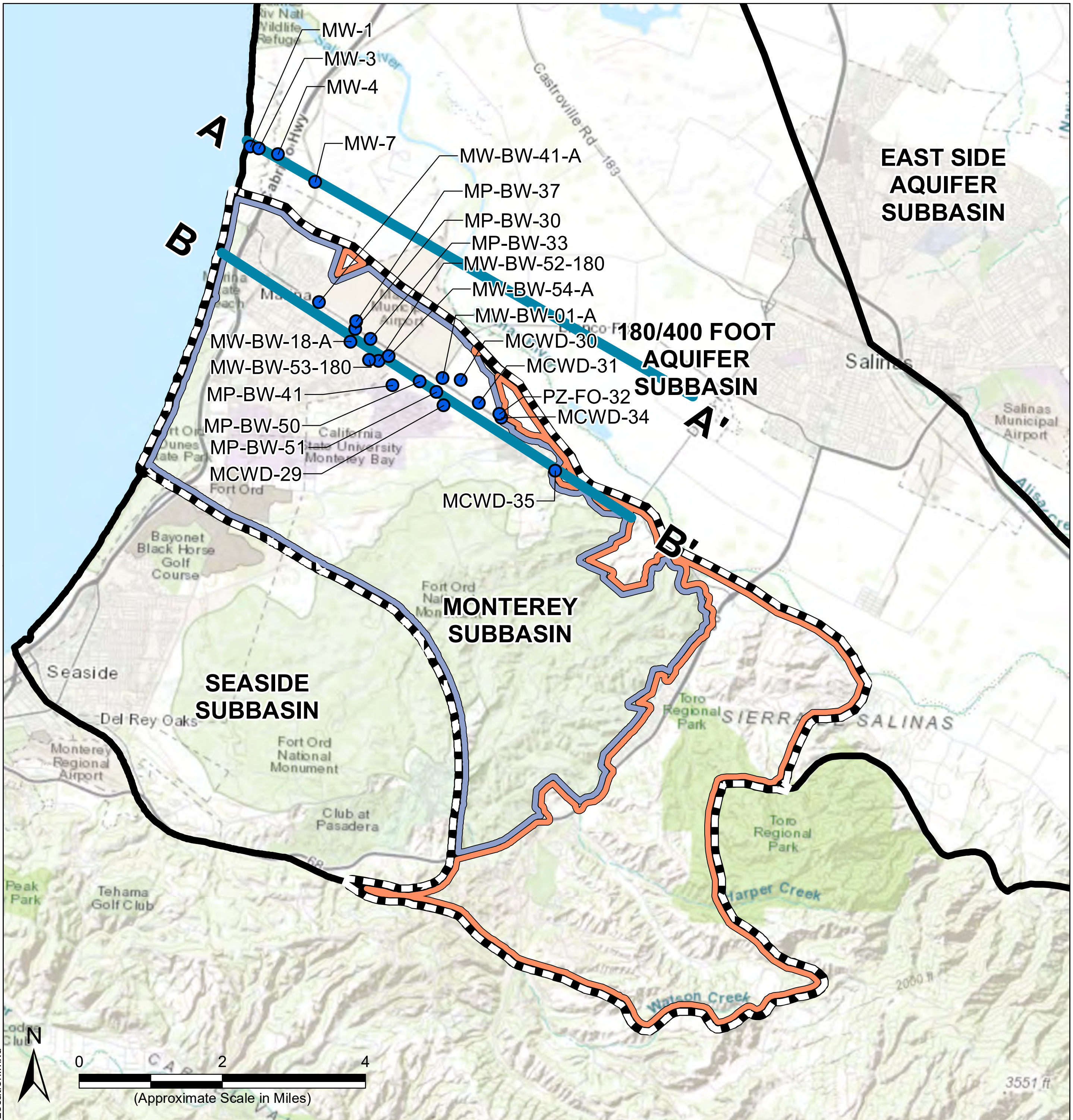
N 0 1.5 3 (Scale in Miles)

Recent Total Dissolved Solids Concentration Marina-Ord Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-24

Path: X:\B60094\Maps\2021\09\Fig5-24_TDS.mxd



Path: X:\B60094\Maps\2021\09\Fig5-25_SeawaterIntrusion_SectionLocation.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Well Locations
- Cross-Section

Management

- Marina-Ord
- Corral de Tierra

Notes

1. All locations are approximate.

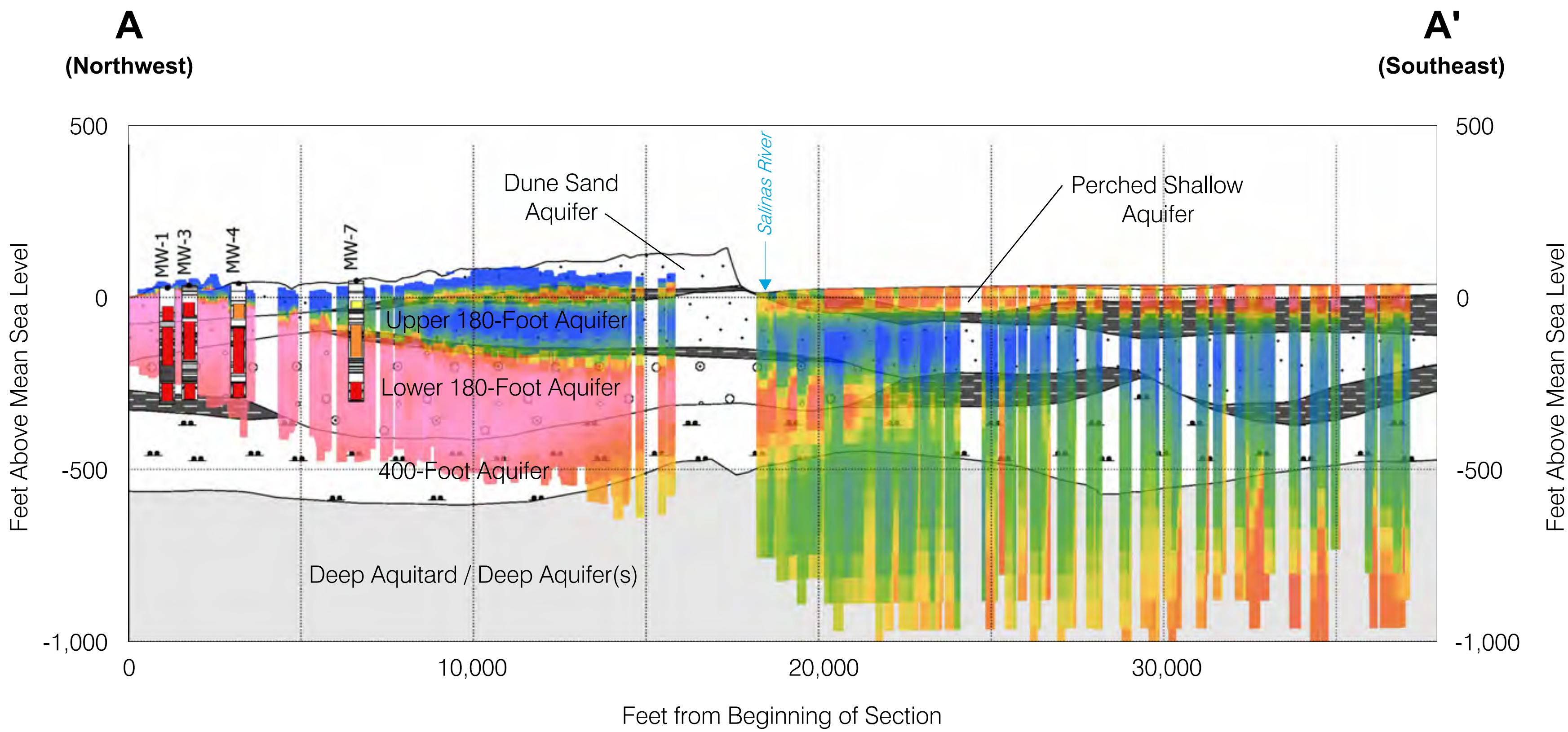
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.

Seawater Intrusion Cross-Section Locations

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-25



Legend:

Hydrostratigraphy Model
- Aquifers
- Aquitards
- Deep Aquitard / Deep Aquifer(s)

Logged Borehole Soil Category
- Coarse
- Medium
- Unknown
- Fine
- Top Soil

Screen Interval by TDS (mg/L)
- < 500
- ≤ 3000
- > 10000
- ≤ 1000
- ≤ 10000

AEM Resistivity (ohm-m)

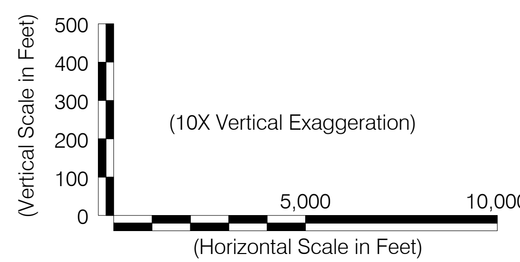
0.3 7.7 15.1 22.6 30

Abbreviations:

AEM = airborne electromagnetic
mg/L = milligrams per liter
TDS = total dissolved solids

Notes:

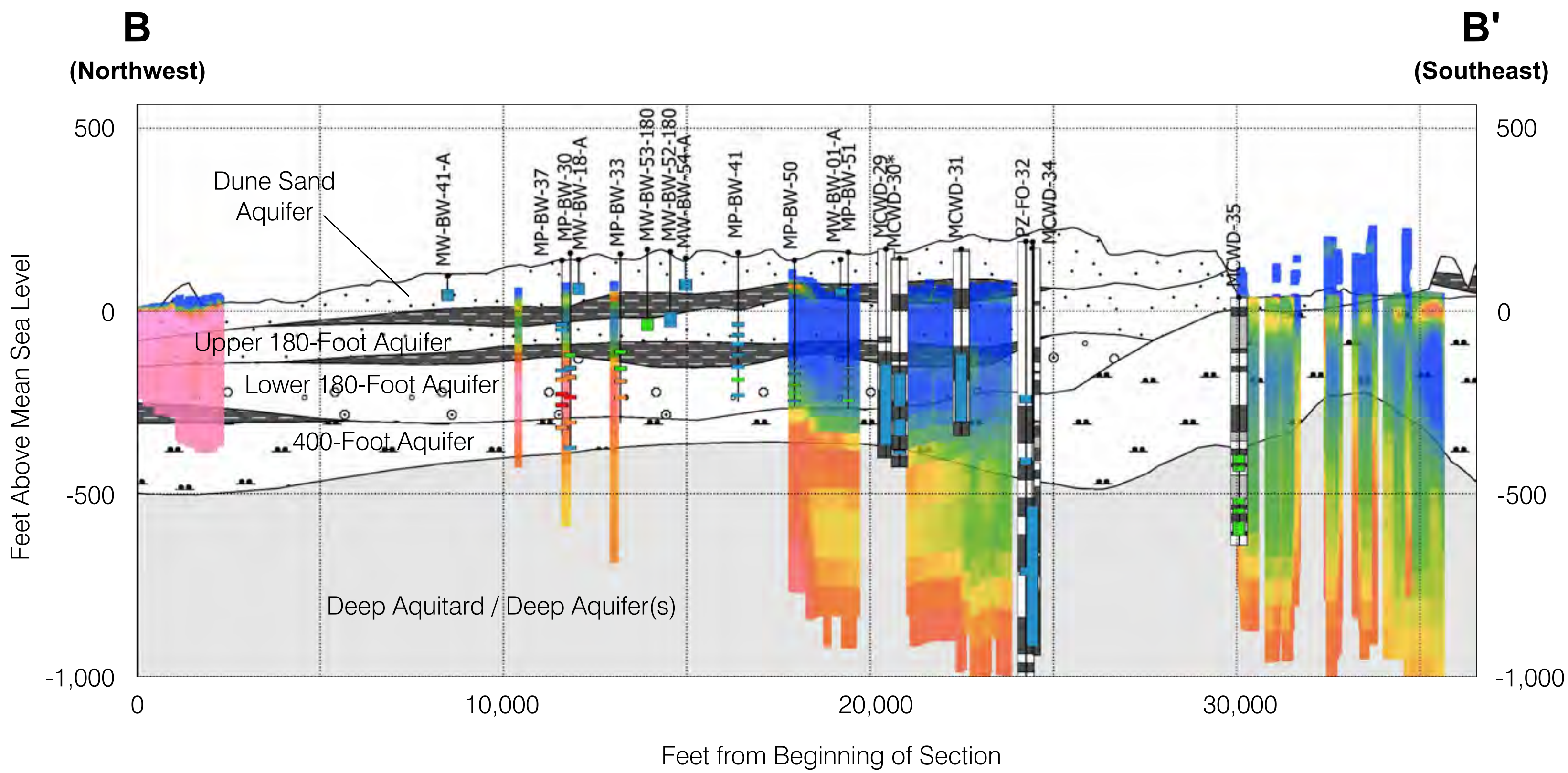
1. All locations are approximate.
2. AEM data shown are from the 2019 AEM survey (Aqua Geo Frameworks, 2019). AEM resistivity of below 75 ohm-m is used to identify saturated groundwater zones. Within sandy and gravelly aquifers, AEM resistivities of above 13.2 and below 7.2 is associated with groundwater with TDS below 3,000 mg/L and above 10,000 mg/L, respectively, per the TDS-AEM Resistivity relationship developed by Aqua Geo Frameworks (2019).
3. The hydrostratigraphy model is Model A obtained from Stanford/Aqua Geo Frameworks (2018), developed based on cross-sections from previously published reports, borehole lithology logs, and 2017 AEM survey data. The hydrostratigraphy model is approximate.



Seawater Intrusion Cross-Section A-A'

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-26



Legend:

Hydrostratigraphy Model
- Aquifers
- Aquitards
- Deep Aquitard / Deep Aquifer(s)

Logged Borehole Soil Category
- Coarse
- Medium
- Unknown
- Fine
- Top Soil

Screen Interval by TDS (mg/L)
- < 500
- ≤ 3000
- > 10000
- ≤ 1000
- ≤ 10000

AEM Resistivity (ohm-m)

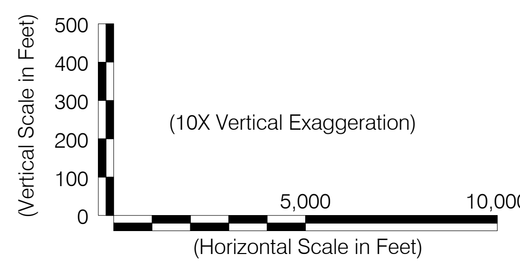
0.3 7.7 15.1 22.6 30

Abbreviations:

AEM	= airborne electromagnetic
mg/L	= milligrams per liter
TDS	= total dissolved solids

Notes:

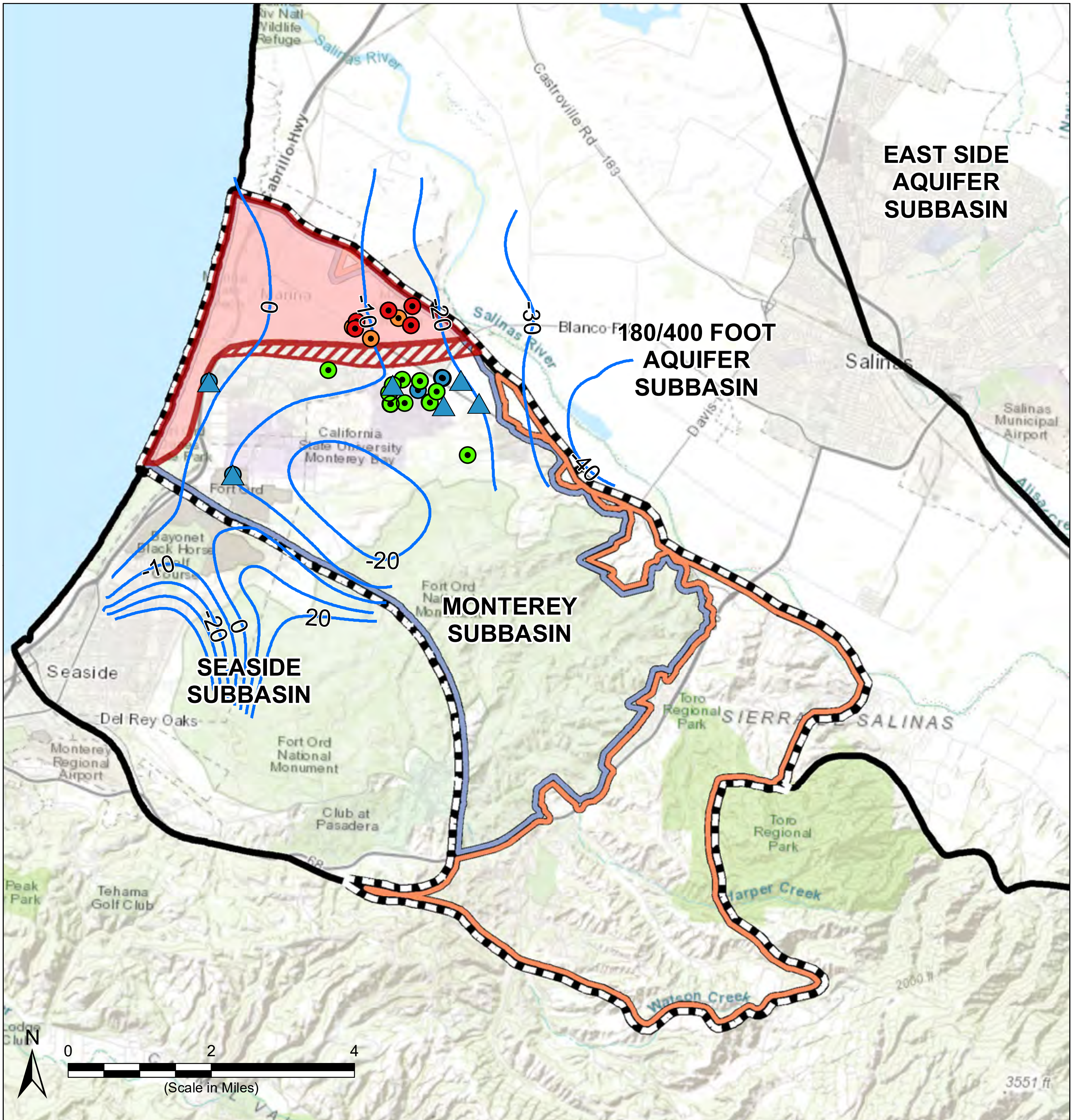
1. All locations are approximate.
2. AEM data shown are from the 2019 AEM survey (Aqua Geo Frameworks, 2019). AEM resistivity of below 75 ohm-m is used to identify saturated groundwater zones. Within sandy and gravelly aquifers, AEM resistivities of above 13.2 and below 7.2 is associated with groundwater with TDS below 3,000 mg/L and above 10,000 mg/L, respectively, per the TDS-AEM Resistivity relationship developed by Aqua Geo Frameworks (2019).
3. The hydrostratigraphy model is Model A obtained from Stanford/Aqua Geo Frameworks (2018), developed based on cross-sections from previously published reports, borehole lithology logs, and 2017 AEM survey data. The hydrostratigraphy model is approximate.



Seawater Intrusion Cross-Section B-B'

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-27



Path: X:\B60094\Maps\2021\09\Fig5-28_SeawaterIntrusion_Cl.mxd

Legend

2017 Fall Groundwater Contours in the 400-Foot Aquifers

Estimated Seawater Intrusion in Monterey Subbasin (Note 3)

Area of Known Seawater Intrusion

Area of Potential Seawater Intrusion

Post 2015 Chloride Sampling Results (mg/L)

22 - 250

Post 2015 TDS Measurements

≤ 500 mg/L

500 - 1,000 mg/L

1,000 - 3,000 mg/L

3,000 - 10,000 mg/L

>10,000 mg/L

Abbreviations

mg/L = miligram per liter

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021
2. TDS and chloride measurements are obtained from various agencies.
3. Extent of seawater intrusion estimated for areas with TDS >1,000 mg/L based on AEM survey and groundwater monitoring data.

Seawater Intrusion Extent in the Lower 180-Foot, 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-28

5.3.4 Historical Progression of Seawater Intrusion

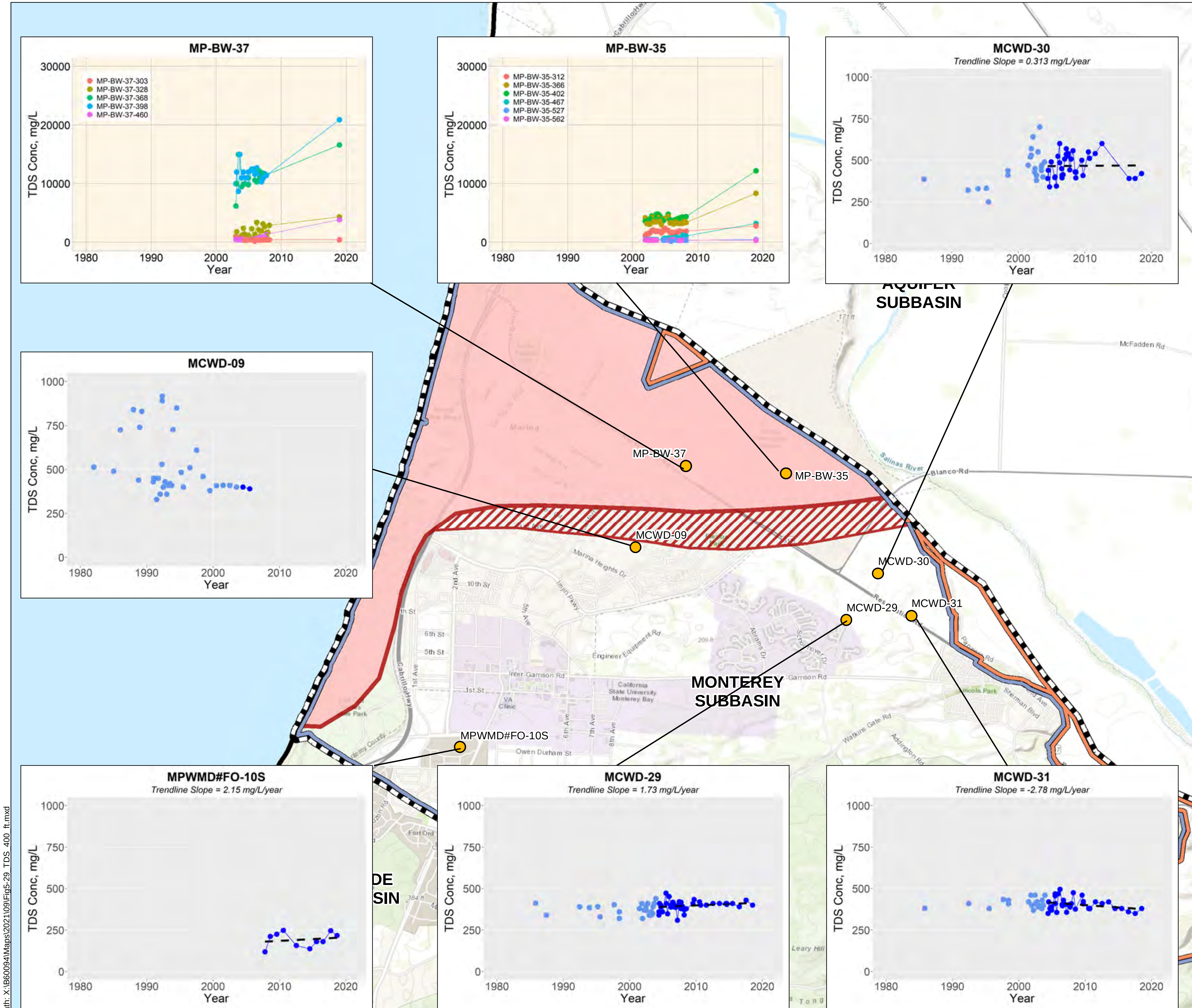
Seawater intrusion has been documented in the Salinas Valley Basin since the 1940s (DWR, 1946). However, consistent records of the water quality indicators related to seawater intrusion within the Subbasin are only available back to the 2000s and at selected locations. Thus, the spatial variability of water quality data is insufficient to access the historical rate of seawater intrusion within the Subbasin prior to this time period. In this section, TDS trends in selected wells near the seawater intrusion front are presented to evaluate historical seawater intrusion rates during this time period.

Seven wells screened within the lower 180-Foot and 400-Foot Aquifers with relatively long TDS records are shown on Figure 5-29. Increasing Long-term trends in TDS concentrations are observed in areas that are seawater intruded. Additionally, high TDS groundwater has migrated downward within the seawater intruded area. TDS concentrations have increased in wells screens MP-BW-35-467 (i.e., screened 467 ft bgs at MP-BW-35) and MP-BW-37-460 (screened 460 ft bgs at MP-BW-37) between 2008 and 2018. Also, TDS concentrations detected in wells MCWD-30 and MCWD-09 fluctuate significantly, which indicates that saline groundwater exists close proximately to these wells.

The lateral extent of seawater intrusion within the Subbasin has been relatively stable over the past two decades. Specifically, immediately northwest of the seawater intrusion front, screens located from approximately 300 ft bgs to 400 ft bgs in multi-port wells MP-BW-37 and MP-BW-35 have been seawater intruded for nearly 20 years, or since 2001 when the wells were installed and records were available. Immediately southeast of the seawater intrusion front, wells MCWD-30, MCWD-29, and the multi-port wells MP-BW-42 have shown relatively stable TDS concentrations at or below 1,000 mg/L over the past two decades. Although there has been some increase in TDS concentration in wells that were previously seawater intruded, there has been no observed expansion of the location of seawater intruded area over the historic period.

One CASGEM well in the southwestern portion of the Marina-Ord Area, MPWMD#FO-10, showed a recent increase in TDS concentration in 2020. Induction logging on the well suggested that the increase in TDS concentration was not due to casing leakage. However, the exact cause of the elevated TDS/chloride concentration is unknown. The GSAs will collect additional data in the vicinity during GSP implementation in collaboration with the Seaside Basin Watermaster.

The current seawater intrusion front is parallel to the groundwater flow direction in the lower 180-Foot and 400-Foot Aquifers; therefore, seawater continues to flow across the area that is intruded towards the 180/400-Foot Aquifer Subbasin, while there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Lower 180-Foot, 400-Foot Aquifer Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion

Single Completion Wells

- TDS Measurements Between 2004 and 2018 (15 Years)
- TDS Measurements Before 2004
- Trendline (Note 1)

Multi-Completion Monitoring Wells

- TDS Measurements (Note 2)

Abbreviations

Conc.	= Concentration
DWR	= California Department of Water Resources
mg/L	= miligram per liter
TDS	= total dissolved solids

Notes

1. Trendline analysis was performed for the period from 1 January 2004 to 31 December 2018 for single completion wells that have three or more TDS measurements during that period.
2. TDS measurements are shown in different colors for multi-completion wells, and no trendline analysis was performed for these wells.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 0.75 1.5
(Scale in Miles)

Total Dissolved Solid Concentration Trends in the Lower 180-Foot, 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-29

5.4 Groundwater Quality Concerns

This section presents a summary of current groundwater quality conditions. The GSAs do not have regulatory authority over groundwater quality which is under the purview of other state and federal agencies (e.g., the Regional Water Quality Control Board). Projects and management actions implemented by MCWD and SVBGSA must not further degrade groundwater quality.

The known groundwater quality concerns in the Marina-Ord Area aquifers are elevated chloride and TDS concentrations and point-source contaminants such as Volatile Organic Carbons (VOCs) and per- and poly-fluoroalkyl substances (PFAS). The primary source of high TDS and chloride concentrations in groundwater within the Marina-Ord Area is seawater intrusion, as described above in Section 5.3.

In the Corral de Tierra Area, the most prevalent water quality concern is arsenic.

5.4.1 Data Sources

The assessment of groundwater quality conditions is based on comparing data compiled from various monitoring agencies to applicable screening levels for the various beneficial uses (i.e., Maximum Contaminant Levels [MCLs] for domestic/municipal and industrial (M&I) use and various thresholds for irrigated agricultural use).

Groundwater quality samples are collected within the Monterey Subbasin on a regular basis for various studies and programs. Groundwater quality samples have also been collected on a regular basis for compliance with regulatory programs, including drinking water and contamination cleanup programs. Groundwater quality data for this assessment were collected from:

- The US Army Corps of Engineers Fort Ord Data Integration System (FODIS);
- The USGS Groundwater Ambient Monitoring and Assessment Program (GAMA) reports (Kulongoski and Belitz, 2005; Burton and Wright, 2018);
- State Water Resources Control Board's GAMA website (SWRCB, 2020a);
- State Water Resource Control Board's GeoTracker website (SWRCB, 2020b);
- State Water Resources Control Board's Safe Drinking Water Information System (SWRCB, 2020c); and
- The California Department of Toxic Substance Control's Envirostor website (DTSC, 2020).

5.4.2 Distribution and Concentrations of Point-Source Contamination

Clean-up and monitoring of point source pollutants are generally under the responsibility of either State or Federal regulatory agencies such as the Central Coast Regional Water Quality Control Board (CCRWQCB), California State Department of Toxic Substances Control (DTSC), the

United States Environmental Protection Agency (U.S. EPA), and/or the United States Armed Forces. There are a number of active point-source contamination sites within the Subbasin, as identified on the SWRCB GeoTracker website[19] and the DTSC EnviroStor website[20]. These sites, shown on Figure 5-30 and listed in Table 5-2, are primarily located within the former Fort Ord and are a part of Fort Ord's environmental cleanup program.

The former Fort Ord was placed on EPA's National Priorities List (NPL) in 1990 following environmental investigations conducted in 1984 and 1986. The same year, a Federal Facility Agreement (FFA) was signed by the Army, U.S. EPA, DTSC, and the CCRWQCB. The FFA established schedules for performing remedial investigations and feasibility studies and required remedial actions be completed as expeditiously as possible. The base-wide Remedial Investigation Feasibility Study (RI/FS) commenced in 1991. The Army performs these activities pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) also known as Superfund.

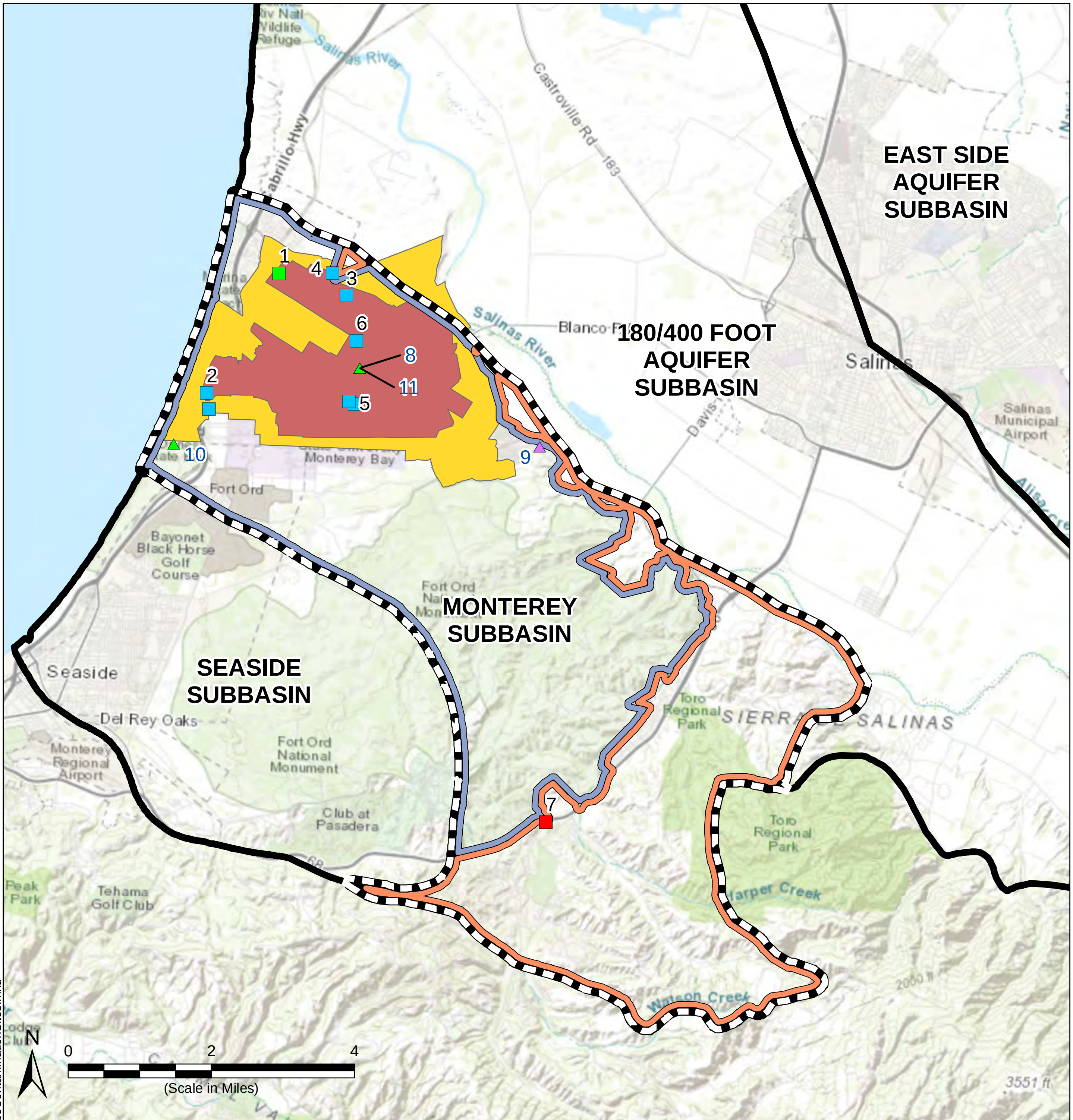
Groundwater remedial action objectives and aquifer cleanup goals at Fort Ord are established within the Records of Decision (ROD) and subsequent Explanations of Significant Difference (ESD) prepared for each operable unit where groundwater impacts have been detected. These documents are part of the administrative record and have been endorsed by state and federal agencies. The ROD documents selected remedy and cleanup levels that comply with the federal and state requirements that are applicable or relevant and appropriate (ARAS) to the site, such as drinking water Maximum Contaminant Levels (MCLs) and CCRWQCB Basin Plan Water Quality Objectives.

The approximate extent of contamination plumes that have historically been identified in groundwater within former Fort Ord are delineated by the location of the well prohibition area, also shown on Figure 5-30 and described in detail in Chapter 3. These contamination plumes are primarily located within the Dune Sand and 180-Foot Aquifers. No contamination has been detected in the 400-Foot Aquifer and the Deep Aquifers. The most frequently detected chemicals in these areas are trichloroethene (TCE) and carbon tetrachloride (CT). In addition, there is one cleanup program site located within the City of Marina and a Leaking Underground Storage Tank (LUST) cleanup site located by Highway 68.

[19] http://geotracker.waterboards.ca.gov
[20] https://www.envirostor.dtsc.ca.gov/public/

Table 5-2. List of Active Point Source Contamination Sites

Label	Site Name	Site Type	Status	Constituents of Concern
1	Don's One Hour Dry Cleaners	Cleanup Program Site	Open - Verification Monitoring	Other Chlorinated Hydrocarbons, Tetrachloroethylene (PCE)
2	Fort Ord - Fort Ord - Sites 2 and 12	Military Cleanup Site	Open - Remediation	Chlorinated Hydrocarbons
3	Fort Ord - Fort Ord OU1 (Fritzsche Army Airfield Fire Drill Area, On-Site Plume)	Military Cleanup Site	Open - Remediation	Gasoline, Chlorinated Hydrocarbons
4	Fort Ord - Fort Ord OU1 (Off-Site Plume)	Military Cleanup Site	Open - Remediation	Gasoline, Chlorinated Hydrocarbons
5	Fort Ord - Fort Ord - OU2	Military Cleanup Site	Open - Remediation	Gasoline, Chlorinated Hydrocarbons
6	Fort Ord - Fort Ord - OUCTP	Military Cleanup Site	Open - Remediation	Chlorinated Hydrocarbons
7	Former Exxon - Corral De Tierra	LUST Cleanup Site	Open - Eligible for Closure	Gasoline, MTBE / TBA / Other Fuel Oxygenates
8	Fort Ord Reuse Authority (Early Transfer)	Federal Superfund	Active	--
9	Fort Ord - East Garrison (VCA)	Federal Superfund	Certified	--
10	Fort Ord State Park-MOU with DPR	Federal Superfund	Active	--
11	Fort Ord Reuse Authority MOA	Federal Superfund	Active	--



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

GeoTrackerSites

- Cleanup Program Site, Open
- LUST Cleanup Site, Open
- Military Cleanup Site, Open

EnviroStor Sites

- Certified Federal Superfund
- Active Federal Superfund

Fort Ord Special Groundwater Protection Zones Related to Contamination Within the Former Fort Ord (Note 2)

- Prohibition Zone
- Consultation Zone

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Locations of contamination sites from SWRCB GeoTracker website (http://geotracker.waterboards.ca.gov/datadownload) accessed 27 February 2018 and Department of Toxic Substances Control EnviroStor website (https://www.envirostor.dtsc.ca.gov/public/) accessed 11 May 2018.

Location of Active Point Source Contamination Sites

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-30

Path: X:\B60094\Maps\2021\09\Fig5-30_LocationofActivePointSourceContaminationSites.mxd

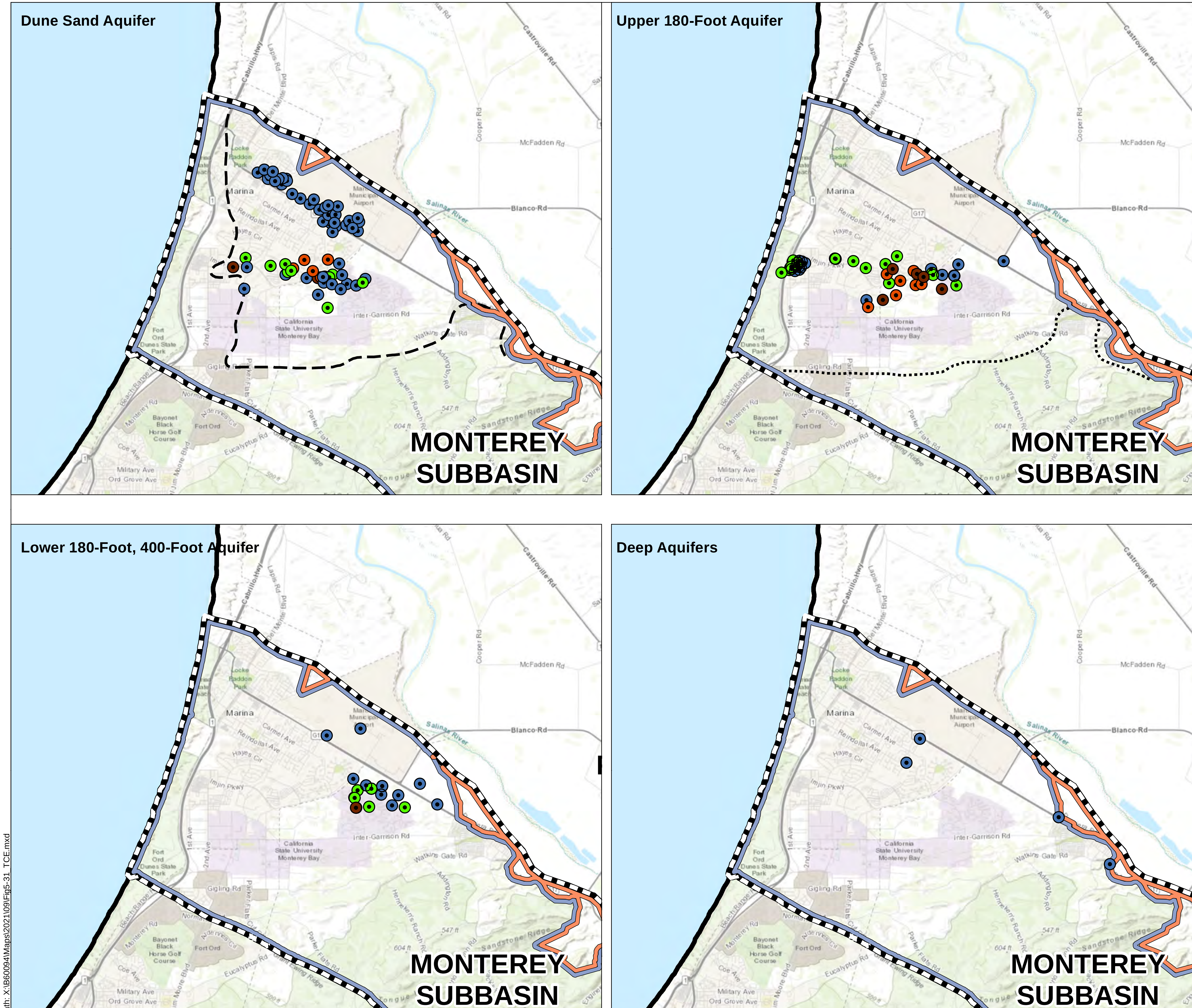
To date, no point-source contaminants have been detected above MCLs in domestic/M&I supply wells within the Subbasin. However, as of June 2019, trichloroethylene (TCE), carbon tetrachloride (CT), perfluorobutanesulfonic acid (PFBS), and perfluorohexanoic acid (PFHxA) have been detected above their respective detection limits in MCWD supply wells screened in the 180- and 400-Foot Aquifers-.

- Trichloroethylene (TCE) and carbon tetrachloride (CT): TCE and CT are among the major chemicals of concern detected in groundwater within Fort Ord Operable Unit 2 (OU2) and Operable Unit Carbon Tetrachloride Plume (OUCTP). These operable units are located in the center of the Marina-Ord Area southeast of MCWD production wells. TCE was detected in MCWD lower 180-Foot, 400-Foot Aquifer production wells since the 2000s and was most recently detected at concentrations ranging from 0.57 ug/L in MCWD-30 to 1.80 ug/L in MCWD-29 in June 2019[21]. CT was also recently detected in these wells at low concentrations. Figure 5-31 illustrates TCE concentrations detected in Fort Ord monitoring wells and MCWD production wells in June 2019. As shown on Figure 5-31, within the former Fort Ord, TCE exceeding the MCL (5 ug/L) was detected in monitoring wells in the Dune Sand Aquifer as well as the upper and lower 180-Foot Aquifers. Discontinuity of aquitards and the downward vertical groundwater gradient have contributed to the downward migration of contamination. The closest monitoring well with TCE concentration detected above the MCL is located in the lower 180-Foot Aquifer one-mile upgradient of MCWD production wells.
- Perfluorobutanesulfonic acid (PFBS) and perfluorohexanoic acid (PFHxA): PFBS and PFHxA are Per- poly-fluoroalkyl substances (PFASs), which is a group of emerging man-made contaminants that were used in firefighting foam, protective coatings, and stain and water-resistant products until the 2000s. During MCWD's January 2020 PFAS sampling event, PFBS and PFHxA were detected in lower 180-Foot, 400-Foot Aquifer production well MCWD-29. There are no current drinking water regulations in California for these two substances. To date, no sampling of PFBS and PFHxA has been conducted in non-MCWD wells.

  In 2019, the USACE conducted a review of historical activities with the potential to cause PFAS contamination at the Fort Ord (USACE, 2019). The study identified that the primary mechanism for release of PFAS was through the historical use of Aqueous Film-Forming Foam (AFF) in former fire drill areas, aviation areas, and subsequent transport to landfill and sewage treatment areas. Additionally, groundwater sampling for the two PFAS contaminants with established regulatory limits (Perfluorooctanoic acid [PFOA] and perfluorooctanesulfonic acid [PFOS]) was conducted as part of the study. The United States Environmental Protection Agency (U.S. EPA) issued a lifetime health advisory for PFOA and PFOS in drinking water at a total concentration of 0.07 ug/L. Even though no MCLs have been promulgated, the California SWRCB established notification levels (NLs)

[21] The MCL for TCE is 5 ug/L.

for PFOA and PFOS at 0.0051 ug/L and 0.0065 ug/L, respectively. PFOA and PFOS were measured above their respective NLs in the Dune Sand 180-Foot Aquifers that are adjacent to the Fort Ord OU2 Landfill.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Southern Extent of FO-SVA (Harding ESE, 2001)
- Southern Extent of Valley Fill Deposits (Harding ESE, 2001)

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

June 2019 TCE Sampling Locations

- < 1.5 ug/L or Not Detected
- 1.5 - 5 ug/L
- 5 - 10 ug/L
- > 10 ug/L

Abbreviations

AEM = airborne electromagnetic
mg/L = miligram per liter
TCE = Trichloroethylene

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. TCE measurements are obtained from SWRCB GAMA Online Tool, Fort Ord, California Public Water Systems, and USGS.

N

0 1.5 3

(Scale in Miles)

Recent Trichloroethylene Concentration Within the Former Fort Ord

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-31

Path: X:\B60094\Maps\2021\09\Fig5-31_TCE.mxd

5.4.3 Distribution and Concentrations of Diffuse or Natural Groundwater Constituents

In addition to the single point source of groundwater contamination described above, the CCRWQCB monitors and regulates activities and discharges that can contribute to non-point source pollutants, which are constituents released to groundwater over large areas.

In the El Toro Primary Aquifer System, the most prevalent non-point source water quality concern is arsenic. It has been reported that primary and secondary MCLs are exceeded in several wells in the area, with arsenic being a constituent of concern for additional groundwater development (GeoSyntec, 2007). In addition, nitrate and coliform bacteria may present problems in areas with more dense occurrences of septic tanks and shallow wells (GeoSyntec, 2007). Concentrations of TDS range from 355 to 1650 mg/L (DWR 1967; GeoSyntec, 2007). However, there is some variability between hydrostratigraphic units.

Groundwater quality conditions in the Subbasin were summarized in two USGS water quality studies. The USGS 2005 GAMA study in the Salinas Valley characterized deeper groundwater resources used for public water supply (Kulongoski and Belitz, 2005). The USGS 2018 GAMA study in the Salinas Valley focused on domestic well water quality (Burton and Wright, 2018). All quality-assured data collected for these two studies and the GAMA Program are publicly available through the SWRCB GAMA and GeoTracker groundwater information systems (SWRCB, 2020a; SWRCB, 2020b).

Table 5-3 reports the constituents of concern in the Monterey Subbasin based on GAMA and GeoTracker data. These data include on-farm domestic wells monitored under the Irrigation Lands Regulatory Program (ILRP), irrigation supply wells sampled under ILRP, as well as public supply wells monitored under the Division of Drinking Water (DDW) programs. As such, Table 5-3 compares sampling results to applicable screening levels for the various beneficial uses (i.e., Tittle 22 MCLs for domestic/ Municipal and Industrial (M&I) use and various thresholds for irrigated agricultural use from the CCRWQCB's 2019 Basin Plan). The number of wells that exceed the regulatory standard for any given constituent of concern is based on the latest sample for each well in the monitoring network. Not all wells have been sampled for all constituents of concern. Therefore, the percentage of wells with exceedances is the number of wells that exceed the regulatory standard divided by the total number of wells that have ever been sampled for that constituent of concern. Figure 5-32 shows the location of GAMA/GeoTracker database wells with identified exceedances of a regulatory standard in its latest sample.

As shown on Table 5-3, arsenic is the only constituent with a primary MCL standard and a significant percentage of wells with exceedances found within the Subbasin. It should be noted that ILRP often does not sample for arsenic. Thus, the impact arsenic has had on ILRP on-farm domestic and irrigation wells is unknown. This will be a data gap addressed during GSP implementation, especially in shallow domestic wells.

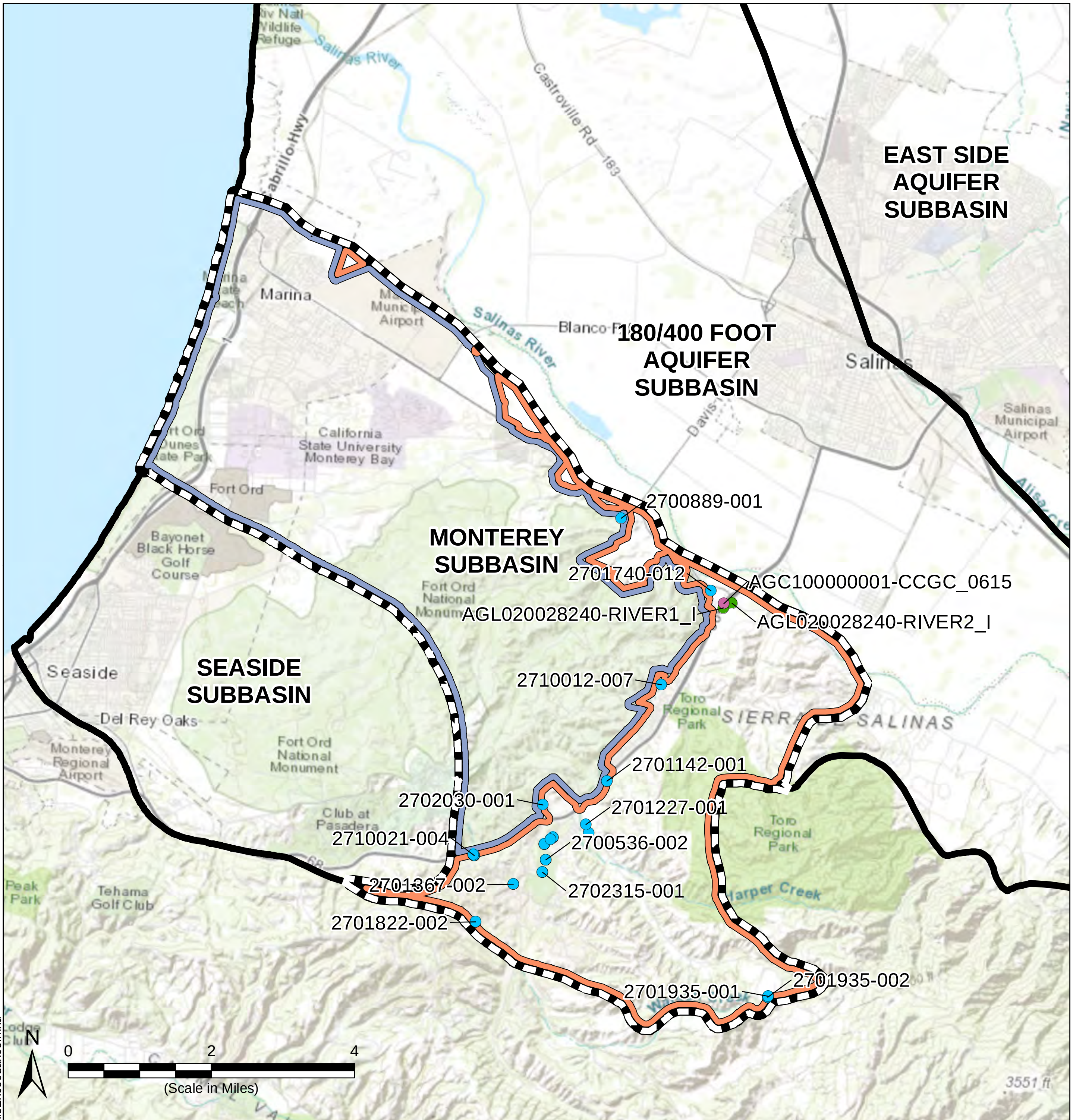
Iron and manganese have been detected above their respective secondary MCLs in over 10% of DDW wells. The only two irrigation ILRP wells within the Subbasin, located along the northern

Subbasin boundary, have shown exceedances of total Nitrate and Nitrite. However, no nitrate exceedances have been identified in any domestic or public drinking water supply wells.

Table 5-3. GAMA/GeoTracker Water Quality Summary[22]

Constituent of Concern	Regulatory Exceedance Standard	Standard Units	Historical Number of Monitoring Wells Sampled	Number of Wells Exceeding Regulatory Standard from latest sample	Percentage of Wells with Exceedances
On-Farm Domestic ILRP Wells (Data from March 2013 to December 2017)					
Total Dissolved Solids	1000	MG/L	7	1	14%
DDW Wells (Data from April 1990 to May 2020)					
Arsenic	10	UG/L	29	7	24%
Benzo(a)Pyrene	0.2	MG/L	21	1	5%
Chromium	50	UG/L	29	2	7%
1,2 Dibromo-3-chloropropane	0.2	UG/L	13	2	15%
Dinoseb	7	UG/L	26	3	12%
Iron	300	UG/L	30	13	43%
Hexachlorobenzene	1	UG/L	12	1	8%
Manganese	50	UG/L	29	11	38%
Nickel	100	UG/L	24	1	4%
Specific Conductance	1600	UMHOS/CM	30	2	7%
1,2,3-Trichloropropane	0.005	UG/L	24	1	4%
Total Dissolved Solids	1000	MG/L	30	2	7%
Vinyl Chloride	0.5	UG/L	37	3	8%
Zinc	5	MG/L	30	1	3%

[22] Inactive, abandoned, or destroyed wells are excluded from this analysis.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Water Quality Monitoring Wells that Exceed a Regulatory Standard in the Last Measurement

- Irrigation IRLP Well
- Domestic IRLP Well
- DDW Well

Management Areas

- Marina-Ord
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Water quality results from GeoTracker GAMA, California Water Boards.

Water Quality Monitoring Wells that Exceed a Regulatory Standard

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-32

Path: X:\B60094\Maps\2021\09\Fig5-32_WaterQualityMonitoringWellsExceedance.mxd

Figure 5-32. Water Quality Monitoring Wells that Exceed a Regulatory Standard

5.5 Land Subsidence

Land subsidence, or the lowering of ground surface, can be caused by excessive groundwater withdrawal that lowers the potentiometric head in compressible fine-grained layers, resulting in depressurization and compaction of those fine grain layers. Land subsidence can be elastic or inelastic. Elastic subsidence is reversible (i.e., the land surface rises again after the potentiometric head increases), whereas inelastic subsidence is irreversible (i.e., the compaction of fine-grained layers is permanent). Inelastic subsidence is considered an undesirable result.

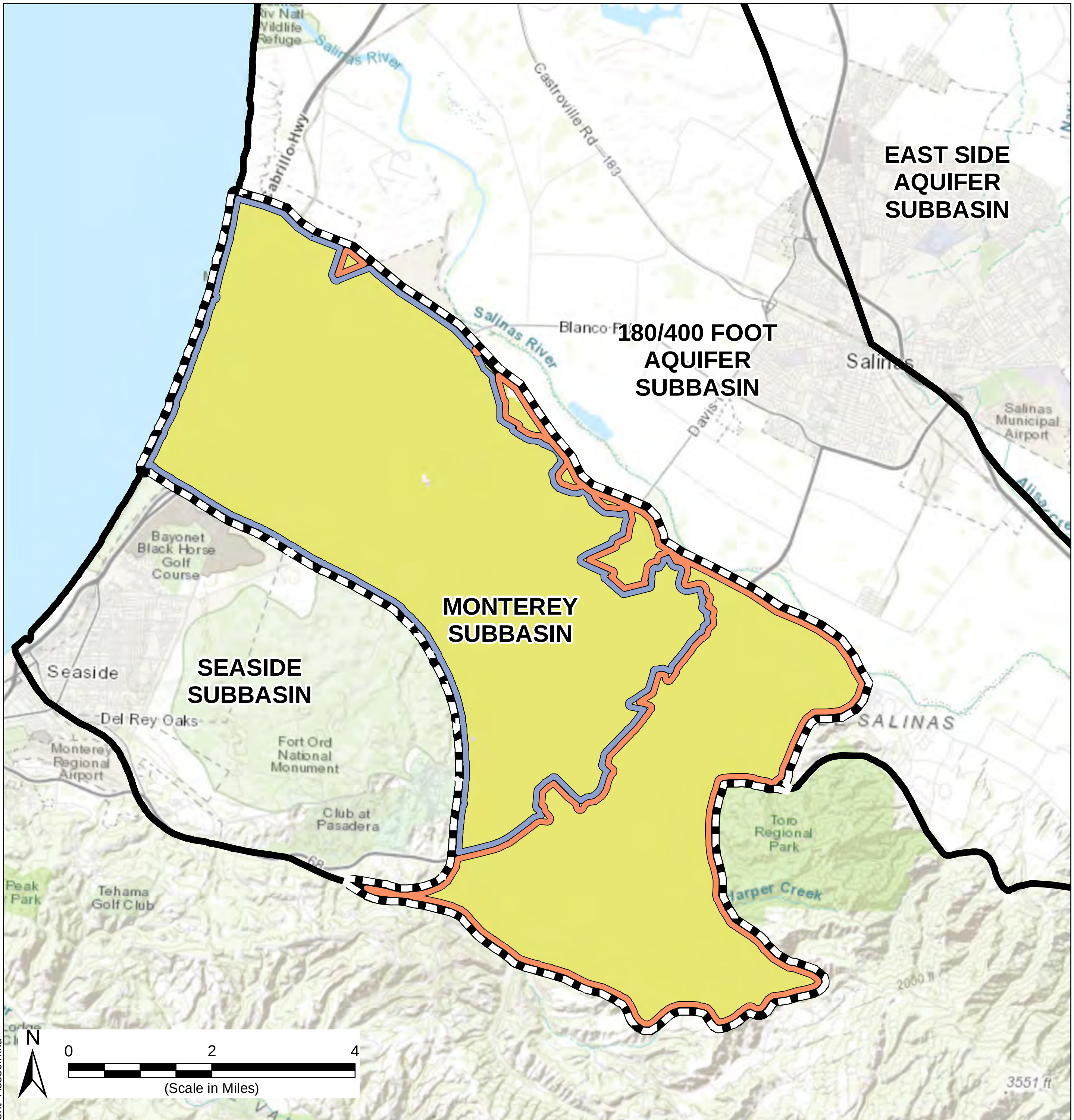
5.5.1 Data Sources

This assessment uses Interferometric Synthetic Aperture Radar (InSAR) satellite data[23] from June 2015 to September 2019. These are the only available data used for estimating subsidence in this GSP.

5.5.2 Subsidence Mapping

Figure 5-33 presents a map showing the average annual subsidence rate in the Monterey Subbasin over the period from June 2015 and September 2019. The yellow area on the map is the area with measured average annual changes in ground elevation of between -0.1 and 0.1 foot per year. As discussed further in Chapter 8, because of inherent error in the InSAR measurement methodology, any measured ground level changes between -0.1 and 0.1 foot per year are not considered subsidence. The map shows that no measurable subsidence has been recorded anywhere in the Monterey Subbasin.

[23] https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_v2019_Total_Since_20150613_Mosaic/ImageServer



Path: X:\B60094\Maps\2021\09\Fig5-33_InSAR Landsubsidence_Mont_Assoc.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

Marina-Ord

Corral de Tierra

Annual Rate of Land Subsidence

-0.1 to 0.1 ft/yr

Abbreviations

ft/yr = foot per year

Notes

1. All locations are approximate.
2. This figure shows the annual land subsidence rate between June of 2015 and September of 2019.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. InSAR subsidence data, "SAR/Vertical_Displacement_TRE_ALTAMIRA_v2019_Total_Since_20150613_Mosaic (ImageServer)." Created by DWR and and obtained from ArcGIS REST Services Directory.

Estimated InSAR Subsidence

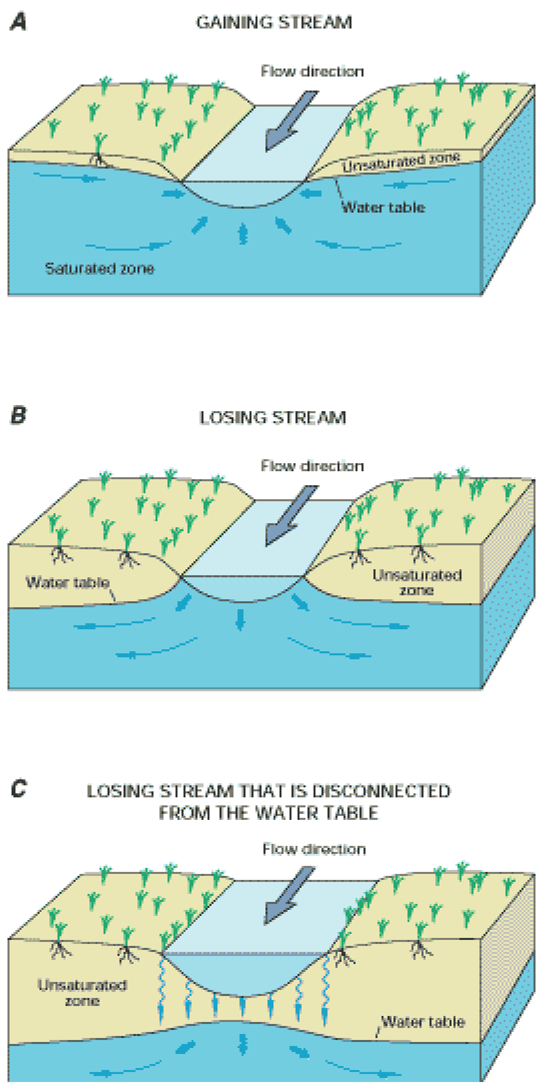
Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-33

5.6 Interconnected Surface Water Systems

Surface water that is connected to the groundwater flow system is referred to as interconnected surface water. If the groundwater elevation in an aquifer that is hydraulically connected to a stream (or other surface water body) is higher than the water level in the stream, the stream is said to be a gaining stream because it gains water from the surrounding underlying groundwater. If the groundwater elevation is lower than the water level in the stream, it is termed a losing stream because it loses water to the surrounding groundwater flow system. If the groundwater elevation is well below the streambed elevation and there is an unsaturated zone between the stream and the groundwater, the stream and groundwater are considered to be disconnected. These concepts are illustrated in Figure 5-34.

Figure 5-34. Conceptual Representation of Interconnected Surface Water (Winter et. al., 1999)



5.6.1 Data Sources

This analysis of interconnected surface water is based on the best available data but contains significant uncertainty. The main source of information for this analysis will be the Monterey Subbasin groundwater model and the SVIHM when they become available. Subject to limitations related to model resolution and overall accuracy, the models will be able to provide a detailed picture of the distribution of hydraulically connected surface water and groundwater in the Subbasin. The assessment herein uses groundwater elevation measured in the shallow-most principal aquifers (i.e., the Dune Sand Aquifer in the coastal Marina-Ord area and the Aromas Sands/Paso Robles Aquifer in the upland Corral de Tierra Area) to identify potential hydraulic connection. As shown below, shallow groundwater elevation is limited within the Subbasin and additional groundwater monitoring wells may be necessary to verify groundwater elevations adjacent to surface water bodies. This is a data gap that will be addressed during GSP implementation. An evaluation of surface water depletion rates is provided in Chapter 6.

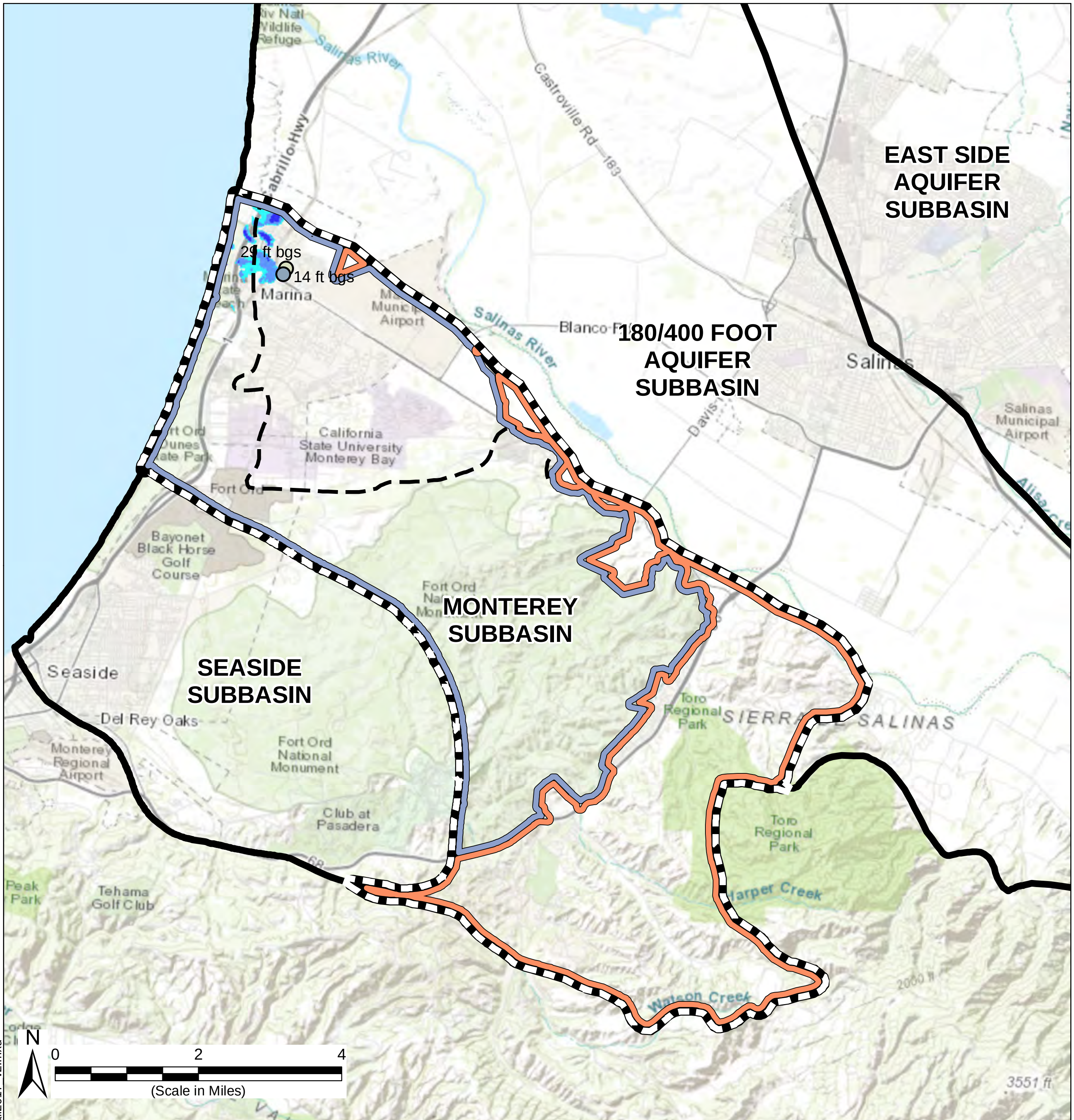
5.6.2 Analysis of Surface Water and Groundwater Interconnection

As described in Section 4.3, surface water streams within the Subbasin are generally small intermittent streams that flow only after storm events, and are unlikely to be connected to groundwater, except for the lower reaches of El Toro Creek and two potential locations along the Salinas River near the Monterey-180/400-Foot Aquifer Subbasin boundary where the Salinas River intercepts the Subbasin in a small portion of the Corral de Tierra Area.

El Toro Creek is a perennial stream below the confluence with Watson Creek below the Corral de Tierra golf course, and runoff-dependent above this point (Feikhart, 2001). Recorded streamflows at USGS gage 11152540 from 1961 to 2001 indicate a mean annual streamflow of 1,590 AFY (GeoSyntec, 2007). This mean annual streamflow was calculated for the entire record from 1961 to 2001. However, El Toro Creek did not record flow every year. It is unclear whether the perennial sections of streamflow in El Toro Creek are supported by groundwater from a principal aquifer. This will be further evaluated as more data becomes available. Other analyses may include locations of shallow groundwater. In the Salinas Valley Basin, groundwater that is within 20 feet of land surface may be assumed to be connected to surface water based on streambed incision. This may not be the case in tributaries such as El Toro Creek. No areas of groundwater within 20 feet of land surface were found in the Corral de Tierra Area in Fall 2017 (Figure 5-35). However, in 2019, there were some areas of groundwater within 20 feet of land surface recorded in the Corral de Tierra Area along El Toro Creek (Figure 5-36). However, there was no area of groundwater within 20 feet of land surface recorded in the Corral de Tierra Area along the Salinas River in Fall 2019.

Another type of surface water that exists within the Subbasin includes ponds and lakes located within the City of Marina and within the Fort Ord federal land area. These surface water features are known as vernal ponds (discussed further in Section 5.7.1 below); however, some of these features are known to contain open water well into the dry season (WRA, 2020). As shown on Figure 5-35 and discussed in Section 5.7 below, groundwater elevations in the Dune Sand Aquifer in the vicinity of the City of Marina are within 20 ft of ground surface and are at similar levels in nearby Dune Sand Aquifer wells. Therefore, the ponds in the vicinity of City of Marina may be supported by groundwater in the Dune Sand Aquifer. There are several shallow groundwater wells within approximately 1,500 feet of the Marina Ponds. No existing shallow groundwater exists in the ponds' vicinity within the former Fort Ord federal lands area.

For areas of the Subbasin that are connected to surface water and groundwater extraction exits, a detailed analysis of hydraulic connection is required. These areas may collection of shallow groundwater elevations and analysis through a numerical model. Additional data are needed to reduce uncertainty and refine the map of interconnected surface waters.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Depth to Water in Selected Wells (ft bgs)

- 11 - 20
- 21 - 30

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Areas of Groundwater Within 20 feet of land Surface (ft bgs)

- 0 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20

Abbreviations

ft bgs = foot below ground surface

Notes

1. All locations are approximate.
2. No areas of groundwater within 20 feet of land surface is found within the Corral de Tierra Area in Fall 2017.

Sources

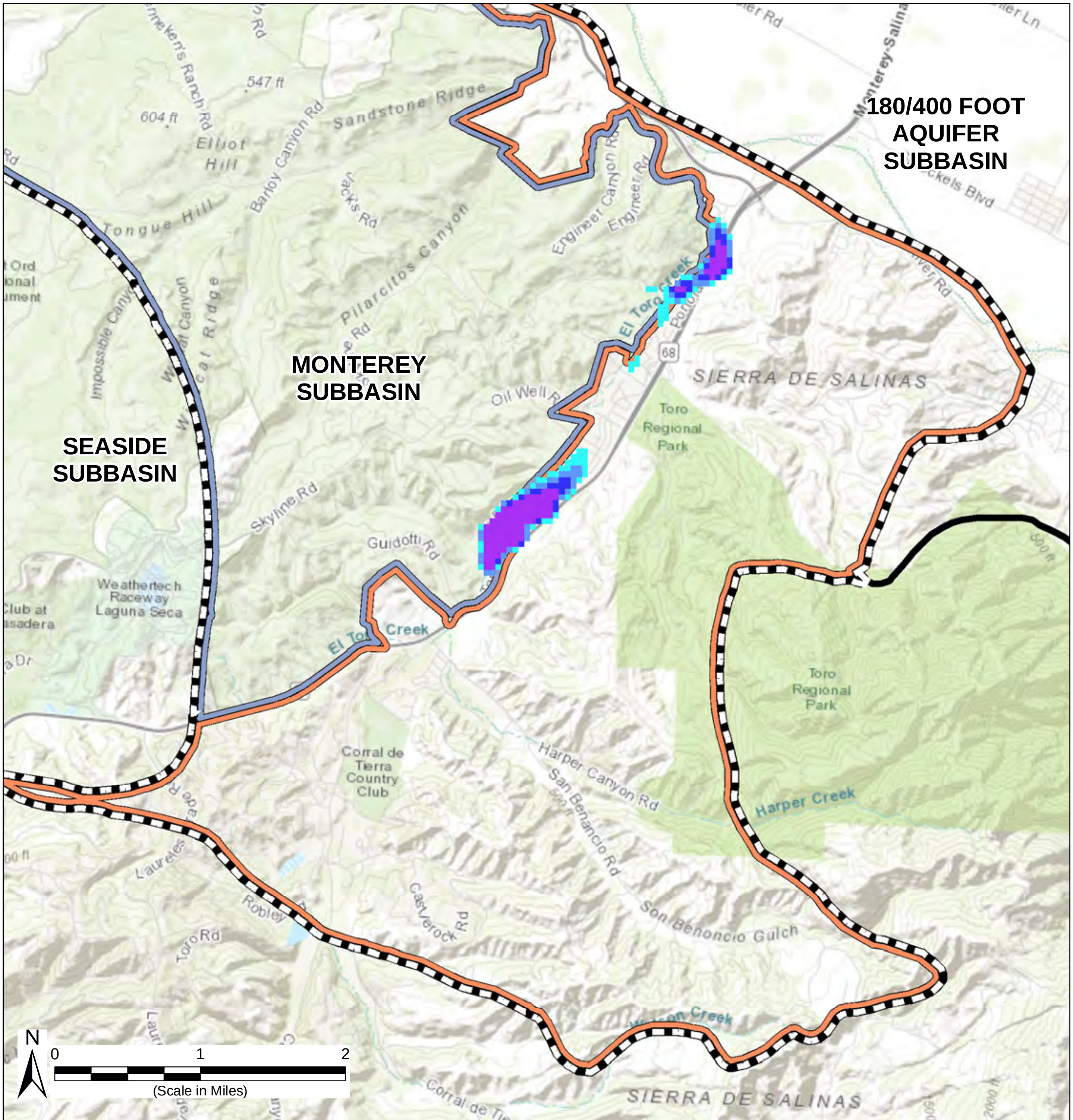
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Depth to water data are calculated by subtracting the 2017 Fall Dune Sand Aquifer contour from land surface in the Marina Ord Area and subtracting the 2017 Fall Paso Robles Aquifer contour from land surface in the Corral de Tierra Area.

Areas of Groundwater Within 20 feet of Land Surface, Fall 2017 Monterey Subbasin

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-35

Path: X:\B60094\Maps\2021\09\Fig5-35_Depth_to_GW_Shallow_Fall2017_v2.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management

Marina-Ord

Corral de Tierra

Areas of Groundwater Within 20 feet of land Surface (ft bgs)

0 - 5

5.1 - 10

10.1 - 15

15.1 - 20

Abbreviations

ft bgs = foot below ground surface

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. Depth to water data are calculated by subtracting the 2019 Fall Paso Robles Aquifer contour from land surface in the Corral de Tierra Area.

Areas of Groundwater Within 20 feet of Land Surface, Fall 2019, Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-36

Path: X:\B60094\Maps\2021\09\Fig5-36_Depth_to_GW_Corral.mxd

5.7 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are natural communities (flora and fauna) that depend on near-surface groundwater as a source of water. While GDEs are not a sustainability indicator as defined by SGMA, they are considered a beneficial use of groundwater and are potentially affected by other sustainability indicators such as chronic lowering of groundwater levels, and therefore must be considered in GSPs. Two main types of ecosystems are commonly associated with groundwater: wetlands associated with the surface expression of groundwater and vegetation that typically draws water from a shallow water table.

GDEs may provide critical habitat for threatened or endangered species. Areas designated as critical habitats for threatened or endangered species contain the physical or biological features that are essential to the conservation of these species, and may need special management or protection (USFWS, 2017). A list of threatened and endangered species that might rely on GDEs in the Subbasin was compiled using information from the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), and The Nature Conservancy (TNC). Several steps were taken to determine which threatened and endangered species were likely found in the Subbasin and of those, which were likely to rely on the GDE habitat. A list of threatened and endangered species for Monterey County was downloaded from the USFWS website and cross-referenced to species identified in the CDFW California Natural Diversity Database. The threatened and endangered species for Monterey County was further cross-referenced with the TNC Critical Species LookBook to identify which species are likely to depend on groundwater, as indicated in Table 5-4.

Ten threatened and endangered species, including the Southern California Steelhead, and the California Red-legged Frog, were identified as likely to rely directly on groundwater in Monterey County, several of which may be found in the Subbasin. Ten species were identified as likely to rely indirectly on groundwater, and the remaining species are unknown with respect to whether they directly rely on GDEs or groundwater. All species listed have the potential for groundwater dependence. There are eight species that appear in both the federal and state list for threatened or endangered species.

Table 5-4. Federal and State Listed Threatened and Endangered Species, and Respective Groundwater Dependence for Monterey County

Groundwater Dependence	Common Name	Federal Status	State Status
Direct	California black rail	-	Threatened
	California red-legged frog	Threatened	-
	California Ridgway's rail	Endangered	Endangered
	longfin smelt	-	Threatened
	Santa Cruz long-toed salamander	Endangered	Endangered
	steelhead - central California coast DPS	Threatened	-
	steelhead - south-central California coast DPS	Threatened	-
	Tidewater Goby	Endangered	-
	tricolored blackbird	-	Threatened
Direct and Indirect	arroyo toad	Endangered	-
Indirect	bald eagle	-	Endangered
	bank swallow	-	Threatened
	Belding's savannah sparrow	-	Endangered
	California condor	Endangered	Endangered
	California least tern	Endangered	Endangered
	least Bell's vireo	Endangered	Endangered
	southwestern willow flycatcher	Endangered	Endangered
	Swainson's hawk	-	Threatened
	willow flycatcher	-	Endangered
Unknown	Bay checkerspot butterfly	Threatened	-
	California tiger salamander	Threatened	Threatened
	foothill yellow-legged frog	-	Endangered
	San Joaquin kit fox	Endangered	Threatened
	short-tailed albatross	Endangered	-
	Smith's blue butterfly	Endangered	-
	vernal pool fairy shrimp	Threatened	-

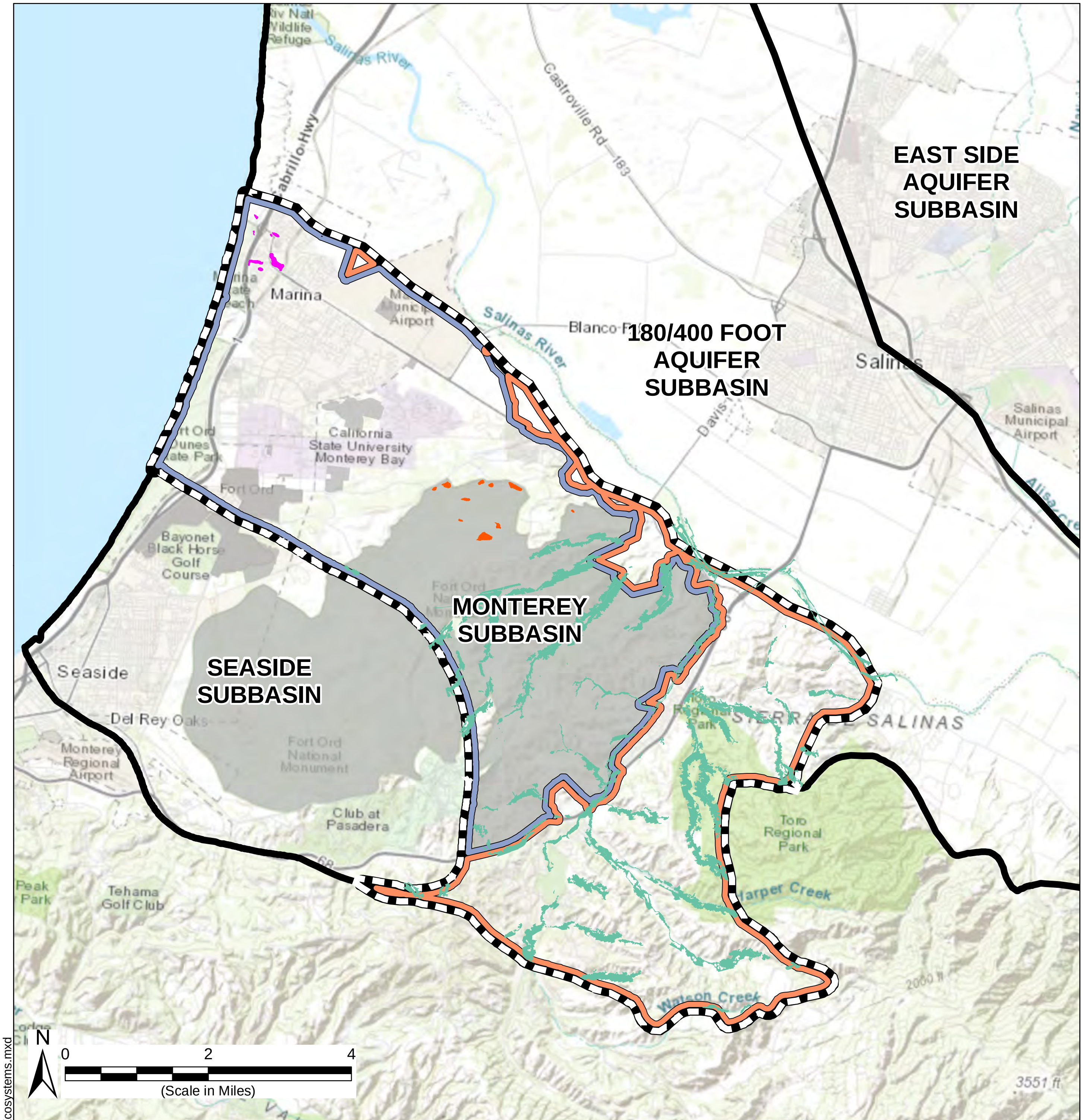
The areas in the Monterey Subbasin where GDEs may be found are in the Vernal Pools, along the lower reaches of Toro Creek, and in the Salinas River where it crosses into the Subbasin. These areas are likely supported by saturated, shallow alluvium, but more investigation is needed to determine whether a continuous saturated zone connects to the principal aquifer(s). This area will require more analysis into the near surface stratigraphy to determine the connection of the principal aquifer to surface water.

Figure 5-37 shows the distribution of potential GDEs within the Subbasin based on the Natural Communities Commonly Associated with Groundwater (NCCAG) Dataset (DWR, 2020b). The NCCAG dataset maps vegetation, wetlands, springs, and seeps in California that are commonly associated with groundwater. These include: (1) wetland features commonly associated with the surface expression of groundwater under natural, unmodified conditions; and (2) phreatophytes. This map does not account for the depth to groundwater or level of interconnection between surface water and groundwater. Actual rooting depth data are limited and will depend on the plant species and site-specific conditions, and availability to other water sources.

The NCCAG dataset and the additional shallow groundwater analysis are not a determination of GDEs by DWR or the GSAs, but rather represent the best available data to provide a starting point for this GSP, as well as to direct monitoring, fill data gaps, guide implementation, and support other field activities initiated or partnered by the GSAs. Field data are needed to ascertain the degree to which identified ecosystems are groundwater dependent, rather than sustained by soil moisture.

Additional resources that contributed to an initial mapping of GDE locations are the CDFW Vegetation Classification and Mapping program (VegCAMP), the USFWS National Wetlands Inventory, and the USFWS online mapping tool for listed species critical habitat, as described in the methodology for the NCCAG development which is publicly accessible on the NC dataset website: https://gis.water.ca.gov/app/NCDatasetViewer/.

Figure 5-37 shows the distribution of potential GDEs within the Subbasin based on DWR's mapping of "Natural Communities Commonly Associated with Groundwater" (NCCAG), modified by information from local habitat management plans and studies. Three GDE and potential GDE units were identified in the Monterey Subbasin and are described below.



Path: X:\B60094\Maps\2021\09\Fig5-37_Groundwater Dependent Ecosystems.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Federal Land

Potential GDEs

Marina Vernal Ponds

Fort Ord Wetland and Open Water Communities

Riparian Wetlands and Vegetations

Management Areas

Marina-Ord Area

Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 1 December 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
3. Potential GDEs based on DWR NCCAG dataset (https://gis.water.ca.gov/app/NCDatasetViewer/) and local habitat management documents (WRA, 2020; FORA, 2019)

Abbreviations

NCCAG = Natural Communities Commonly Associated with Groundwater

GDE = Groundwater Dependent Ecosystem

Notes

1. All locations are approximate.

Potential Groundwater Dependent Ecosystems

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 5-37

5.7.1 Coastal Vernal Ponds within the City of Marina

Vernal ponds are located in the northwestern portion of the Subbasin within the City of Marina. These vernal ponds are "seasonal ponds which expand during the wet season and support marshy wetlands much of the years" (City of Marina, 2013). A recent study conducted by the WRA Environmental Consultants (2020) identified the hydrologic conditions of the Marina vernal ponds and included site visits in June 2020. The study concluded that the ponds rely upon groundwater and should therefore be considered GDEs (WRA, 2020).

WRA observed five aquatic and three upland biological communities at the six ponds. Among those communities were Willow Riparian Forest, Coastal Freshwater Marsh, and Costal Saltwater Marsh communities totaling 19.51 acres. These communities were observed with features that are dependent upon groundwater. Specifically, species that rely on a source of year-round water supply were identified within each pond. A high-water level was observed at each pond similar to the groundwater elevations in the Dune Sand Aquifer. All ponds except for Pond 5 contained open water at the time of the site visit in June 2020.

The study concluded that vegetation associated with the GDEs at these ponds was in good condition.

5.7.2 Wetlands and Open Water Communities Within the Former Fort Ord

Several wetland and open water communities, including vernal ponds and freshwater marshes, are located in the northeastern Fort Ord area (ICF, 2019). There are no shallow groundwater data available in the vicinity of these wetland and open water communities within the former Fort Ord. Therefore, additional shallow groundwater information and field reconnaissance is necessary to verify the existence of these potential GDEs, and whether they constitute true GDEs.

These potential GDEs within the former Fort Ord are located within the federal land areas of the Subbasin not subject to SGMA. Several of these communities are located within the Fort Ord Munition Response Area where munition investigation activities that may disturb these wetlands have been carried out by FORA under the Environmental Services Cooperative Agreement (ESCA) with the Army. These communities as well as other natural resources within the former Fort Ord are being managed and monitored by the USACE, FORA, and ESCA Remediation Response (RP) Team pursuant to the Fort Ord Habitat Management Plan (HMP; USACE, 1997), the FORA Habitat Conservation Plan (HCP; FORA, 2019), and the US Fish and Wildlife Service (USFWS) Biological Opinions (BOs) applicable to Fort Ord. The HMP and BOs identify mitigation measures to minimize impacts during pre-disposal activities. The HCP supersedes the HMP as the primary species and habitat conservation planning document for non-Federal recipients of Fort Ord lands.

5.7.3 Riparian Wetlands and Vegetations

Areas of riparian wetlands and vegetation near local streams and creeks have been identified as NCCAG within the Subbasin. The NCCAG datasets are based on aerial imagery interpretation and are not verified with field studies. These potential GDEs need to be combined with additional analyses to determine whether these wetlands and vegetation are truly groundwater dependent.

Additional shallow groundwater data and field reconnaissance are necessary to verify whether these communities truly rely on groundwater and whether shallow groundwater that these locations are connected with one of the principal aquifers, as not all riparian ecosystems are groundwater dependent; some may be sustained by soil water content. As discussed above, riparian areas that appear to have near-surface groundwater (within 20 feet of land surface) within the principal 400-Foot/Aromas Sands/Paso Robles Aquifer are only identified along El Toro Creek. Insufficient shallow well data are available to sufficiently confirm the depth to groundwater near these potential GDEs.

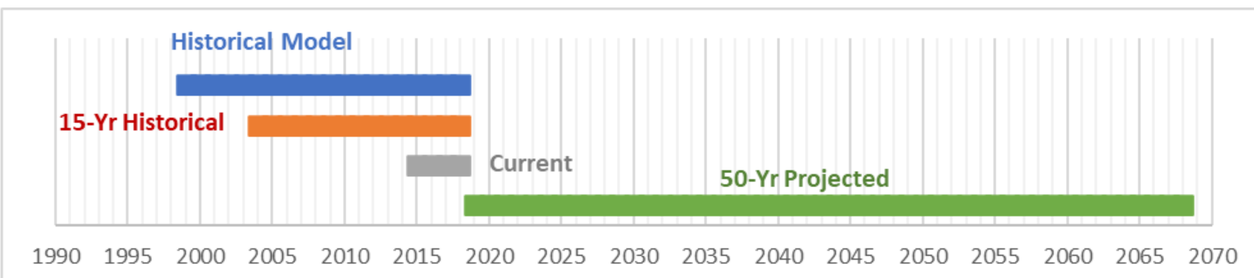
Therefore, these GDE units remain as potential GDEs and should be verified by additional shallow groundwater data in the vicinity of these units, updated field methodologies, and on-the-ground tracking.

6 WATER BUDGET INFORMATION

This section presents information on the water budget for the Monterey Subbasin (Subbasin). Consistent with the Groundwater Sustainability Plan (GSP) Emergency Regulations §354.18 (23-California Code of Regulations [CCR] Division 2 Chapter 1.5 Subchapter 2) and California Department of Water Resources' (DWR) Water Budget Best Management Practices (BMP) (DWR, 2016b), this water budget provides an accounting of the total annual volume of water entering and leaving the Subbasin for historical, current, and projected future conditions.

Three water budget time periods are presented herein:

- A historical water budget period representing 15 years of historical hydrology for the period Water Year[24] (WY) 2004-2018 and calibrated to historical data[25];
- A current conditions water budget period representing average conditions over a recent four-year period (WY 2015-2018), validated against recent data; and
- A 50-year projected water budget period (WY 2019-2068), which results presented as averages for comparison to historical and current conditions.



As discussed in Section 6.1 below, detailed historical and current water budgets are presented for both the land surface system (e.g., precipitation, applied water, and plant evapotranspiration [ET]) and groundwater system (e.g., pumping, cross-boundary flows). To facilitate planning for future sustainability, this GSP also assesses potential future groundwater conditions under various scenarios.

Water budgets for each timeframe are presented for the Subbasin as a whole. In addition, zone budgets are presented for each management area. The Reservation Road portion of the Corral de Tierra has, however, been grouped with the Marina-Ord Area zone budget as it has similar hydrostratigraphy and groundwater from the Marina-Ord Area flows through this area into the

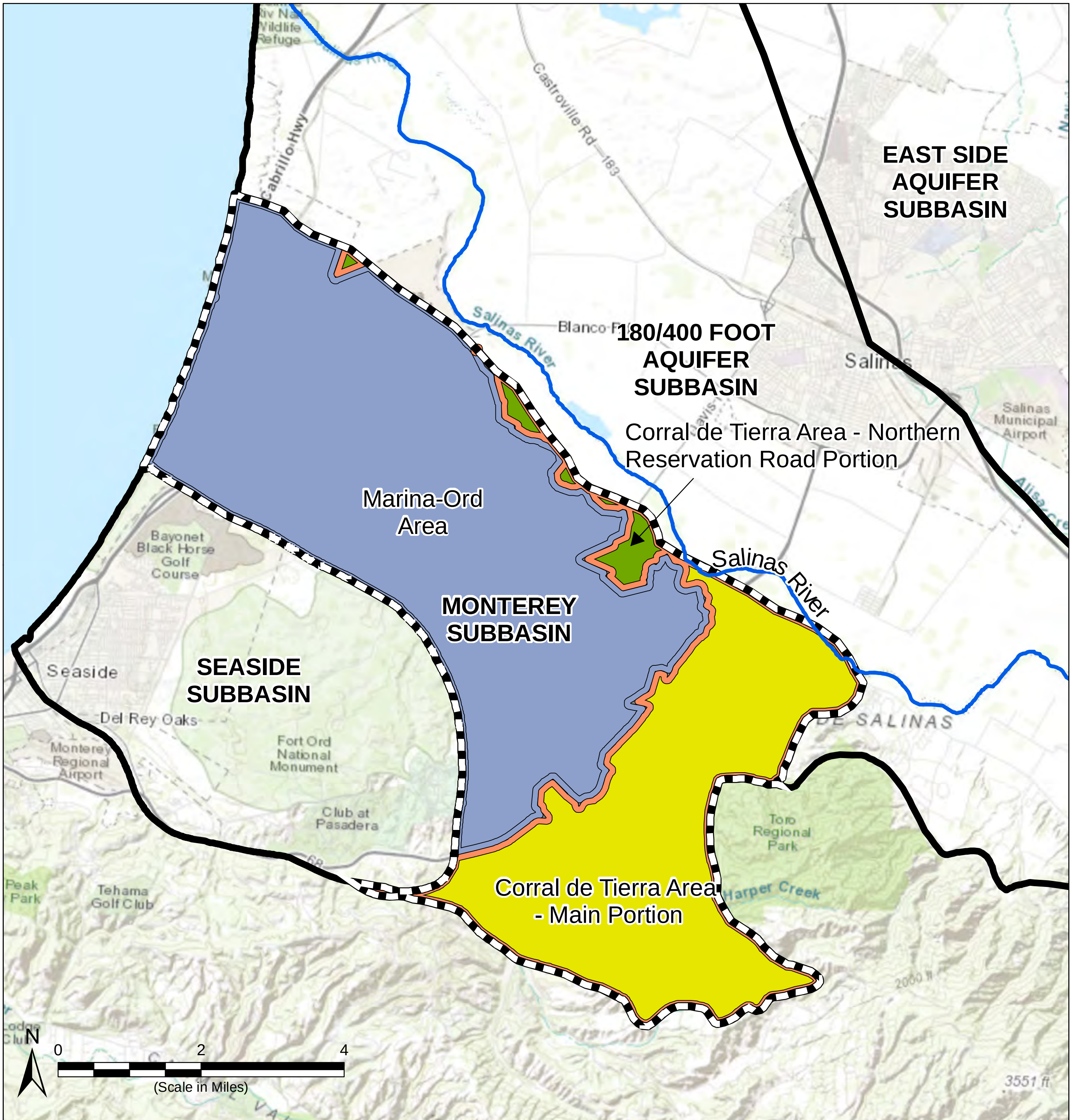
[24] The DWR-defined Water Year runs from October of the previous year to September of the current year (e.g. Water Year 2015 is October 1, 2014 – September 30, 2015.

[25] The historical model spans the 20-year period WY 1999-2018 and includes a five-year equilibration period (WY 1999 – 2003) before historical water budget information is reported. The historical model is calibrated to observed water levels within the Basin from October 1999 – September 2018.

180/400-Foot Aquifer subbasin, without a significant change in storage. As such, zone water budgets are presented for the following areas, as shown on Figure 6-1:

- A basin-wide water budget encompassing the entire Subbasin;
- The Marina-Ord Area – water budget zone (WBZ) includes the Marina-Ord Area as well as the Reservation Road portion of the Corral de Tierra Area, as they share the same principal aquifers;
- The Corral de Tierra Area - Water Budget Zone includes the main portion of the Corral de Tierra Area underlain by the El Toro Primary Aquifer System.

A breakout of the water budget for the Reservation Road portion of the Corral de Tierra Area is included in Appendix 6-A for informational purposes.



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Salinas River

Management

Marina-Ord

Corral de Tierra

Water Budget Zones

Marina-Ord

Corral de Tierra Area - Main Portion

Corral de Tierra Area - Northern Reservation Road Portion

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Water Budget Zones

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

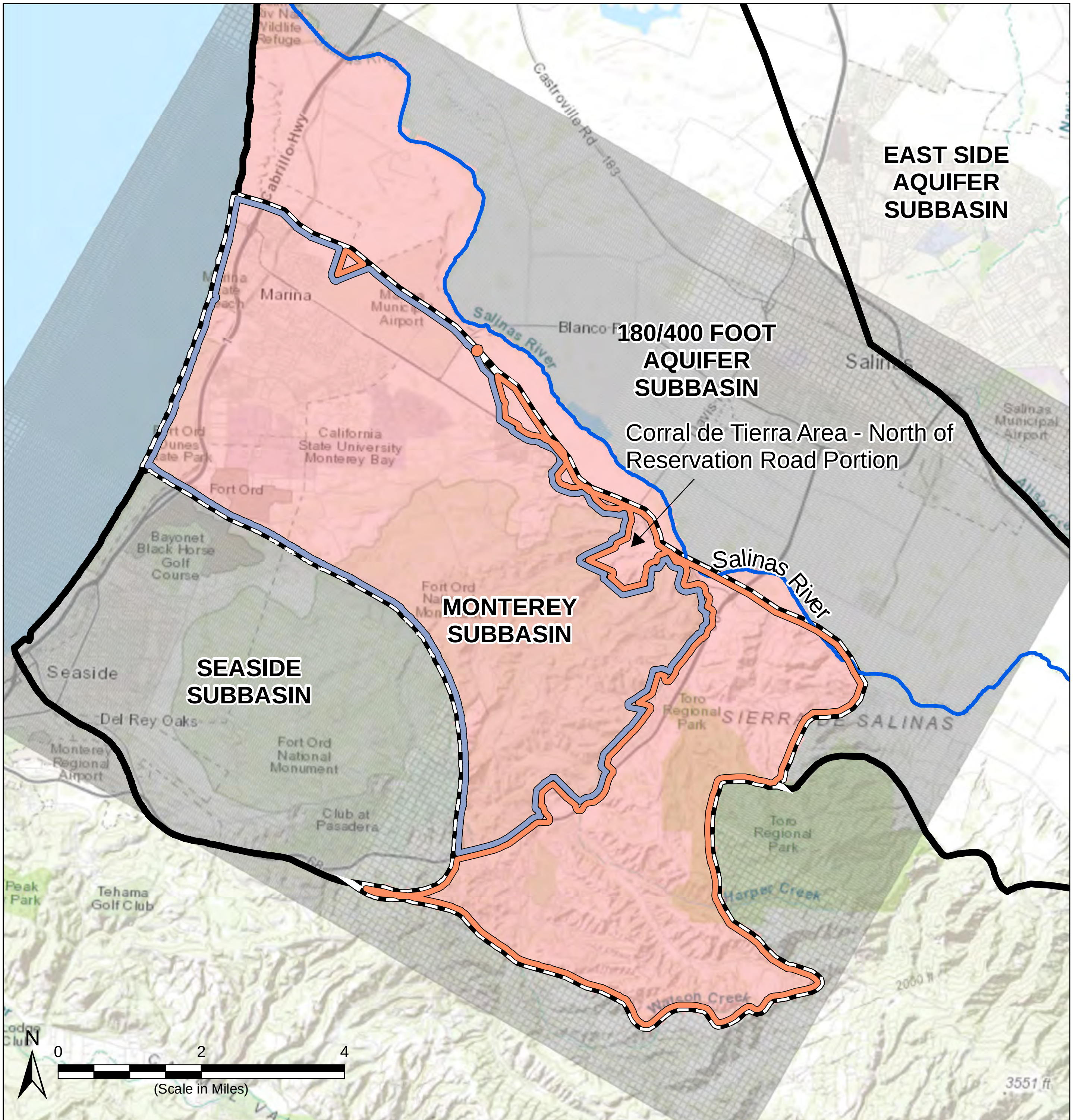
Figure 6-1

Path: X:\B60094\Maps\2021\09\Fig6-1_WaterBudgetZones.mxd

6.1 Water Budget Method

The water budget information presented herein is based on the use of a numerical groundwater flow model developed for the Subbasin, the Monterey Subbasin Groundwater Flow Model (herein referred to as "Monterey Subbasin Model" or "MBGWFM")[26]. The MBGWFM uses the United States Geological Survey (USGS) Newton formulation of the Modular Three-Dimensional Groundwater Modeling platform (MODFLOW-NWT) platform to solve the governing groundwater flow equations. The MBGWFM divides the spatial model domain of the Subbasin into a gridded network of cells, applies data-driven assumptions of groundwater system properties at those cells, applies stresses such as recharge and pumping, and calculates groundwater levels in the cells and groundwater fluxes between cells by solving a system of equations based on groundwater flow principles. Figure 6-2 shows the active extent of the MBGWFM grid.

[26] The SVIHM encompasses the entire Salinas Valley Groundwater Basin and was used to develop water budgets for other Salinas Valley Groundwater Basin GSPs. However, the MCWD GSA and SVBGSA did not select the SVIHM for the Monterey Subbasin as the SVIHM does not accurately reflect hydrologic conditions within the Monterey Subbasin. A detailed discussion of the SVIHM's and the MBGWFM's current construction and calibration results can be found in a technical memorandum presented to the SVBGSA Advisory Committee on April 2, 2021 (Appendix 6-C).



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Salinas River

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Monterey Subbasin Groundwater Flow Model

- Active Model Grids
- Inactive Model Grids

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Monterey Subbasin Groundwater Flow Model Grid Extent

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 6-2

Path: X:\B60094\Maps\2021\09\Fig6-2_ModelGrid.mxd

Details on the MBGWFM development are provided in Appendix 6-B. Key aspects of the MBGWFM include:

- Grid whose active extent covers the entire extent of the Subbasin, as defined by DWR, as well as a small portion of the 180/400-Foot Aquifer Subbasin south of the Salinas River;
- Eight model layers representing the primary aquifer and aquitards in the Subbasin consistent with the Subbasin's Hydrogeological Conceptual Model (HCM), which includes the Dune Sand Aquifer, Salinas Valley Aquitard, Upper 180-Foot Aquifer, 180-Foot Aquitard, Lower 180-Foot Aquifer, 180/400-Foot Aquitard, 400-Foot Aquifer, and Deep Aquifers (the latter two layers together represent the El Toro Primary Aquifer System within the Corral de Tierra Area);
- Transient boundary conditions tied to historical water level observations within the 180/400-Foot Aquifer Subbasin, simulated water levels from the Watermaster's Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018) , and freshwater equivalent sea levels along the Monterey Coast;
- Transient simulation of Salinas River flows and surface water-groundwater interactions using MODFLOW's River (RIV) package;
- Spatially variable groundwater recharge based on the soil moisture budget accounting model (SMB); and
- Groundwater pumping from Marina Coast Water District (MCWD) production wells based on pumping records, pumping from Corral de Tierra Area wells estimated by the Wallace Group for the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA), and other production wells in the active portion of the 180/400-Foot Aquifer Subbasin based on Monterey County Water Resources Agency (MCWRA) pumping records.

Model calibration is an assessment of how a model simulates observed historical conditions. Generally, a model's calibration is evaluated through calibration error statistics – statistics of the normalized magnitude of the error between simulated water levels and observed water levels. A general rule of thumb in assessing model calibration is that the model is considered calibrated when the normalized calibration error statistics[27] are less than 10%. As discussed in Appendix 6-B, the MBGWFM has been calibrated against 30,354 historical water level measurements to achieve normalized calibration error statistics of less than 2% and thus adequately represents the historical conditions of the Subbasin. Therefore, it is appropriate to use the MBGWFM to estimate water budgets for the Monterey Subbasin.

Water budget information is extracted from simulated model results for the spatial and temporal domain of interest. The land surface processes (e.g., precipitation, applied water, and plant

[27] Calibration error statistics include mean absolute residual, residual standard deviation, root mean squared error (RMSE), and coefficient of determination (R-squared).

evapotranspiration [ET]) are simulated by the SMB. The SMB calculates deep percolation on a grid cell basis, which is then specified as recharge in the MBGWFM. Similarly, the SMB calculates private irrigation pumping as the residual ET demand on irrigated lands that is unmet by precip and deliveries of municipal water. Private irrigation pumping reflects the demand of the private well owners located in North of Reservation Road portion of the Corral de Tierra Area. Therefore, the land surface processes are integrated into the groundwater system processes. To quantify all required water budget components as specified in the GSP Emergency Regulations (CCR §354.18(b), this GSP presents results from both the SMB for the land surface system and the MBGWFM for the groundwater system.

6.1.1 Data Sources

Per 23-CCR §354.18(e), the best-available data were used to evaluate the water budget for the Subbasin and include the following:

- Precipitation records, mapped to the MBGWFM grid, from the 4-kilometer Parameter-elevation Regressions on Independent Slopes Model (PRISM)[28] dataset, *Daily, October 1998 – September 2018*
- Reference ET Data from California Irrigation Management Information System (CIMIS) Salinas North #116 and Laguna Seca #229 stations; *Daily, October 1998 – September 2018*
- Spatial Land Use Data including:
    - MCWD current land use survey from the District's 2020 Water Master Plan, *Static, March 2020*
    - DWR historical land use survey, *Static, Fall 2014.*[29]
    - U.S. Department of Agriculture (USDA) Forest Service Region 5 Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG)[30] dataset for Zone 5 (Central Valley), *Static, March 2020*
- Pumping Records including:
    - MCWD pumping volumes from District-owned production wells from the District's internal operations records, *Monthly, October 1998- September 2018*.
    - MCWRA pumping volumes from production wells within the active model portion of the 180/400-Foot Aquifer Subbasin, *Monthly, October 1998- September 2018*.
    - Estimated Corral de Tierra pumping is based on extraction reported to MCWRA and State Water Resources Control Board (SWRCB) where data are available, and

[28] https://prism.oregonstate.edu/recent/
[29] Available online at https://gis.water.ca.gov/app/CADWRLandUseViewer/
[30] Available online at https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192

is approximated based on the number of deliveries for the small water systems and parcel size for the *de minimis* users (i.e., domestic wells).

- Historical Groundwater Level Records from selected wells within the Monterey and 180/400-Foot Aquifer Subbasins; *Seasonal, Fall 1998 – Spring 2018 (data availability varies by well)*
- Delivery Records including:
  - MCWD delivery volumes from the District's internal operations records, *Monthly, October 1998 – September 2018*
  - Delivery volumes for the California American Water (Cal Am) and California Water Service (CWS) service areas within the Subbasin, compiled by the Seaside Watermaster, *Monthly, October 1998 – September 2018*
- Salinas River Flow Data from the USGS Spreckels Gauge #11152500, *Monthly, October 1998 – September 2018*
- Various SMB input datasets, including:
  - Soil properties (i.e., hydrologic group, wilting point, field capacity, soil porosity, saturated hydraulic conductivity, and depth) from the United States Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO)
  - Curve numbers for runoff for agriculture, urban, and native vegetation classifications including conifer forest/woodland, hardwood forest/woodland, mixed conifer and hardwood forest/woodland, shrub, herbaceous, and barren from USDA, 1989, and
  - Crop coefficients and canopy storage properties for native, agricultural, and urban land use types from California Polytechnic State University's Irrigation Training and Research Center (ITRC)
- Model outputs from the Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018), used to simulate cross-boundary subsurface flows with the Seaside Area Subbasin.

6.2 Water Budget Components

Principal components of the Subbasin water budget have been classified into (1) land surface system and (2) groundwater system categories, and are described in detail below.

6.2.1 Land Surface System Water Budget Components

The SMB accounts for most processes relevant to the land surface system budget quantification, including the following:

Precipitation within the Subbasin is available as a 4-kilometer gridded dataset from PRISM. Precipitation falling on Basin lands serves to wet the near-surface soil and then either evaporates, contributes to crop or natural vegetation water demand, or when intense enough, percolates through the root zone to eventually recharge groundwater. The SMB uses daily precipitation rates estimated by PRISM, which provides a representation of the spatial distribution of precipitation over the entire extent of the Subbasin.

Applied Water is a combination of (1) MCWD deliveries of groundwater pumped from MCWD-owned wells into their distribution system, (2) CWS and Cal Am deliveries of groundwater pumped from CWS and Cal Am wells into their distribution systems, and (3) applied water from private irrigation wells which provide groundwater directly to crops and/or golf courses. MCWD, CWS, and Cal Am deliveries comprise a large majority of total applied water in the Subbasin, and are estimated from the water agencies' local operations records. As outdoor deliveries were not specifically tabulated in the operations records, it was assumed that 25% of total deliveries during the summer irrigation period (i.e., April through September) were used to meet outdoor demands, consistent with information provided in the MCWD Urban Water Management Plan (UWMP) (Schaff & Wheeler, 2021). Private irrigation pumping is limited to the ~230 acres of agricultural lands north of the Monterey Subbasin boundary and in the North of the Reservation Road portion of the Corral de Tierra Area, as well as the Corral de Tierra Country Club, and is calculated by the SMB as the residual crop water demand during the summer irrigation period after accounting for contributions from precipitation.

ET is estimated by the SMB for all land use classes using a crop coefficient method, where reference ET data from the two CIMIS stations proximate to the Subbasin are scaled by land-use specific, monthly crop coefficients. The SMB also incorporates an ET stress function that reduces ET when soil moisture is low (i.e., at the wilting point). The SMB calculates an actual ET rate based on the potential ET and with consideration of the available soil moisture. See Appendix 6-B for details.

Runoff is calculated as the amount of precipitation and applied water that does not infiltrate the soil, but rather drains off the land. The SMB calculates rainfall excess runoff based on the U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) curve number method, with curve numbers a function of land use type, soil hydrologic group, and antecedent moisture. The SMB also calculates saturation excess runoff based on soil depth and porosity, although the occurrence of this type of runoff is very rare (i.e., only occurs on thin, low permeability soils during times of high deliveries of applied water or after intense rainfall events).

Root zone storage is calculated on a running basis throughout each SMB daily time step. It is increased by precipitation and applied water and decreased by ET and recharge. Soil moisture also feeds back into the calculation of curve number runoff and ET, as described above.

Recharge to the groundwater system is calculated by the SMB to occur when soil moisture exceeds the field capacity of the soil, after infiltration of the precipitation remaining after curve number runoff and after ET. Recharge is limited to a fraction of the saturated hydraulic conductivity of soil. When the soil is unable to recharge the entire amount of soil moisture in excess of field capacity, the soil moisture can exceed field capacity, eventually building up to reach soil porosity and causing saturation excess runoff, although such occurrence is very rare, as mentioned above.

Stream-groundwater interactions are calculated by the MBGWFM based on Salinas River stage, assumed streambed properties, and the surrounding model-calculated groundwater levels. More information is provided under the groundwater system below. As discussed in Section 4.3, the El Toro Creek is mostly intermittent and includes a perennial reach below the confluence with Watson Creek. Stream gauge data was unavailable for the El Toro Creek for the historical period and thus El Toro Creek was not directly simulated in the model. Direct modeling of the El Toro Creek will be considered in future model updates and as more information becomes available.

6.2.2 Groundwater System Water Budget Components

The MBGWFM accounts for all water flow processes relevant to groundwater system budget quantification. Some values originate from the SMB, whereas others are direct inputs to or outputs from the MBGWFM.

Recharge from excess precipitation and applied water is calculated by the SMB, as described above. Additionally, leakage from water distribution systems contributes to groundwater recharge. Consistent with information provided in the MCWD UWMP (Schaaf & Wheeler, 2021), leakage is estimated as 5% of the total delivered water to MCWD, CWS, and Cal Am service areas, which are entirely supplied by groundwater.

Groundwater pumping includes pumping from MCWD-owned wells and other water systems and private wells in the Corral de Tierra Area. Figure 6-3 shows MBGWFM simulated groundwater pumping by WBZ and management area. Groundwater pumping from MCWD-owned wells is based on MCWD reported data. Groundwater pumping from wells in the Corral de Tierra Area was estimated by the Wallace Group. Using 2019 as an example historical year, 78% of pumped groundwater in the Corral de Tierra is used by municipal and mutual water systems. The Groundwater Extraction Management System (GEMS) maintained by the Monterey County Water Resources Agency (MCWRA) only covers Zones 2, 2A, and 2B which overlap the Corral de Tierra Area. Therefore, these pumping estimates were calculated also using 2019 pumping reported by public water systems to the state, as well as estimates based on land use type, acreage, parcels, and de minimis use. For parcels that are not included in mutual water systems or municipal water systems, analysis of aerial imagery, parcel size analysis, and engineering judgment were used to estimate extraction by private wells.

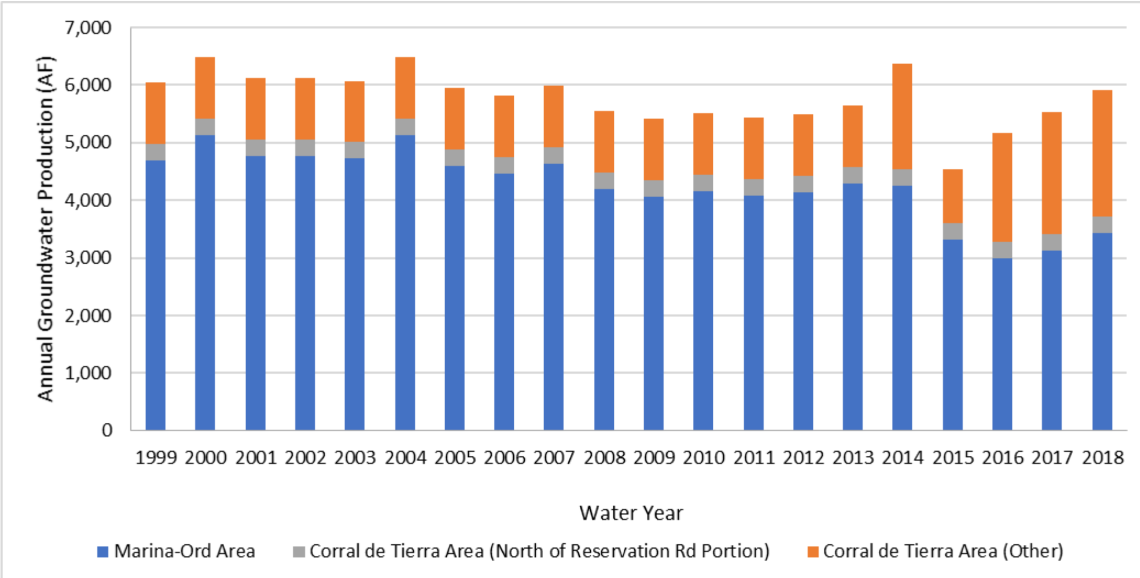


Figure 6-3. MBGWFM Simulated Historical Period Groundwater Pumping

Inter-Basin Cross-Boundary Flow

- Subsurface exchanges with the 180/400-Foot Aquifer Subbasin are calculated by the MBGWFM using a general head boundary condition. The MBGWFM calculates subsurface flow based on observed historical groundwater elevations at wells within the 180/400-Foot Aquifer Subbasin proximate to the northern active model boundary, distances from those wells to the active model boundary, and lateral hydraulic conductivities at boundary cells.

- Subsurface exchanges with the Seaside Area Subbasin are calculated by the MBGWFM using a general head boundary condition. The MBGWFM calculates subsurface flow based on modeled groundwater head outputs at the Seaside boundary from the historical Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018) and lateral hydraulic conductivities at boundary cells. However, as described in Appendix 6B, there are notable differences in hydrogeologic conceptualization and geometry between the MBGWFM and the Seaside Model. The Seaside Model defines aquifer units differently than the MBGWFM and includes a different number of layers. The discrepancies between the two models will be rectified in early GSP implementation to better assess flows between these subbasins.

- Subsurface exchanges with the Pacific Ocean are calculated by the MBGWFM using a constant head boundary condition. The MBGWFM calculates subsurface flow based on freshwater equivalent sea levels along the Monterey Coast[31]. This subsurface flow exchange with the ocean may consist of seawater or freshwater and is not explicitly distinguished within the model.

- Because the Subbasin is bounded on the east and southeast by mostly metamorphic bedrock formations, they are treated as no-flow boundaries and therefore it is assumed that the Subbasin does not receive subsurface inflows from these areas.

Stream-groundwater interactions are calculated by the MBGWFM based on the Salinas River stage, assumed streambed properties, and the surrounding model-calculated groundwater levels. Salinas River stage is directly provided as input to the RIV package of the MBGWFM based on monthly flow measurements recorded at the USGS Spreckels Gauge (Site #11152500). Corresponding stream-groundwater exchanges are calculated based on modeled hydraulic gradients between the streambed and underlying groundwater system. The Salinas River is the only major surface water body explicitly modeled in the MBGWFM. As discussed above, there is currently insufficient data to directly model the El Toro Creek. All other contributing streams to the Subbasin are ephemeral in nature and either flow into the Salinas River during precipitation events or otherwise dry up before leaving the Subbasin, likely contributing to additional groundwater recharge.

Change in groundwater storage is calculated by the MBGWFM by solving the groundwater flow equation. The groundwater storage inflows and outflows extracted from the MBGWFM are referenced to the groundwater storage domain instead of the groundwater system domain. For the purposes of this GSP, change in groundwater storage is calculated as the groundwater system inflows minus the groundwater system outflows. Therefore, a positive change in storage indicates an increase in groundwater storage, and a negative change in storage indicates a decrease in groundwater storage.

Water budget information for the historical and current water budget periods is presented in Section 6.4 below and water budget information for the projected future scenarios is presented in Section 6.5 below.

6.3 Water Budget Time Frames

Time periods must be specified for each of the three required water budgets. The GSP Emergency Regulations require water budgets for historical conditions, current conditions, and projected conditions.

[31] Freshwater equivalent sea levels are calculated based on the equivalent freshwater head formula presented in the Report (USGS, 2002) (see Appendix 6-B, Section 2.4.2.3.2). The depths and distances at which principal aquifer units (namely, the Aromas Sand and Paso Robles Formations) outcrop along the seafloor were estimated to inform corresponding freshwater equivalent heads at the aquifer-seafloor interface.

6.3.1 Historical Water Budget Time Period

23-CCR §354.18(c)(2) requires quantification of historical water budget components for at least the past ten years. Additionally, per DWR's Water Budget BMP, the water budget should represent average hydrology, with both wet and dry years (DWR, 2016b).

The historical water budget is intended to evaluate how past land use and water supply availability has affected aquifer conditions and the ability of groundwater users to operate within the sustainable yield. GSP Emergency Regulations require that the historical water budget include at least the most recent ten years of water budget information. DWR's Water Budget BMP document further states that the historical water budget should help develop an understanding of how historical conditions concerning hydrology, water demand, and surface water supply availability or reliability have impacted the ability to operate the Subbasin within the sustainable yield. Accordingly, historical conditions should include the most reliable historical data that are available for GSP development and water budgets calculations.

As shown on Figure 6-4, the long-term average precipitation on subbasin lands based on PRISM records was 15.46 inches per year (in/yr) between the period of 1896 through 2019. Using these historical rainfall records, a 15-year period representing WY 2004-2018 was defined as the historical water budget period. The average precipitation based on PRISM data over the historical water budget period (WY 2004-2018) is 15.50 in/yr and is similar to the long-term average. This historical water budget time period contains a variety of water year types and therefore adequately represents average hydrologic conditions for purposes of quantifying the historical subbasin water budget.

In addition to the historical water budget and calibration period, a five-year preconditioning period (WY 1998-2003) was established to allow the model to stabilize from initial conditions, resulting in a total 20-year model evaluation period.

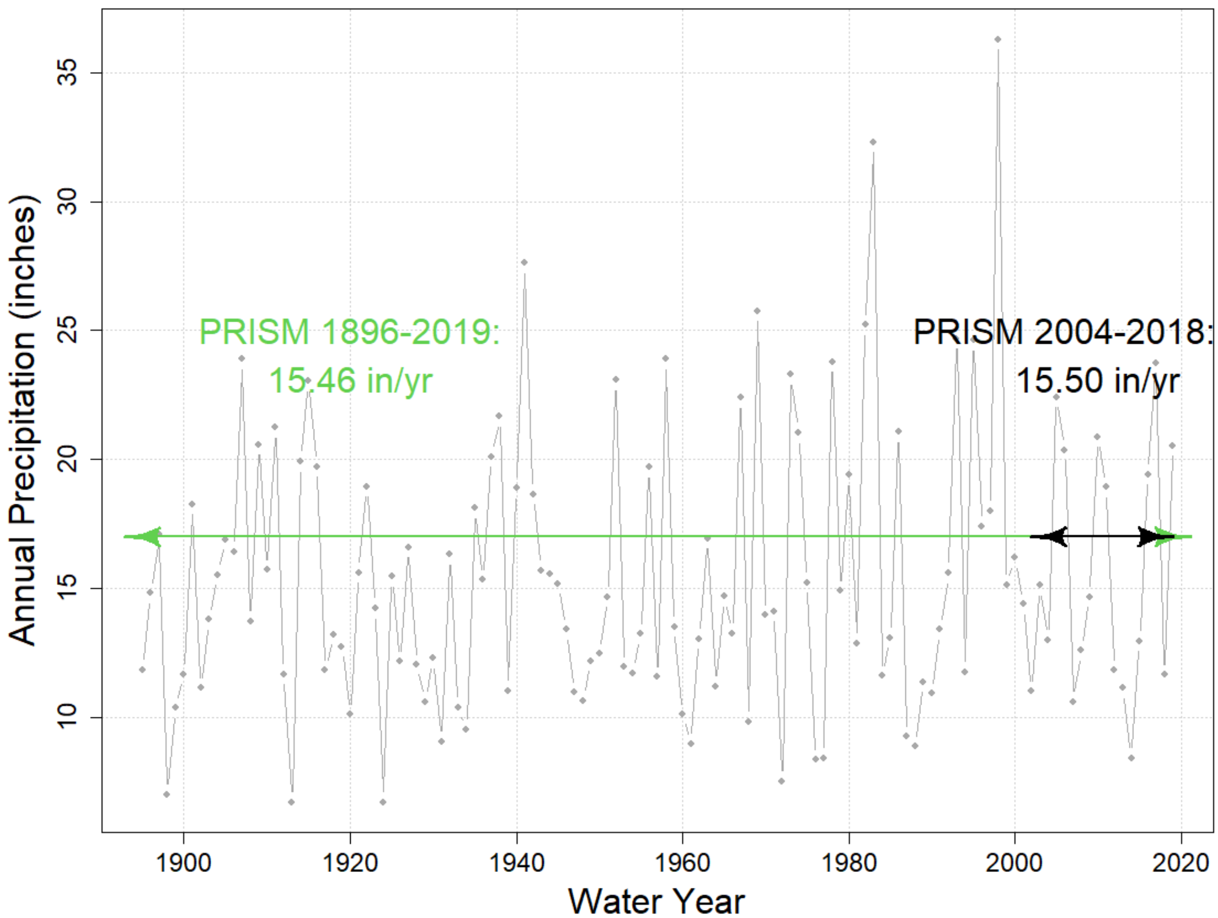


Figure 6-4. Monterey Subbasin Long-Term Precipitation Records

6.3.2 <u>Current Water Budgets Time Period</u>

A four-year period representing WY 2015-2018 was defined as the current water budget period, which is reflective of recent patterns of climate, groundwater use, and boundary conditions. As shown on Figure 6-4, the average precipitation falling on subbasin lands based on PRISM data between WY 2015-2018 was 16.94 in/yr.

The current water budget is intended to allow the Groundwater Sustainability Agencies (GSAs) and DWR to understand the existing supply, demand, and change in storage under the most recent population, land use, and hydrologic conditions. Current conditions are generally the most recent conditions for which adequate data are available and that represent recent climatic and hydrologic conditions. Current conditions are not well defined by DWR but can include an average over a few recent years with various climatic and hydrologic conditions.

6.3.3 Projected Water Budgets Time Period

Per 23-CCR §354.18(e)(2)(A), the projected water budgets must use 50 years of historical precipitation, evapotranspiration, and streamflow information as the basis for evaluating future conditions under baseline and climate-modified scenarios. To develop the required 50 years of projected hydrologic input information, an "analog period" was created by repeating select sequences of the historical hydrologic record in a way that maintains long-term historical average hydrologic conditions, as detailed below.

The projected water budget is intended to quantify the estimated future baseline conditions. The projected water budget estimates the future baseline conditions concerning hydrology, water demand, and surface water supply over a 50-year planning and implementation horizon. It is based on historical trends in hydrologic conditions which are used to project forward 50 years while considering projected climate change and sea-level rise if applicable.

To develop the required 50 years-worth of hydrologic input information, first an "analog period" was created from 20 years-worth of historical information (WY 1999-2018) by combining the years in a specific way that, on average, maintained the long-term average hydrologic conditions. This approach allowed for the creation of a complete 50-year period to inform the projected water budget analysis, even when certain component datasets were not available for that length of time. The sequence of actual years that were combined to create the 50-year analog period is as follows:

- Analog Years 1-20: Based on actual years 1999-2018
- Analog Years 21-40: Based on actual years 1999-2018
- Analog Years: 41-50: Based on actual years 1999-2008

The above mapping of actual years to analog years within the required 50-year projected water budget period applies to precipitation and ET datasets.

6.4 Historical and Current Water Budget

This section presents water budget results from the calibrated MBGWFM and associated SMB. Results are presented below in terms of both annual values and averages during the historical water budget period (WY 2004–2018) and the current water budget period (WY 2015-2018).

Historical and current water budget information is presented for the following areas as shown on Figure 6-5 through Figure 6-7:

- The basin-wide water budget encompassing the entire subbasin (Section 6.4.1);
- The Marina-Ord Area – Water Budget Zone (Marina-Ord Area WBZ) which includes the Marina-Ord Area as well as the Reservation Road portion of the Corral de Tierra Area (Section 6.4.2); and

- The Corral de Tierra Area – Water Budget Zone (Corral de Tierra Area WBZ) which includes the main portion of the Corral de Tierra Area underlain by the El Toro Primary Aquifer System (Section 6.4.3).

6.4.1 Basin-Wide Water Budget

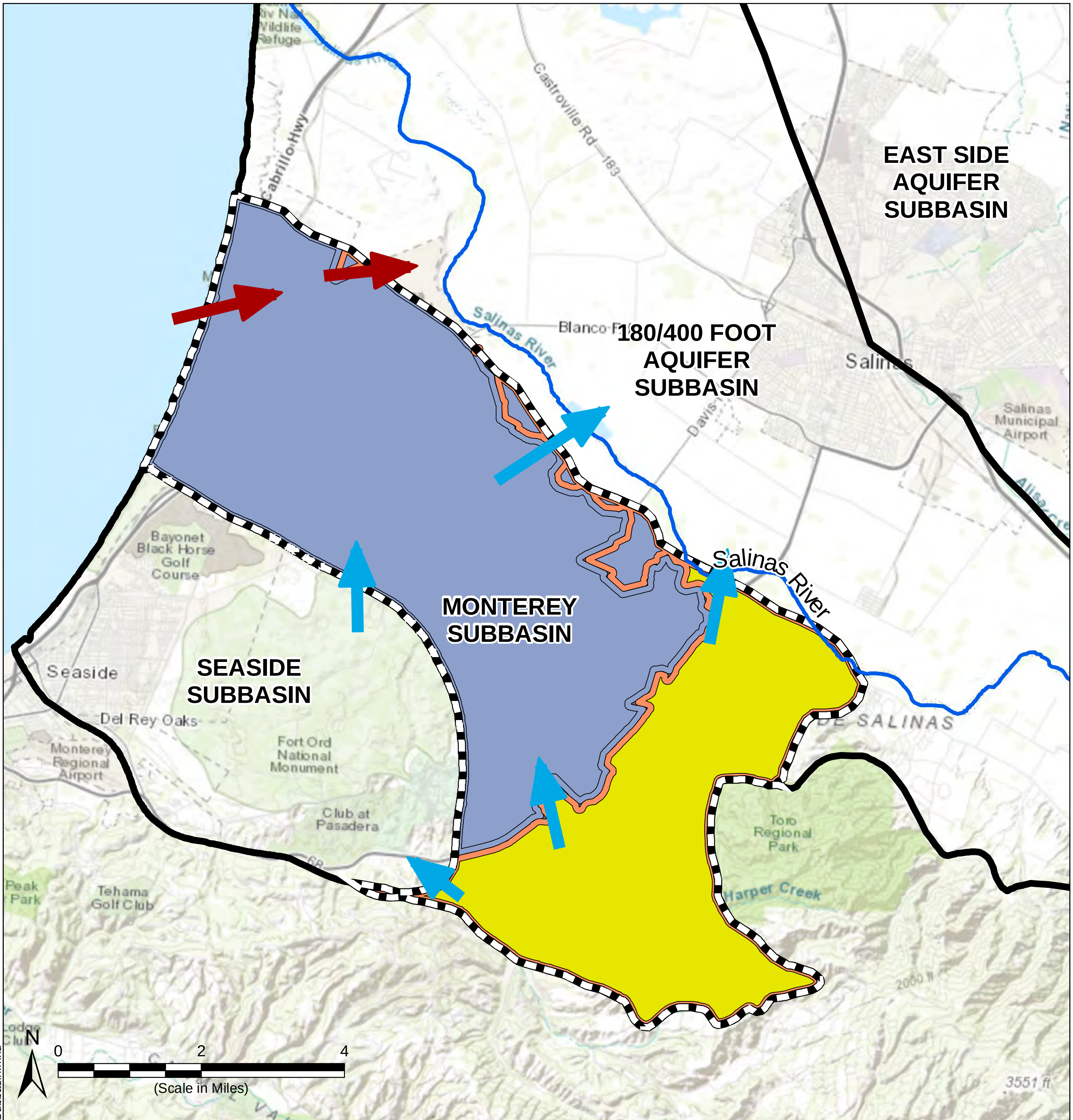
Table 6-1 summarizes inflows to and outflows from the basin-wide groundwater system by water source type during the historical water budget period (WY 2004–2018) and the current water budget period (WY 2015-2018). Water budget components include: recharge, well pumping, net inter-basin flow, and net river exchange. Positive values indicate a net inflow to the Monterey Subbasin and negative values indicate a net outflow from the Subbasin. Further description regarding the modeling of each of these water budget components is described Section 6.2 and provided in Appendix 6-B.

Table 6-1. Historical and Current Groundwater Water Budget Results, Monterey Subbasin

Net Annual Groundwater Flows (AFY) (a)	Historical Annual Inflows/Outflows WY 2004 – 2018	Current Annual Inflows/Outflows WY 2015 – 2018
Recharge		
• Rainfall, leakage, irrigation	**10,055**	**12,060**
Well Pumping		
• Well Pumping	**-5,641**	**-5,274**
Net Inter-Basin Flow (Presumed Freshwater) (b)		
• Seaside Subbasin	918	1,334
• 180/400-Foot Aquifer Subbasin	-9,393	-9,307
• Ocean	-524	-574
	-8,999	**-8,547**
Net Inter-Basin Flow (Presumed Seawater) (b)		
• 180/400-Foot Aquifer Subbasin	-2,872	-3,258
• Ocean	2,872	3,258
	0	**0**
Net Surface Water Exchange		
• Salinas River Exchange	**151**	**153**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-4,434**	**-1,609**

Notes:

(c) Positive values indicate a net inflow and negative values indicate a net outflow.
(d) All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400-Foot Aquifer Subbasin boundary, as evidenced by negligible expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period. See further discussion in Section 6.4.1.1.3.



Path: X:\B60094\Maps\2021\09\Fig6-5_GW_Flow_Comp_MontereySubbasin.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Salinas River

Management Areas

- Marina-Ord
- Corral de Tierra

Groundwater Flow Direction

- Freshwater
- Seawater

Water Budget Zones

- Marina-Ord
- Corral de Tierra Area - North of Reservation Road Portion
- Corral de Tierra Area - Main Portion

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 6 December 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Example Schematic of Groundwater Flow Components, Monterey Subbasin

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 6-5

6.4.1.1 Historical Water Budget

6.4.1.1.1 Recharge

Estimated average annual recharge to the Subbasin during the historical period was 10,055 AFY. This recharge was estimated utilizing the SMB and incorporates land surface system processes and estimated leakage of total delivered water by MCWD. Outputs from the SMB are included in Appendix 6-A.

6.4.1.1.2 Well Pumping

The estimated average annual well pumping in the Subbasin during the historical period was 5,641 AFY. It includes pumping from MCWD-owned wells and pumping from other water systems and private wells in the Corral de Tierra Area.

This value is significantly less than the estimated annual recharge to the Subbasin (10,055 AFY) during the historical period. The annual well pumping value is negative in Table 6-1 as it represents an outflow from the Subbasin.

6.4.1.1.3 Net Inter-basin Flows

Net annual inter-basin flows represent the sum of inflows and outflows along the entire boundary of each adjacent subbasin and the ocean. They represent the aggregate groundwater flow in all principal aquifers across a given boundary. The basis for calculating these flows and calibrating conditions along each of the model boundaries during the historical and current period is outlined in Section 6.2.2 and described in Appendix 6-B.

Estimated net inter-basin flows include:

- Subsurface groundwater flows between the Monterey Subbasin and the adjacent subbasins including the Seaside Subbasin and the 180/400-Foot Aquifer Subbasin and
- Subsurface groundwater flows between the Monterey Subbasin and the ocean.

They are further subdivided by type (i.e., presumed freshwater and presumed seawater). Although the MBGWFM does not specifically distinguish between seawater and freshwater, freshwater and seawater inflow and outflow components can be estimated based on the following assumptions:

- Inflows into the Monterey Subbasin across the ocean boundary are 100% seawater, as ocean water is presumed to saline.
- Outflows from the Monterey Subbasin across the ocean boundary are 100% freshwater, because outflows to the ocean generally only occur within the Dune Sand Aquifer which contains freshwater (see Appendix 6-A and Section 5.3.3).

- Seawater inflows into the Monterey Subbasin during the historical period were equivalent to seawater outflows to the 180/400-Foot Aquifer Subbasin, as (1) there has been negligible expansion of the seawater intrusion front within the Monterey Subbasin over the historical period and (2) groundwater from the coastal portion of the Monterey Subbasin flows toward the 180/400-Foot Aquifer Subbasin in the lower 180-and 400-Foot aquifers where seawater intrusion has been observed.

Figure 6-5 depicts the general direction of inter-basin cross boundary flows between the subbasins and the ocean, including the direction of presumed freshwater and seawater inflows and outflows from the Subbasin. The estimated magnitude of each of these inter-basin cross boundary flows are itemized in Table 6-1 and described below.

Based on the assumptions above, it is estimated that net annual freshwater outflows from the Monterey Subbasin averaged 8,999 AFY during the historical period. These net annual freshwater outflows consisted of the following inter-basin flows:

- 918 AFY of net annual inflows from the Seaside Subbasin into the Monterey Subbasin. These flows are represented as positive in Table 6-1 because they represent an inflow from the Seaside Subbasin into the Monterey Subbasin. The estimated magnitude of these inflows is generally consistent with those estimated by the Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018) over the same time period (i.e., 935 AFY) (see Appendix 6-B). However, as discussed in Section 6.2.2, the MBGWFM will be refined within the first five years of GSP implementation to better characterize and improve the accuracy of these estimated cross boundary flows with respect to the model layers, formations, and principal aquifers.

- 9,393 AFY of net outflows from the Monterey Subbasin into the 180/400-Foot Aquifer Subbasin. These flows are identified as negative in Table 6-1 as they represent an outflow from the Monterey Subbasin. These estimated outflows are very significant and are reflective of the large inland gradients that exist between the Monterey subbasin and the 180/400-Foot Aquifer Subbasin. 180/400-Foot Aquifer Subbasin

- 524 AFY of net outflows from the Monterey Subbasin into the ocean. These outflows generally occur within the Dune Sand Aquifer (see Appendix 6-A), which contains fresh water and has seaward hydraulic gradients.

Estimated net annual seawater inter-basin flows averaged 0 AFY. Based on model results, the magnitude of these net annual seawater flows consisted of the following:

- 2,872 AFY of net seawater inflows into the Monterey Subbasin from the ocean. The majority of these inflows occur within the Lower 180- and 400-Foot Aquifers where seawater intrusion is occurring.

- 2,872 AFY of net seawater outflows from the Monterey Subbasin into the 180/400-Foot Aquifer Subbasin. The magnitude of these presumed seawater inter-basin outflows is assumed to be equivalent based on estimated inflows into the Monterey Subbasin across the ocean boundary, given that there has been negligible expansion of the seawater intrusion front within the Monterey Subbasin over the historical period.

6.4.1.1.4 Net River Exchange

The estimated annual net river exchange was 151 AFY over the historical period. It represents inflows to the Subbasin that occur along the Salinas River, which intersects the Subbasin in a small portion of the Corral De Tierra Area[32].

6.4.1.1.5 Net Annual Change in Groundwater Storage

Change in groundwater storage is the sum of all flow components pertaining to the groundwater system as shown in Table 6-1. Although estimated groundwater recharge (10,055 AFY) exceeded pumping in the Monterey Subbasin (5,651 AFY) during the historical period, the net estimated annual change in groundwater storage in the Monterey Subbasin was -4,434 AFY. This value is negative indicating a loss of storage during the historical period. Inter-basin outflows accounted for the majority of the Subbasin's groundwater outflow over the historical period. Net inter-basin outflows (8,999 AFY) well exceeded groundwater pumping and were close to total estimated recharge in the Subbasin. These estimated outflows are reflective of the large inland gradients that exist between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin. As discussed in Chapter 5, groundwater levels in the 180/400-Foot Aquifer Subbasin are more than 40 feet below sea level in the 180- and 400-Foot Aquifers and have recently declined to over 100 feet below sea level in the Deep Aquifers. Although there are also areas of the Monterey Subbasin where groundwater levels are below sea level, groundwater levels in the 180/400-Foot Aquifer Subbasin are significantly lower and draw groundwater inland. Meanwhile, groundwater levels in the southern Corral de Tierra Area, which lies in the upland portions of the Monterey Subbasin can be as high as 800 ft above sea level. As such, very significant hydraulic gradients exist between the Corral de Tierra Area and the 180/400-Foot Aquifer Subbasin. These water budget results demonstrate the relationship and interdependence between inter-basin inflows, outflows, and the Subbasin water budget and the need for coordinated sustainable groundwater management in all of these subbasins.

The loss in storage is reflected in the groundwater level declines that have been observed in the 400-Foot Aquifer and Deep Aquifers within the Marina-Ord Area and within the El Toro Primary Aquifer in the Corral de Tierra Area. The negative net annual change in storage indicates that the Monterey Subbasin was in overdraft during the historical period.

---

[32] Stream gauge data was unavailable from El Toro Creek for the historical period, and thus El Toro Creek was not directly simulated in the model.

6.4.1.2 Current Water Budget

The current basin-wide water budget is based upon water years (WY) 2015 through 2018 and is also presented in Table 6-1. The current water budget includes the same water budget components as the historical water budget (see Section 6.2) but characterizes basin conditions over a much shorter period of time. The current period includes one wet year (2017), two above normal years (2016 and 2018), and one dry year (2015). Although the current water budget includes both dry and wet years, average precipitation during this period (16.94 in/yr) was higher than the historical period (15.50 in/yr). As such, recharge was much higher than during the historical period. The magnitude of other groundwater budget components include: well pumping, net freshwater inter-basin flows and net river exchange stayed relatively constant with historic values, which resulted in a much smaller net annual change in groundwater storage (-1,609 AFY) during the current period. However, this value is likely not representative of long-term conditions as it is not reflective of the long-term hydrologic cycle.

6.4.2 The Marina-Ord Area – Water Budget Zone

Table 6-2 summarizes the Marina-Ord Area WBZ budget during the historical water budget period (WY 2004–2018) and current water budget period (WY 2015-2018). Similar to the basin-wide budget, water budget components included in the Marina-Ord Area WBZ include: recharge, well pumping, and net inter-basin flow. In addition, the Marina-Ord Area WBZ includes estimated net intra-basin flows from the Corral de Tierra Area. There is no surface water exchange component as the Salinas River does not extend into the Marina-Ord Area WBZ.

Positive values in Table 6-2 indicate a net inflow to the Marina-Ord Area WBZ and negative values indicate a net outflow from the Marina-Ord Area WBZ. Further description regarding the modeling of each of these water budget components is described Section 6.2 and provided in Appendix 6-B.

Table 6-2. Historical and Current Groundwater Water Budget Results, Marina-Ord Area

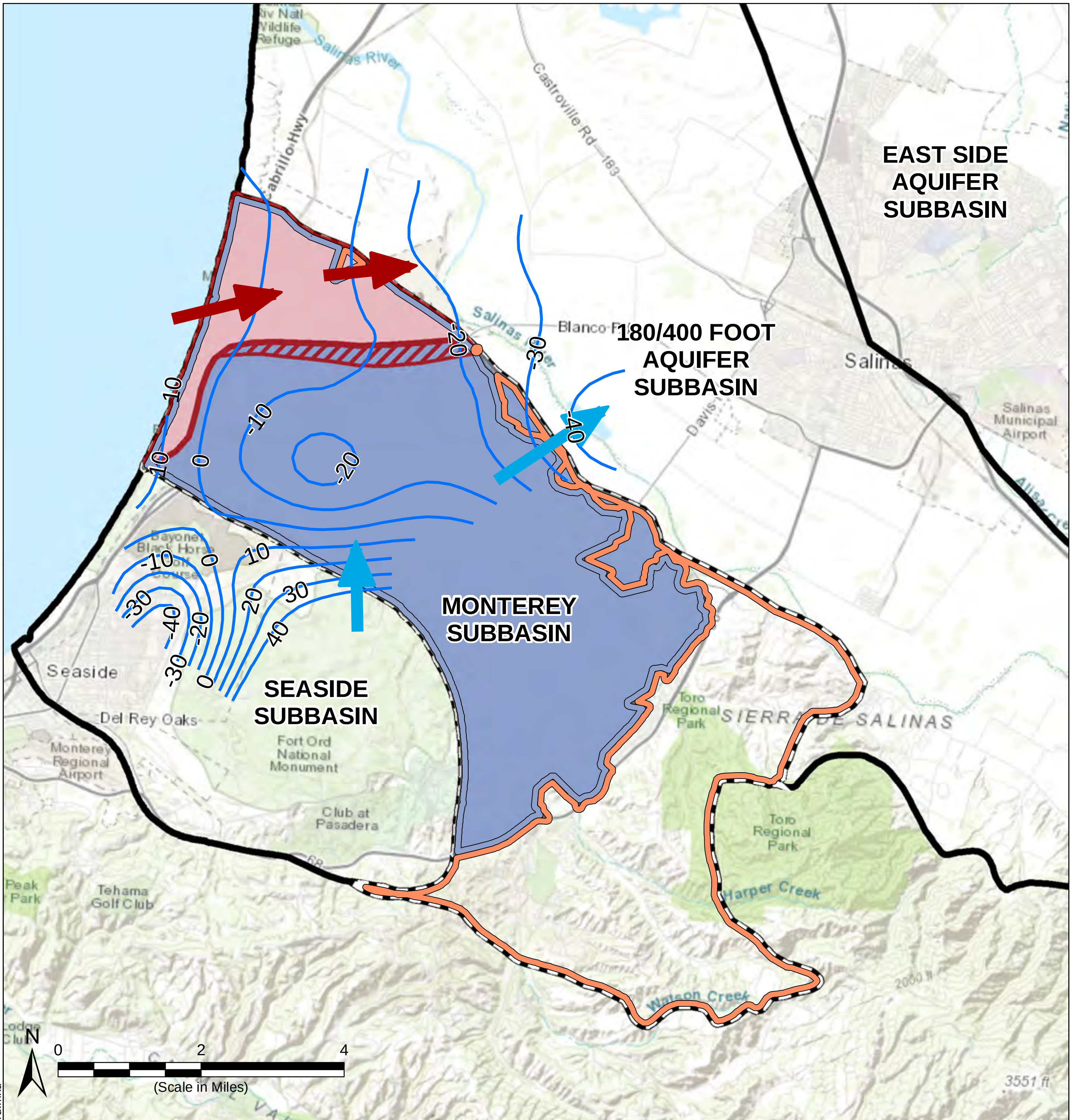
Net Annual Groundwater Flows (AFY) (b)	Historical Annual Inflows/Outflows WY 2004 - 2018	Current Annual Inflows/Outflows WY 2015 - 2018
Recharge		
● Rainfall, leakage, irrigation	**6,144**	**7,624**
Well Pumping		
● MCWD (180-Foot and 400-Foot Aquifers)	-1,797	-773
● MCWD (Deep Aquifers)	-2,262	-2,445
● Reservation Road Portion	-287	-285
	-4,346	**-3,503**
Net Inter-Basin Flow (Presumed Freshwater) (c)		
● Seaside Subbasin	1,310	1,715
● 180/400-Foot Aquifer Subbasin	-5,761	-6,450
● Ocean	-524	-574
	-4,975	**-5,308**
Net Inter-Basin Flow (Presumed Seawater) (c)		
● 180/400-Foot Aquifer Subbasin	-2,872	-3,258
● Ocean	2,872	3,258
	0	**0**
Net Intra-basin Flow		
● Corral de Tierra Area (Water Budget Zone)	**1,544**	**1,397**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-1,632**	**209**

Notes:

(a) The Marina-Ord Area Zone Budget includes inflows to and outflows from the portion of Corral de Tierra that is north of Reservation Rd.

(b) Positive values indicate a net inflow and negative values indicate a net outflow.

(c) All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400-Foot Aquifer Subbasin boundary, as evidenced by negligible expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period. See further discussion in Section 6.4.2.1.3.



Path: X:\B60094\Maps\2021\09\Fig6-6_GW_Flow_Comp_Marina-Ord.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

2017 Fall Groundwater Contours in the Lower 180-Foot, 400-Foot Aquifer (NAVD 88)

Management Areas

Marina-Ord Area

Corral de Tierra

Estimated Seawater Intrusion in Monterey Subbasin

Area of Known Seawater Intrusion

Area of Potential Seawater Intrusion

Groundwater Flow Direction

Freshwater

Seawater

Water Budget Zone - Marina-Ord Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 6 December 2021.
2. DWR groundwater basins are based on in California's Groundwater, Bulletin 118 - 2018 Update.

Example Schematic of Groundwater Flow Components, Marina-Ord Area Zone

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 6-6

6.4.2.1 Historical Water Budget

6.4.2.1.1 Recharge

Estimated average annual recharge to the Marina-Ord Area WBZ during the historical period was 6,144 AFY. This recharge was estimated utilizing the SMB and incorporates land surface system processes and estimated leakage of total delivered water by MCWD. Outputs from the SMB are included in Appendix 6-A.

6.4.2.1.2 Well Pumping

Estimated average annual well pumping in the Marina-Ord Area WBZ was 4,346 AFY and included:

- 1,797 AFY by MCWD from the 180- and 400-Foot Aquifers;
- 2,262 AFY by MCWD from the Deep Aquifers; and
- 287 AFY from Corral de Tierra North of Reservation Rd.

The estimated well pumping in the Marina-Ord Area WBZ was significantly lower than the average annual recharge during the historical period. The well pumping values are negative in Table 6-2 as they represent an outflow from the Marina-Ord Area WBZ.

6.4.2.1.3 Net Inter-basin and Intra-basin Flows

Figure 6-6 depicts the general direction of presumed freshwater and seawater cross-boundary flows to and from the Marina-Ord Area WBZ within the Lower 180- and 400- Foot Aquifer zone where the majority of seawater intrusion is occurring. Net inter-basin and intra-basin flows from the Marina-Ord Area WBZ include:

- Presumed freshwater and seawater inter-basin flows between the Marina-Ord Area WBZ, the ocean and adjacent subbasins; and
- Presumed freshwater intra-basin flows between the Marina-Ord Area WBZ and the Corral de Tierra Area WBZ.

The estimated magnitude of each of these net inter- and intra- basin cross boundary flows are itemized in Table 6-2 and described below. These net inter- and intra- basin cross boundary flows represent the aggregate flow in all principal aquifers across each subbasin and management area boundary.

Estimated net annual freshwater inter-basin outflows from the Marina-Ord Area WBZ averaged 4,975 AFY during the historical period. These net annual freshwater outflows consisted of the following inter-basin flows:

- 1,310 AFY of net annual inflows from the Seaside Subbasin into the Marina-Ord Area WBZ.

- 5,761 AFY of net outflows from the Marina-Ord Area WBZ into the 180/400-Foot Aquifer Subbasin.

- 524 AFY of net outflows from the Marina-Ord Area WBZ into the ocean. These outflows generally occur within the Dune Sand Aquifer (see Appendix 6-A), which contains fresh water and has seaward hydraulic gradients.

Estimated net annual seawater inter-basin flows from the Marina-Ord Area WBZ averaged 0 AFY. Based on model results, the magnitude of these net annual seawater flows consisted of:

- 2,872 AFY of net seawater inflows from the Marina-Ord Area WBZ from the ocean. The majority of these inflows occur within the Lower 180- and 400-Foot Aquifers where seawater intrusion is occurring.

- 2,872 AFY of net seawater outflows from the Marina-Ord Area WBZ into the 180/400-Foot Aquifer Subbasin. The magnitude of these presumed seawater inter-basin outflows is assumed to be equivalent based on estimated inflows into the Marina-Ord Area WBZ across the ocean boundary, given that that there has been negligible expansion of the seawater intrusion front within the Marina-Ord Area WBZ over the historical period.

Further quantification of these net cross boundary flows by principal aquifer are provided in Appendix 6-A.

Estimated net annual freshwater intra-basin inflows from the Corral de Tierra Area WBZ into the Marina-Ord Area WBZ averaged 1,544 AFY over the historical period. As discussed in Section 6.4.3, the Corral de Tierra Area WBZ is located in the Santa Lucia range where groundwater naturally flows toward lower lying coastal areas of the Monterey subbasin and the 180/400-Foot Aquifer Subbasin.

6.4.2.1.4 Net Annual Change in Groundwater Storage

Similar to basin-wide water budget results, groundwater recharge (6,144 AFY) exceeded pumping in the Marina-Ord Area WBZ (4,346 AFY) during the historical period. However, the net estimated annual change in groundwater storage in the Marina-Ord Area WBZ was -1,632 AFY. Net inter-basin outflows from the Marina-Ord Area WBZ (4,975 AFY) were very significant. These results demonstrate the relationship and interdependence between inter-basin inflows, outflows, and the Marina-Ord Area WBZ water budget and the need for coordinated sustainable groundwater management in all subbasins.

6.4.2.2 Current Water Budget

The current water budget for the Marina-Ord Area WBZ is based upon water years 2015 through 2018 and is also presented in Table 6-2. The current water budget includes the same water budget components as the historical water budget (see Section 6.2) but characterizes basin conditions over a much shorter period of time. The current period includes one wet year (2017), two above normal years (2016 and 2018), and one dry year (2015). Although the current water budget includes both dry and wet years, precipitation during this period (16.94 in/yr) was higher than the historical period (15.50 in/yr). As such, recharge was much higher than during the historical period. In addition, due to MCWD's water conservation efforts groundwater pumping in the Marina-Ord Area WBZ has decreased since the beginning of the historical period. Average pumping during the current period (3,503 AFY) was lower than average pumping during the historical period (4,346 AFY). These factors resulted in a net increase in groundwater storage (209 AFY) during the current period. However, this value is likely not representative of long- term conditions as it is not reflective of the long-term hydrologic cycle.

The current water budget results also quantify net annual inter-basin flows into the Marina-Ord Area WBZ. These net annual inter-basin flows represent the sum of inflows and outflows along the entire boundary with each adjacent subbasin and the ocean. They represent the aggregate groundwater flow in all principal aquifers across a given boundary.

These water budget results indicate that total net freshwater and seawater annual outflows from the Marina-Ord Area WBZ into to the 180/400-Foot Aquifer Subbasin during the current period were 9,709 AFY. These total net freshwater and seawater annual outflows are substantially higher than those averaged during the historical period (8,633 AFY). This increase in outflows is consistent with observed declines in groundwater levels within the 180/400-Foot Aquifer Subbasin between 2004 and 2018 (see chapter 5). Increased annual outflows from the Marina-Ord Area WBZ to the 180/400-Foot Aquifer Subbasin during the current period resulted in increased inflows from the ocean and the Seaside Subbasin during this period. These results demonstrate the relationship and interdependence between inter-basin inflows and outflows in the Marina-Ord Area and the need for coordinated sustainable groundwater management in all of these subbasins.

6.4.3 The Corral de Tierra Area – Water Budget Zone

Table 6-3 summarizes the Corral de Tierra Area WBZ budget during the historical water budget period (WY 2004–2018) and current water budget period (WY 2015-2018). Similar to the basin-wide budget, water budget components included in the Corral de Tierra Area WBZ include: recharge, well pumping, net inter-basin flow, and net river exchange[33]. In addition, the Corral de Tierra Area WBZ includes estimated net intra-basin flows to the Marina-Ord Area. Positive values indicate a net inflow to the Corral de Tierra Area WBZ and negative values indicate a net outflow from the Corral de Tierra Area WBZ. Further description regarding the modeling of each of these water budget components is described Section 6.2 and provided in Appendix 6-B.

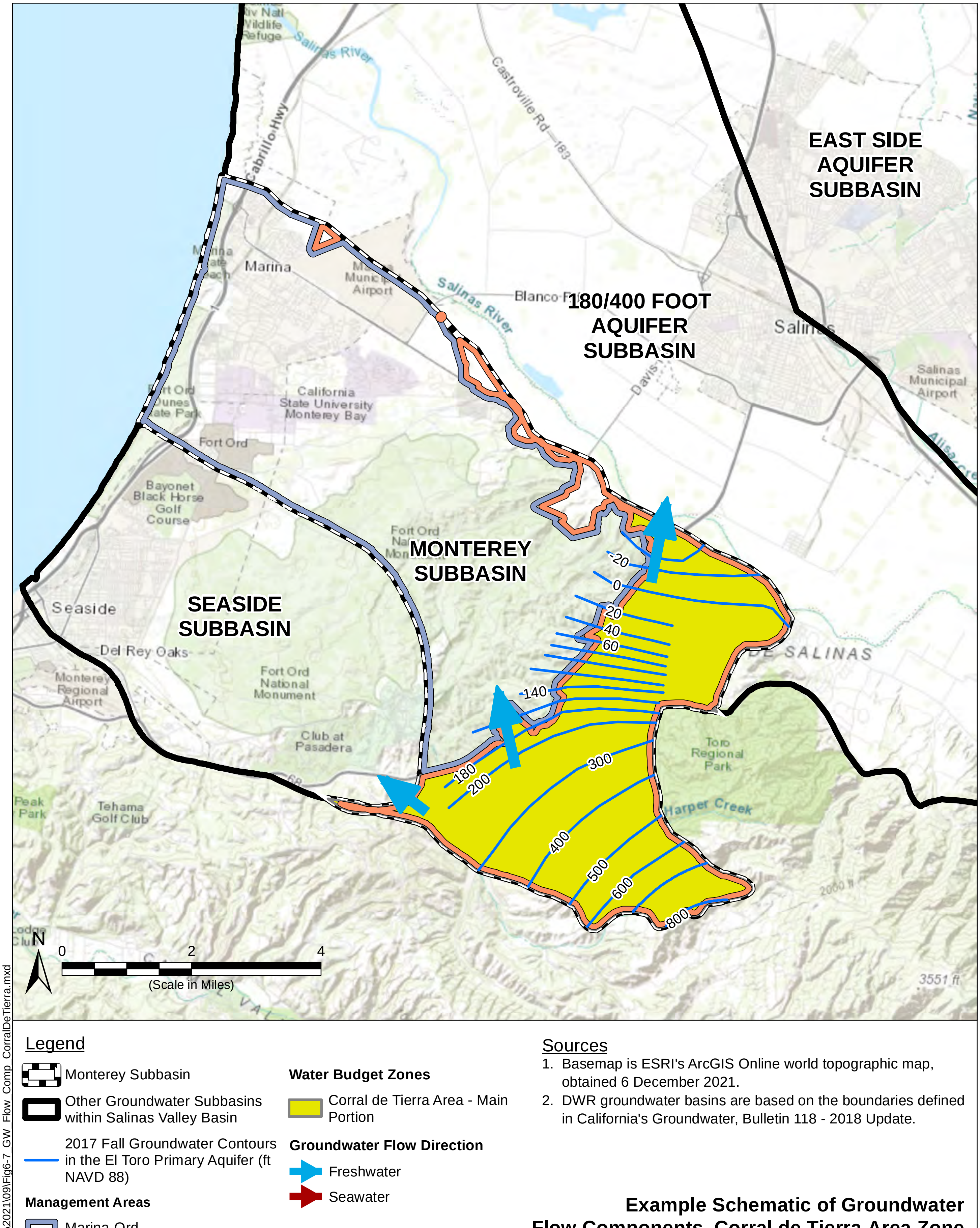
[33] Stream gauge data was unavailable from El Toro Creek for the historical period, and thus El Toro Creek was not directly simulated in the model. The net river exchange values are based on the estimated Salinas River exchange.

Table 6-3. Historical and Current Groundwater Water Budget Results, Corral de Tierra Area Zone

Net Annual Groundwater Flows (AFY) (b)	Historical Annual Inflows/Outflows WY 2004 - 2018	Current Annual Inflows/Outflows WY 2015 - 2018
Recharge		
● Rainfall, leakage, irrigation	**3,910**	**4,435**
Well Pumping		
● El Toro Primary Aquifer System	**-1,296**	**-1,771**
Net Inter-Basin Flow (Presumed Freshwater) (c)		
● Seaside Subbasin	-392	-381
● 180/400-Foot Aquifer Subbasin	-3,632	-2,857
● Ocean	0	0
	-4,024	**-3,238**
Net Intra-basin Flow		
● Marina-Ord Area (Water Budget Zone)	**-1,544**	**-1,397**
Net Surface Water Exchange		
● Salinas River Exchange	**151**	**153**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-2,803**	**-1,818**

Notes:

(a) The Corral de Tierra Area Zone Budget does not include inflows to and outflows from the portion of Corral de Tierra Area that is north of Reservation Rd.
(b) Positive values indicate a net inflow and negative values indicate a net outflow.
(c) Net cross boundary flows are reflective of 100% freshwater as no seawater inflows to the Subbasin reach the Corral de Tierra Area.



Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 6 December 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Example Schematic of Groundwater Flow Components, Corral de Tierra Area Zone

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 6-7

6.4.3.1 Historical Water Budget

6.4.3.1.1 Recharge

Estimated average annual recharge to the Corral de Tierra Area WBZ during the historical period was 3,910 AFY. This recharge was estimated utilizing the SMB and incorporates land surface system processes. Outputs from the SMB are included in Appendix 6-A.

6.4.3.1.2 Well Pumping

Estimated average annual well pumping in the Corral de Tierra Area WBZ during the historical period was 1,295 AFY. The well pumping values are negative in Table 6-3 and represent an outflow from the Corral de Tierra Area WBZ. It is important to note this area is characterized by many domestic wells and small water systems, which have different reporting requirements than other groundwater extractors. This means that pumping in the Corral de Tierra Area is estimated using the known data and may be missing a significant amount of pumping. This is a data gap that will be addressed during implementation as described in Chapter 10.

6.4.3.1.3 Net Inter-basin and Intra-basin Flows

Table 6-3 depicts the general direction of groundwater cross-boundary flows to and from the Corral de Tierra Area WBZ. These cross-boundary flows consist of freshwater flows:

- Between the El Toro Primary Aquifer System in the Corral de Tierra Area WBZ and the multiple principal aquifers in adjacent subbasins; and
- Between the principal aquifers in the Marina-Ord Area WBZ and the El Toro Primary Aquifer System in the Corral de Tierra Area WBZ.

The estimated magnitude of each of these inter- and intra- basin cross boundary flows are itemized in Table 6-3 and described below. These

Estimated net annual freshwater inter-basin outflows from the Corral de Tierra Area WBZ averaged 4,024 AFY during the historical period. These net annual freshwater outflows consisted of the following inter-basin flows:

- 392 AFY of net annual outflows from the Corral de Tierra Area WBZ into the Seaside Subbasin.
- 3,602 AFY of net annual outflows from the Corral de Tierra Area WBZ into the 180/400-Foot Aquifer Subbasin.

Estimated net annual freshwater intra-basin inflows from the Corral de Tierra Area WBZ into the Marina-Ord Area WBZ averaged 1,544 AFY over the historical period. As shown on Figure 4-5, the Corral de Tierra Area WBZ is located in the Santa Lucia Range and land surface elevations ranges from 300 feet to 1,900 feet above mean sea level. Groundwater from this area naturally flows toward lower lying coastal areas of the Monterey Subbasin where the Marina-Ord Area is located and the El Toro Creek Canyon which connects to lower lying areas of the 180/400-Foot Aquifer Subbasin.

6.4.3.1.4 Net Annual Change in Groundwater Storage

Similar to basin-wide water budget results, groundwater recharge (3,910 AFY) exceeded pumping in the Corral de Tierra Area WBZ (1,295 AFY) during the historical period. It is important to note that recharge is not immediately available to the locations and depths of the principal aquifer that are experiencing the most pumping. Recharge and pumping are also not always occurring within the same time periods. In addition, the net estimated annual change in groundwater storage in the Corral de Tierra Area WBZ was -2,803 AFY based on groundwater modeling results, which is over twice the amount of groundwater pumping during this period. This discrepancy is partly due to the data gap related to pumping from small water systems and *de minimis* wells which characterize the area and have different reporting requirements than larger water systems and agricultural users. Net inter-basin outflows from the Corral de Tierra Area WBZ (4,024 AFY) were very significant and close to the area's groundwater recharge. These results demonstrate that extraction data and estimates may underestimate actual extraction in the area and the interdependence of groundwater budgets between subbasins.

6.4.3.2 Current Water Budget

The current water budget for the Corral de Tierra Area WBZ is based upon water years 2015 through 2018 and is also presented in Table 6-3. The current water budget includes the same water budget components as the historical water budget but characterizes basin conditions over a much shorter period of time. Although the current water budget includes both dry and wet years, precipitation during this period (16.94 in/hr) was higher than the historical period (15.50 in/yr). The increased precipitation during this period is the result of higher than average precipitation in the years following the 2012-2016 drought period. As such, recharge was much higher than during the historical period. As shown in Table 6A-3 in Appendix 6-A, groundwater pumping in the Corral de Tierra Area WBZ increased during the period of WY 2004-2018. Therefore, average pumping during the current period (1,771 AFY) was higher than average pumping during the historical period (1,296 AFY). The net change in groundwater storage during the current period (-1,818 AFY) was smaller than that of the historical period (-2,803 AFY).

The current results also indicate that net annual outflows from the Corral de Tierra Area WBZ into to the 180/400-Foot Aquifer Subbasin and the Marina-Ord Area WBZ during the current period were 3,238 AFY and 1,397 AFY, respectively. These total net freshwater annual outflows are lower than those averaged during the historical period. These results indicate that increased groundwater pumping and observed groundwater elevation declines between 2004 and 2018 (see Chapter 5) have resulted in less groundwater leaving the Corral de Tierra Area WBZ. These results demonstrate that extraction data and estimates may underestimate actual extraction in the area, and the degree of interdependence of groundwater budgets between subbasins.

6.5 Projected Water Budget

Per 23-CCR §354.18(e)(2), projected water budgets are required as a way to estimate future conditions of water supply and demand within a basin, as well as the aquifer response to implementation of the Plan over the planning and implementation horizon. To develop the projected water budget, the same tools and methodologies that were used for the historical and current water budget were used, with updated inputs for climate variables (i.e., precipitation and ET), land use (water demand), and future Subbasin boundary conditions. Given that historical water budget results indicate that conditions in the Monterey Subbasin are highly sensitive to conditions in adjacent subbasins, projected water budget results are presented for three alternative sets of boundary conditions in the 180/400-Foot Aquifer Subbasin. These boundary conditions include:

- Minimum Threshold (MT) Boundary Conditions
- Measurable Objective (MO) Boundary Conditions, and
- Seawater Intrusion (SWI) Protective Boundary Conditions.

Each of these boundary condition scenarios is predicated on the assumption that the 180/400-Foot Aquifer Subbasin will be managed to its SMCs over the 50-year projected model period. In addition, boundary conditions for the Seaside Subbasin, which is an adjudicated subbasin, are assumed to remain stable at Fall 2017 levels[34] (as further described in Section 6.5.2).

The chief purpose of this projected water budget analysis is to assess the magnitude of the net water supply deficit that would need to be addressed through Projects and Management Actions to prevent Undesirable Results (discussed further in Chapters 8 and 9) and achieve the Sustainability Goal. This section describes the development and results of the projected water budget for the entire subbasin and by water budget zones.

6.5.1 Projected Scenarios Data Sources

Per the GSP Emergency Regulations 23-CCR §354.18(c)(3), the projected water budgets must use "50 years of historical precipitation, evapotranspiration, and streamflow" for estimating future hydrology, "the most recent land use, evapotranspiration, and crop coefficient information" for estimating future water demand. To develop the required 50 years of projected hydrologic input information, an "analog period" was created by repeating select sequences of the historical hydrologic record in a way that maintains long-term historical average hydrologic conditions. The analog period used for projected water budget simulations is discussed in detail in Section 6.3.3.

[34] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period. See discussion in Section 6.5.2.

Per 23-CCR §354.18(e), the best-available data were used to develop the projected water budgets for the Subbasin and include the following:

- Monthly Precipitation, ET, and Salinas River flows from the historical simulation period. See Section 6.1.1. for details on the historical data sources.
- Monthly climate change factors for precipitation and ET, and for the 2030 and 2070 Central Tendency scenarios (DWR, 2020). Precipitation and ET climate change factors are spatially variable and mapped to a variable infiltration capacity (VIC) grid. Climate change factors for the VIC grid cells which intersect the Subbasin were used to vary historical precipitation and ET estimates.
- Future MCWD land use from the District's 2020 Water Master Plan. The historical urban footprint within MCWD was adjusted to include future planned urban developments.
- Future MCWD demands from the District's 2020 UWMP (Schaff & Wheeler, 2021). Projected demands from 2020-2040 were used to adjust groundwater pumping assumptions within MCWD-owned wells and subsequent deliveries of irrigation water in the MCWD service area.
- Water Augmentation Alternatives Study for Former Fort Ord Area (EKI, 2020). Projected recycled water or other augmented supply availability within MCWD was used to develop a "Project" based scenario where future MCWD groundwater demands are partially offset by augmented surface water supplies, as described in detail in Section 9.6.1.
- Water Level Sustainability Criteria for the 180/400-Foot Aquifer Subbasin Representative Monitoring Network. Minimum Thresholds and Measurable Objectives defined for nearby representative monitoring sites (RMS) included in the 180/400-Foot Aquifer Subbasin GSP were used to develop projected groundwater elevations along the northern active model boundary.
- Projected Sea Level Conditions from the 180/400-Foot Aquifer Subbasin GSP were used to develop projected sea levels along the Monterey Coast.
- Seaside Basin Groundwater Flow Model. September 2017 historical groundwater elevations output from the Seaside model (Hydrometrics 2009 & 2018) were used to develop projected groundwater elevations at the Seaside Area Subbasin boundary. However, as discussed in Section 6.2.2 and Appendix 6-B, the Seaside Subbasin model represents principal aquifer units differently than the MBGWFM and includes a different number of layers. Therefore, a few simplifying assumptions were made to link head outputs from the Seaside model into each layer of the MBGWFM along the Seaside boundary to ensure cross-boundary flow estimates were in close agreement between the two models. The boundary conditions will be revisited and/or a regional model including both subbasins will be created to address these discrepancies in model layers within this first five years of GSP implementation.

There is less information regarding projected future water demands and land use data available for the Corral de Tierra Area, and as such a few assumptions needed to be made for the model development and projected water budget runs associated with these inputs. Further description regarding each of the assumptions included in projected model simulations is provided below.

6.5.1.1 *Projected Water Demands and Land Use*

Projected basin-wide water demand and land use are based on (a) projected urban development within MCWD's projected future service area through 2040, and (b) current land use and continued pumping in the Corral de Tierra Area at estimated 2018 extraction rates. The 2018 pumping (i.e., 2,474 AFY) is taken from the very end of the current period to best encapsulate the known maximum amount of pumping in the Corral de Tierra Area. It includes ongoing extraction of 286 AFY from the Reservation Road portion and 2,188 AFY from the remainder of the Corral de Tierra Area.

MCWD's projected service area is located within the Marina-Ord Area and portions of the Seaside Subbasin and 180/400-Foot Aquifer Subbasin. Based on information provided in Table 4.10 of MCWD's 2020 UWMP (Schaff & Wheeler, 2021), water demand within the MCWD service area is anticipated to increase from 3,367 AFY in 2020 to 8,314 AFY by 2040[35]. For the purposes of these projected water budgets, it has been assumed that potable water demands for the entire MCWD future service area would be supplied by pumping from existing MCWD wells in the Marina-Ord Area. This groundwater pumping has been divided roughly evenly between the 180/400-Foot Aquifer and Deep Aquifers based on the pumping distributions inferred from MCWD's historical operations.

Projected basin-wide land use was adjusted from historical land use to reflect projected development within MCWD's projected future service area. Land use information was obtained from MCWD's 2020 Water Master Plan, consistent with local land use plans and approved development. As discussed above in Section 6.2.1, this projected land use data serves as an input to the SMB that calculates projected runoff and recharge as a result of land use changes.

6.5.1.2 *Projected Hydrology and Variable Climate Scenarios*

Projected water budget results are presented for three alternative sets of hydrology and climate conditions which have been identified as:

- Baseline (Historical Analog) Conditions
- 2030 ("Near future") Climate Conditions, and
- 2070 ("Late future") Climate Conditions

[35] An additional 1,270 AFY are anticipated to be met by recycled water or other augmented surface water supplies, to meet a total demand of 9,584 AFY by 2040.

To develop the required 50 years-worth of hydrologic input information, first an "analog period" was created from 20 years-worth of historical information (WY 1999-2018) by combining the years in a specific way that, on average, maintained the long-term average hydrologic conditions. This approach allowed for the creation of a complete 50-year period to inform the projected water budget analysis, even when certain component datasets were not available for that length of time. The analog period used for projected water budget simulations is discussed in detail in Section 6.3.3.

- Baseline Climate Scenario: As discussed in Section 6.3.3, a 50-year analog period was created to inform the project water budget analysis. This hydrologic input information was developed using a sequence of historical hydrologic input information that reflects the Subbasin's long-term average hydrologic conditions.
- 2030 Climate Change Scenario: In order to estimate the potential effects on the projected water budget of climate change during GSP implementation period (i.e., between 2020 and 2040), a water budget scenario based on 2030 climate change factors published by DWR was developed. For this scenario, precipitation and ET were both adjusted using the monthly 2030 change factors published by DWR. Constant head boundary conditions along the Monterey Coast are adjusted using projected 2030 sea levels.
- 2070 Climate Change Scenario*:* In order to estimate the potential effects on the projected water budget of climate change towards the end of the planning and implementation horizon (i.e., 50 years out into the future), a water budget scenario based on 2070 "central tendency" climate change factors published by DWR was developed. It should be noted that estimates of climate change impacts on water supplies this far into the future have significant uncertainty. For this scenario, precipitation and ET were both adjusted using the monthly 2070 "central tendency" change factors published by DWR. Constant head boundary conditions along the Monterey Coast are adjusted using projected 2070 sea levels.

6.5.1.3 Projected Subbasin Boundary Conditions

Historical water budget results demonstrate that conditions in the Monterey Subbasin are highly sensitive to conditions in adjacent subbasins. As such, projected water budget results are presented for three alternative sets of boundary conditions in the 180/400-Foot Aquifer Subbasin, which have been identified as:

- Minimum Threshold (MT) Boundary Conditions
- Measurable Objective (MO) Boundary Conditions, and
- Seawater Intrusion (SWI) Protective Boundary Conditions.

Each of these boundary condition scenarios is predicated on the assumption that the 180/400-Foot Aquifer Subbasin will be managed to its SMCs over the 50-year projected model period. In addition, it has been assumed that the Seaside subbasin, which is an adjudicated subbasin, will be managed such that groundwater levels remain stable at 2017 levels into the future.

The 180/400-Foot Aquifer Subbasin has been designated as a critically overdrafted subbasin by DWR, and is subject to the Sustainable Groundwater Management Act (SGMA). The GSP for the 180/400-Foot Aquifer Subbasin establishes MTs and MOs for both groundwater levels and seawater intrusion. These SMCs have been utilized to simulate potential future boundary conditions along the 180/400-Foot Aquifer Subbasin for the projected water budget. Groundwater levels along the northern active model boundary (just north of the Monterey Subbasin boundary) were established as follows over the 50-year projected model period for each boundary condition scenarios:

- MT Boundary Condition: Groundwater levels in RMS wells located near the Monterey Subbasin are raised from 2018 model predicted values to water level MTs established in the 180/400-Foot Aquifer GSP during the 20-year GSP implementation period (i.e., between 2020 and 2040) and then kept constant for the following 30 years of the projected model period.
- MO Boundary Condition: Groundwater levels in RMS wells located near the Monterey Subbasin raised from 2018 model predicted values to water level MOs following their five year interim milestone (IM) trajectories established in the 180/400-Foot Aquifer GSP during the 20-year GSP implementation period (i.e., between 2020 and 2040) and then kept constant for the following 30 years of the projected model period.
- SWI Protective Boundary Condition: Groundwater levels along the entire boundary of the Monterey Subbasin and 180/400-Foot Aquifer Subbasin are raised from 2018 model predicted values to levels protective against further seawater intrusion within the 180- and 400- Foot aquifers. These SWI protective elevations are projected over the 20-year GSP implementation period (i.e., between 2022 and 2042). In the absence of the installation of a hydraulic injection and/or extraction barrier, these SWI protective elevations represent the minimum groundwater elevations that would be needed in the coastal portions of the 180/400-Foot Aquifer Subbasin to stop further seawater intrusion consistent with the MTs for seawater intrusion established in the 180/400-Foot Aquifer Subbasin GSP[36]. Seawater intrusion has not been observed to date in the Deep Aquifers. As such groundwater levels in Deep Aquifer RMS wells located near the Monterey Subbasin are set at water level MOs established in the 180/400-Foot Aquifer GSP, consistent with the MO Boundary Condition.

The Seaside Subbasin is subject to adjudication requirements that require that rates of groundwater extraction within the Subbasin not exceed the estimated basin safe yield. For the projected simulations, a simplifying assumption was made that the Seaside Subbasin will maintain Fall 2017 water levels over the long term. As such, September 2017 water level outputs

[36] SWI Protective elevations were calculated for the 180 Foot Aquifers and the 400 Foot Aquifer based upon the *equivalent freshwater head formula presented in the USGS 2002 Report (USGS, 2002)* (see Appendix 6-B, Section 2.4.2.3.2).

from the Seaside Model were used to define specified heads along the Seaside Subbasin boundary for all projected simulations.

One exception to this assumption is along the southeastern edge of the Seaside-Monterey boundary (i.e., near Laguna Seca). In this area, simulated Fall 2017 water levels from the Seaside Model are already below the Minimum Thresholds (MTs), which are based on 2015 groundwater levels for wells in the Corral de Tierra Area. MTs for these wells are 170 feet above mean sea level [ft msl], (see Sections 7 and 8). As such, projected water levels were adjusted to 170 ft msl in the Monterey Groundwater Flow model for boundary cells whose simulated water levels were below 170 ft (see section 2.4.2.2.2 of Appendix 6-B). However, it should be noted that the Seaside Basin Watermaster predictive modeling of the Laguna Seca subarea of the Seaside subbasin found that groundwater levels in the eastern portion of the Laguna Seca subarea could not be managed such that groundwater levels would remain stable, even if all pumping in the Laguna Seca subarea stopped, because of projected declines in groundwater levels in the Corral de Tierra Area. Further analysis of the interconnection between these areas and these boundary conditions will be performed during the early stage of implementation of the GSP.

6.5.2 Projected Water Budget Scenarios

All of the projected water budget scenarios presented in this chapter are based upon projected future water demands and land use changes described in Section 6.5.1 above. They assume that, in the absence of any projects, these projected water demands will be met through groundwater pumping from the Monterey Subbasin. Projected water budgets are provided for project-based scenarios for each management area in Section 9.6.

The "No Project" scenarios do not incorporate the potential benefits of any new projects or management actions. However, these projected water budgets do assume that benefits from the following ongoing projects/management actions will continue into the future:

- *Stormwater Recharge Management* within the Marina-Ord Area (Section 9.4.4, project M1); and
- *MCWD Demand Management Measures* within the Marina-Ord Area (Section 9.4.5, project M2).

Further description of the anticipated benefits of these projects is included in Chapter 9.

Projected water budgets for two "No Project" scenarios have been developed. These projected water budgets assess basin inflows and outflows under a range of potential future boundary conditions and climate conditions described in Section 6.5.1 above. They include:

- "No Project" Scenario with Variable Boundary Conditions: This scenario estimates the projected water budget under variable boundary conditions with the 180/400-Foot Aquifer Subbasin as described in Section 6.5.1.2 including:

- MT Boundary Conditions;
- MO Boundary Conditions, and
- SWI Protective Boundary Conditions.

As described in Section 6.5.1.3, boundary conditions with the Seaside subbasin are kept constant as part of this projected water budget scenario. This water budget scenario does not include the implementation of any new projects. It assumes 2030 Climate Conditions versus Baseline climate conditions, as 2030 Climate conditions (i.e., recharge and seawater level rise) fall within the middle of the range of projected climate scenarios used to estimate basin recharge and seawater level rise. An overview of projected budget results for this scenario is included in Section 6.5.4. Additional details regarding specific inflows and outflow components are detailed in Appendix 6-B.

- "No Project" Scenario with Variable Climate Conditions: This scenario estimates the projected water budget under the variable climate conditions described in Section 6.5.1.3 including:
    - Baseline Climate conditions
    - 2030 Climate Conditions;
    - 2070 Climate Conditions

This water budget scenario does not include the implementation of any new projects. It assumes MO boundary conditions at the 180/400-Foot Aquifer Subbasin boundary, as these boundary conditions fall within the middle of the range of projected boundary conditions. As described in section 6.5.1.3, boundary conditions with the Seaside subbasin are kept constant. An overview of projected budget results for this scenario is included in Section 6.5.4. Additional details regarding specific inflows and outflow components are detailed in Appendix 6-B.

6.5.2.1 Projected Water Budget Scenario Results

Consistent with historical and current water budget results, projected water budget information for each scenario is assessed for:

- The entire Monterey Subbasin;
- The Marina-Ord Area WBZ; and
- The Corral de Tierra Area WBZ.

An overview of these "No Project" water budget results are summarized in the following section and tables.

- Table 6-4 through Table 6-6: "No Project" Scenario with Variable Boundary Conditions and 2030 Climate Condition for Monterey Subbasin, Marina-Ord Area WBZ, and Corral de Tierra Area WBZ;
- Table 6-7: "No Project" Scenario with Variable Climate Conditions and Measurable Objective Boundary Condition for the Monterey Subbasin;

These tables summarize the magnitude of water budget components associated with each projected water budget scenario. The water budget components include: recharge, well pumping, net inter-basin flow, net intra-basin flow[37], and net river exchange. Similar to historical and current water budget results, positive values identified in these tables indicate a net inflow to the Subbasin or WBZ and negative values indicate a net outflow from the Subbasin or WBZ. However, unlike historical and current water budget results, only ocean inter-basin flows are characterized as freshwater or seawater. Net inter-basin flows between subbasins are not subdivided between those that are presumed to be freshwater versus seawater, as it is difficult to predict if seawater inflows from the ocean will continue to pass through the Monterey Subbasin into the 180/400-Foot Aquifer Subbasin as they did during the historical period. It is anticipated that the magnitude and direction of seawater flows could change as the magnitude and direction of inter-basin flows and gradients change. In particular, any inflows within the 180-Foot and 400-Foot Aquifers from the 180/400-Foot Aquifer Subbasin into the Monterey Subbasin are likely to be saline and could cause expansion of the seawater intrusion front in the Monterey Subbasin. Such inflows could occur as a result of increased water levels in the 180/400-Foot Aquifer Subbasin or increases in groundwater extraction within the Monterey Subbasin. As such, projected water budgets should be viewed with caution and cannot be used to assess actual changes in freshwater storage in the Subbasin. However, they can be used to assess overall inflows and outflows from the Subbasin and predict the relative magnitude of seawater inflows from the ocean under each scenario.

In addition, Figure 6-8 through Figure 6-9 identify average projected changes in groundwater elevations at RMS wells within the identified management area WBZs. The figures also identify the average change in water levels required to reach MTs and MOs at RMS wells within the identified management area WBZs. Although not well specific, these graphs indicate if water level MTs and MOs will be reached within the associated management area WBZ.

Due to the strong interdependence of conditions within the Monterey Subbasin and conditions in adjacent subbasins, water budget results are presented for three alternative sets of boundary conditions including:

- MT Boundary Conditions;
- MO Boundary Conditions, and

[37] Intra-basin flows are only included in WBZ water budget tables as they are not relevant to basin-wide results.

- SWI Protective Boundary Conditions.

These alternative boundary conditions are further described in Section 6.5.1.2 above. Each of these conditions is predicated on the assumption that the adjacent Seaside Subbasin and 180/400-Foot Aquifer Subbasin will be managed sustainably as determined in their respective planning documents over the projected 50-year analog period.

For comparison purposes, these results are presented along with the basin-wide water budget for the historical period (WY 2004-2018). 2030 climate conditions have been assumed for all projected water budget boundary condition scenarios. 2030 climate conditions fall within the middle of the range of projected climate scenarios, which are used to estimate basin recharge and seawater level rise. Impacts of climate variability are also assessed based on the baseline, 2030, and 2070 climate Scenarios. However, the projected water budget results indicate that the climate scenarios have a much smaller impact on changes in storage and groundwater levels within the Subbasin than the identified boundary conditions.

The magnitude of each of the budget components is generally described on a basin-wide basis. Predicted net annual changes in storage and changes in groundwater levels are also discussed by management area WBZ, as each management area has its own RMS wells and sustainable management criteria.

Table 6-4. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Monterey Subbasin

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows 2030 Climate Conditions		
		Minimum Threshold Boundary Conditions	Measurable Objective Boundary Conditions	Seawater Intrusion Protective Boundary Conditions
Recharge				
● Rainfall, leakage, irrigation	**10,055**	**10,928**	**10,928**	**10,928**
Well Pumping				
● Well Pumping	**-5,641**	**-10,955**	**-10,955**	**-10,955**
Net Inter-Basin Flow				
● Seaside Subbasin	918	2,414	1,258	-453
● 180/400-Foot Aquifer Subbasin	-12,265	-5,583	-3,412	-295
● Ocean (Presumed Freshwater)	-524	-725	-752	-794
● Ocean (Presumed Seawater)	2,872	2,939	2,369	1,308
	-8,999	**-955**	**-537**	**-234**
Net Surface Water Exchange				
● Salinas River Exchange	**151**	**261**	**254**	**279**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-4,434**	**-721**	**-310**	**18**

Notes:

(b) Positive values indicate a net inflow and negative values indicate a net outflow.

Table 6-5. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows (b) 2030 Climate Conditions		
		Minimum Threshold Boundary Conditions	Measurable Objective Boundary Conditions	Seawater Intrusion Protective Boundary Conditions
Recharge				
● Rainfall, leakage, irrigation	**6,144**	**6,823**	**6,823**	**6,823**
Well Pumping				
● Well Pumping	**-4,346**	**-8,767**	**-8,767**	**-8,767**
Net Inter-Basin Flow				
● Seaside Subbasin	1,310	2,513	1,361	-347
● 180/400-Foot Aquifer Subbasin	-8,633	-3,849	-1,927	1,171
● Ocean (Presumed Freshwater)	-524	-725	-752	-794
● Ocean (Presumed Seawater)	2,872	2,939	2,369	1,308
	-4,975	**878**	**1,051**	**1,338**
Net Intra-basin Flow				
● Corral de Tierra Area (Water Budget Zone)	**1,544**	**923**	**1,026**	**985**
Net Surface Water Exchange				
● Salinas River Exchange	**0**	**0**	**0**	**0**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-1,632**	**-143**	**133**	**379**

Notes:

(a) The Marina-Ord Area Zone Budget includes inflows to and outflows from the portion of Corral de Tierra that is north of Reservation Rd.

(b) Positive values indicate a net inflow and negative values indicate a net outflow.

Table 6-6. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Corral de Tierra Area WBZ

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows (b) 2030 Climate Conditions		
		Minimum Threshold Boundary Conditions	Measurable Objective Boundary Conditions	Seawater Intrusion Protective Boundary Conditions
Recharge				
● Rainfall, leakage, irrigation	**3,910**	**4,105**	**4,105**	**4,105**
Well Pumping				
● Well Pumping	**-1,296**	**-2,188**	**-2,188**	**-2,188**
Net Inter-Basin Flow				
● Seaside Subbasin	-392	-99	-103	-107
● 180/400-Foot Aquifer Subbasin	-3,632	-1,734	-1,485	-1,466
	-4,024	**-1,833**	**-1,588**	**-1,573**
Net Intra-basin Flow				
● Marina-Ord Area (Water Budget Zone)	**-1,544**	**-923**	**-1,026**	**-985**
Net Surface Water Exchange				
● Salinas River Exchange	**151**	**261**	**254**	**279**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-2,803**	**-578**	**-443**	**-362**

Notes:

(a) The Corral de Tierra Area Zone Budget does not include inflows to and outflows from the portion of Corral de Tierra Area that is north of Reservation Rd.

(b) Positive values indicate a net inflow and negative values indicate a net outflow.

Table 6-7. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Climate Conditions and Measurable Objective Boundary Condition, Monterey Subbasin

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows (b) (c) Measurable Objective Boundary Conditions		
		Baseline Climate Conditions	2030 Climate Conditions	2070 Climate Conditions
Recharge				
● Rainfall, leakage, irrigation	**10,055**	**10,152**	**10,928**	**11,952**
Well Pumping				
● Well Pumping	**-5,641**	**-10,955**	**-10,955**	**-10,955**
Net Inter-Basin Flow				
● Seaside Subbasin	918	1,527	1,258	885
● 180/400-Foot Aquifer Subbasin	-12,265	-3,071	-3,412	-3,901
● Ocean (Presumed Freshwater)	-524	-721	-752	-804
● Ocean (Presumed Seawater)	2,872	2,288	2,369	2,534
	-8,999	**24**	**-537**	**-1,286**
Net Surface Water Exchange				
● Salinas River Exchange	**151**	**259**	**254**	**249**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-4,434**	**-520**	**-310**	**-40**

Notes:

(a) Positive values indicate a net inflow and negative values indicate a net outflow.

6.5.3 Projected Annual Basin-Wide Inflows/Outflows

Table 6-4 and Table 6-7 summarize projected annual inflows and outflows from the basin-wide groundwater system by water source type for the "No Project" scenario under variable boundary and climate scenarios.

6.5.3.1 Projected Recharge

Table 6-4 and Table 6-7 indicate that the estimated average annual recharge to the Subbasin during the projected 50-year analog period (10,152 AFY) is generally consistent with the historical period under the baseline climate conditions. Projected recharge in the Subbasin increases by approximately 7.6 percent under 2030 Climate Conditions and by approximately 17.7 percent under 2070 Climate Conditions.

6.5.3.2 Projected Well Pumping

The projected recharge is generally consistent with or exceeds projected average annual well pumping in the Subbasin (10,955 AFY) under the "No Project" scenario. As discussed in Section 6.5.1.1, this well pumping reflects (a) projected water demands within MCWD's projected future service area through 2040, and (b) current land use and continued pumping in the Corral de Tierra Area WBZ at estimated 2018 extraction rates (i.e., 2,188 AFY) and in the Corral de Tierra North of Reservation Portion (i.e., 268 AFY). Total projected pumping rates are higher than pumping rates estimated over the historical period (5,641 AFY).

6.5.3.3 Projected Net Inter-Basin Flows

Projected net annual inter-basin outflows range up to 1,286 AFY for all identified boundary and climate change scenarios presented in Table 6-4 and Table 6-7. These projected net annual inter-basin outflows are significantly below those estimated for the historical period (8,999 AFY). The decrease in net inter-basin outflows principally reflects a reduction in outflows to the 180/400-Foot Aquifer Subbasin. This reduction in outflows is primarily the result of the projected increases in water levels at the boundary of the 180/400-Foot Aquifer subbasin as this basin reaches its determined MTs, MOs and/or SWI protective elevations. The magnitude of these outflows sequentially decreases as water levels at this boundary increase from MTs, to Mos, to SWI protective elevations.

As expected, ocean inflows into the Subbasin also decrease as water levels at this boundary increase from MTs, to MOs, and to SWI protective elevations (see Table 6-7). However, there is little reduction in net ocean inflows between the historical water budget and the projected baseline water budgets under MT or MO boundary conditions. Consistent with historical groundwater flow patterns, it is anticipated that a substantial percentage of ocean inflows will pass through the Monterey Subbasin into the 180/400-Foot Aquifer Subbasin under the MT and MO boundary condition scenarios, as MTs and MOs in the 180/400-Foot Aquifer Subbasin are below sea level near the coast and are generally lower than MT and MOs established within the Monterey Subbasin along the Subbasin boundary. Further, projected water budgets also indicate that substantial groundwater outflows from the Monterey Subbasin continue to occur into the 180/400-Foot Aquifer Subbasin under MT and MO boundary condition scenarios. Estimated ocean inflows are significantly reduced under the SWI protective boundary conditions (i.e., 1,308 AFY under the 2030 climate scenario). Variable climate condition results presented in Table 6-7 indicate that ocean inflows generally increase under 2030 and 2070 climate conditions relative to baseline conditions due to sea-level rise.

All model estimated ocean inflows should, however, be viewed with caution as the MBGWFM is not a dual-density model and therefore cannot accurately assess the seawater/freshwater interface. Monitoring will be used to verify that expansion of the seawater intrusion front does not occur in the Monterey Subbasin consistent with established SMCs.

Projected net annual inflows from the Seaside Subbasin into the Monterey Subbasin also appear to be influenced by projected 180/400-Foot Aquifer boundary conditions. As shown in Table 6-4 and Table 6-7, these net annual inflows:

- Increase relative to historical inflows in the projected water budget for the MT boundary condition scenario;
- Stay in the same range as historical inflows under MO conditions depending on future climate conditions (see Table 6-7); and
- Become slightly negative (i.e., become outflows) under SWI Protective Boundary Conditions and 2030 climate conditions.

However, inflows from the Seaside Subbasin into the Monterey Subbasin will also be significantly influenced by groundwater levels in the Seaside Subbasin, which have been assumed to stay constant at 2017 levels[38]. Further analysis of potential inflows and outflows along the Seaside Subbasin boundary is proposed as part of future modeling efforts identified in implementation action Future Modeling of Seawater Intrusion and Projects, Section 9.5.6.

Further quantification of projected net cross-boundary flows by management area WBZ are provided in Section 6.5.3.3 and are further discussed in Appendix 6-B. Net annual changes in storage and groundwater levels are described by management area WBZ in Sections 6.5.4 and 6.5.5 below.

6.5.3.4 Projected Net River Exchange

The projected estimated annual net river inflows[39] range between 261 and 279 AFY for the variable boundary condition and climate change scenarios presented in Table 6-4 and Table 6-7. These inflows occur in the Corral de Tierra Area WBZ along the Salinas River and are slightly

[38] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period.

[39] Stream gauge data was unavailable from El Toro Creek for the historical period, and thus El Toro Creek was not directly simulated in the model. The net river exchange is based on the Salinas River.

higher than those estimated during the historical period (151 AFY) and are a relatively small component of the Subbasin's water budget.

6.5.3.5 *Basin-wide Projected Net Annual Change in Groundwater Storage*

The net annual change in basin-wide groundwater storage ranges between -721 and 18 AFY for the "No Project" scenario projected boundary condition and climate scenarios presented in Table 6-4 and Table 6-7. The net annual change in groundwater storage is significantly lower than that calculated for the historical period (-4,434 AFY), and indicates that inflows and outflows to the Subbasin would be slightly negative to balanced under this range of boundary and climate conditions. However, further assessment for each management area is required to evaluate where overdraft is occurring within the Subbasin, and to compare projected water levels with management area-specific SMCs to assess the Subbasin sustainable yield. Projected net annual changes in groundwater storage and groundwater levels in the Marina-Ord and Corral de Tierra Area WBZs are provided in Sections 6.5.4.2 and 6.5.4.3, respectively.

6.5.4 Marina-Ord Area WBZ Projected Net Annual Change in Storage and Projected Changes in Water Elevations Relative to SMCs

Table 6-5 summarizes projected annual inflows, outflows, and net change in storage within the Marina-Ord Area WBZ under variable boundary conditions. As shown on this table, the projected net annual change in groundwater storage ranges between -143 and 379 AFY for the "No Project" scenario within the Marina-Ord Area WBZ. The net annual change in groundwater storage is significantly lower than that calculated for the historical period (-1,632 AFY), and indicates that the Marina-Ord Area WBZ inflows and outflows would be essentially balanced under any of these boundary condition scenarios. The climate scenario results presented in Appendix 6-A indicate that this conclusion is true under all identified climate change scenarios. As such, these projected water budget results suggest that this management area will not be in overdraft if adjacent basins are managed sustainably and SMCs are achieved.

However, the potential for expansion of the seawater intrusion front within the Marina-Ord Area WBZ must be considered under projected water budget scenarios. Although ocean (i.e., seawater) inflows into the Marina-Ord Area WBZ are generally equal to or lower than those observed during the historical period, it is difficult to predict if (a) these seawater inflows will continue to pass through the Monterey Subbasin into the 180/400-Foot Aquifer Subbasin as they did during the historical period or if (b) changes in boundary conditions and increased extraction in the Subbasin could cause saline groundwater from the 180/400-Foot Aquifer Subbasin or ocean to flow further inland within the Monterey Subbasin. It is noted that MCWD has significant operational flexibility regarding extraction rates from its wells and could potentially modify the location and depth at which groundwater is extracted to limit such impacts. Further assessment and monitoring are required pursuant to this GSP to verify that expansion of the seawater intrusion front, which has been identified as an undesirable result, does not occur under all future scenarios.

In addition, projected water level elevations for the “No Project” scenario must be compared to water level MTs and MOs established in the Marina-Ord Area WBZ, to determine if projects and management actions need to be implemented to meet these sustainability criteria. Figure 6-8 depicts average projected changes in groundwater elevations at RMS wells in the Marina-Ord Area WBZ under the “No Project” scenario with variable boundary conditions. This figure also identifies the average change in water levels required to reach MTs and MOs at RMS wells in the Marina-Ord Area WBZ.[40] As shown on Figure 6-8, groundwater elevations are projected to stabilize under all boundary conditions scenarios within the first ten years of GSP implementation. However, the resulting average groundwater elevation varies significantly between the various boundary scenarios. The under baseline “no project” scenario results imply that groundwater elevations in RMS wells within the Marina-Ord Area WBZ will:

- generally reach MTs under MT Boundary Conditions, but fall below MTs during drought periods;
- be below MOs under MO Boundary Conditions, and
- be well above MOs and MTs at SWI Protective Boundary Conditions.

Figure 6-9 presents the effects of variable climate scenarios on groundwater elevations within Marina-Ord Area WBZ under the “No Project” scenario with MO Boundary Conditions. This figure indicates that variable climate conditions have limited impacts on projected water levels in RMS wells relative to boundary condition scenarios.

In aggregate, these results suggest that projects and/or management actions may be required to consistently maintain water levels above MTs and to achieve MOs within the Marina-Ord Area unless SWI Protective Boundary Conditions are achieved in the adjacent subbasins.

[40] This figure shows average projected groundwater elevation changes in the 35 RMS wells in the Marina-Ord Area with respect to those modeled at the end of the historical period (i.e., 2018). The MT and MO elevations shown on this graph reflects their average elevations with respect to 2018 water levels at the RMS wells. For example, MTs, which are set based on the minimum fall measurements in 1995 to 2015 water levels, are on average 2 feet higher than 2018 water levels in these RMS wells.

Figure 6-8. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ

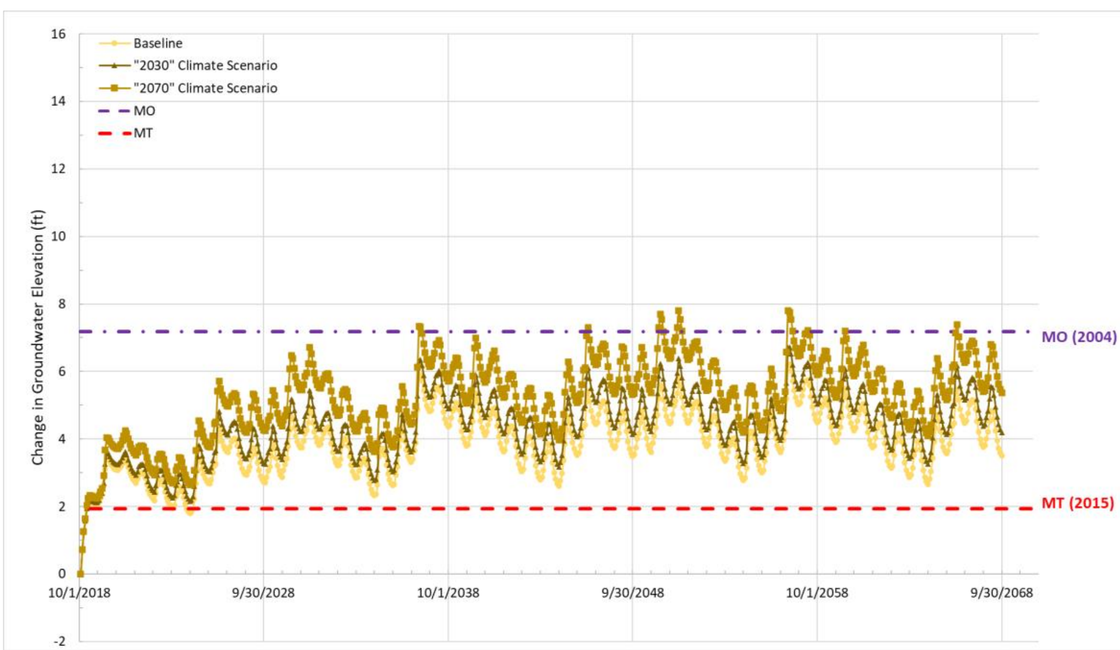


Figure 6-9. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Climate Condition and Measurable Objective Boundary Condition, Marina-Ord Area WBZ

6.5.5 Corral de Tierra Area WBZ Net Annual Change in Groundwater Storage and Projected Changes in Groundwater Elevations relative to SMCs

Table 6-6 summarizes projected annual inflows and outflows from the Corral de Tierra Area WBZ under variable boundary conditions. The projected net annual change in groundwater storage ranged between -578 and -362 AFY in the Corral de Tierra Area WBZ for the "No Project" scenario under variable boundary conditions. The net annual change in groundwater storage is significantly lower than that calculated for the historical period (-2,803 AFY), but is still in slight overdraft over the entirety of the 50-year analog period. The climate scenario results presented in Appendix 6-A indicate that this conclusion is true under all of the identified climate change scenarios. As such, these projected water budget results suggest that this management area will be in overdraft even if adjacent basins are managed to their MOs and no projects are undertaken.

Figure 6-10 depicts average projected changes in groundwater elevations at RMS wells in the Corral de Tierra Area WBZ under the "No Project" scenario with variable boundary conditions. This figure also identifies the average change in water levels required to reach MTs and MOs at RMS wells in the Corral de Tierra Area WBZ. As shown on Figure 6-10, groundwater elevations in RMS wells within the Corral de Tierra Area WBZ appear to stabilize in the last ten years of the 50 year analog period. However, they stabilize at levels that are on average 17 to 25 feet lower than groundwater elevation MTs and 28 to 36 feet lower than groundwater elevation MOs even if SMCs are achieved in adjacent subbasins under these boundary condition scenarios.

Figure 6-11 presents the effects of variable climate scenarios on groundwater elevations within Corral de Tierra Area WBZ under the "No Project" scenario with MO Boundary conditions. This figure indicates that variable climate conditions have limited impacts on projected water levels in RMS wells relative to boundary condition scenarios.

In aggregate, these results suggest that projects and/or management actions will be required to raise water levels above MTs and to achieve MOs within the Corral de Tierra Area WBZ.

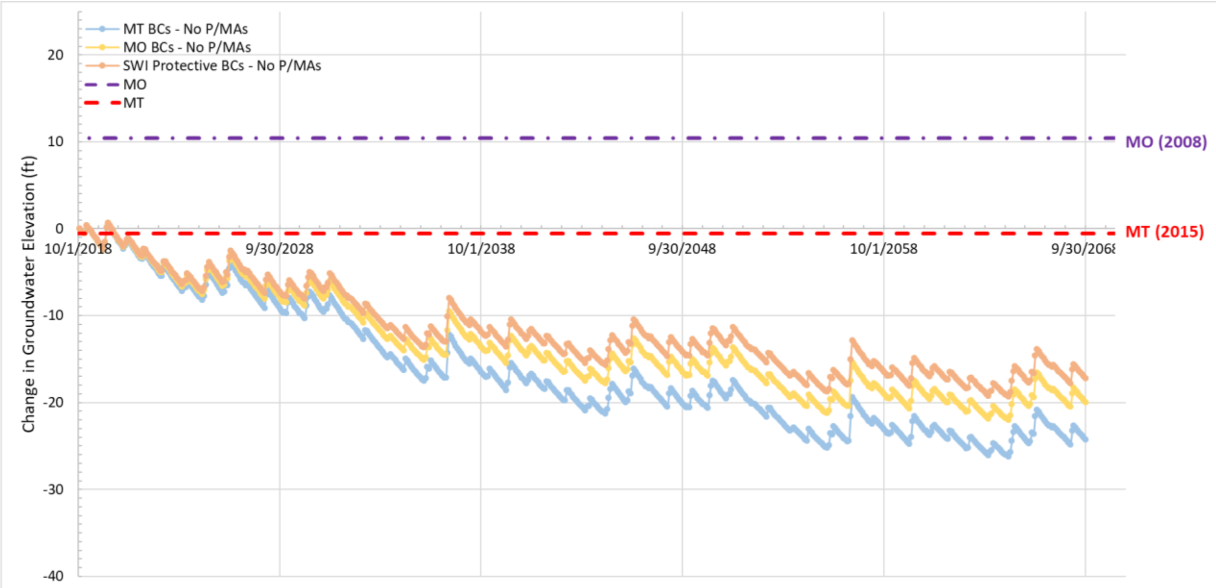


Figure 6-10. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Corral de Tierra Area WBZ

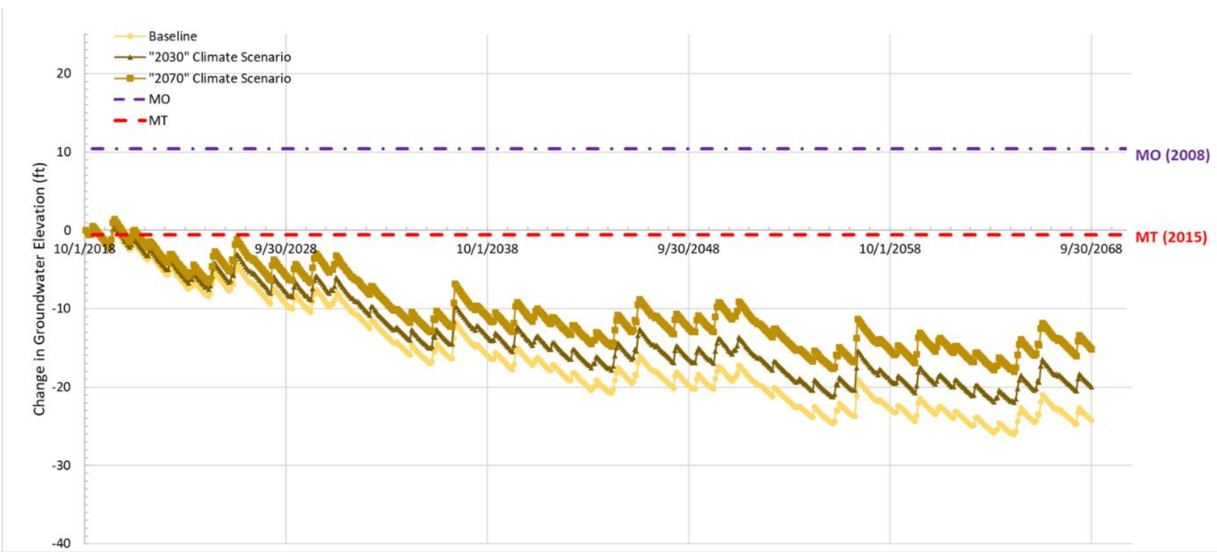


Figure 6-11. Comparison of Groundwater Elevation Changes Under "No Project" Scenario with Various Climate Condition and Measurable Objective Boundary Condition, Corral de Tierra Area WBZ

6.5.6 Historical, Current, and Projected Overdraft and Sustainable Yield

SGMA defines sustainable yield as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the Subbasin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result"

(CWC §10721(w)). DWR's Water Budget BMP (DWR, 2016b) further states that "Water budget accounting information should directly support the estimate of sustainable yield for the Subbasin and include an explanation of how the estimate of sustainable yield will allow the Subbasin to be operated to avoid locally defined undesirable results. The explanation should include a discussion of the relationship or linkage between the estimated sustainable yield for the Subbasin and local determination of the sustainable management criteria (sustainability goal, undesirable results, minimum thresholds, and measurable objectives)."

A key part of the codified definition and the BMP statement is the avoidance of undesirable results, defined as "significant and unreasonable" effects for any of the six SGMA sustainability indicators. For example, declining levels during a drought do not constitute an Undesirable Result for chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reduction in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods (CWC §10721(x)(1)). Therefore, while the water budget should provide support for sustainable yield, determination of the sustainable yield for the Subbasin ultimately depends upon whether undesirable results are avoided within the timeframes required by SGMA.

The sustainable yield of the Monterey Subbasin is significantly affected by recharge, pumping, and conditions in adjacent subbasins. As such, the sustainable yield established based on historical overdraft has significant uncertainty and does not address all undesirable results. Groundwater conditions in adjacent subbasins are projected to change as these subbasins move toward sustainability. A first-order estimate of the sustainable yield is estimated by subtracting overdraft from extraction; however, since sustainable management criteria were not established historically, the historical sustainable yield does not reflect sustainability as it is defined in this GSP. Projected water budget results have been used to estimate the projected sustainable yield. The sustainable yield has been evaluated by Management Area (i.e., water budget zone) as conditions vary and independent SMCs have been established for each area.

6.5.6.1 Marina-Ord Area WBZ

An estimate of the three sustainable yields of the groundwater system underlying the Marina-Ord Area WBZ can be made on the basis of the water budget data presented in Table 6-2, and the "No Project" water budget results presented in Section 6.4.2.

The simplifying assumption for estimating historical sustainable yield is that a first-order estimate can be developed by subtracting the historical average overdraft from the historical average extractions. Data in Table 6-2 show that the historical pumping in the Marina-Ord Area WBZ was 4,346 AFY, and the historical overdraft was 1,632 AFY. This calculation leads to an estimated historical sustainable yield in the WBZ of 2,714 AFY.

Data in Table 6-2 additionally show that the average annual pumping in the current time period is 3,503 AFY, and average annual overdraft in the current time period is 209 AFY. This calculation leads to an estimated current sustainable yield in the WBZ of 3,294 AFY. The current time period represents only a few years and is not indicative of long-term groundwater conditions. Therefore, the current sustainable yield and overdraft estimates should not be used for developing long-term groundwater management strategies.

The projected water budget for the "No project" scenario results in a positive net increase in storage over the 50-year analog period, under all identified boundary conditions and climate condition scenarios. Further, projected groundwater level data presented in Section 6.5.4 indicate that groundwater levels stabilize within the first ten years of GSP implementation and are constant over the 30-year post-GSP implementation period under all identified boundary and climate conditions. Annual rates of groundwater extraction during this 30-year post-GSP implementation period average 9,870 AFY. As such, these projected water budget results support the conclusion that 9,870 AFY can be pumped from the Marina-Ord Area WBZ with no long-term loss in storage, and provide the first-order estimate of the sustainable yield of the Marina-Ord Area WBZ. They also support the conclusion that the Marina-Ord Area WBZ will not be in overdraft in the future if adjacent subbasins are managed sustainably. 180/400-Foot Aquifer Subbasin.

These calculations provide only first-order estimates of the magnitude of the Marina-Ord Area WBZ sustainable yield. The historical and current sustainable yield estimates are for information only and do not guide groundwater management activities in this GSP. The projected sustainable yield provides a first-order estimate of anticipated sustainable pumping if no projects are implemented. However, simply reducing pumping to within the sustainable yield is not proof of sustainability under SGMA, which must be demonstrated by avoiding undesirable results for all six sustainability indicators.

Comparison of projected groundwater levels within the Marina-Ord Area WBZ under the "no project" and "project" scenarios presented in Section 9.6 with established groundwater level MTs and MOs provides significant insight regarding the projected sustainable yield as defined under SGMA. As discussed above, the attainment of MTs and MOs, which are established to avoid undesirable results and achieve basin sustainability, should be considered in the estimation of sustainable yield under SGMA. As discussed in Sections 6.5.4, 9.6, and 9.6.1, projected groundwater level data indicate that:

- Under the "no project" scenario, groundwater levels in RMS wells stabilize and are generally higher than groundwater level MTs during non-drought periods under all identified boundary conditions and climate scenarios and reach groundwater level MOs if SWI Protective Boundary Conditions are achieved in adjacent subbasins.

- Under the "Project" scenario, groundwater levels stabilize and are higher than groundwater level MTs and reach groundwater level MOs in RMS wells within the Marina-Ord Area WBZ, if MT and MO boundary conditions are achieved in adjacent subbasins, respectively.

These results indicate that the projected sustainable yield of the Marina-Ord Area WBZ ranges from approximately 4,400[41] AFY if adjacent subbasins are managed to their groundwater level MTs and adjudication goals as defined in their respective groundwater planning documents, to approximately 9,900[42] AFY if adjacent subbasins are managed to SWI protective groundwater levels[43]. As such, the actual sustainable yield of the Marina-Ord area will be impacted by groundwater levels achieved and methods used to address seawater intrusion and meet seawater intrusion MTs within adjacent subbasins, e.g., groundwater recharge, seawater intrusion extraction or injection barrier, or a combination of methods. Therefore, a coordinated approach will be required to reach sustainability within the Monterey subbasin and adjacent subbasins. Further, 180/400-Foot Aquifer Subbasin although these projected budget results provide potential insight into the sustainable yield of the Marina-Ord Area, confirmation that these quantities could be extracted without inducing seawater intrusion has to be verified.

6.5.6.2 Corral de Tierra Area WBZ

Information regarding the sustainable yield of the groundwater system underlying the Corral de Tierra Area WBZ can be garnered based on the projected water budget for the historical water budget data presented in Table 6-3 and the “No Project” scenario presented in Section 6.5.4.

The simplifying assumption for estimating historical sustainable yield is that a first-order estimate can be developed by subtracting the historical average overdraft from the historical average extractions. Data in Table 6-3 show that the historical pumping in the Corral de Tierra Area WBZ was 1,296 AFY, and the historical overdraft was 2,803 AFY. This calculation leads to an estimated sustainable yield in the WBZ of -1,507 AFY. While this is only a rough first-order estimate, the negative sustainable yield suggests that no amount of pumping reduction in the WBZ could have historically brought the area into balance. The outflows to adjacent subbasins and the Marina-Ord Area WBZ result in an overdraft independent of the WBZ pumping. Using the same method to estimate the current sustainable yield, the annual pumping during the current period in the Corral de Tierra Area WBZ was 1,771 AFY, and the current overdraft was 1,818 AFY. This leads to an estimated sustainable yield in the WBZ of -47 AFY. The current time period represents only a few years with more precipitation and is not indicative of long-term groundwater conditions. Therefore, the current sustainable yield and overdraft estimates should not be used for developing long-term groundwater management strategies.

The projected sustainable yield is calculated using projected pumping and overdraft during the latter 30 years of the projected analog period that represents stabilized boundary conditions

[41] Groundwater levels stabilize above groundwater level MTs and MOs in the Marina-Ord Area when annual rates of pumping during the 30-year GSP implementation period average 4,376 AFY for the “project” scenario under MT and MO Boundary Condition Scenarios, respectively.

[42] Groundwater levels stabilize above groundwater level MTs and MOs when annual rates of pumping during the 30-year GSP implementation period average 9,870 AFY for the “no project” scenario under SWI Protective Boundary Conditions.

[43] In the absence of the installation of a seawater intrusion extraction or injection barrier, SWI Protective Boundary Conditions will be required to achieve seawater intrusion MTs in the 180/400-Foot Aquifer Subbasin.

(e.g., as groundwater elevations stabilize as shown on Figure 6-11). Under the baseline "No Project" scenario, and during this 30-year analog period, annual rates of groundwater extraction averages to 2,188 AFY and an estimated overdraft averages to 89 AFY. Following the method described above for the historical and current sustainable yield calculations, the projected sustainable yield for the Corral de Tierra area is calculated to be 2,100 AFY. The baseline projected sustainable yield is calculated based on the projected "No Project" scenario, with 2030 climate conditions and boundary conditions at measurable objectives in the adjacent basins. Note that these values presented here for the projected baseline water budget are not represented in Table 6-6 since they are based on the latter 30 years of the projected analog period instead of the entire 50-year period. These values represent a first-order estimate, and further analysis is needed to assess if this sustainable yield avoids all undesirable results. This estimate of sustainable yield is the sustainable yield to hold groundwater levels where they are after the first 20 years of GSP implementation if there are no projects undertaken. Since groundwater levels are declining, this groundwater level would be significantly below current groundwater levels and below groundwater level MTs. Therefore, this sustainable yield estimate of 2,100 AFY is likely an overestimate of the true sustainable yield where all undesirable results are avoided.

The historical and current sustainable yield estimates are for information only and do not guide groundwater management activities in this GSP. The projected sustainable yield provides a first-order estimate of anticipated sustainable pumping if no projects are implemented. However, simply reducing pumping to within the sustainable yield is not proof of sustainability, which must be demonstrated by avoiding undesirable results for all six sustainability indicators. Further analysis is necessary to refine estimates of where pumping should be reduced to address all sustainability indicators.

6.6 Water Budget Uncertainty and Limitations

Models are mathematical representations of physical systems. They have limitations in their ability to represent physical systems exactly and due to limitations in the data inputs used. There is also inherent uncertainty in groundwater flow modeling itself since mathematical (or numerical) models can only approximate physical systems and have limitations in computing data. However, DWR (2018) recognizes that although models are not exact representations of physical systems because mathematical depictions are imperfect, they are powerful tools that can provide useful insights. As mentioned in Section 6.1 and described in detail in Appendix 6-B, the MBGWFM was developed using established scientific practices and principles for groundwater flow simulation, and calibrated using the best available data within the Subbasin. Inputs to the models are carefully selected using the best available data, the model's calculations represent established science for groundwater flow, and the model calibration error is within acceptable bounds. Therefore, the models are the best available tools for estimating water budgets and simulating projected groundwater conditions. As demonstrated by the calibration error statistics summarized in Section 6.1 and presented in detail in Appendix 6-B, the MBGWFM reasonably represents historical groundwater conditions within the Subbasin.

As is the case with any numerical groundwater flow model, the MBGWFM is subject to uncertainties and data gaps in hydrogeologic conceptualization (e.g., depth and extent of principal aquifer units), model parameterization (e.g., aquifer transmitting and storage properties) and calibration data (i.e., historical water level monitoring data), and simulated stresses (e.g., recharge, pumping, and boundary conditions). Here, "uncertainty" refers to the incomplete understanding of the physical setting, characteristics, and current conditions that significantly affect the calculation of the water budgets presented above. "Data gaps" refer to limitations in the spatial coverage of measured data or periods of time when no data are available. Each of these main categories of uncertainty and/or data gaps contribute to the overall uncertainty in the water budget outputs from MBGWFM.

The following list groups water budget components in increasing order of uncertainty.

(a) Measured: metered municipal, agricultural, and some small water system pumping

(b) Estimated: domestic pumping, including depth, rate, and location

(c) Simulated primarily based on climate data: precipitation, evapotranspiration, irrigation pumping

(d) Simulated based on calibrated model: all other water budget components

Simulated components based on calibrated model have the most uncertainty because those simulated results encompass uncertainty of other water budget components used in the model in addition to model calibration error.

As part of MBGWFM development and calibration, model uncertainty was evaluated by performing a sensitivity analysis on simulated stresses and aquifer parameters. A detailed description of the model sensitivity and uncertainty analysis is provided in Appendix 6-B. A summary of the main limitations of the model and corresponding water budgets identified from this analysis is provided below.

- <u>Uncertainty in Simulated Boundary Conditions.</u> As described in Section 6.2.2, inter-basin cross-boundary flows were simulated at the 180/400-Foot Aquifer Subbasin boundary based on historical groundwater elevation measurements from nearby wells, at the Seaside Area Subbasin boundary based on outputs from the historical Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018), and at the Monterey Coast based on freshwater equivalent sea levels. The datasets and assumptions used to model boundary conditions at each Subbasin boundary are subject to their own uncertainties, data gaps, and limitations, including:
    - *Lack of Deep Aquifer wells with historical data in the 180/400-Foot Aquifer Subbasin.* Only a small number of wells exist in the Deep Aquifers within the 180/400-Foot Aquifer Subbasin with observed water level data spanning the full duration of the Historical Period. As such, simulated Deep Aquifers heads along the northern model boundary are subject to the limitations in available data to

the north of the boundary, which may impact resulting calculations of 180/400-Foot Aquifer Subbasin exchanges within the water budget.

- *Incomplete conceptualization of Principal Aquifer units in the Seaside Basin Groundwater Flow Model.* The Seaside model does not explicitly simulate groundwater flow from each principal aquifer unit defined in the Monterey Subbasin GSP, but rather uses a unique conceptualization of aquifer units that is primarily based on the main geologic formations encountered in the Seaside Subbasin (i.e., the Aromas Sands, Paso Robles Formation, and Santa Margarita/Purisima Formations). As such, there is considerable uncertainty surrounding the assumptions employed to link outputs from the Seaside model to individual layers of the MBGWFM[44], which may impact resulting calculations of Seaside Area Subbasin exchanges within the water budget. Further analysis of potential inflows and outflows with respect to the model layers and principal aquifers along the Seaside Subbasin boundary is proposed as part of proposed future modeling efforts identified in implementation action Future Modeling of Seawater Intrusion and Projects, Section 9.5.6.
- *Uncertainty in freshwater equivalent head calculations at the Monterey Coast.* As discussed in Section 6.2, freshwater equivalent sea levels at the Monterey Coastline are calculated based on the equivalent freshwater head formula presented in the USGS 2002 Report (USGS, 2002). The depths and distances at which principal aquifer units outcrop along the seafloor were estimated to inform corresponding freshwater equivalent heads at the aquifer-seafloor interface. There is considerable uncertainty surrounding the depths and distances at which each principal aquifer unit comes in contact with the seafloor, which may impact resulting calculations of Ocean exchanges within the water budget.

- <u>Uncertainty in Pumping Estimates within the Corral de Tierra (CDT) Management Area.</u> Very limited historical groundwater pumping data are available for the CDT Management Area. As such, CDT groundwater pumping demands were estimated for small water systems and domestic wells by the Wallace Group using extraction reported to MCWRA and SWRCB where available and approximated based on the number of households to account for small water systems connections and *de minimis* pumpers. Therefore, the accuracy of CDT groundwater pumping estimates included in the water budget is limited by the lack of available pumping data and uncertainty in the CDT pumping estimates provided by SVBGSA.

- <u>Uncertainty in Deep Aquifers Representation.</u> Groundwater elevation data collected from the Deep Aquifers and the El Toro Primary Aquifer System (both represented by model Layer 8) show heterogeneous conditions in the upper and lower portions of these

[44] See Appendix 6-B for further details.

aquifers. As discussed in Section 5.1.4 and shown on Figure 5-12, a vertical gradient exists between the Paso Robles and Santa Margarita formations of the El Toro Primary Aquifer System. In addition, heterogeneous groundwater elevations were observed in the shallow and deep screens of Deep Aquifer well clusters, as shown on Figure 5-14. However, currently, there is not enough spatial coverage of data to characterize the upper and lower portions of these aquifers as separate aquifers. Refining representation of the Deep Aquifers and the El Toro Primary Aquifer System will facilitate connectivity between the MBGWFM and the Seaside Subbasin Model, and therefore refine the calculation of inter-basin flows. Additional data is needed within both (a) the Monterey Subbasin to characterize and calibrate upper and lower portions of these aquifers and (b) the adjacent subbasins to establish improved boundary conditions.

- Lack of Water Level Calibration Data. Though the MCWD service area, former Fort Ord Site, and CWS/Cal Am water service areas within CDT are well monitored, very limited historical groundwater elevation data exist in other portions of the Subbasin, including near the Reservation Rd area, in the Fort Ord Hills, and within the Deep Aquifer unit. As such, MBGWFM calibration in these areas is limited by the lack of available calibration data to quantify model error and inform localized adjustments to model parameterization.

- Climate Change Uncertainty. As described in Section 6.5.1., climate change scenarios were developed based on DWR's 2030 and 2070 Central Tendency climate modeling scenarios (DWR, 2020). These climate scenarios provide a standard framework for defining what might be considered the most likely future climate conditions within the Subbasin; however, they are inherently subject to considerable uncertainty. As stated in DWR (2018):

    - *"Although it is not possible to predict future hydrology and water use with certainty, the models, data, and tools provided [by DWR] are considered current best available* science *and, when used appropriately should provide GSAs with a reasonable* point *of reference for future planning.*

    - *All models have limitations in their interpretation of the physical system and the types of data inputs used and outputs generated, as well as the interpretation of outputs. The climate models used to generate the climate and hydrologic data for use in water budget development were recommended by [the DWR Climate Change Technical Advisory Group] for their applicability to California water resources planning."*

- Uncertainty in Aquifer Parameters. As mentioned above and described in detail in Appendix 6-B, a sensitivity analysis was performed to identify the most sensitive aquifer parameters that will impact model-calculated water levels, and was subsequently used to direct further calibration efforts. In general, it was discovered that the model was most sensitive to specific storage and lateral hydraulic conductivity parameters in each principal aquifer unit. These aquifer parameters were further calibrated using a combination of *Model-Independent Parameter Estimation and Uncertainty Analysis* (PEST) calibration procedures and professional judgement. As described in Appendix 6-B, all final calibrated aquifer parameters fell within their respective ranges reported in available pumping test data collected from wells within the Subbasin.

As discussed in Chapter 10, MCWD GSA and SVBGSA are planning data gap filling activities and monitoring network expansion within the Monterey Subbasin and in the adjacent 180/400-Foot Aquifer Subbasin. These activities are informed by the uncertainties and data gaps identified above and include:

- Monitoring network expansion and aquifer investigations in the 400-Foot Aquifer and Deep Aquifers near the Seaside Subbasin boundary;
- Monitoring network expansion and aquifer investigations in the Corral de Tierra Area near the 180/400-Foot Aquifer Subbasin boundary, including the Reservation Road portion and CWS/Cal Am service areas; and
- GEMS expansion and enhancement as well as a well registration program that intends to cover the entire Monterey Subbasin.

As additional groundwater elevation, aquifer properties, and groundwater extraction data become available, they will be used to refine representation of these aquifers as part of future modeling efforts during the first 5-years of GSP implementation.

7 MONITORING NETWORKS

This chapter describes the monitoring networks within the Monterey Subbasin that will be used to assess sustainable management criteria (SMCs) explained further in Chapter 8. This description of monitoring networks has been prepared in accordance with the Groundwater Sustainability Plan (GSP) Regulations §354.32 to include monitoring objectives, monitoring protocols, and data reporting requirements.

In addition to the monitoring networks within the Monterey Subbasin, the Marina Coast Water District (MCWD) Groundwater Sustainability Agency (GSA) and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) will include data from wells in the adjacent subbasins as part of the monitoring network and will continue their collaboration with agencies in adjacent subbasins. Further information on the wells in the adjacent subbasins can be found in the 180/400-Foot Aquifer Subbasin GSP and the Basin Management Action Plan for the Seaside Subbasin.

7.1 Introduction

7.1.1 Monitoring Network Objectives

SGMA requires monitoring networks to collect data of sufficient quality, frequency, and distribution to characterize groundwater and related surface water conditions in the Subbasin, and to evaluate changing conditions that occur as the Plan is implemented. The monitoring networks are intended to:

- Monitor changes in groundwater conditions relative to measurable objectives and minimum thresholds;
- Demonstrate progress toward achieving measurable objectives;
- Monitor impacts to the beneficial uses or users of groundwater; and
- Quantify annual changes in water budget components.

7.1.2 Approach to Monitoring Networks

Monitoring networks are developed for each of the six sustainability indicators that are relevant to the Subbasin:

- Chronic lowering of groundwater levels
- Reduction in groundwater storage
- Seawater intrusion
- Degraded water quality

- Land subsidence
- Depletion of interconnected surface water

Representative Monitoring Sites (RMS) are a subset of the monitoring network and are focused on monitoring changes in groundwater conditions relative to Undesirable Results described further in Chapter 8. These are also limited to sites with data that are publicly available and not confidential.

MCWD GSA and SVBGSA established the density of monitoring sites and the frequency of measurements to demonstrate short-term, seasonal, and long-term trends. If the monitoring site density is determined to be inadequate, MCWD GSA and SVBGSA will expand monitoring networks as needed during GSP implementation. Filling data gaps and developing more extensive and complete monitoring networks will improve MCWD GSA and SVBGSA's ability to demonstrate sustainability and refine the existing conceptual and numerical hydrogeologic models. Chapter 10 provides a plan and schedule for resolving data gaps. MCWD GSA and SVBGSA will review the monitoring network in each five-year assessment. This review will include an evaluation of uncertainty and assess remaining data gaps that could affect the ability of the GSP to achieve the sustainability goal for the Subbasin.

7.1.3 Management Areas

If Management Areas are established, GSP Emergency Regulations require that the quantity and density of monitoring sites in those areas shall be sufficient to evaluate conditions of the Basin Setting and sustainable management criteria specific to that area.

As introduced in Section 1.4, this GSP establishes two Management Areas within the Subbasin including the Marina-Ord Area and the Corral de Tierra Area. These Management Areas have been developed to facilitate GSP implementation in these areas. As such, an adequate number of representative monitoring sites for each sustainability indicator has been identified for each Management Area. In Chapter 8, a basin-wide approach is taken for establishing Undesirable Results, however, where the drivers of Undesirable Results are different between Management Areas, SMCs are developed separately for each Management Area. Therefore, Management Area-specific monitoring networks are identified in this Chapter.

7.2 Representative Monitoring Sites

Representative monitoring sites (RMS) are defined in the GSP Emergency Regulations as a subset of monitoring sites that are representative of conditions in the Subbasin and will be used to establish Sustainable Management Criteria (SMCs). The sections below discuss the existing monitoring sites in the Subbasin as well as the RMS networks for each sustainability indicator. The monitoring networks for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy to monitor the reduction in groundwater storage, as described in Chapter 8.

7.3 Groundwater Elevation Monitoring Network

The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells. The GSP Emergency Regulations require a network of monitoring wells sufficient to demonstrate groundwater occurrence, flow directions, and hydraulic gradients between principal aquifers and surface water features.

Management Area-specific groundwater elevation monitoring networks are identified for monitoring of chronic lowering of groundwater levels within the Subbasin. The groundwater elevation monitoring network comprises over 390 wells monitored by U.S. Army, MCWRA, or MPMWD in the Marina-Ord Area; and 18 wells monitored by MCWRA in the Corral de Tierra Area. Of these wells that are actively monitored by a local agency, 35 are selected as groundwater elevation RMS wells in the Marina-Ord Area and 13 are selected as groundwater elevation RMS wells in the Corral de Tierra Area. Figure 7-1 through Figure 7-6 show the locations of the groundwater elevation monitoring network and wells selected for the RMS network within the Marina-Ord Area and the Corral De Tiera Area.

The groundwater elevation monitoring network and RMS network for each management area are broken out by principal aquifer. However, as discussed in Chapters 4 and 5, the 180-Foot Aquifer is separated into an “upper” and a “lower” portion by a thin clay layer in the coastal areas of the Marina-Ord Area. In these areas, groundwater elevation and seawater intrusion conditions in the upper 180-Foot Aquifer are distinct from those in the lower 180-Foot Aquifer, while conditions in the lower 180-Foot Aquifer are consistent with those observed in the 400-Foot Aquifer. Therefore, the monitoring network and RMS network are selected to additionally distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer. Known seawater intrusion conditions in the lower 180-Foot and 400-Foot Aquifers are included on Figure 7-7 to demonstrate the selected groundwater elevation and seawater intrusion RMS network.

The RMS wells within each Management Area have been selected to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8. The groundwater elevation RMS network in the Marina-Ord area has been coordinated with the seawater intrusion RMS network (Section 7.5). Groundwater elevation data will be utilized in conjunction with salinity data from these wells to monitor the potential expansion of the seawater intrusion front. Criteria for selecting wells as part of the RMS network include:

- RMS wells should facilitate monitoring of groundwater elevations within each principal aquifer;
- RMS wells should cover areas of the Subbasin where beneficial uses of groundwater are occurring (e.g., groundwater extraction, groundwater dependent ecosystems, etc.);
- RMS wells should facilitate monitoring along the existing seawater intrusion front to verify that water levels in these areas are not declining and increasing the risk of seawater intrusion.

- RMS wells that could be included in both the groundwater elevation and seawater intrusion RMS networks are preferred;
- RMS wells should be located on public parcels or on properties where access agreements have been negotiated;
- RMS wells must have known depths and well completion data;
- RMS wells should have relatively long periods of historical data (i.e., greater than 10 years and/or 50 water level measurements) and exhibit high-quality groundwater elevation data;
- RMS well hydrographs should be visually representative of the hydrographs from surrounding wells; and
- RMS wells should not be influenced by nearby infiltration, groundwater pumping, or groundwater remediation activities at Fort Ord.

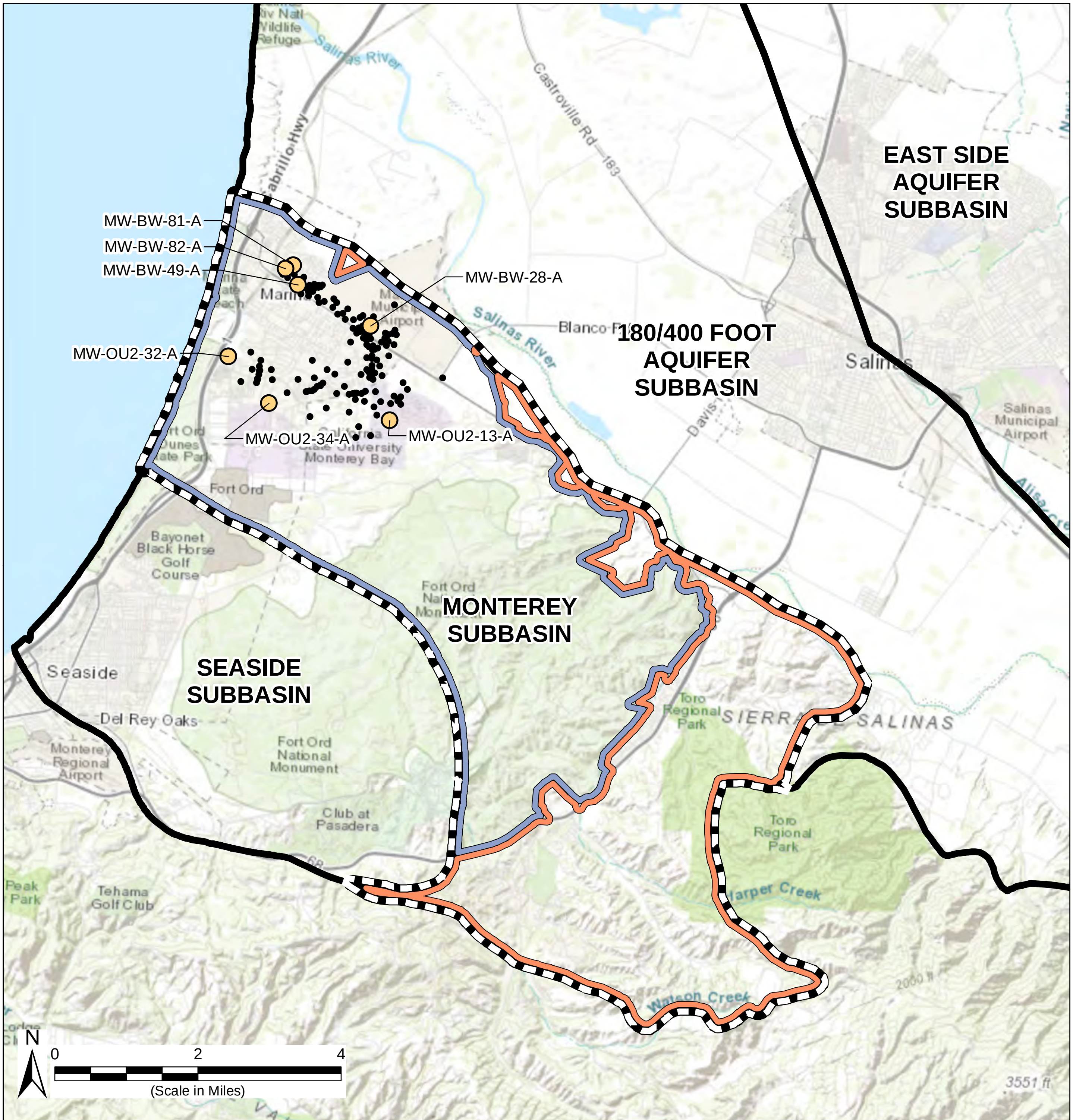
Data from RMS wells will be considered public and will be used for groundwater elevation maps and analyses unless the owner of the RMS well opts out through correspondence with MCWD GSA or SVBGSA.[45]

Visual inspection of the geographic distribution of the monitoring network indicates there are no wells in the south-eastern portion of the Marina-Ord Area (i.e., the Fort Ord hills). However, no monitoring of groundwater levels is needed in this area because:

- It is undeveloped and overseen by the Bureau of Land Management (BLM) and has no current or likely future groundwater use or extraction.
- It is far from the ocean and therefore not subject to seawater intrusion.
- It is part of the Federal land area not subject to SGMA.

The RMS wells included in the groundwater level monitoring network are listed by Management Area in Table 7-1. The need for any additional wells is discussed in Section 7.3.2. Appendix 8-A presents well construction information and historical hydrographs for each RMS well. As previously discussed in Chapter 7, MCWD GSA will include wells in the adjacent subbasins as part of the groundwater level monitoring network and consider their data in groundwater management. However, those wells are not included as RMS wells in the Monterey Subbasin.

[45] If an owner opts out of public data reporting, another well will be identified for RMS monitoring.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Notes

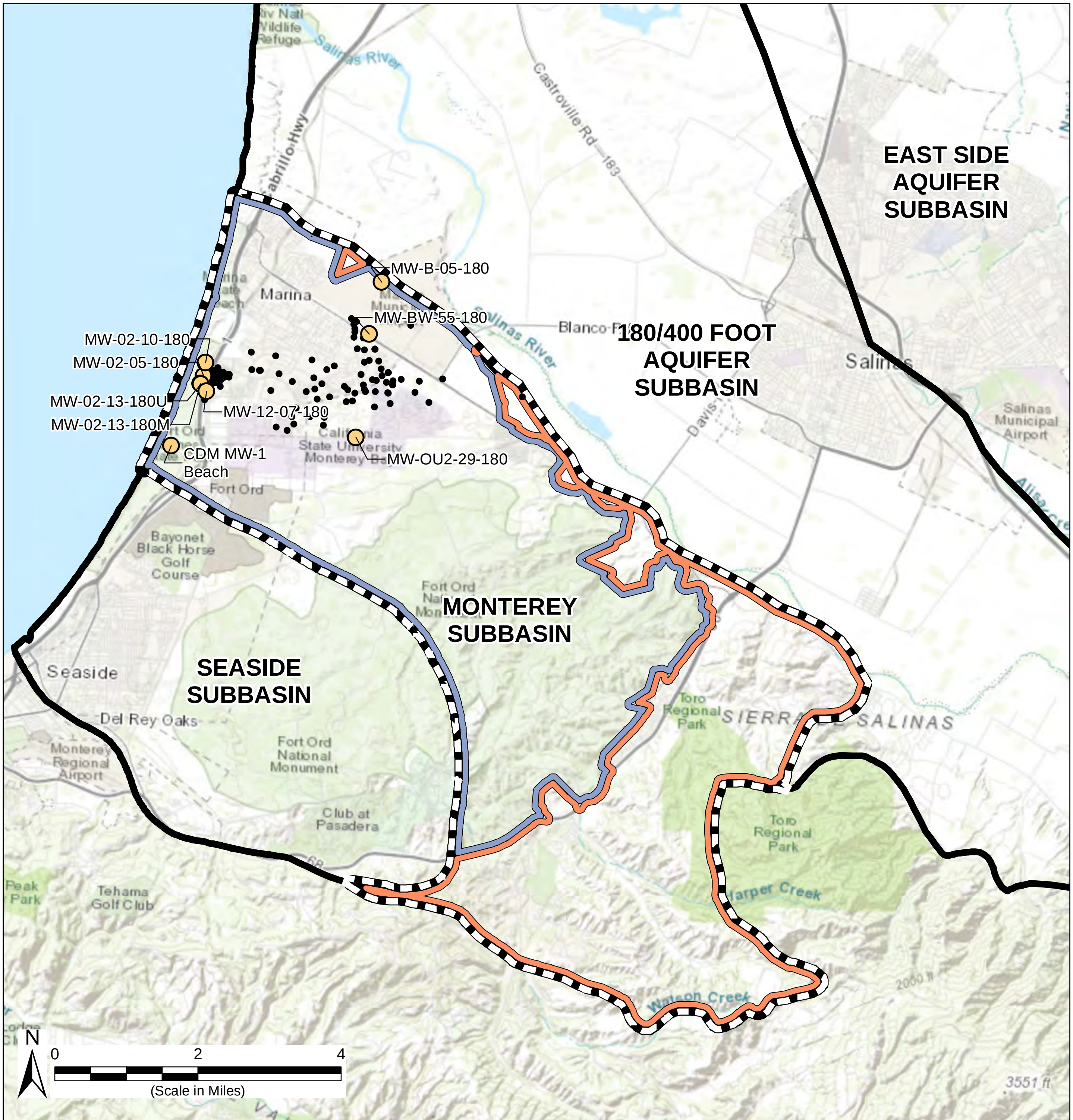
1. All locations are approximate.

Marina-Ord Area: Monitoring Network for Groundwater Elevations Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-1

Path: X:\B60094\Maps\2021\09\Fig7-1_MN_wells_DuneSand.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Notes

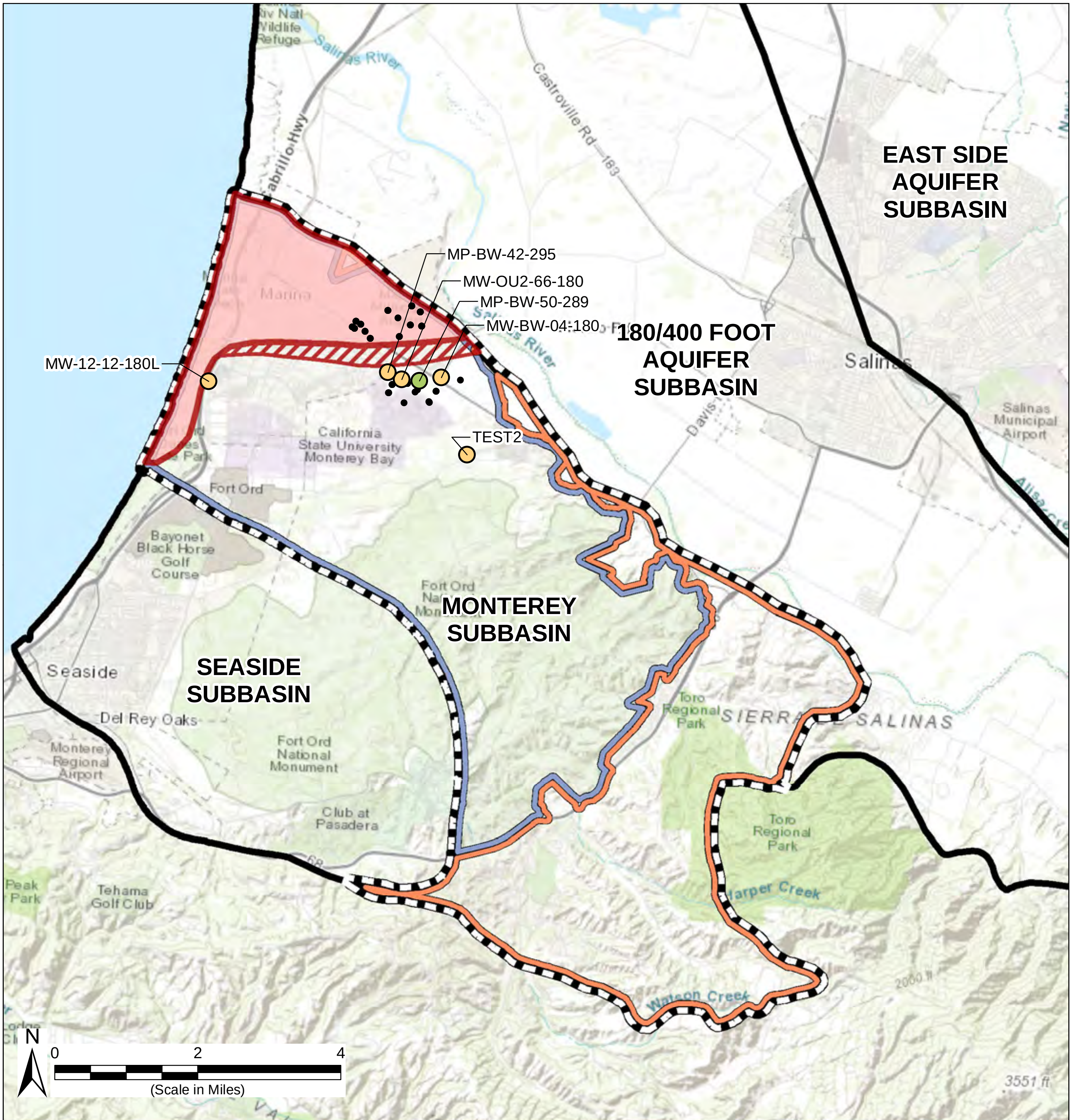
1. All locations are approximate.

Marina-Ord Area: Monitoring Network for Groundwater Elevations Upper 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-2

Path: X:\B60094\Maps\2021\09\Fig7-2_MN_wells_Upper180.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer

Notes

1. All locations are approximate.

Sources

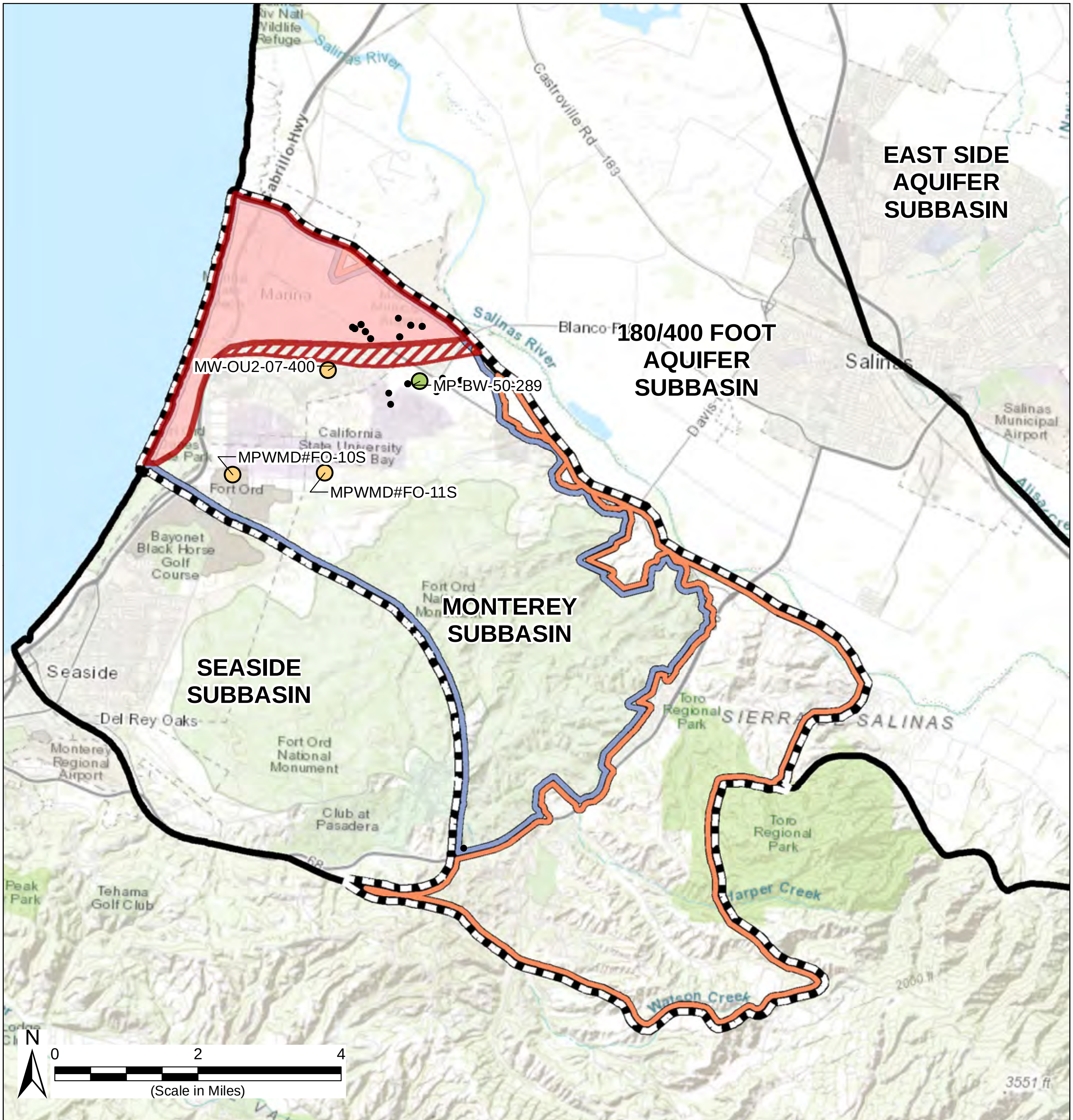
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations Lower 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-3

Path: X:\B60094\Maps\2021\09\Fig7-3_MN_wells_Lower180.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Active Groundwater Elevation Monitoring Wells

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion

Management Areas

- Marina-Ord Area
- Corral de Tierra

Representative Monitoring Sites for Groundwater Elevations

- 400-Foot Aquifer (Paso Robles Aquifer)
- Lower 180-Foot, 400-Foot Aquifer

Notes

1. All locations are approximate.
2. MPWMD#-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer.

Sources

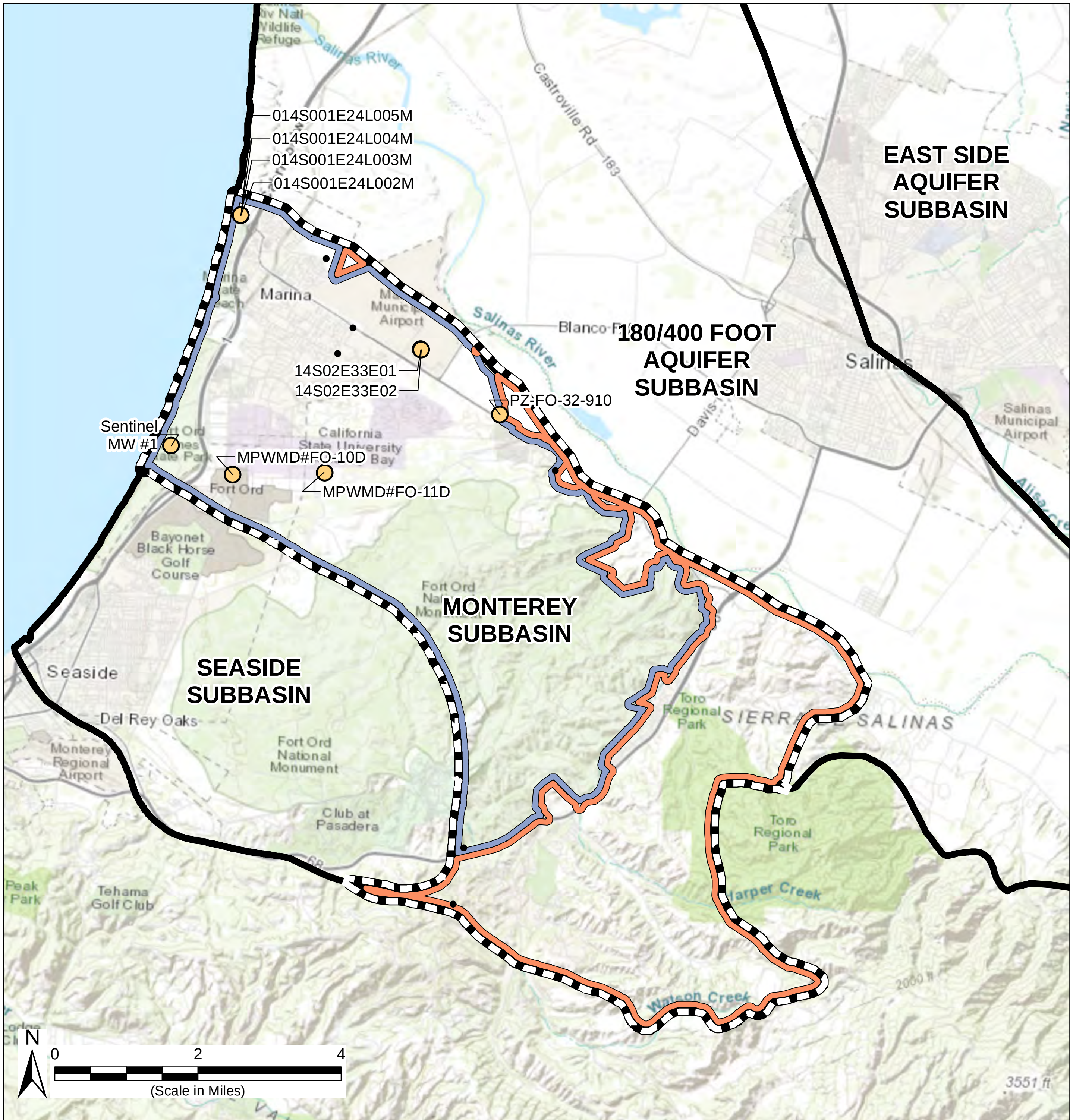
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-4

Path: X:\B60094\Maps\2021\09\Fig7-4_MN_wells_400.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

Active Groundwater Elevation Monitoring Wells

Management Areas

Marina-Ord Area

Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations Deep Aquifers

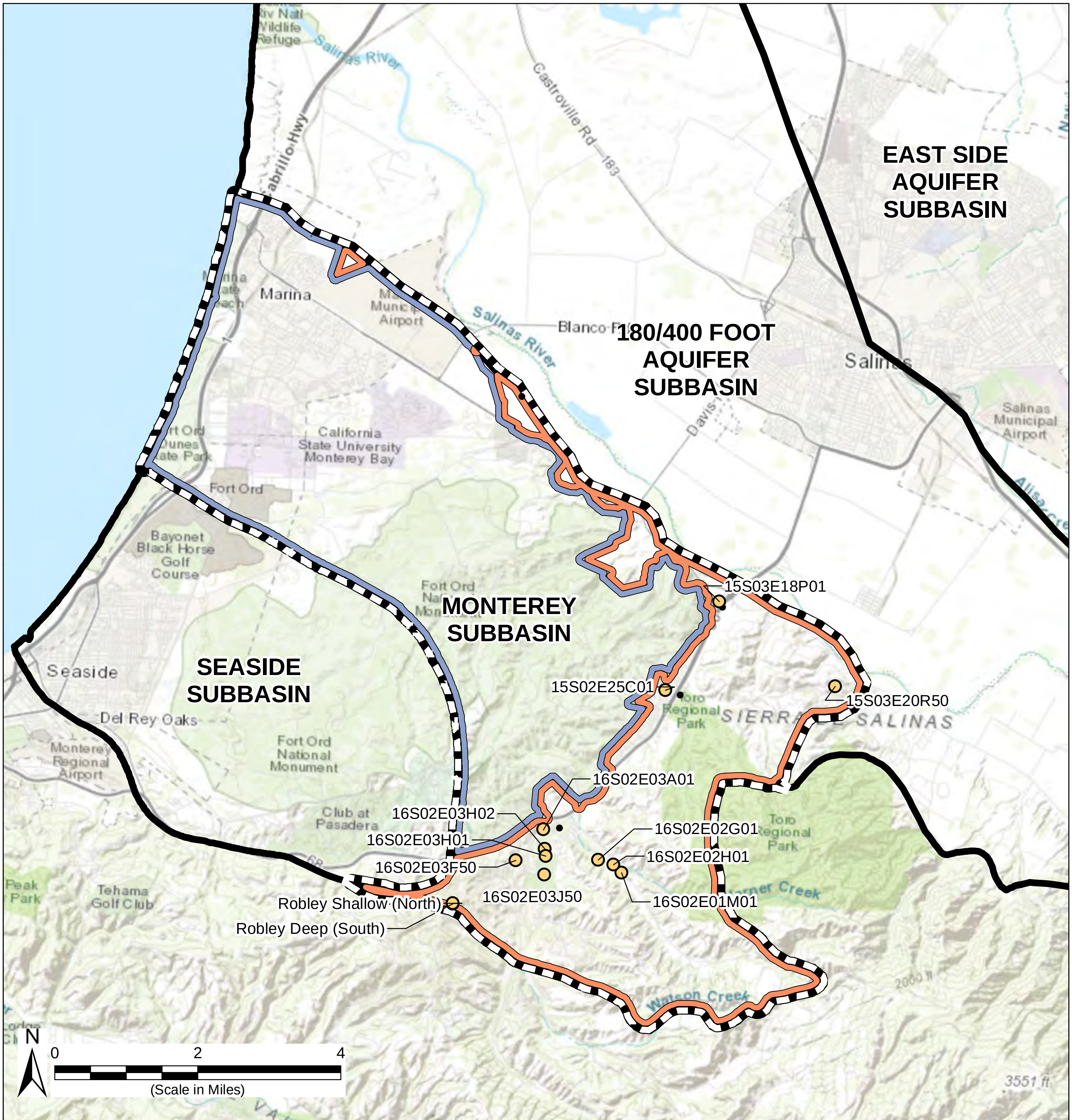
Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-5

Notes

1. All locations are approximate.
2. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Path: X:\B60094\Maps\2021\09\Fig7-5_MN_wells_Deep.mxd



Legend

- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells
- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Corral de Tierra Area: Monitoring Network for Groundwater Elevations El Toro Primary Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-6

Path: X:\B60094\Maps\2021\09\Fig7-6_MN_wells_ElToro.mxd

Table 7-1. Monterey Subbasin Groundwater Elevation Representative Monitoring Sites

Site Name	Aquifer	CASGEM Well Number (c)	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of WL Record (years)
Marina/Ord Area								
MW-BW-28-A	Dune Sand Aquifer	--	--	Monitoring	114	36.6775	-121.7744	19
MW-BW-49-A	Dune Sand Aquifer	--	--	Monitoring	62	36.6854	-121.7928	18
MW-BW-81-A	Dune Sand Aquifer	--	--	Monitoring	82	36.6893	-121.7942	12
MW-BW-82-A	Dune Sand Aquifer	--	--	Monitoring	74	36.6886	-121.7961	12
MW-OU2-13-A	Dune Sand Aquifer	--	--	Monitoring	146	36.6584	-121.7689	32
MW-OU2-32-A	Dune Sand Aquifer	--	--	Monitoring	140	36.6705	-121.8098	27
MW-OU2-34-A	Dune Sand Aquifer	--	--	Monitoring	166	36.6613	-121.7993	27
CDM MW-1 Beach	Upper 180-Foot Aquifer (a)	366521N1218 236W001	MW-1 Beach	Monitoring	140	36.6521	-121.8236	13
MW-02-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	69	36.6664	-121.8159	27
MW-02-10-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	64	36.6691	-121.8155	25
MW-02-13-180M	Upper 180-Foot Aquifer (a)	--	--	Monitoring	137	36.6648	-121.8167	21
MW-02-13-180U	Upper 180-Foot Aquifer (a)	--	--	Monitoring	78	36.6648	-121.8166	21
MW-12-07-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	96	36.6633	-121.8152	25
MW-B-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	210	36.6865	-121.7719	27
MW-BW-55-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	202	36.6758	-121.7747	16
MW-OU2-29-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	286	36.6548	-121.7772	27
MP-BW-42-295	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	16
MW-12-12-180L	Lower 180-Foot Aquifer (a)	--	--	Monitoring	179	36.6652	-121.8146	21
MW-BW-04-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	364	36.6674	-121.7560	20
MW-OU2-66-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	339	36.6667	-121.7661	20
TEST2	Lower 180-Foot Aquifer (a)	--	--	Monitoring	425	36.6519	-121.7490	18
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	8
MPWMD#FO-10S	400-Foot Aquifer (a) (b)	366466N1218 079W001	Fort Ord 10 - Shallow	Monitoring	650	36.6466	-121.8079	22
MPWMD#FO-11S	400-Foot Aquifer (a)	366474N1217 847W002	FO-11-Shallow	Monitoring	740	36.6474	-121.7847	22

Site Name	Aquifer	CASGEM Well Number (c)	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of WL Record (years)
MW-OU2-07-400	400-Foot Aquifer (a)	--	--	Monitoring	580	36.6683	-121.7847	32
014S001E24L002M	Deep Aquifers	--	USGS DMW1--1	Monitoring	1880	36.6993	-121.8077	22
014S001E24L003M	Deep Aquifers	--	USGS DMW1--2	Monitoring	1430	36.6993	-121.8077	22
014S001E24L004M	Deep Aquifers	--	USGS DMW1--3	Monitoring	1080	36.6993	-121.8077	22
014S001E24L005M	Deep Aquifers	--	USGS DMW1--4	Monitoring	970	36.6993	-121.8077	22
14S02E33E01	Deep Aquifers	--	Airport Well 2" Shallow	Monitoring	1095	36.6730	-121.7615	17
14S02E33E02	Deep Aquifers	--	Airport Well 3" DEEP	Monitoring	1760	36.6730	-121.7614	17
PZ-FO-32-910	Deep Aquifers	--	MCWRA_21356	Monitoring	910	36.6604	-121.7413	13
MPWMD#FO-10D	Deep Aquifers (b)	366466N1218079W002	MPWMD #FO-10-Deep	Monitoring	1420	36.6466	-121.8079	22
MPWMD#FO-11D	Deep Aquifers	366474N1217847W001	FO-11-Deep	Monitoring	1130	36.6474	-121.7847	22
Sentinel MW #1	Deep Aquifers (b)	366521N1218236W002	SGB--MW #1	Monitoring	1500	36.6521	-121.8236	13
Corral de Tierra Area								
16S/02E-01M01	El Toro Primary Aquifer System	365680N1217073W001	16797	Residential	294	36.5680	-121.7072	58
16S/02E-02G01	El Toro Primary Aquifer System	365705N1217134W001	16820	Residential	440	36.5704	-121.7132	58
Robley Deep (South)	El Toro Primary Aquifer System	365608N1217494W001	Robley Deep (South)	Monitoring	820	36.5608	-121.7494	30
Robley Shallow (North)	El Toro Primary Aquifer System	365608N1217494W002	Robley Shallow (North)	Monitoring	430	36.5608	-121.7494	30
15S/02E-25C01	El Toro Primary Aquifer System	--	1840	Residential	680	36.6053	-121.6974	14
15S/03E-18P01	El Toro Primary Aquifer System	--	1804	Monitoring	810	36.6235	-121.6845	14
16S/02E-02H01	El Toro Primary Aquifer System	--	16823	Residential	204	36.5696	-121.7094	56
16S/02E-03H02	El Toro Primary Aquifer System	--	20813	Irrigation	920	36.5724	-121.7267	14
15S/03E-20R50	El Toro Primary Aquifer System	--	22683	Public Supply	680	36.6070	-121.6548	10
16S/02E-03A01	El Toro Primary Aquifer System	--	16842	Irrigation	134	36.5763	-121.7271	58
16S/02E-03F50	El Toro Primary Aquifer System	--	21073	Residential	510	36.5700	-121.7339	21
16S/02E-03H01	El Toro Primary Aquifer System	--	16877	Irrigation	948	36.5710	-121.7264	55
16S/02E-03J50	El Toro Primary Aquifer System	--	16862	Irrigation	810	36.5672	-121.7266	14

Notes:

(a) The RMS network is selected to additionally distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer, since conditions in the upper 180-Foot are distinct from those in the lower 180-Foot Aquifer, as described in Chapter 5.

(b) Wells MPWMD#FO-10S, MPWMD#FO-10D, and Sentinel MW#1 are monitored by MPWMD on behalf of the Seaside Watermaster. MPWMD#FO-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer; MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

(c) CASGEM well numbers are provided for existing CASGEM wells. It is the GSAs' understanding that the SGMA monitoring program will supersede the CASGEM program once the GSP is adopted and SGMA monitoring is in effect.

7.3.1 Groundwater Elevation Monitoring Protocols

Groundwater elevation measurements will be collected pursuant to the protocols identified in the following documents. These monitoring plans are included in Appendices 7-A through 7-C.

- Chapter 4 of the MCWRA CASGEM monitoring plan includes a description of existing MCWRA CASGEM groundwater elevation monitoring procedures (MCWRA, 2015b). Groundwater elevation measurements will be collected at least two times per year to represent seasonal low and seasonal high groundwater conditions. The monitoring protocols described in Appendix 7-A cover multiple monitoring methods for collecting data by hand and by automated pressure transducers.
- MPWMD CASGEM monitoring plan (Appendix 7-B) describes groundwater elevation monitoring procedures implemented by MPWMD (MPMWD, 2012). Groundwater elevation measurements will be collected twice a year, once at the end of September and once at the end of March. Groundwater elevation measurements will be taken by electric measuring tape to the nearest hundredth of a foot.
- Appendix A of the Quality Assurance Project Plan (QAPP; Appendix 7-C) for the former Fort Ord includes a description of groundwater monitoring procedures at the former Fort Ord (U.S. Army, 2019). Groundwater elevation measurements will be collected at least semi-annually, subject to future monitoring program revisions, and in accordance with applicable Standard Operating Procedures covered in the QAPP.

These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.3.2 Groundwater Elevation Monitoring Network Data Gaps

Based on the GSP Emergency Regulations and BMPs published by DWR on monitoring networks (DWR, 2016b), a visual analysis of the existing monitoring network was performed. This analysis was conducted using professional judgment to evaluate whether there are data gaps in the groundwater elevation monitoring network based upon potential significant and unreasonable conditions within the Subbasin.

While there is no definitive requirement on monitoring well density, the BMP cites several studies (Heath, 1976; Sophocleous, 1983; Hopkins, 1984) that recommend 0.2 to 10 wells per 100 square miles. The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors.

The Monterey Subbasin encompasses a total of 48.2 square miles. The Marina-Ord Area covers approximately 30.2 square miles and the Corral de Tierra Area covers approximately 18.0 square miles. If BMP guidance recommendations are applied to each of the areas, the monitoring network should include between 1 and 3 wells in the Marina-Ord Area and between one and two wells in the Corral de Tierra Area. The current RMS network includes 35 wells in the Marina-Ord Area (2 to 6 wells per principal aquifer) and 13 wells in the Corral de Tierra Area. In addition, the monitoring network includes over 390 wells in the Marina-Ord Area and 17 wells in the Corral de Tierra Area that are regularly monitored by local agencies. Data from wells in the monitoring network will be used by the GSAs to assess groundwater conditions and inform SGMA implementation. The number of groundwater elevation monitoring wells in Monterey Subbasin therefore exceed the number recommended in BMP guidance.

As discussed above, although no wells exist in the south-eastern portion of Marina-Ord Area (i.e., the Fort Ord hills), no monitoring of groundwater levels is needed in this area because it is part of a federal land area and has no current and future planned groundwater extraction. However, additional wells are necessary to provide additional groundwater elevation data near the ocean in areas subject to seawater intrusion.

For the Corral de Tierra Area, visual inspection of the geographic distribution of the monitoring network indicates that additional wells are necessary to monitor groundwater levels and characterize the Area. A higher density of monitoring wells is recommended near residential areas or other locations where groundwater withdrawal is significant.

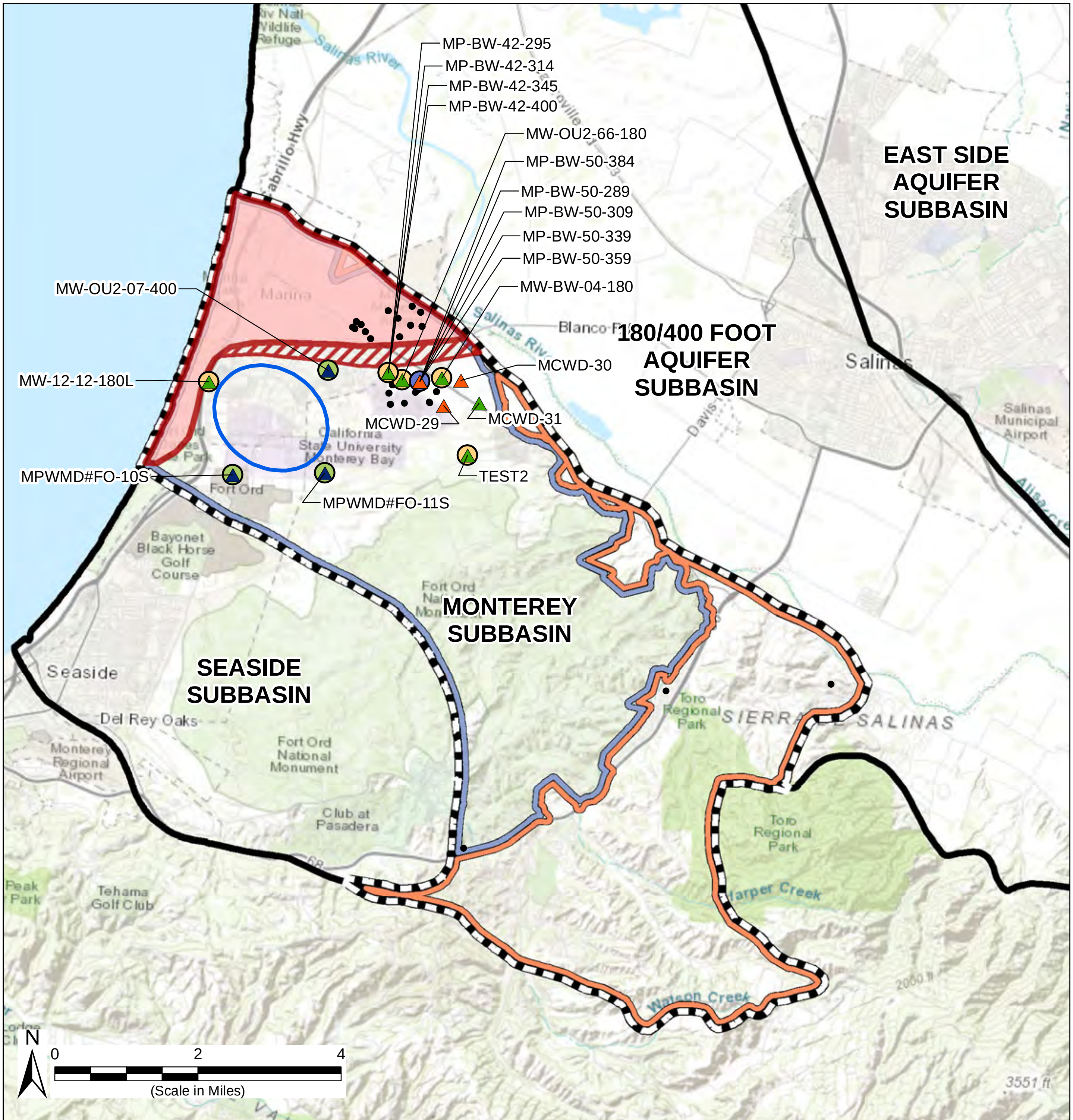
The generalized locations for proposed new monitoring wells were based on addressing the criteria listed in the monitoring BMP including:

- Providing adequate data to produce seasonal potentiometric maps;
- Providing adequate data to map groundwater depressions and recharge areas;
- Providing adequate data to estimate the change in groundwater storage; and
- Demonstrating conditions at Subbasin boundaries.

Figure 7-7 through Figure 7-9. show the locations of existing groundwater elevation monitoring wells and the generalized locations where additional monitoring wells are needed in the Monterey Subbasin. These areas include:

- Within the Lower 180-Foot, 400-Foot Aquifer in the Marina-Ord Area to address a lack of coverage near the central coastline;
- Within the Deep Aquifers in the Marina-Ord Area to address a lack of coverage near the central coastline; and
- Within the El Toro Primary Aquifer in the Corral de Tierra Area to address lack of coverage near areas with substantial groundwater withdrawal.

In the Marina-Ord Area, additional wells are also needed in the identified areas to augment the seawater intrusion monitoring network as discussed in Section 7.5.2. The data gap areas shown on Figure 7-7 through Figure 7-9. will be addressed during GSP implementation by either identifying an existing well in each area that meets the criteria for a valid monitoring well, or drilling a new well in each area, as further described in Chapter 10.



Legend

- Monterey Subbasin
- Active Groundwater Elevation Monitoring Wells

Representative Monitoring Sites for Seawater Intrusion

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer
- 400-Foot Aquifer (Paso Robles Aquifer)

Management Areas

- Marina-Ord Area
- Corral de Tierra

- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer
- 400-Foot Aquifer (Paso Robles Aquifer)

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion
- Monitoring Network Data Gaps

Notes

1. All locations are approximate.

Sources

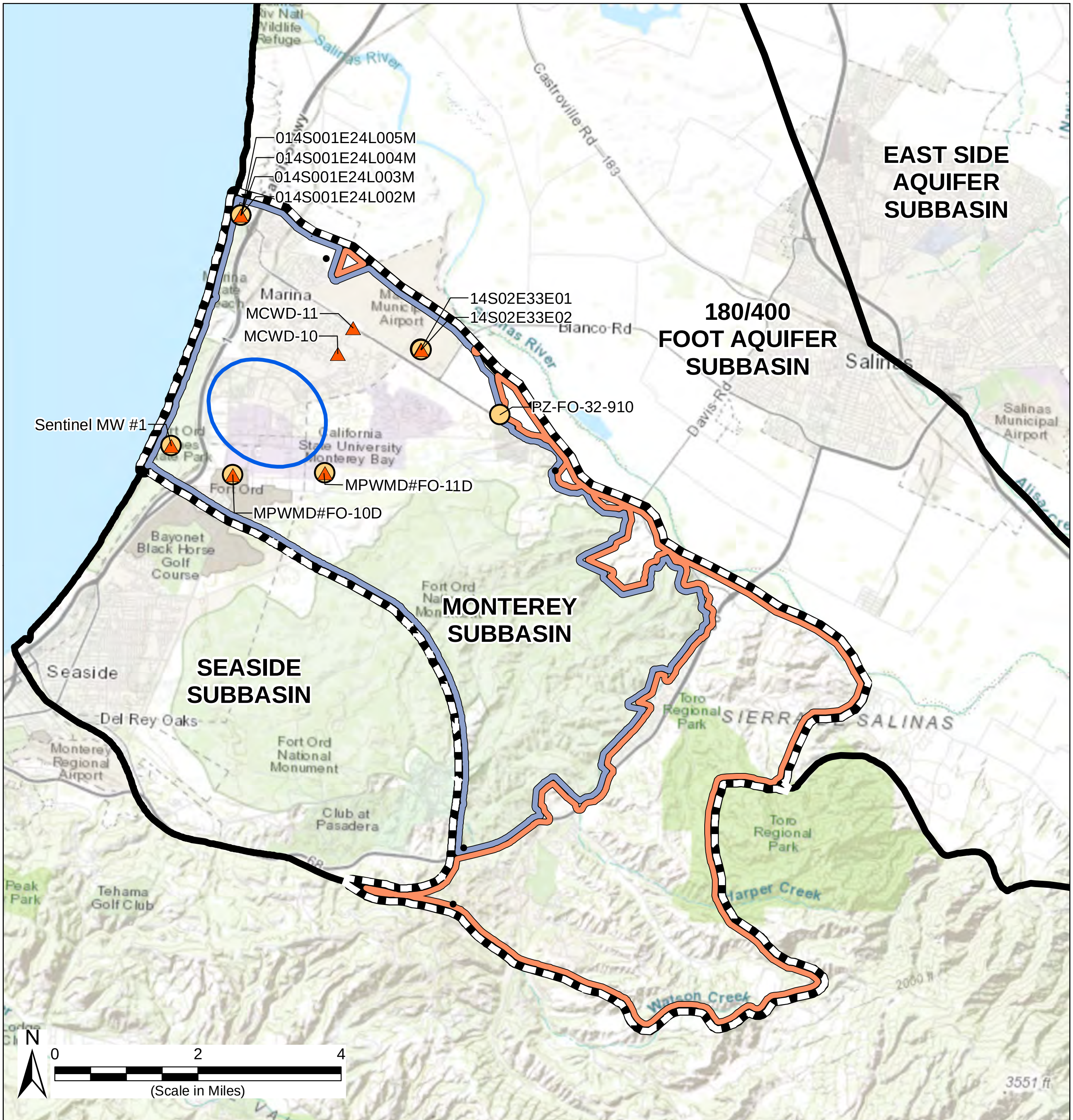
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.

Marina-Ord Area: Monitoring Network Data Gaps Lower 180-Foot and 400-Foot Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-7

Path: X:\B60094\Maps\2021\09\Fig7-7_DataGaps_400.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Seawater Intrusion
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra Area
- Monitoring Network Data Gaps

Notes

1. All locations are approximate.

Sources

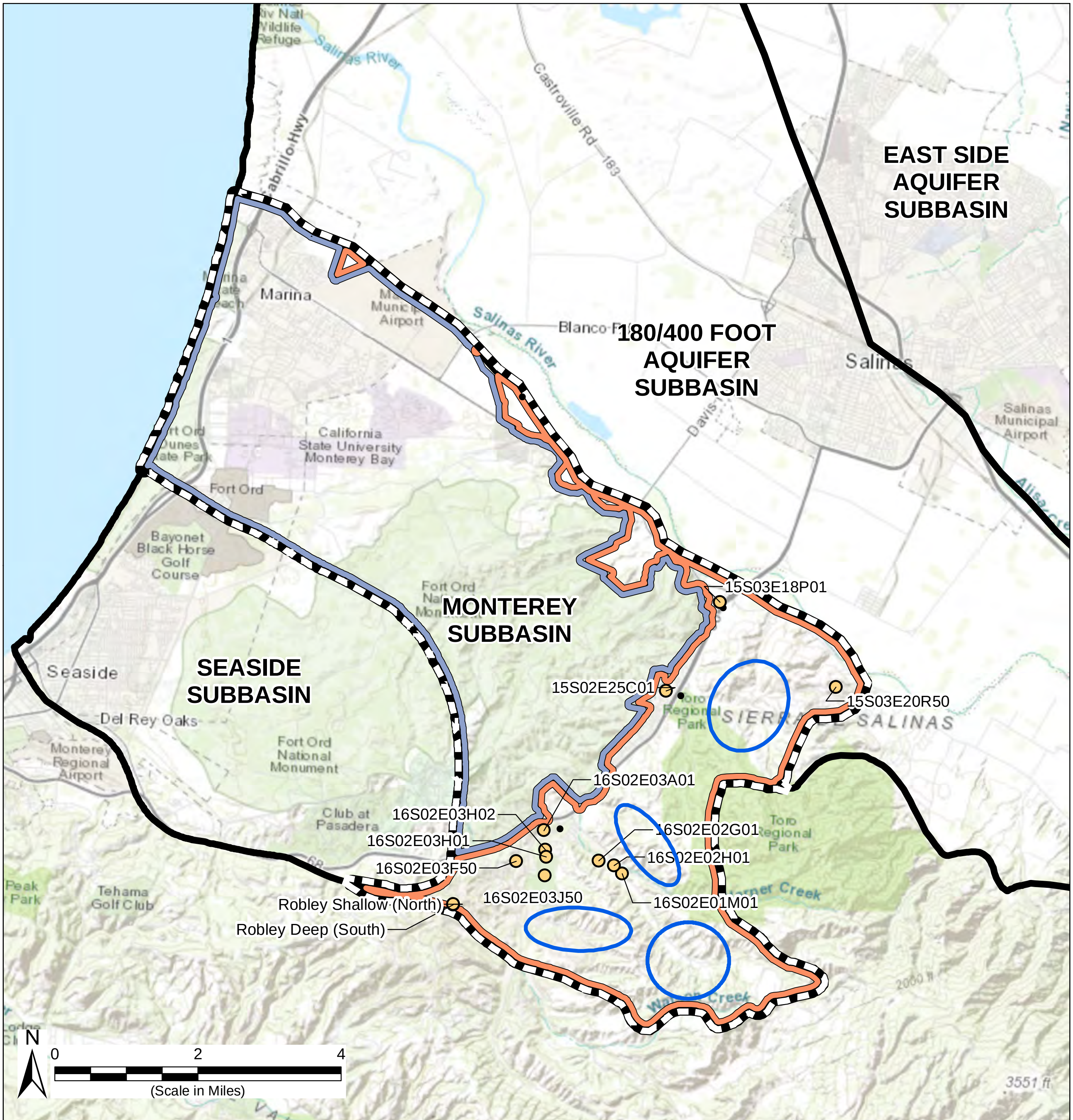
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network Data Gaps Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-8

Path: X:\B60094\Maps\2021\09\Fig7-8_DataGaps_Deep.mxd



Legend

- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells
- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management Areas

- Marina-Ord Area
- Corral de Tierra Area
- Monitoring Network Data Gaps

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Corral de Tierra Area: Monitoring Network Data Gaps El Toro Primary Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-9

Path: X:\B60094\Maps\2021\09\Fig7-9_DataGap_ElToro.mxd

7.3.3 Protective Groundwater Gradient Monitoring

As discussed in Section 5.3.4, the hydraulic gradient and groundwater flow direction within the seawater intruded lower 180-Foot, 400-Foot Aquifer in the Marina-Ord Area is parallel to the current seawater intrusion front. It appears that, under the current hydraulic gradient and groundwater flow direction, there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin and that the lateral extent of seawater intrusion within the Subbasin has been relatively stable over the past two decades.

To ensure groundwater use within the Subbasin will not create groundwater gradients that actively draw intruding seawater inland within the Monterey Subbasin or into any adjacent subbasins, the MCWD GSA will also regularly evaluate the magnitude and direction of the hydraulic gradient from selected wells within the lower 180-Foot, 400-Foot Aquifer near the southern extent of the seawater intruded front. Specifically, selected wells will be assigned to groups of three. The magnitude and direction of the hydraulic gradient will be calculated for each group of wells. MCWD GSA will use this information to verify that the direction of the hydraulic gradient does not shift further to the south than has been measured over the last 10 years. This monitoring is conducted in addition to monitoring of groundwater elevations in the lower 180-Foot, 400-Foot Aquifer RMS located south of the seawater intruded front and ensure they meet the identified SMCs.

The wells selected for inland seawater intrusion protective groundwater gradient monitoring are listed in Table 7-2 and shown on Figure 7-10. These wells are located near the seawater intrusion front where it is closest to current groundwater production in the Marina-Ord Area. The magnitude and direction of hydraulic gradient measured in the Fall of 2017 based on these wells are listed in Table 7-3 and illustrated on Figure 7-11. As shown in Table 7-3, the magnitude and direction of the hydraulic gradient were approximately 0.0015 ft/ft and 64 degrees due north, respectively.

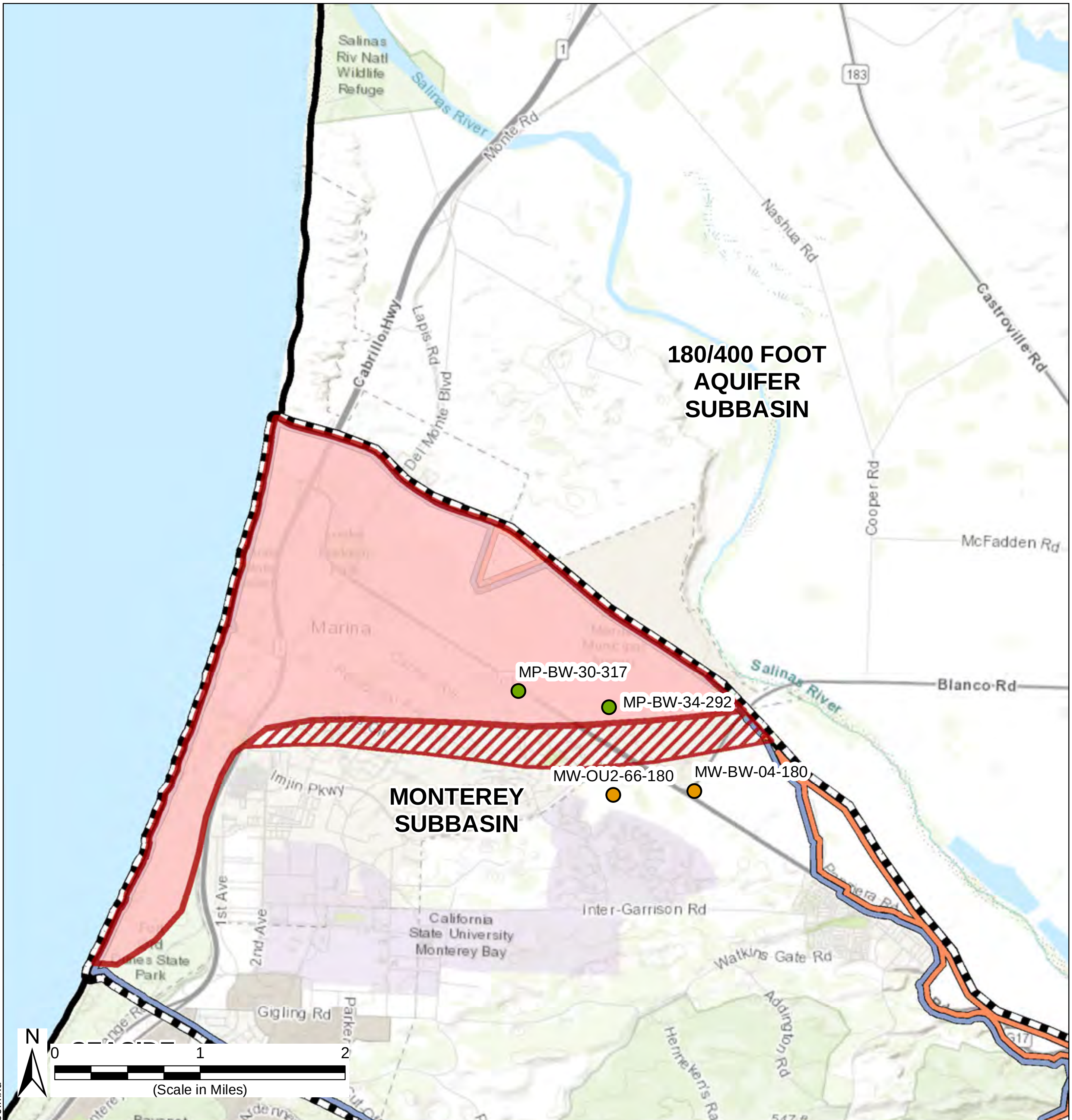
These protective groundwater gradients focus on limiting the expansion of the seawater intrusion extent in the Lower 180-Foot, 400-Foot Aquifer within the Monterey Subbasin and in the adjacent Seaside Subbasin, consistent with seawater intrusion minimum thresholds and measurable objectives established in Chapter 8.

Table 7-2. Wells Selected for Protective Groundwater Gradient Monitoring

Site Name	X (ft NAD83 State Plane IV)	Y (ft NAD83 State Plane IV)	2017 Fall Groundwater Elevation (ft NAVD 88)
MP-BW-30-317	5747078.37	2141302.81	-9.064
MP-BW-34-292	5750371.95	2140709.06	-13.061
MW-OU2-66-180	5750538.4265	2137520.5686	-11.221
MW-BW-04-180	5753483.211	2137660.1282	-15.321

Table 7-3. Fall 2017 Hydraulic Gradient and Flow Direction

Group	Sites	Hydraulic Gradient (L/L)	Direction (deg)
Group 1	MP-BW-30-317 MP-BW-34-292 MW-OU2-66-180	0.001479	64.08
Group 2	MP-BW-34-292 MW-OU2-66-180 MW-BW-04-180	0.001508	64.54



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Estimated Seawater Intrusion in Monterey Subbasin

Area of Known Seawater Intrusion

Area of Potential Seawater Intrusion

Management Areas

Marina-Ord

Corral de Tierra

Protective Groundwater Gradient Monitoring Wells

Lower 180-Foot

Lower 180-Foot, 400-Foot Aquifer

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Notes

1. All locations are approximate.
2. The areas of known and potential seawater intrusion are from Figure 5-28.

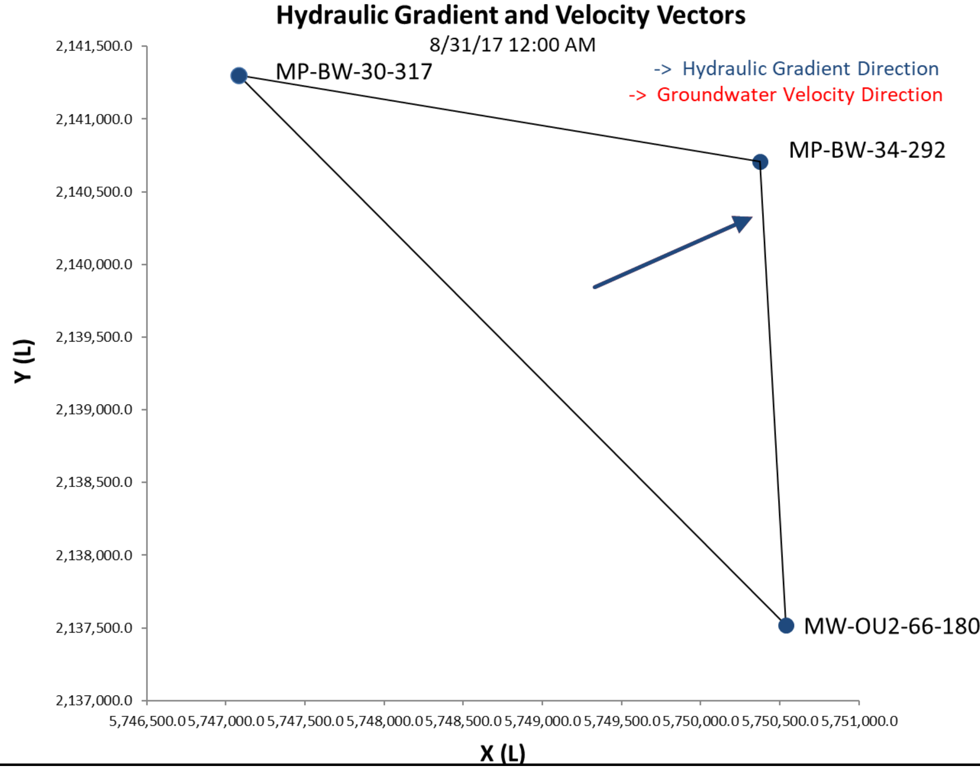
Marina-Ord Area: Protective Groundwater Gradient Monitoring Wells Lower 180-Foot and 400-Foot Aquifers

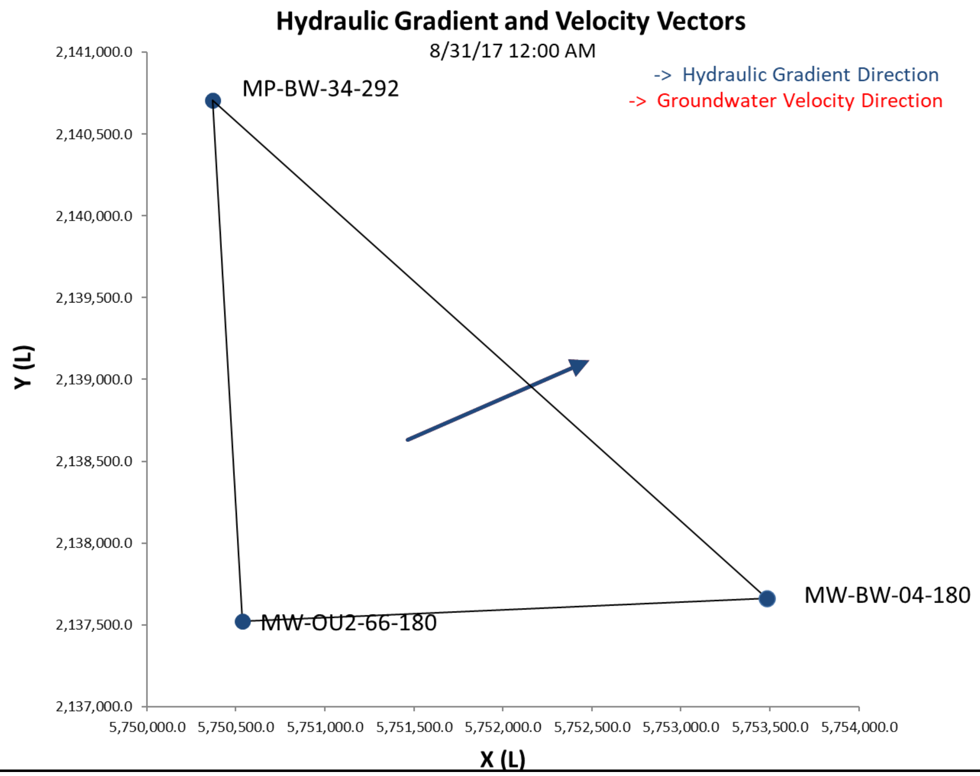
Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-10

Path: X:\B60094\Maps\2021\09\Fig7-10_ProtectiveGradientwells_400.mxd

Figure 7-11. Fall 2017 Hydraulic Gradient and Flow Direction





7.4 Groundwater Storage Monitoring Network

Data and minimum thresholds used to define undesirable results for chronic lowering of groundwater levels and seawater intrusion will also be used to assess reduction of groundwater storage (see Chapter 8). As such, the reduction of groundwater storage monitoring network will consist of the same RMS wells as described in Sections 7.3 and 7.5. Minimum thresholds for chronic lowering of groundwater levels and seawater intrusion are sufficiently protective to ensure prevention of significant and unreasonable occurrences of reduction in groundwater storage.

7.5 Seawater Intrusion Monitoring Network

Pursuant to §354.34 of the GSP Emergency Regulations, seawater intrusion should be monitored "using chloride concentrations, or other measurements convertible to chloride concentrations, so that the current and projected rate and extent of seawater intrusion for each applicable principal aquifer may be calculated". The sustainability indicator for seawater intrusion is evaluated using the location of the 500 milligrams per liter (mg/L) chloride isoconcentration contour that is based on chloride concentrations, equivalent total dissolved solids (TDS) concentrations, and/or specific conductivity measurements (Figure 5-23).

The seawater intrusion monitoring network comprises 42 RMS wells monitored by MCWD, U.S. Army, MCWRA, MPMWD, and the Seaside Groundwater Basin Watermaster in the Marina-Ord Area (see Figure 7-12 through Figure 7-16). All monitoring wells that are currently monitored for seawater intrusion in the Subbasin are included as part of the RMS network. Additional sites are added to the RMS network to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8.

The seawater intrusion RMS network in the Marina-Ord area has been coordinated with the groundwater elevation RMS network (Section 7.3). Groundwater elevation data will be utilized in conjunction with chloride data from these wells to monitor potential expansion of the seawater intrusion front. The RMS wells within each management area have been selected to facilitate monitoring of significant and unreasonable groundwater conditions identified in Chapter 8. Criteria for selecting wells as part of the seawater intrusion RMS network include:

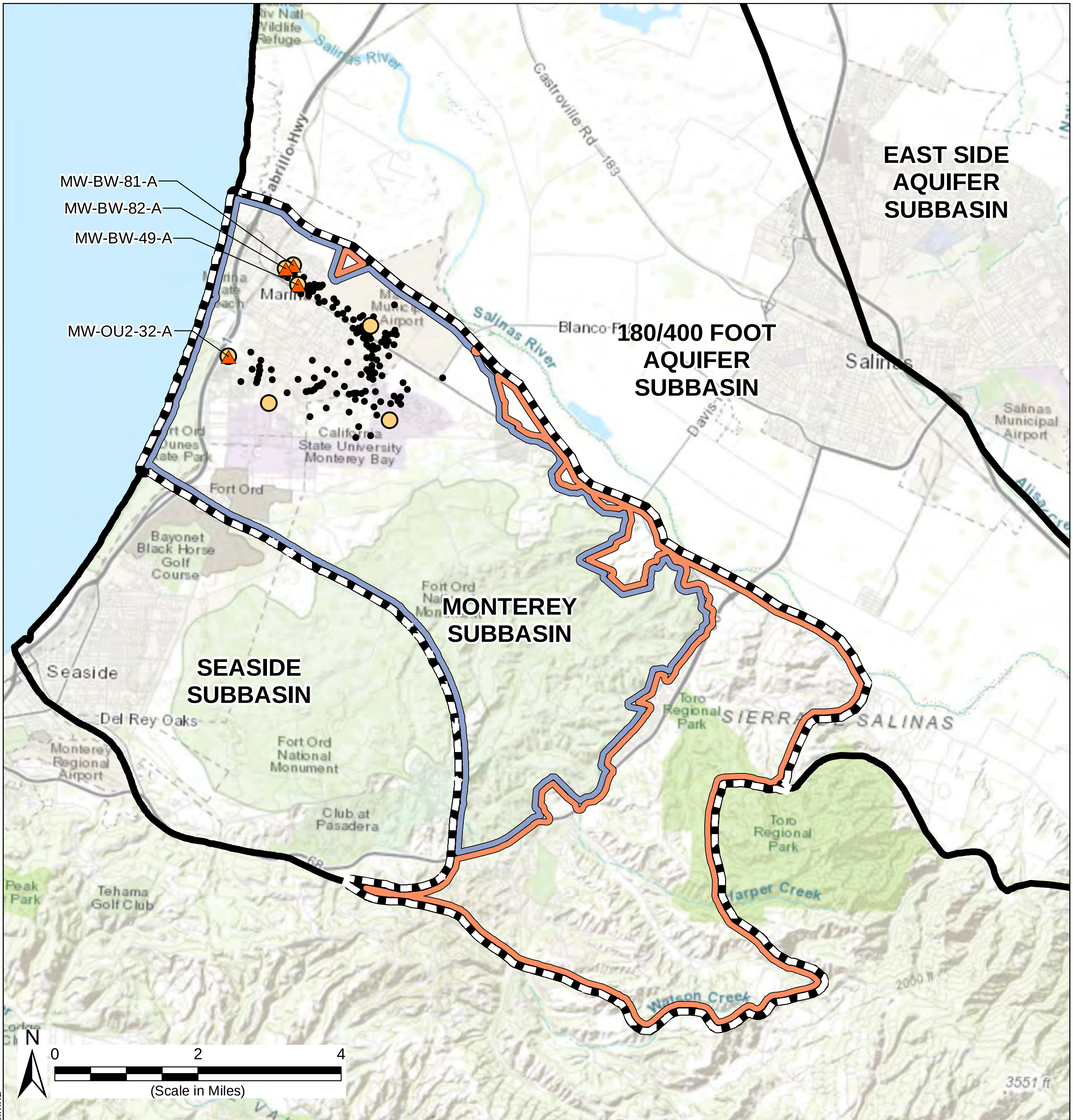
- RMS wells should facilitate monitoring seawater intrusion within all principal aquifers;
- RMS wells should be located near the coast in aquifer zones where seawater intrusion has not been identified (i.e., the Dune Sand Aquifer, the upper 180-Foot Aquifer, and the Deep Aquifers);
- RMS wells should be located near the coast and at the extent of the 500 mg/L chloride isoconcentration contour in aquifers where seawater intrusion has already occurred (i.e., the Lower 180-Foot/400-Foot Aquifer);

- RMS wells that could be included in both the groundwater elevation and seawater intrusion RMS networks are preferred;
- RMS wells should be located on public parcels or on properties where access agreements have been negotiated;
- RMS wells must have known depths and well completion data;
- RMS wells should not be influenced by nearby infiltration or groundwater remediation activities;
- RMS wells with available historical chloride and groundwater elevation data are preferred, but wells without this information may be used where alternate wells are not available; and
- Available chloride and/or water level data for seawater intrusion RMS wells should be representative of similar data from nearby surrounding wells.

Data from seawater intrusion RMS wells will be considered public and will be used for seawater intrusion maps and analyses unless the owner of the well opts out through correspondence with MCWDGSA or SVBGSA.[46]

The RMS wells currently in the seawater intrusion monitoring network are listed in Table 7-4. The need for any additional wells is discussed in Section 7.5.2.

[46] If an owner opts out of public data reporting, another well will be identified for SWI monitoring.



Path: X:\B60094\Maps\2021\09\Fig7-12_MN_wells_SWI_DuneSand.mxd

Legend

- Representative Monitoring Sites for Seawater Intrusion
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells
- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Management

- Marina-Ord
- Corral de Tierra Area

Notes

1. All locations are approximate.

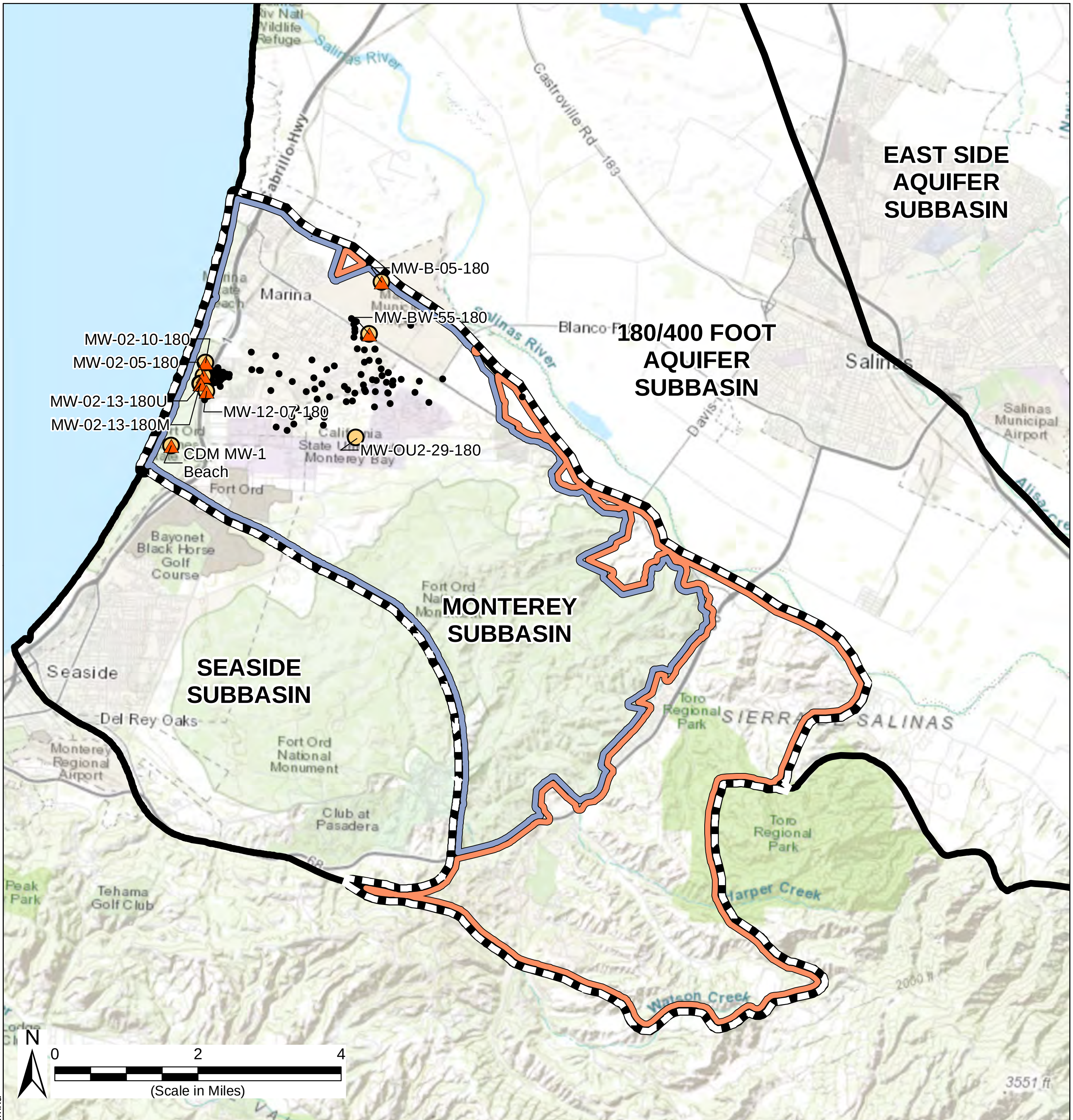
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
Apirl 2021

Figure 7-12



Path: X:\B600094\Maps\2021\09\Fig7-13_MN_wells_SWI_Upper180.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Seawater Intrusion
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord
- Corral de Tierra

Notes

1. All locations are approximate.

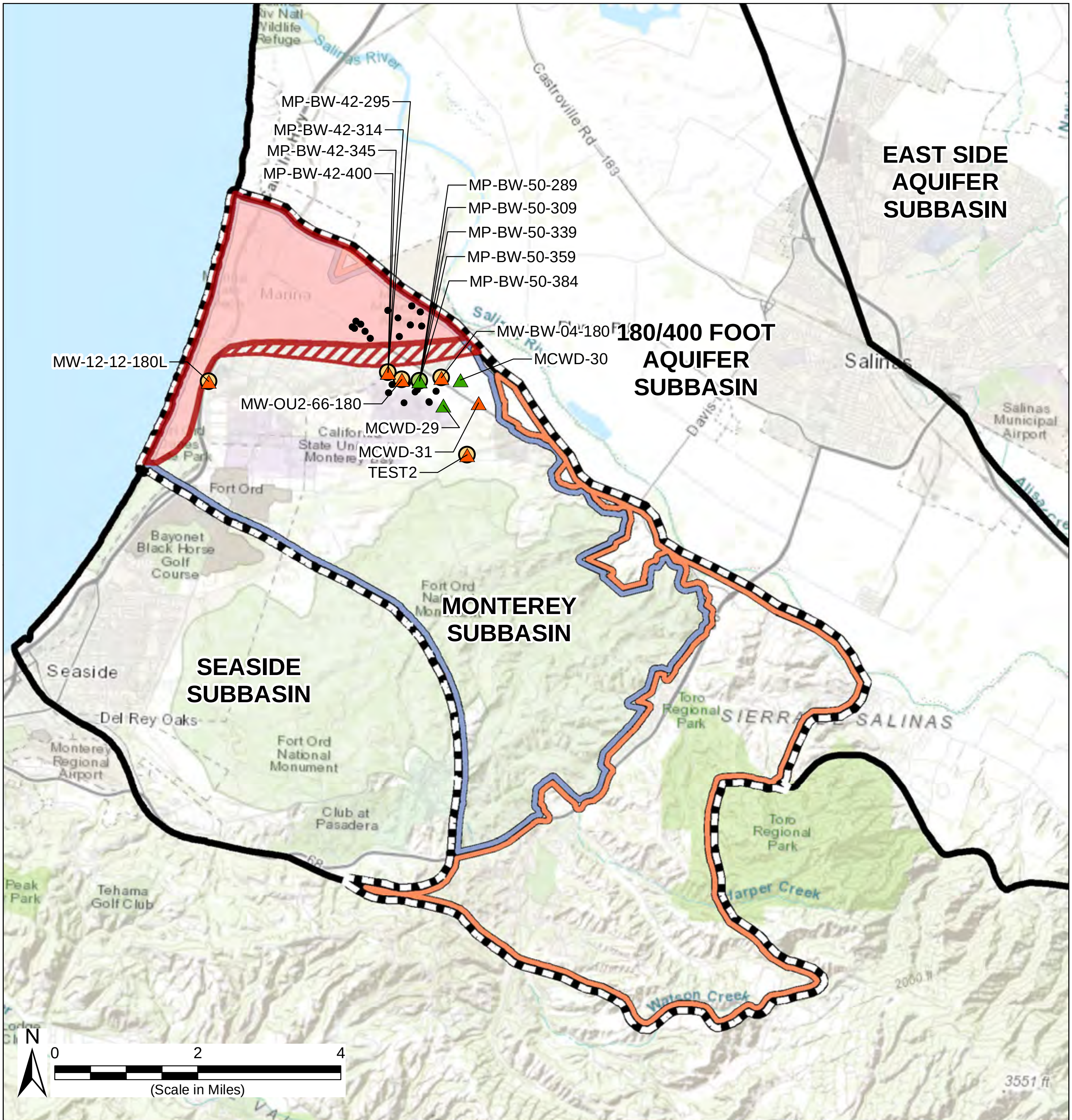
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion Upper 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-13



Path: X:\B60094\Maps\2021\09\Fig7-14_MN_wells_Lower 180.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Active Groundwater Elevation Monitoring Wells

Management

- Marina-Ord
- Corral de Tierra

Representative Monitoring Sites for Seawater Intrusion

- Lower 180-Foot
- Lower 180-Foot, 400-Foot

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot
- Lower 180-Foot, 400-Foot

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion

Notes

1. All locations are approximate.

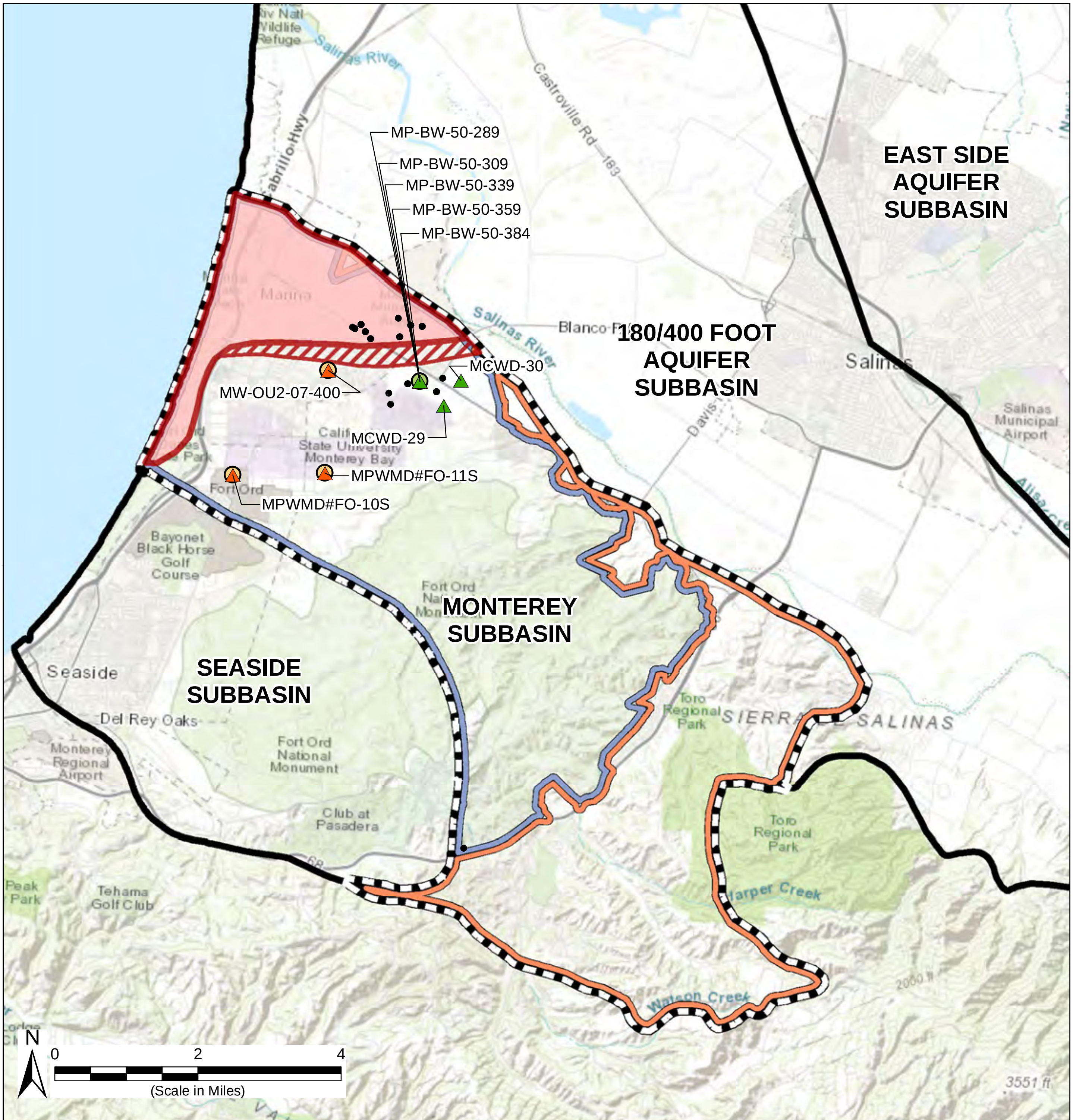
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion Lower 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-14



Path: X:\B60094\Maps\2021\09\Fig7-15_MN_wells_400-ft.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Active Groundwater Elevation Monitoring Wells

Estimated Seawater Intrusion in Monterey Subbasin

- Area of Known Seawater Intrusion
- Area of Potential Seawater Intrusion

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites for Seawater Intrusion

- 400-Foot Aquifer (Paso Robles Aquifer)
- Lower 180-Foot, 400-Foot Aquifer

Representative Monitoring Sites for Groundwater Elevations

- 400-Foot Aquifer (Paso Robles Aquifer)
- Lower 180-Foot, 400-Foot Aquifer

Notes

1. All locations are approximate.
2. MPWMD#-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer.

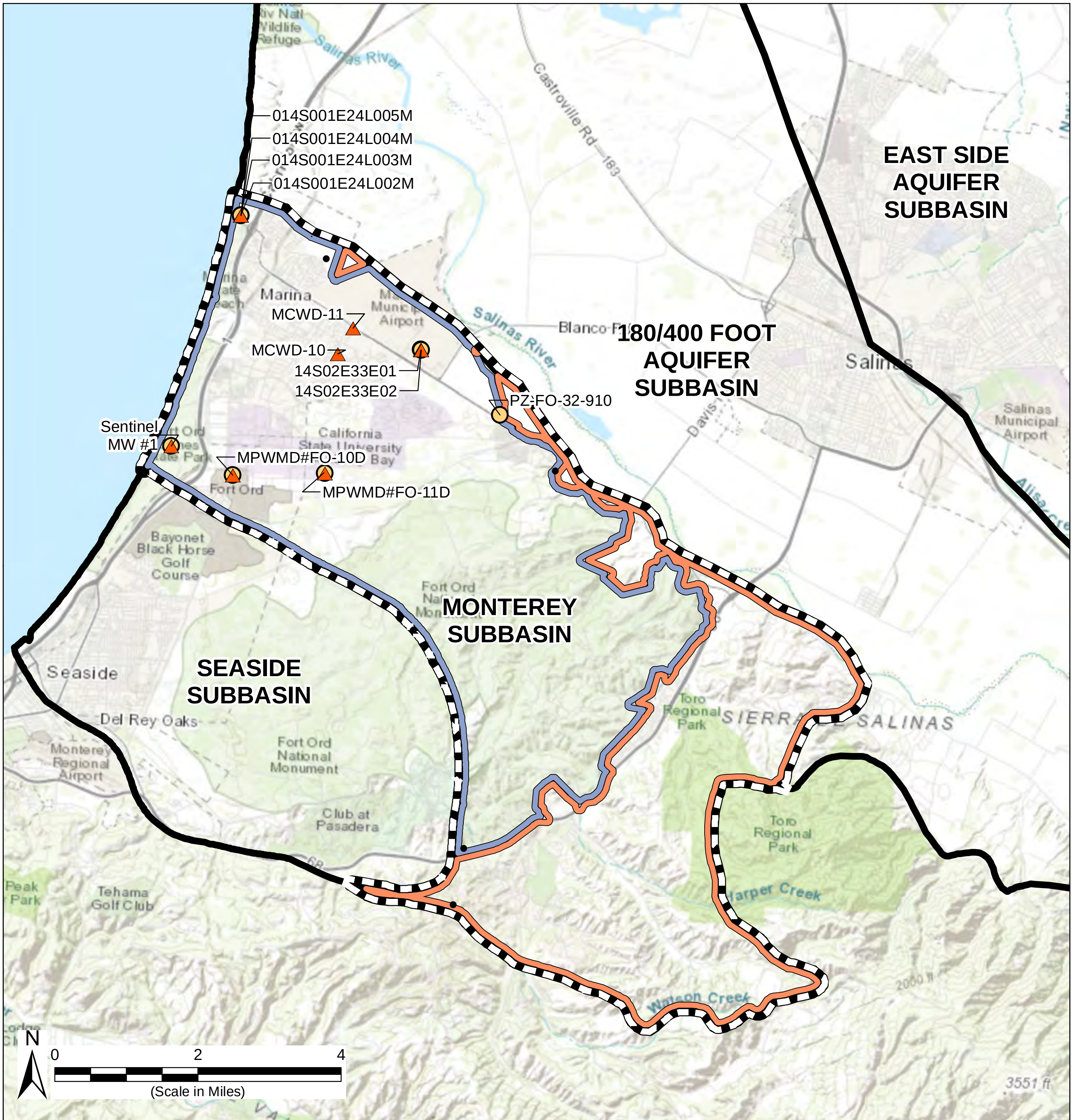
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-15



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Seawater Intrusion
- Representative Monitoring Sites for Groundwater Elevations
- Active Groundwater Elevation Monitoring Wells

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Notes

1. All locations are approximate.
2. MPWMD#FO-10D and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

Marina-Ord Area: Monitoring Network for Groundwater Elevations and Seawater Intrusion Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-16

Path: X:\B60094\Maps\2021\09\Fig7-16_MN_wells_Deep.mxd

Table 7-4. Monterey Subbasin Seawater Intrusion Representative Monitoring Sites

Site Name	Aquifer	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of TDS/Cl Record (years)
MW-BW-49-A	Dune Sand Aquifer	--	--	Monitoring	62	36.6854	-121.7928	1
MW-BW-81-A	Dune Sand Aquifer	--	--	Monitoring	82	36.6893	-121.7942	NA
MW-BW-82-A	Dune Sand Aquifer	--	--	Monitoring	74	36.6886	-121.7961	NA
MW-OU2-32-A	Dune Sand Aquifer	--	--	Monitoring	140	36.6705	-121.8098	6
CDM MW-1 Beach	Upper 180-Foot Aquifer (a)	366521N1218 236W001	MW-1 Beach	Monitoring	140	36.6521	-121.8236	NA
MW-02-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	69	36.6664	-121.8159	27
MW-02-10-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	64	36.6691	-121.8155	17
MW-02-13-180M	Upper 180-Foot Aquifer (a)	--	--	Monitoring	137	36.6648	-121.8167	22
MW-02-13-180U	Upper 180-Foot Aquifer (a)	--	--	Monitoring	78	36.6648	-121.8166	5
MW-12-07-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	96	36.6633	-121.8152	19
MW-B-05-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	210	36.6865	-121.7719	6
MW-BW-55-180	Upper 180-Foot Aquifer (a)	--	--	Monitoring	202	36.6758	-121.7747	1
MCWD-31	Lower 180-Foot Aquifer (a)	--	Well 31	Public Supply	490	36.6625	-121.7465	36
MP-BW-42-295	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-314	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-345	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MP-BW-42-400	Lower 180-Foot Aquifer (a)	--	--	Monitoring	467	36.6682	-121.7695	6
MW-12-12-180L	Lower 180-Foot Aquifer (a)	--	--	Monitoring	179	36.6652	-121.8146	9
MW-BW-04-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	364	36.6674	-121.7560	9
MW-OU2-66-180	Lower 180-Foot Aquifer (a)	--	--	Monitoring	339	36.6667	-121.7661	9

Site Name	Aquifer	CASGEM Well Number	Local Well Designation	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)	Period of TDS/Cl Record (years)
TEST2	Lower 180-Foot Aquifer (a)	--	--	Monitoring	425	36.6519	-121.7490	NA
MCWD-29	Lower 180-Foot, 400-Foot Aquifer (a)	--	Well 29	Public Supply	557	36.6618	-121.7553	36
MCWD-30	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Public Supply	552	36.6670	-121.7513	36
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-309	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-339	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-359	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MP-BW-50-384	Lower 180-Foot, 400-Foot Aquifer (a)	--	--	Monitoring	397	36.6666	-121.7616	1
MPWMD#FO-10S	400-Foot Aquifer (a) (b)	366466N1218079W001	Fort Ord 10 - Shallow	Monitoring	650	36.6466	-121.8079	24
MPWMD#FO-11S	400-Foot Aquifer (a)	366474N1217847W002	FO-11-Shallow	Monitoring	740	36.6474	-121.7847	1
MW-OU2-07-400	400-Foot Aquifer (a)	--	--	Monitoring	580	36.6683	-121.7847	16
014S001E24L002M	Deep Aquifers	--	USGS DMW1--1	Monitoring	1880	36.6993	-121.8077	4
014S001E24L003M	Deep Aquifers	--	USGS DMW1--2	Monitoring	1430	36.6993	-121.8077	4
014S001E24L004M	Deep Aquifers	--	USGS DMW1--3	Monitoring	1080	36.6993	-121.8077	4
014S001E24L005M	Deep Aquifers	--	USGS DMW1--4	Monitoring	970	36.6993	-121.8077	4
14S02E33E01	Deep Aquifers	--	Airport Well 2'' Shallow	Monitoring	1095	36.6730	-121.7615	NA
14S02E33E02	Deep Aquifers	--	Airport Well 3" DEEP	Monitoring	1760	36.6730	-121.7614	NA
MCWD-10	Deep Aquifers	--	Marina 10	Public Supply	1550	36.6717	-121.7824	36
MCWD-11	Deep Aquifers	--	Marina 11	Public Supply	1660	36.6770	-121.7788	35
MPWMD#FO-10D	Deep Aquifers (b)	366466N1218079W002	MPWMD #FO-10-Deep	Monitoring	1420	36.6466	-121.8079	13
MPWMD#FO-11D	Deep Aquifers	366474N1217847W001	FO-11-Deep	Monitoring	1130	36.6474	-121.7847	NA
Sentinel MW #1	Deep Aquifers (b)	366521N1218236W002	SGB--MW #1	Monitoring	1500	36.6521	-121.8236	NA

Notes:

(a) The RMS network is selected to distinguish the upper 180-Foot Aquifer and the lower 180-Foot Aquifer, since conditions in the upper 180-Foot are distinct from those in the lower 180-Foot Aquifer, as described in Chapter 5.

(b) Wells MPWMD#FO-10S, MPWMD#FO-10D, and Sentinel MW#1 are monitored by MPWMD on behalf of the Seaside Watermaster. MPWMD#FO-10S is known to be screened in the Paso Robles Aquifer, which is likely connected to the 400-Foot Aquifer; MPWMD#FO-10D, and Sentinel MW#1 are screened in the Santa Margarita Aquifer, which is likely connected to the Deep Aquifers.

7.5.1 Seawater Intrusion Monitoring Protocols

Groundwater quality data or specific conductivity measurements will be collected pursuant to the following protocols as applicable to the monitoring agency of each well. These monitoring plans are included in appendices hereto.

- The Monterey County Quality Assurance Project Plan (QAPP; Appendix 7-D) describes existing MCWRA groundwater quality data monitoring protocols.
- The Seaside Basin Watermaster Monitoring and Management Program (SBWMMP, revision date September 5, 2006; Appendix 7-E) describes MPMWD groundwater monitoring protocols conducted on behalf of the Seaside Watermaster. Groundwater quality measurements for wells within the Monterey Subbasin are collected annually. Sentinel MW#1 is also monitored by the Seaside Watermaster via induction logging and more frequent transducer and datalogger based groundwater elevation monitoring.
- Appendix A of the Quality Assurance Project Plan (QAPP; Appendix 7-C) for the former Fort Ord includes a description of groundwater monitoring procedures at the former Fort Ord (U.S. Army, 2019). Groundwater quality or specific conductivity measurements will be collected annually and in accordance with applicable Standard Operating Procedures covered in the QAPP.

Additionally, groundwater quality data will be collected from MCWD production wells pursuant to Title 22 Drinking Water Program requirements.

These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.5.2 Seawater Intrusion Monitoring Network Data Gaps

There is no definitive requirement regarding seawater intrusion monitoring well density. The current network includes 2 to 10 seawater intrusion monitoring wells in the aquifers with no evidence of seawater intrusion and a total of 13 seawater intrusion monitoring wells in the lower 180-Foot, 400-Foot Aquifer where seawater intrusion has occurred. Additional seawater intrusion monitoring wells may be appropriate at the following locations:

- Within the 400-Foot Aquifer to address lack of coverage near the central coastline between wells MCWD-09 and MPWMD#FO-10S; and

- Within the Deep aquifers to address a lack of coverage near the central coastline between MCWD-10 and MPWMD#FO-10D.

These locations are consistent with data gap locations identified as part of the groundwater elevation monitoring network within the Marina-Ord area, which also focuses on preventing seawater intrusion as shown on Figure 7-7 and Figure 7-8 above.

The data gap areas shown on Figure 7-7 and Figure 7-8 will be addressed during GSP implementation by either identifying an existing well in each area that meets the criteria for a valid monitoring well, or drilling a new well in each area, as further described in Chapter 10.

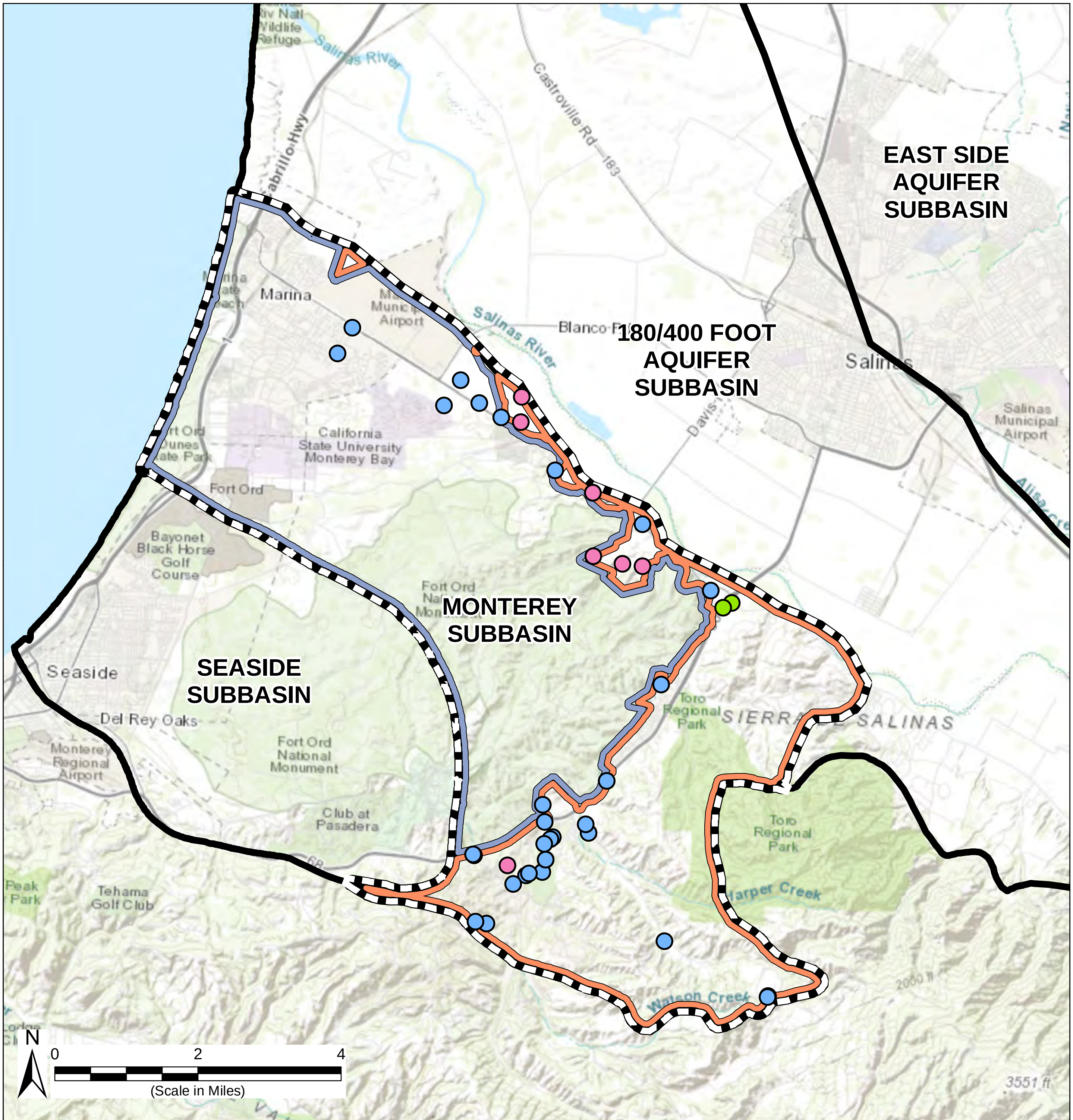
7.6 Water Quality Monitoring Network

The sustainability indicator for degraded water quality is evaluated by monitoring groundwater quality at a network of existing water supply wells. The GSP Emergency Regulations require sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators to address known water quality issues.

As described in Chapter 8, separate minimum thresholds are set for the constituents of concern for public water system supply wells, on-farm domestic wells, and irrigation supply wells. Therefore, although there is a single groundwater quality monitoring network, different wells in the network are reviewed for different constituents. Constituents of concern for drinking water are assessed at public water supply wells and on-farm domestic wells, and constituents of concern for crop health are assessed at agricultural supply wells. The constituents of concern for the three sets of wells are listed in Chapter 5.

The municipal public water system supply wells included in the monitoring network were identified by reviewing data from the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW). The SWRCB collects data for municipal systems; community water systems; non-transient, non-community water systems; and non-community water systems that provide drinking water to at least 15 service connections or serve an average of at least 25 people for at least 60 days a year. The RMS network consists of eight DDW wells in the RMS network in the Ord Area and 24 wells in the Corral de Tierra Area. These wells are shown on Figure 7-17. and listed in Appendix 7-F.

All on-farm domestic wells and agricultural supply wells have been sampled through the CCRWQCB's Irrigated Lands Regulatory Program. Under the existing Ag Order, there are 10 ILRP wells in the Corral de Tierra Area that have been sampled through the CCRWQCB's IRLP are included in the RMS network. The locations of these wells are shown on Figure 7-17. and listed in Appendix 7-F. No active ILRP wells exist within the Fort Ord Area. The MCWDGSA and SVBGSA assume that Ag Order 4.0 will have a similar representative geographic distribution of wells within the Subbasin. The agricultural groundwater quality monitoring network will be revisited and revised when the Ag Order 4.0 monitoring network is finalized.



Path: X:\B60094\Maps\2021\09\Fig7-17_GAMA_WQ_Wells.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

GeoTracker GAMA Water Quality Monitoring Wells

ILRP Domestic Well

ILRP Irrigation Well

DDW Well

Management Areas

Marina-Ord

Corral de Tierra

Abbreviations

DDW = Division of Drinking Water
GAMA = Groundwater Ambient Monitoring and Assessment
ILRP = Irrigated Lands Regulatory Program

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.

Locations of Wells in the Groundwater Quality Monitoring Network

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-17

7.6.1 Groundwater Quality Monitoring Protocols

Water quality data from public water systems are collected, analyzed, and reported in accordance with protocols that are reviewed and approved by the SWRCB, DDW, in accordance with the state and federal Safe Drinking Water Acts. Monitoring protocols may vary by agency.

ILRP data are currently collected under CCRWQCB Ag Order 3.0. ILRP samples are collected under the Tier 1, Tier 2, or Tier 3 monitoring and reporting programs. Under Ag Order 4.0, ILRP data will be collected in 3 phases and each groundwater basin within the Central Coast Region has been assigned to one or more of these phases. The designated phase for each ILRP well is provided in SWRCB's GeoTracker database and is publicly accessible at: https://geotracker.waterboards.ca.gov/. Ag Order 4.0 will take effect in the Subbasin beginning in 2027. Copies of the Ag Orders 3.0 and 4.0 monitoring and reporting programs are included in Appendix 7-G and are incorporated into this GSP. These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.6.2 Groundwater Quality Monitoring Data Gaps

There is adequate spatial coverage to assess impacts to beneficial uses and users for the DDW monitoring program. MCWDGSA nor SVBGSA plan on expanding the monitoring network at this time because the monitoring network relies on existing supply wells and neither MCWDGSA nor SVBGSA plan to independently sample wells for any COC. As new domestic and agricultural supply wells are added to Ag Order 4.0 and/or the County makes water quality data from small systems easily available, they will be added to this monitoring program.

7.7 Land Subsidence Monitoring Network

As described in Section 5.5, DWR collects land subsidence data using InSAR satellite data, and makes these data available to GSAs. This subsidence dataset represents the best available data for the Monterey Subbasin and is therefore used as the subsidence monitoring network.

7.7.1 Land Subsidence Monitoring Protocols

The land subsidence monitoring protocols are the ones used by DWR for InSAR measurements and interpretation. If the annual monitoring indicates subsidence is occurring at a rate greater than the minimum thresholds, then additional investigation and monitoring may be warranted. In particular, the GSAs will implement a study to assess if the observed subsidence can be correlated to declining groundwater elevations, and whether a reasonable causality can be established. These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.7.2 Land Subsidence Data Gaps

There are no data gaps associated with the subsidence monitoring network.

7.8 Interconnected Surface Water Monitoring Network

As detailed in Chapter 8, shallow groundwater elevations near locations of interconnected surface water will be used as a proxy metric for this indicator. As such, the interconnected surface water monitoring network will be comprised of RMS sites adjacent to potential interconnected surface waters where minimum thresholds and measurable objectives based on shallow groundwater levels are developed for depletion of interconnected surface water.

As described in Section 5.6 of this GSP, potential interconnected surface water locations identified within the Subbasin are (1) the ponds and lakes located within the City of Marina (Figure 5-35), (2) the lower reaches of the El Toro Creek where groundwater within 20 feet of land surface has been recorded (Figure 5-36), (3) two locations along the Salinas River near the Monterey-180/400-Foot Aquifer Subbasin boundary. These areas may require additional evaluation of potential hydraulic interaction between surface water elevations and groundwater extractions.

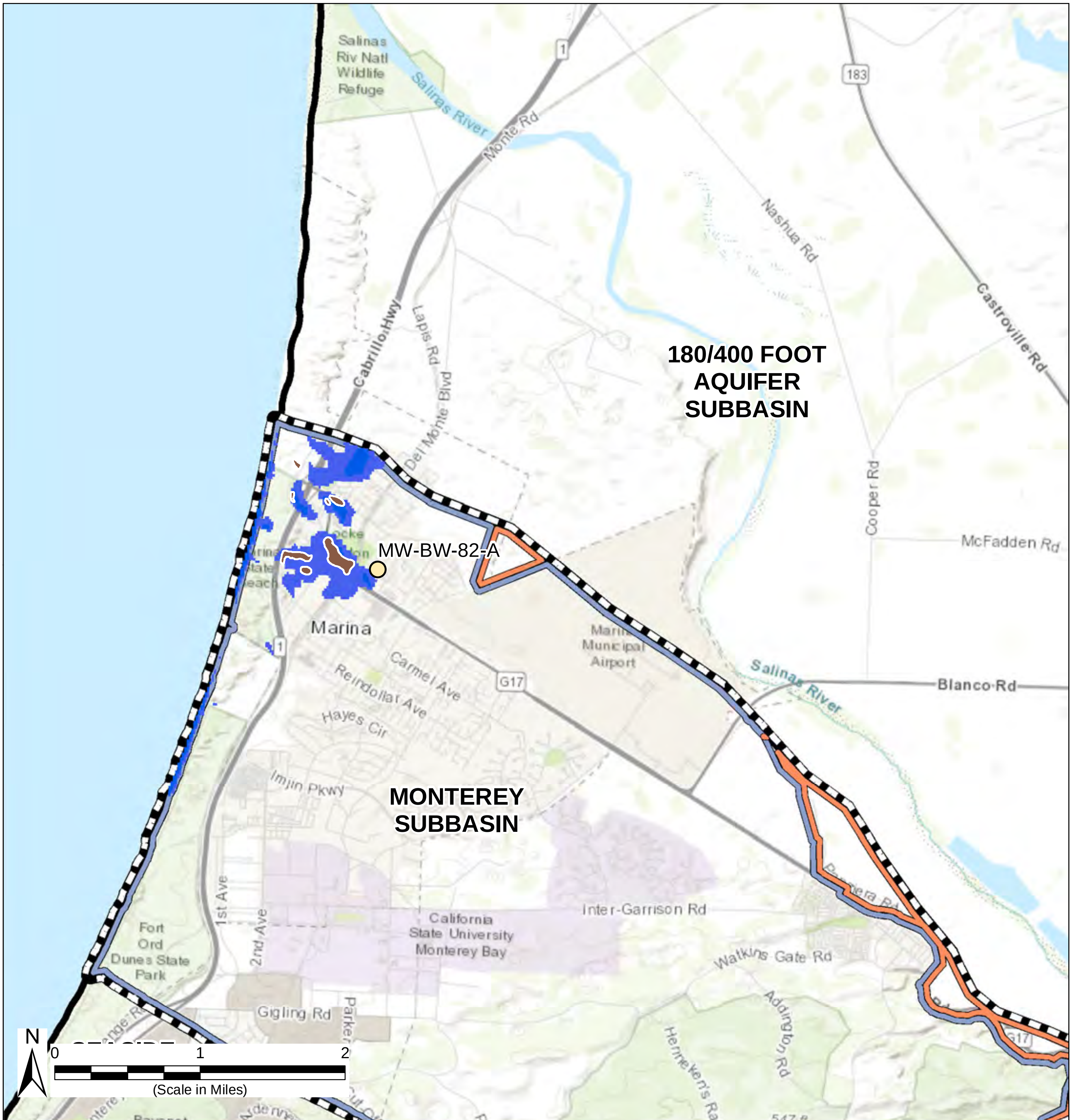
The primary tool for assessing depletions of interconnected surface water will be shallow monitoring wells adjacent to the Subbasin's interconnected surface water locations. Groundwater elevations measured in shallow wells adjacent to interconnected surface water bodies will serve as the primary approach for monitoring depletion of surface water.

One RMS well is included in the interconnected surface water monitoring network in the Marina-Ord Area, as shown in Table 7-5 and on Figure 7-18. As discussed in Chapter 8, given the stable groundwater patterns in the Dune Sand Aquifer, there is no significant and unreasonable depletion of interconnected surface water under current conditions. In the event that future groundwater activities in the Subbasin or the adjacent 180/400-Foot Aquifer Subbasin may influence the condition of the Marina vernal ponds and/or the Dune Sand Aquifer, the GSAs will work with project proponents to install additional shallow groundwater monitoring wells.

There are currently no RMS wells included in the interconnected surface water monitoring network near the El Toro Creek or Salinas River. As described in Section 5.6, the level of interconnection between the El Toro Creek to the principal aquifer is unclear. As shown on Figure 7-19, an analysis of shallow groundwater levels is used to identify areas of potential interconnection between surface water and groundwater. Additionally, the SVBGSA plans to install one shallow well near El Toro Creek into the interconnected surface water monitoring network and may work with the United States Geological Survey (USGS) to reactivate the stream gauge along Toro Creek. The conjunctive data collection will help correlate the potential seasonal flows with shallow groundwater and assess both the interconnectivity as well as the relationship with deeper wells in the area.

Table 7-5. Monterey Subbasin Interconnected Surface Water Representative Monitoring Sites

State Well Number	Aquifer	Well Use	Total Well Depth (ft)	Latitude (NAD 83)	Longitude (NAD 83)
Marina-Ord Area					
MW-BW-82-A	Dune Sand Aquifer	Monitoring	74	36.6886	-121.7961



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Selected Monitoring Wells for GDEs
- Marina Vernal Ponds

Management Areas

- Marina-Ord Area
- Corral de Tierra

Areas of Groundwater Within 20 feet of land Surface (ft bgs)

- 0 - 10
- 11 - 20
- 20 - 30
- 31 - 40
- 41 - 50
- >50

Notes

1. All locations are approximate.

Abbreviations

ft bgs = foot below ground surface
GDE = Groundwater Dependent Ecosystem

Sources

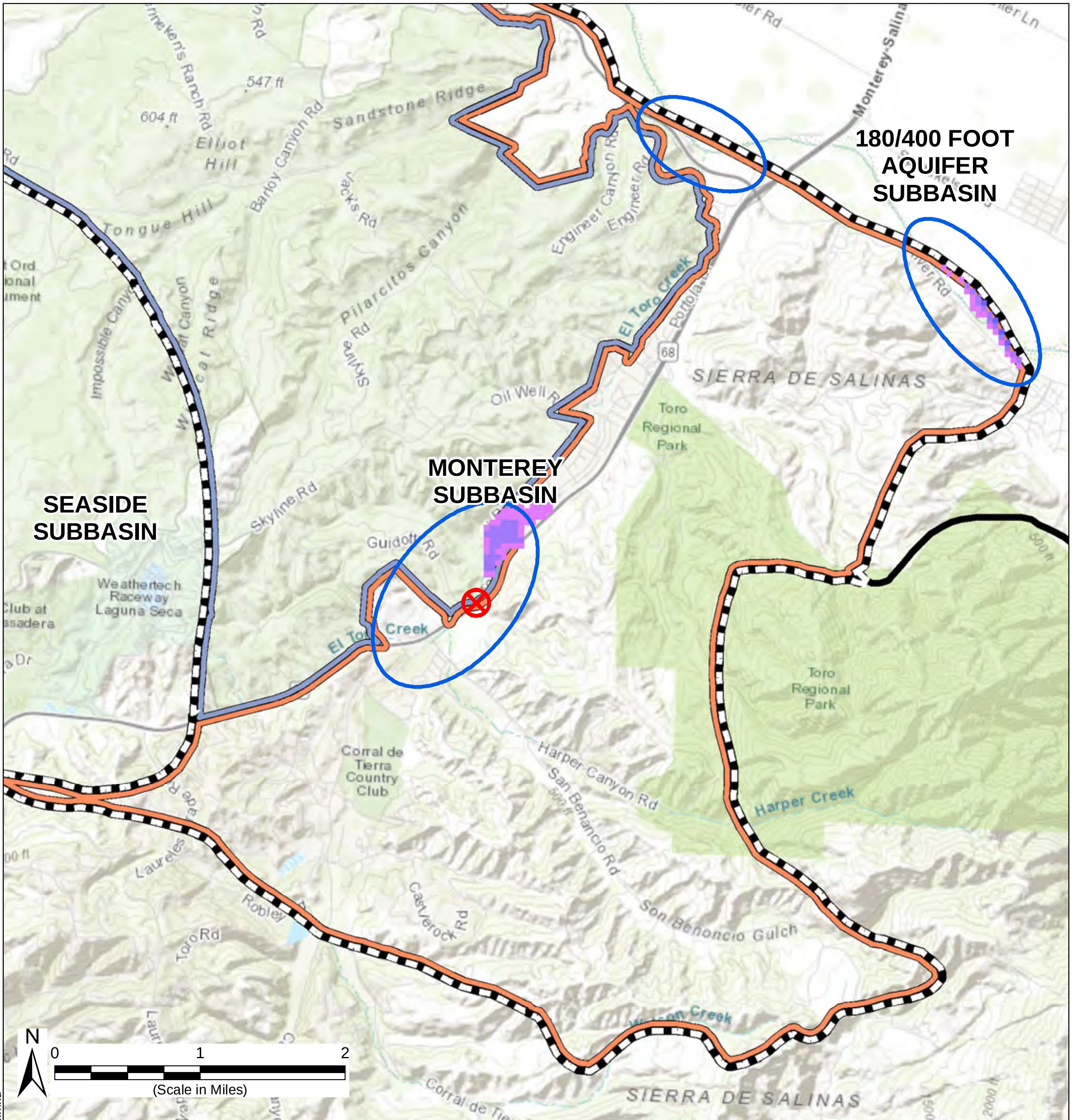
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
3. Depth to water data are calculated by subtracting the 2017 Fall Dune Sand Aquifer contour from land surface.

Interconnected Surface Water Representative Monitoring Sites Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-18

Path: X:\B60094\Maps\2021\09\Fig7-18_MN_ISW_wells.mxd



Path: X:\B60094\Maps\2021\09\Fig7-19_MN_ISW_wells - Corel_rev.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- USGS El Toro Creek Gauge
- ISW Monitoring Network Data Gaps

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Areas of Groundwater Within 20 feet of land Surface (ft bgs)

- 0 - 10
- 11 - 20
- 20 - 30
- 31 - 40
- 41 - 50
- >50

Notes

1. All locations are approximate.

Abbreviations

ft bgs = foot below ground surface
ISW = Interconnected Surface Water
USGS = United States Geological Survey

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
3. Depth to water data are calculated by subtracting the 2017 Fall Paso Robles Aquifer contour from land surface.

Interconnected Surface Water Representative Monitoring Sites El Toro Primary Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 7-19

7.9 Other Monitoring Networks

7.9.1 Groundwater Extraction Monitoring Network

Under Monterey County Ordinance No. 3717 and No. 3718, public water systems and agricultural pumpers using wells with an internal discharge pipe greater than 3 inches within Zones 2, 2A, and 2B report extractions annually to MCWRA's GEMS. Extraction is self-reported by well owners or operators. Agricultural wells report their data based on MCWRA's reporting year that runs from November 1 through October 31. Urban and industrial wells report extraction on a calendar year basis. When extraction data are summarized annually, MCWRA combines industrial and urban extractions into a single urban water use. However, these zones do not provide sufficient coverage of the Corral de Tierra Area. This data gap is further discussed in Section 7.9.1.2.

GEMS data is used where available, and groundwater withdrawn outside of Zones 2, 2A, and 2B in the Corral de Tierra Area is estimated following the approach taken by the Wallace Group. Their analysis was based on municipal pumping that is estimated using reported pumping data for public drinking water systems, as well as estimates based on land use type, acreage, parcels, and de minimis use. Pumping data for public water systems is reported annually to SWRCB's DDW Electronic Annual Report database, publicly accessible at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/eardata.html. An analysis of aerial imagery, parcel size analysis, and engineering judgment was used to estimate extraction by private wells was done for the parcels that are not part of a public drinking water system.

7.9.1.1 Groundwater Extraction Monitoring Protocols

Groundwater extraction monitoring uses existing monitoring programs performed by MCWD and other agencies. This includes MCWRA's GEMS program and the annual public drinking water system pumping reported to SWRCB by public water systems including MCWD. These monitoring protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.9.1.2 Groundwater Extraction Monitoring Data Gaps

An accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. This information exists within the Marina-Ord Area, however, is more limited in the Corral de Tierra Area. As proposed in Chapter 9, SVBGSA will undertake well registration during implementation to develop a database of existing and active groundwater wells. This database will draw from the existing MCWRA database, DWR's OSWCR database, and the Monterey County Health Department database of state small and local small water systems. As part of the assessment, SVBGSA will verify well completion information and location and whether the well is active, abandoned, or destroyed, as is discussed further in Chapter 9.

SVBGSA will also expand and enhance the GEMS program to address groundwater extraction monitoring data gaps. The current GEMS program only covers a small southern portion of the Corral de Tierra Area resulting in a data gap. In addition, the accuracy and reliability of groundwater pumping reported through GEMS is constantly being updated. SVBGSA will work with MCWRA to address these data gaps during GSP implementation by expanding the GEMS program and considering other potential enhancements as described in Chapter 9.

7.9.2 Salinas River Watershed Diversions

Salinas River watershed monthly diversion data are collected annually in the SWRCB's eWRIMS, used to track information of water rights in the state, publicly accessible at: https://ciwqs.waterboards.ca.gov/ciwqs/ewrims/reportingDiversionDownloadPublicSetup.do. These data also include diversions from tributaries of the Salinas River.

7.9.2.1 Salinas River Watershed Diversions Monitoring Protocols

Salinas River watershed diversion monitoring protocols are those that the SWRCB has established for the collection of water right information. These protocols are consistent with data and reporting standards described in GSP Emergency Regulations §352.4.

7.9.2.2 Salinas River Watershed Diversions Monitoring Data Gaps

These data are lagged by a year because the reporting period does not begin until February of the following year.

7.10 Data Management System and Data Reporting

Data collected from the SGMA Monitoring Network will be uploaded to a Data Management System to be established and managed for the Monterey Subbasin and reported to the DWR in accordance with the Monitoring Protocols developed for the Subbasin, as described in the appendices hereto. Additional data collected as part of the Subbasin's other monitoring programs may be used in conjunction with data collected from the SGMA Monitoring Network to meet compliance with requirements regarding annual reporting (GSP Emergency Regulations §356.2) or as otherwise deemed necessary by the GSAs.

8 SUSTAINABLE MANAGEMENT CRITERIA

This chapter defines the conditions that constitute sustainable groundwater management; and establishes minimum thresholds, measurable objectives, and undesirable results for each sustainability indicator. This chapter includes adequate data to explain how sustainable management criteria (SMCs) were developed and how they influence all beneficial uses and users.

The chapter is structured to address all the GSP Emergency Regulations regarding SMCs. To retain an organized approach, the SMCs are grouped by sustainability indicators. The discussion of each sustainability indicator follows a consistent format that contains all information required by §354.22 et. seq of the GSP Emergency Regulations, and as further clarified in the SMCs BMP (DWR, 2017; CCR, 2016).

8.1 Definitions

The SGMA legislation and GSP Emergency Regulations contain terms relevant to SMCs. The definitions included in the GSP Emergency Regulations are repeated below. Where appropriate, additional explanatory text is added in italics. This explanatory text is not part of the official definitions of these terms.

- **Sustainability indicator** refers to any of the effects caused by groundwater conditions occurring throughout the Subbasin that, when significant and unreasonable, cause undesirable results, as described in California Water Code §10721(x).

  The six sustainability indicators relevant to this subbasin include chronic lowering of groundwater levels; reduction of groundwater storage; degraded water quality; land subsidence; seawater intrusion; and depletion of interconnected surface waters.

- **Undesirable Results** occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the Subbasin.

  The GSP Emergency Regulations requires that the description of undesirable results include (1) the cause of groundwater conditions that would lead to or has led to undesirable results; (2) a quantitative description of the combination of minimum threshold exceedances that cause significant and unreasonable effects in the Subbasin (i.e., the undesirable result criteria); and (3) potential effects that may occur or are occurring from undesirable results. An example undesirable result criteria could be defined as: more than 10% of the measured groundwater elevations being lower than the minimum thresholds.

- **Significant and Unreasonable Conditions**

  Significant and unreasonable is not defined in the Regulations. However, the definition of undesirable results states, "Undesirable results occur when significant and unreasonable effects … are caused by groundwater conditions…". The SGMA BMP states that "the GSAs *must consider and document the conditions at which each of the six sustainability indicators become significant and unreasonable, including reasons for justifying each particular threshold selected." Therefore, this GSP adopts the phrase significant and unreasonable conditions to be the qualitative description of conditions used to justify selected minimum thresholds and undesirable results criteria.*

- **Measurable objectives** refer to specific, quantifiable goals for the maintenance or improvement of specified groundwater conditions that have been included in an adopted Plan to achieve the sustainability goal for the Subbasin.

  Measurable objectives are goals that the GSP is designed to achieve.

- **Minimum threshold** refers to a numeric value for each sustainability indicator used to define undesirable results.

  Minimum thresholds are quantitative indicators of an unreasonable condition.

- **Interim milestone** refers to a target value representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan.

  Interim milestones are targets such as groundwater elevations that will be achieved every five years to demonstrate progress towards sustainability.

8.2 Sustainability Goal

The sustainability goal of the Monterey Subbasin is to manage groundwater resources for long-term community, financial, and environmental benefits to the Subbasin's residents and businesses. The goal of this GSP is to ensure long-term viable water supplies to local communities at a reasonable cost. In addition, because the Subbasin is hydrologically connected with other Salinas Valley Basin Subbasins, this GSP aims to develop a coordinated approach to groundwater management within this Subbasin and neighboring Subbasins. The Subbasin will achieve long-term sustainability through the implementation of inter- and intra-basin coordination as well as projects and management actions.

Several projects and management actions are included in this GSP and detailed in Chapter 9. These projects and management actions will diversify the Subbasin's water supply portfolio, increase supply reliability, and protect the Subbasin's groundwater resources against seawater intrusion. The Subbasin's historical efforts to invest in water conservation will continue under SGMA.

These management actions and project types include:

- Multi-basin Projects
  - Seasonal Release with ASR and Direct Delivery
  - Regional Municipal Supply
  - Multi-benefit Stream Channel Improvements

- Marina-Ord Area Local Projects and Management Actions
    - MCWD Demand Management Measures
    - Stormwater Recharge Management
    - Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse
    - Monitoring Well(s)
- Corral de Tierra Area Local Projects and Management Actions
    - Pumping Allocation and Control
    - Check Dams
    - Recharge from Surface Water Diversions
    - Wastewater Recycling for Reuse
    - Decentralized Residential In-Lieu Recharge Projects
    - Decentralized Stormwater Recharge Projects
    - Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley (Artesian Well)
- Implementation Actions
    - Support Implementation of the 180/400-Foot Aquifer Subbasin GSP and Seaside Watermaster Actions
    - Deep Aquifers Investigation
    - Support Restrictions on Additional Wells in the Deep Aquifers
    - Adopt 2022/2023 Priority Actions for Deep Aquifers in Absence of New Well Construction Ordinance if Conditions Threaten Sustainability in Near Term
    - Seawater Intrusion Working Group
    - Seawater Intrusion Modeling
    - Incorporate Monterey Subbasin Model into the Salinas Valley Integrated Hydrologic Model (SVIHM)
    - Well Registration
    - Groundwater Extraction Management System (GEMS) Expansion and Enhancement
    - Dry Well Notification System
    - Water Quality Partnership
    - Land Use Jurisdiction Coordination Program
    - Arsenic Implementation Action

8.3 Achieving Long-Term Sustainability

The GSP addresses long-term groundwater sustainability. Correspondingly, the Subbasin GSAs intend to develop SMCs to avoid undesirable results under future hydrogeologic conditions with long-term, deliberate management of groundwater. The Subbasin GSAs' best understanding of future conditions is based on historical precipitation, evapotranspiration, streamflow, and reasonably anticipated climate change and sea-level rise, which have been estimated based on the best available climate science (DWR, 2018). These parameters underpin the estimated future water budget over the planning horizon (see Section 6.5). Groundwater conditions that are the result of extreme climatic conditions, which are worse than those anticipated based on the best available climate science, do not constitute an undesirable result. As such, SMCs may be modified in the future to reflect observed future climate conditions.

The GSAs will track hydrologic conditions during GSP implementation. These observed hydrologic conditions will be compared to predicted future hydrologic conditions for the Subbasin as presented in this GSP. This information will be used to interpret the Subbasin's performance against SMCs.

Further, since the GSP addresses long-term groundwater sustainability, exceedance of some SMCs during an individual year does not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code §10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during prolonged droughts, which could be more extreme than those anticipated based on historical data and expected climate change conditions. Such temporary exceedances do not constitute an undesirable result.

The SMCs presented in this current draft Chapter 8 have been developed based on historically observed hydrologic conditions and, in most cases, reasonably anticipated climate change. These SMCs may be updated in future drafts to reflect changes in anticipated climate conditions and climate change based upon groundwater modeling results.

8.4 Management Areas

As introduced in Section 1.4, this GSP establishes two Management Areas within the Subbasin including the Marina-Ord Area and the Corral de Tierra Area. These Management Areas have been developed to facilitate GSP implementation considering the differences in jurisdiction, water use sector, and principal aquifer characteristics described in Chapters 3 through 5.

Per GSP Emergency Regulations §354.20(a), "[m]anagement areas may define different minimum thresholds and be operated to different measurable objectives than the basin at large, provided that undesirable results are defined consistently throughout the basin"; and §354.20 (b) "A basin that includes one or more Management Areas shall describe the following in the Plan… (2) The minimum thresholds and measurable objectives established for each management area and an explanation of the rationale for selecting those values, if different from the basin at large."

This chapter takes a basin-wide approach for establishing undesirable results and identifies the drivers of undesirable results within each management area. The drivers for undesirable results often differ between the Management Areas, which warrant selection of different minimum thresholds and measurable objectives. For example, the primary concern of groundwater management in the Marina-Ord Area is seawater intrusion. Due to the land use characteristics and groundwater conditions in this area, effects that are typically associated with chronic lowering of groundwater levels, such as dewatering of wells, are not likely to occur. However, groundwater elevation SMCs in the Marina-Ord Area need to be established at levels that can control seawater intrusion. The Corral de Tierra Area is generally located further inland, where seawater intrusion not likely to occur. However, the area supports groundwater use by numerous municipal water systems, small water users, and domestic users where chronic lowering of groundwater levels may cause dewatering of wells, increased pumping costs, or reductions in storage that are significant and unreasonable. Therefore, groundwater elevation SMCs in the Corral de Tierra Area need to be established at levels that protect the ability to pump from domestic and small water system wells.

Minimum thresholds and measurable objectives defined in this chapter are developed through close coordination between the two subbasin GSAs to ensure the criteria within one management area do not cause undesirable results in the other. In addition, SMCs identified in this chapter consider SMCs and conditions identified in adjacent subbasins, which are in direct hydraulic communication with the Monterey Subbasin as described in Chapters 4 and 5. Due to the interconnectivity between the Monterey Subbasin and adjacent subbasins, the Monterey Subbasin groundwater elevation minimum thresholds are intended to be consistent with adjacent subbasins and are based on the assumption that SMCs and sustainability goals will be met in the adjacent subbasins. Therefore, continued coordination of SMCs and sustainability goals is critical, as each subbasin's ability to achieve sustainability is affected by the adjacent subbasins' ability to manage their groundwater sustainably. Through implementation, continued monitoring, data collection, additional analysis, and modeling will be used to validate the impact of the SMCs on the Monterey Subbasin and adjacent subbasins to inform the GSAs of compliance and needed adjustments.

Chapter 7 identifies the management area-specific monitoring networks that facilitate monitoring of SMCs defined in this chapter.

8.5 General Process for Establishing Sustainable Management Criteria

MCWD GSA and SVBGSA established a Technical Committee and a Steering Committee for the Monterey Subbasin to facilitate coordination between the two GSAs in development of this GSP. These Committees are established in accordance with the GSAs' Framework Agreement. The Technical Committee consists of GSA staff and consultants, and meets on a biweekly basis. The

Technical Committee is the platform for coordinating technical analysis, data sharing, and communication in development of the GSP. The Steering Committee consists of one Board Member and the General Manager of each GSA. The purpose of the Steering Committee is to resolve any issues raised by the Technical Committee and reach consensus between the GSAs.

The SMCs presented in this chapter were developed using publicly available information, hydrogeologic analysis, feedback gathered during public meetings, and coordination between MCWD GSA and SVBGSA via the Monterey Subbasin Technical and Steering Committees.

The general process included:

- Establishing a procedure to SMCs development in the Technical Committee;
- Gathering input and developing preferences for establishing SMCs for each GSA's respective management area, including consultation with stakeholders and discussions within GSA staff;
- Reconciling management area-level input in the Technical Committee;
- Presenting proposed SMCs to GSA governing bodies and stakeholder groups;
- Modifying SMCs based on input from the public, GSA staff, and Board Members.

8.6 Sustainable Management Criteria Summary

Table 8-1 provides a summary of the SMCs for each of the six sustainability indicators. Measurable objectives are the goals that reflect the Subbasin's desired groundwater conditions for each sustainability indicator. These provide operational flexibility above the minimum thresholds. The minimum thresholds are quantitative indicators of the Subbasin's locally defined significant and unreasonable conditions. The undesirable result is a combination of minimum threshold exceedances that show a significant and unreasonable condition across the Subbasin as a whole. This GSP is designed to not only avoid undesirable results, but to achieve the sustainability goals within 20 years, along with interim milestones every 5 years that show progress. The management actions and projects provide sufficient options for reaching the measurable objectives within 20 years and maintaining those conditions for 30 years for all 6 sustainability indicators. The rationale and background for developing these criteria are described in detail in the following sections. The SMCs presented in Table 8-1 are part of the GSA's 50-year management plan: SGMA allows for 20 years to reach sustainability and requires the Subbasin have no undesirable results for the subsequent 30 years.

Table 8-1. Sustainable Management Criteria Summary

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Chronic lowering of groundwater levels	Measured through the groundwater elevation representative monitoring well network within each management area	**Marina-Ord Area:** Minimum groundwater elevations historically observed between 1995 and 2015 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers. **Corral de Tierra Area:** Groundwater elevations observed in 2015 in the El Toro Primary Aquifer System.	**Marina-Ord Area:** Groundwater elevations observed in 2004 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers. **Corral de Tierra Area:** Groundwater elevations observed in 2008 in the El Toro Primary Aquifer System.	Over the course of any one year, exceedance of more than 20% of groundwater level minimum thresholds in **either** (a) both the Dune Sand and upper 180-Foot Aquifers, or (b) both the lower 180-Foot and 400-Foot Aquifers, or (c) the Deep Aquifers, or (d) the El Toro Primary Aquifer System.	**Whole Subbasin:** Interim milestones are described in Table 8-3 for each RMS well that is defined in Chapter 7.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Reduction in groundwater storage	Measured through the groundwater elevation and seawater intrusion representative monitoring well networks.	**Whole Subbasin:** Minimum thresholds for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage minimum threshold.	**Whole Subbasin:** Measurable objectives for chronic lowering of groundwater levels and seawater intrusion will be used as a proxy for reduction of groundwater storage measurable objective.	Over the course of any one year, (1) exceedance of more than 20% of groundwater level minimum thresholds in **either** (a) both the Dune Sand and upper 180-Foot Aquifers, or (b) both the lower 180-Foot and 400-Foot Aquifers, or (c) the Deep Aquifers, or (d) the El Toro Primary Aquifer System; OR (2) Exceedance of seawater intrusion minimum thresholds.	**Whole Subbasin:** Groundwater elevation and seawater intrusion interim milestones described respectively in Table 8-3 and Section 8.9.4.2 will serve as a proxy for reduction of groundwater storage interim milestones.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Seawater intrusion	Measured through seawater intrusion representative monitoring well network.	**Whole Subbasin:** The approximate location in 2015 of the 500 mg/L chloride concentration isocontour in the lower 180-Foot and 400-Foot Aquifers; Approximately 3,500 feet from the coast in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers. This distance is generally consistent with the location of Highway 1 in the Monterey Subbasin and seaward of groundwater extraction wells in the Subbasin. No seawater intrusion in the El Toro Primary Aquifer System.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedance of the minimum threshold is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives. No seawater intrusion above 500 mg/L chloride in RMS wells.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Degraded groundwater quality	Groundwater quality data downloaded annually from state sources.	**Whole Subbasin:** No additional exceedances of drinking water standards in potable supply wells or Basin Plan water quality objectives for agricultural supply wells as a result of GSP implementation. Exceedances are only measured in public water system supply wells and domestic and agricultural (ILRP) wells. See Table 8-5 for the list of constituents.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedances of minimum thresholds during any one year as a direct result of projects or management actions conducted pursuant to GSP implementation is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions
Subsidence	Measured using DWR-provided InSAR data.	**Whole Subbasin:** Zero net long-term subsidence, with no more than 0.1 foot per year of measured vertical displacement between June of one year and June of the subsequent year to account for InSAR measurement errors.	**Whole Subbasin:** Measurable objective is identical to the minimum threshold.	Any exceedances of minimum thresholds during any one year due to lowered groundwater elevations is considered as an undesirable result.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions.

Sustainability Indicator	Measurement	Minimum Threshold	Measurable Objective	Undesirable Result	Interim Milestones
Depletion of interconnected surface water (ISW)	Measured through shallow groundwater elevations as a proxy near potential locations of ISW in the ISW representative monitoring well network.	**Whole Subbasin:** Minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of interconnected surface water.	**Whole Subbasin:** Identical to minimum threshold shallow groundwater elevations.	Any minimum threshold exceeded in a shallow groundwater well near any location of ISW for more than two consecutive years.	**Whole Subbasin:** Identical to minimum thresholds and measurable objectives, which represent current conditions.

8.7 Chronic Lowering of Groundwater Levels SMCs

Chronic lowering of groundwater levels is arguably the most fundamental Sustainability Indicator, as it influences several other key sustainability indicators, including seawater intrusion, reduction of groundwater storage, land subsidence, and interconnected surface water. Groundwater levels are also some of the most readily available and measurable metrics of groundwater conditions, which allows for a systematic, data-driven approach to the development of Sustainable Management Criteria.

8.7.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable groundwater elevations in the Marina-Ord and Corral de Tierra Areas are identified as follows.

Marina-Ord Area

Significant and unreasonable groundwater elevations in the Marina-Ord Area include:

- Groundwater elevations below those historically observed prior to 2015[47]:
    - Near the coast in the Dune Sand, 180-Foot, and 400-Foot Aquifers (where seawater intrusion was not observed),
    - Near the seawater intrusion front in the lower 180-Foot and 400-Foot Aquifers, and
    - Throughout the Deep Aquifers, because such groundwater elevations could cause lateral or vertical expansion of the existing seawater intrusion extent and/or eventual migration of saline water into Deep Aquifer wells.

As discussed in Section 3.1.6, groundwater use within the Marina-Ord Area is almost exclusively limited to generation of municipal supplies by MCWD. Groundwater elevations are significantly higher than municipal production well screen elevations in all aquifers in the Marina-Ord Area, and there is limited concern regarding the potential dewatering of groundwater production wells. Therefore, groundwater levels that could cause undesirable results associated with other locally relevant sustainability indicators, such as the lateral or vertical expansion of the existing seawater intrusion extent and/or eventual migration of saline water into Deep Aquifer wells, have been used to define groundwater level minimum thresholds in the Marina-Ord Area.

Corral de Tierra Area

Significant and unreasonable groundwater elevations in the Corral de Tierra Area include:

- Groundwater elevations at or below those observed in 2015. Lower groundwater elevations could lead to inadequate water production in a significant number of domestic

[47] Based upon the historical period (Water Year 2003 through 2017)

and small water system wells, not only in the Corral de Tierra Area but also in the Laguna Seca subarea of the adjacent Seaside Subbasin.

- Groundwater elevations that cause undesirable results associated with other locally relevant sustainability indicators, including interconnected surface water and groundwater quality, as described in the sections below.

These significant and unreasonable conditions were determined based on input collected during MCWD stakeholder meetings, SVBGSA Subbasin Planning Committee meetings, and discussions with GSA staff during Subbasin Technical Committee meetings.

8.7.2 Undesirable Results

Undesirable results have been defined within each management area. However, pursuant to the GSP Emergency Regulations, which state that Undesirable Results are to be defined consistently throughout the Subbasin (23 CCR §354.20), the definitions of undesirable results have been coordinated between Management Areas by subbasin GSAs and are described below.

8.7.2.1 Criteria for Determining Undesirable Results

The chronic lowering of groundwater levels undesirable result is a quantitative combination of groundwater level minimum threshold exceedances. For the Subbasin, the undesirable result for chronic lowering of groundwater levels occurs when

> *Over the course of any one year, exceedance of more than 20% of the groundwater level minimum thresholds in either:*
>
> a. *both the Dune Sand Aquifer and Upper 180-Foot Aquifer, or*
> b. *both the Lower 180 Foot and 400 Foot aquifer, or*
> c. *the Deep Aquifers, or*
> d. *the El Toro Primary Aquifer System.*

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater levels minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code §10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

Setting undesirable results based on an allowable percentage of minimum threshold exceedances provides flexibility in defining sustainability. Increasing the percentage of allowed minimum threshold exceedances allows for greater localized fluctuations in water levels but may lead to significant and unreasonable conditions for some beneficial users. Reducing the percentage of allowed minimum threshold exceedances ensures strict adherence to minimum thresholds but reduces operational flexibility due to unanticipated hydrogeologic conditions. The undesirable result is set at 20% within each principal aquifer or group of principal aquifers. The percentages balance the interests of beneficial users with the practical aspects of groundwater management under uncertainty and apply to both Management Areas.

This undesirable result definition refers to and relies on minimum thresholds established for each principal aquifer, or group of principal aquifers. As discussed further below and in Chapter 7, minimum thresholds for groundwater levels are set at 35 Representative Monitoring Sites in the Marina-Ord Area and 13 Representative Monitoring Sites in the Corral de Tierra Area. Within the Marina-Ord Area and the Reservation Road portion of the Corral de Tierra Area where the hydrogeological setting is similar, it is considered an undesirable result for chronic lowering of groundwater levels if minimum thresholds are exceeded in 20% or more of the Representative Monitoring Sites within either (a) the Dune Sand and Upper 180-Foot Aquifer, or (b) the Lower 180-Foot and 400-Foot Aquifer*s*, or (c) the Deep Aquifers. Undesirable results for chronic lowering of water levels within the Marina-Ord Area and the Reservation Road portion of the Corral de Tierra Area are set based on minimum thresholds within these groups of aquifers, because of how they are hydraulicly connected near the coast where the greatest potential for additional seawater intrusion exists and the RMS networks are primarily focused. For example, groundwater levels within the Dune Sand Aquifer and Upper 180-Foot are very similar in coastal wells due to the pinching out of the Fort Ord Salinas Valley Aquitard (FO-SVA)[48]. Similarly, groundwater elevations in the lower 180-Foot Aquifer are similar to those measured in the 400-Foot Aquifer across much of the Marina-Ord Area.

The 20% limit on minimum threshold exceedances in the undesirable result allows for:

(a) A total of 3 exceedance out of the 16 existing RMS wells within the Dune Sand Aquifer and upper 180-Foot Aquifer,

(b) A total of 2 exceedances out of the 9 existing RMS wells within the Lower 180-Foot Aquifer and 400-Foot Aquifer,

(c) A total of 2 exceedances out of the 10 existing RMS wells within the Deep Aquifer, and

(d) A total of 3 exceedances out of the 13 existing RMS wells within the El Toro Primary Aquifer System.

This number of exceedances is considered reasonable given the hydrogeologic uncertainty of the Subbasin. As the monitoring system grows, additional exceedances will be allowed. One additional exceedance will be allowed for approximately every five new monitoring wells.

[48] See discussion in Chapter 5

8.7.2.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result include the following:

- **Unsustainable groundwater management in adjacent subbasins**. Due to the hydrologic connectivity between the Subbasin and other Salinas Valley Basin Subbasins, increased groundwater extraction or reduced recharge in either the Subbasin or the greater Salinas Valley Basin may lead to undesirable results.
- **Localized pumping clusters**. Even if regional pumping is maintained within the sustainable yield, clusters of high-capacity wells may cause excessive localized drawdowns that lead to undesirable results.
- **Expansion of *de minimis* pumping**. Individual *de minimis* pumpers do not have a significant impact on groundwater elevations. However, many *de minimis* pumpers are often clustered in specific residential areas. Pumping by these *de minimis* users is not regulated under this GSP. Adding additional domestic *de minimis* pumpers in these areas may result in excessive localized drawdowns and undesirable results.
- **Expansion of municipal or agricultural pumping**. Additional extractions for municipal or agricultural purposes, without an offsetting increase in recharge, cross-boundary flows and/or projects will reduce groundwater elevations.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought**. Minimum thresholds were established based on historical groundwater elevations and reasonable estimates of future climatic conditions and groundwater elevations. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations and undesirable results.

An undesirable result for chronic lowering of groundwater levels currently exists because during recent fall 2020 monitoring, or 2019 if fall 2020 was not available:

(1) groundwater elevations within the Marina-Ord Area exceeded minimum thresholds in

   a. 2 out of 9 existing RMS wells (22%) in the lower 180-Foot Aquifer, 400-Foot Aquifer, and

   b. 7 out of 10 existing RMS wells (70%) in the Deep Aquifers; and

(2) Groundwater elevations within the Corral de Tierra Area exceeded minimum thresholds in 7 out of 13 existing RMS wells (54%).

8.7.2.3 Effects on Beneficial Users and Land Uses

As discussed in Section 3.1.6, groundwater use within the Marina-Ord Area is almost exclusively limited to generation of municipal supplies by MCWD. There is one recognized disadvantaged community (DACs) within the subbasin as shown on Figure 2-1. This community relies on water services provided by MCWD.

As discussed above, undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion and other locally relevant sustainability indicators. These sustainability indicators have been considered when defining groundwater level minimum thresholds in the Marina-Ord Area.

The primary potential effects of undesirable results caused by chronic lowering of groundwater levels in the Corral de Tierra Area include dewatering of domestic and small water system wells, increased energy costs, or interference with other locally relevant sustainability indicators, which have been used to define groundwater level minimum thresholds in the Corral de Tierra Area. Similar results could occur in the adjacent Laguna Seca subarea from chronic lowering of groundwater levels in the Corral de Tierra Area. Allowing multiple exceedances can have detrimental effects on beneficial users if more than one exceedance take place in a small geographic area. Allowing 20% exceedances in the Corral de Tierra Area are only reasonable if the exceedances are spread out across the management area, and as long as any one well does not regularly exceed its minimum threshold. If the exceedances are clustered in a small area, it will indicate that significant and unreasonable effects are being born by a localized group of landowners and water users and should be evaluated.

8.7.3 Minimum Thresholds

Minimum thresholds for chronic lowering of groundwater levels ("groundwater elevation minimum thresholds") in the **Marina-Ord Area** are defined as follows:

> *Minimum groundwater elevations historically observed between 1995 and 2015 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers.*

Groundwater elevation minimum thresholds in the **Corral de Tierra Area** are defined as follows:

> *Groundwater elevation observed in 2015 in the El Toro Primary Aquifer System.*

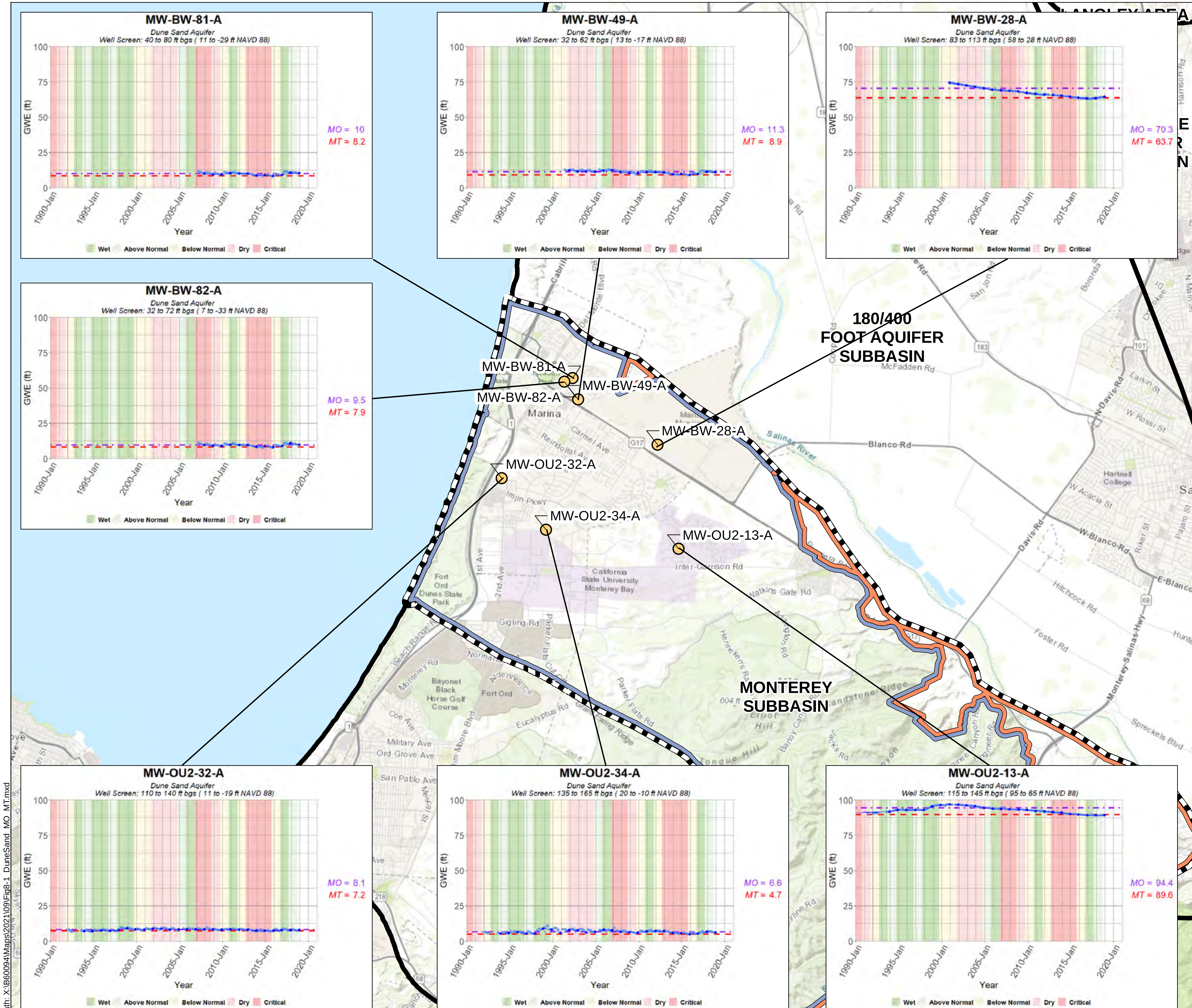
Groundwater elevation measurements collected during the fourth quarter (i.e., October, November, December) are used to establish minimum thresholds and measurable objectives in the Subbasin and will be used in the future for comparison to these thresholds. This methodology is (1) consistent with the methodology used in the adjacent 180/400-Foot Aquifer Subbasin; and (2) considers the existing monitoring schedule for the majority of RMS wells. The U.S. Army monitors 26 of the RMS wells once every quarter; MCWRA monitors 19 of the RMS wells between November and December as part of its annual groundwater elevation monitoring program; and the Seaside Watermaster has eight of the RMS wells monitored on a quarterly or more frequent basis.

Minimum thresholds for each well within the groundwater elevation representative monitoring network are provided in Table 8-2. Maps showing minimum thresholds and measurable objectives for each RMS are included in Appendix 8-A.

Table 8-2. Chronic Lowering of Groundwater Elevations Minimum Thresholds and Measurable Objectives

Monitoring Site	Aquifer	Minimum Threshold (ft NAVD88)	Measurable Objective (ft NAVD88)
Marina-Ord Area			
MW-BW-28-A	Dune Sand Aquifer	63.7	70.3
MW-BW-49-A	Dune Sand Aquifer	8.9	11.3
MW-BW-81-A	Dune Sand Aquifer	8.2	10.0
MW-BW-82-A	Dune Sand Aquifer	7.9	9.5
MW-OU2-13-A	Dune Sand Aquifer	89.6	94.4
MW-OU2-32-A	Dune Sand Aquifer	7.2	8.1
MW-OU2-34-A	Dune Sand Aquifer	4.7	6.6
CDM MW-1 Beach	Upper 180-Foot Aquifer	3.3	3.3
MW-02-05-180	Upper 180-Foot Aquifer	6.5	8.4
MW-02-10-180	Upper 180-Foot Aquifer	6.5	7.3
MW-02-13-180M	Upper 180-Foot Aquifer	6.0	6.8
MW-02-13-180U	Upper 180-Foot Aquifer	6.8	7.3
MW-12-07-180	Upper 180-Foot Aquifer	6.1	7.0
MW-B-05-180	Upper 180-Foot Aquifer	-8.0	-3.4
MW-BW-55-180	Upper 180-Foot Aquifer	-6.4	-5.7
MW-OU2-29-180	Upper 180-Foot Aquifer	-9.0	-7.2
MW-12-12-180L	Lower 180-Foot Aquifer	3.3	3.8
MW-BW-04-180	Lower 180-Foot Aquifer	-11.0	-11.0
MW-OU2-66-180	Lower 180-Foot Aquifer	-10.0	-9.2
TEST2	Lower 180-Foot Aquifer	-11.9	-10.6
MP-BW-42-295	Lower 180-Foot, 400-Foot Aquifer	-8.9	-8.1
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer	-8.4	-7.1
MPWMD#FO-10S	400-Foot Aquifer	-10.3	-3.0
MPWMD#FO-11S	400-Foot Aquifer	-25.9	-6.4
MW-OU2-07-400	400-Foot Aquifer	-6.6	-4.2
014S001E24L002M	Deep Aquifers	-29.6	-20.8
014S001E24L003M	Deep Aquifers	-6.8	3.5
014S001E24L004M	Deep Aquifers	-34.7	-21.1
014S001E24L005M	Deep Aquifers	-26.6	-6.0
14S02E33E01	Deep Aquifers	-43.8	-29.3
14S02E33E02	Deep Aquifers	-21.1	-13.9

Monitoring Site	Aquifer	Minimum Threshold (ft NAVD88)	Measurable Objective (ft NAVD88)
MPWMD#FO-10D	Deep Aquifers	-10.6	-3.8
MPWMD#FO-11D	Deep Aquifers	-4.8	3.3
PZ-FO-32-910	Deep Aquifers	-44.1	-19.7
Sentinel MW #1	Deep Aquifers	-25.4	-18.8
Corral de Tierra Area			
15S/02E-25C01	El Toro Primary Aquifer System	23.0	33.0
15S/03E-18P01	El Toro Primary Aquifer System	-46.4	-28.4
15S/03E-20R50	El Toro Primary Aquifer System	29.0	39.0
16S/02E-01M01	El Toro Primary Aquifer System	291.5	301.5
16S/02E-02G01	El Toro Primary Aquifer System	294.9	304.9
16S/02E-02H01	El Toro Primary Aquifer System	278.9	288.9
16S/02E-03A01	El Toro Primary Aquifer System	227.0	232.0
16S/02E-03F50	El Toro Primary Aquifer System	220.7	225.7
16S/02E-03H01	El Toro Primary Aquifer System	210.1	220.1
16S/02E-03H02	El Toro Primary Aquifer System	221.5	226.5
16S/02E-03J50	El Toro Primary Aquifer System	193.3	210.1
Robley Deep (South)	El Toro Primary Aquifer System	169.8	183.5
Robley Shallow (North)	El Toro Primary Aquifer System	245.2	255.2



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- Measurable Objectives
- Minimum Thresholds
- Interim Milestones
- Current Measurement

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

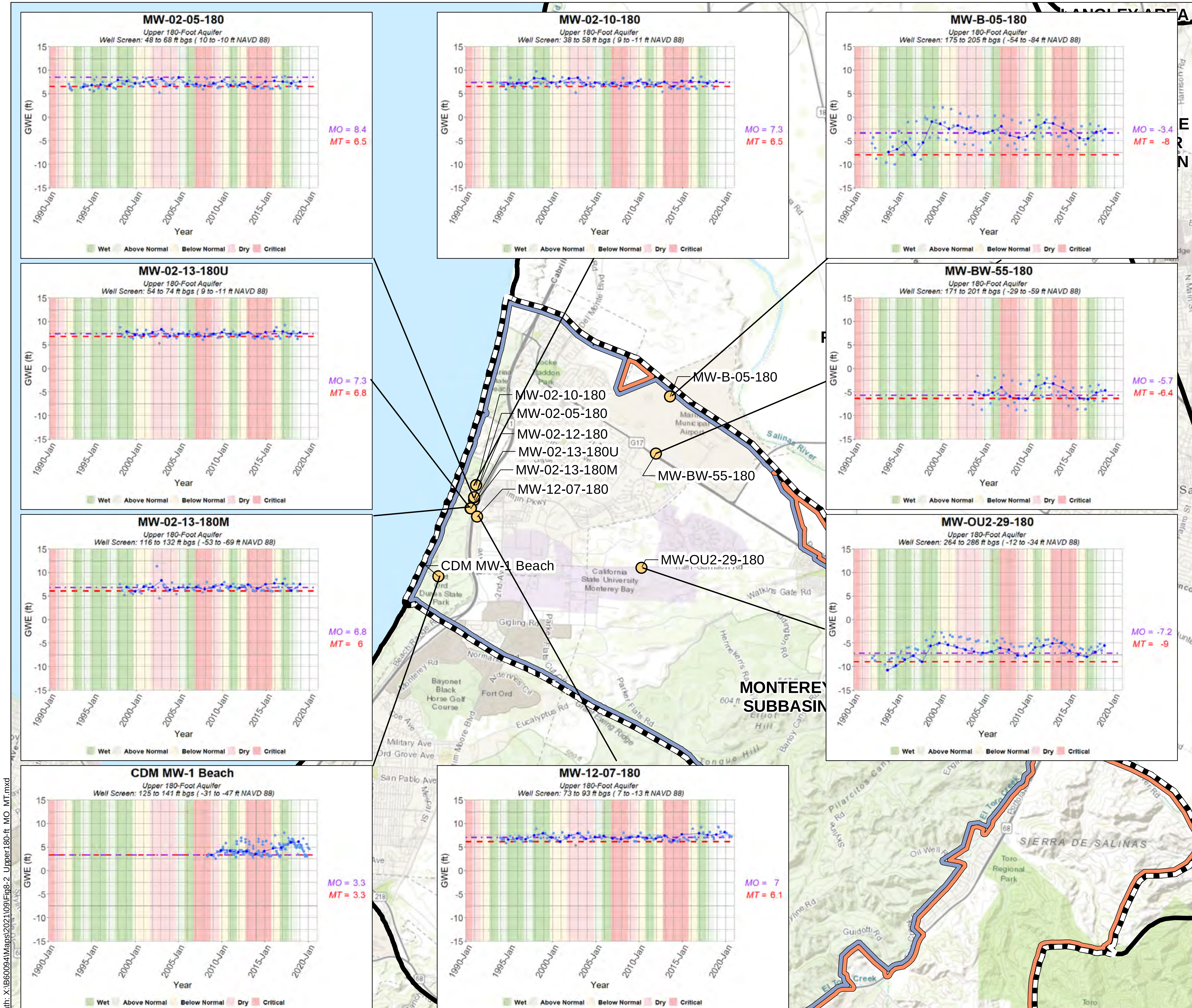
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3
(Scale in Miles)

Marina-Ord Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-1



Legend

Monterey Subbasin
Other Groundwater Subbasins within Salinas Valley Basin
Representative Monitoring Sites for Groundwater Elevations

Management Areas

Marina-Ord Area
Corral de Tierra Area

Representative Monitoring Sites

Selected Fourth Quarter GWE Measurements
Other GWE Measurements
MO
MT

Abbreviations

DWR = California Department of Water Resources
ft = foot
GWE = groundwater elevation
MO = Measurable Objectives
MT = Minimum Thresholds
NAVD 88 = North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Marina-Ord Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives Upper 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-2

Path: X:\B60094\Maps\2021\09\Fig8-2_Upper180-ft_MO_MT.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot

Management Areas

- Marina-Ord Area
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

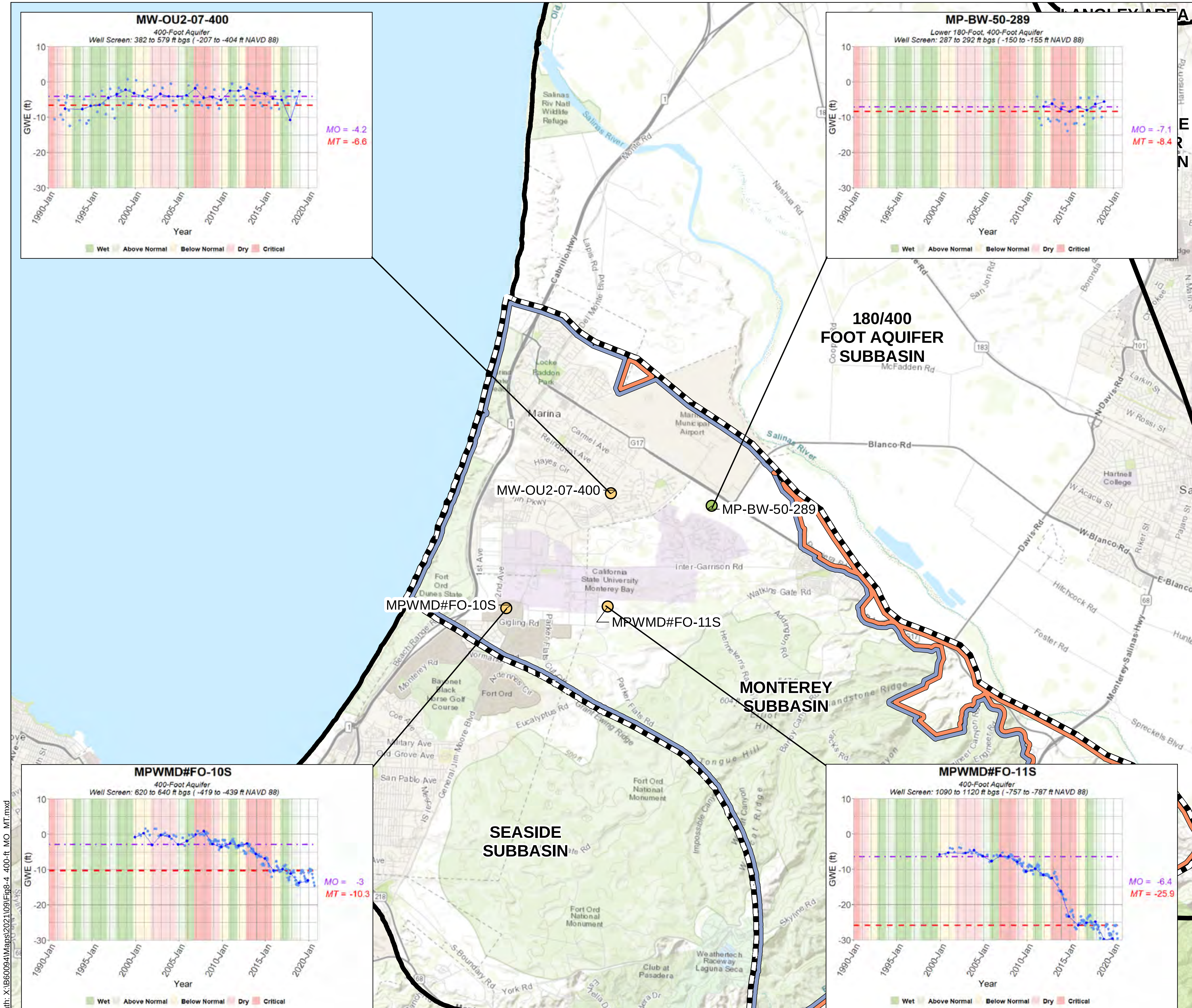
N 0 1.5 3 (Scale in Miles)

Marina-Ord Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives Lower 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-3

Path: X:\B60094\Maps\2021\09\Fig8-3_Lower180-ft_MO_MT.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- 400-Foot Aquifer (Paso Robles
- Lower 180-Foot, 400-Foot

Management Areas

- Marina-Ord Area
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Marina-Ord Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-4

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR = California Department of Water Resources
ft = foot
GWE = groundwater elevation
MO = Measurable Objectives
MT = Minimum Thresholds
NAVD 88 = North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 12 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Marina-Ord Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-5

Path: X:\B60094\Maps\2021\09\Fig8-5_Deep_MO_MT.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

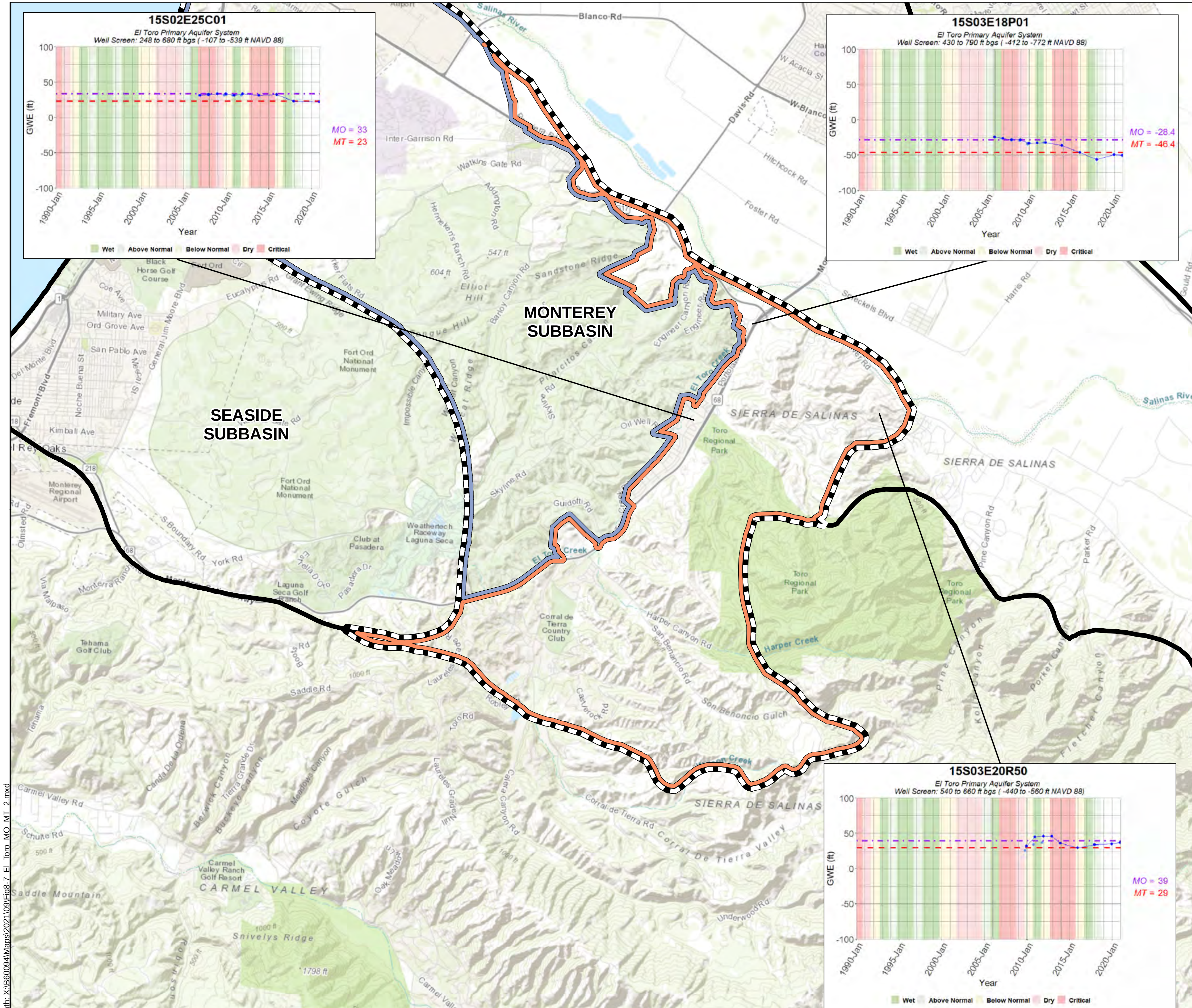
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Corral de Tierra Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives El Toro Primary Aquifer (South)

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-6



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

Management Areas

Marina-Ord Area

Corral de Tierra

Representative Monitoring Sites

Selected Fourth Quarter GWE Measurements

Other GWE Measurements

MO

MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 14 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3
(Scale in Miles)

Corral de Tierra Area: Groundwater Elevation Minimum Thresholds and Measurable Objectives El Toro Primary Aquifer (North)

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-7

8.7.3.1 Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives

A similar process is used to develop minimum thresholds and measurable objectives for each Management Area.

Consistent with the GSP Emergency Regulations §354.28(c), the definition of groundwater elevation minimum thresholds is based on considerations of historical groundwater elevation trends, water year types, projected water use in Management Areas, and relationships with other sustainability indicators.

The information and criteria relied on to establish minimum thresholds and measurable objectives in the Marina-Ord Area include:

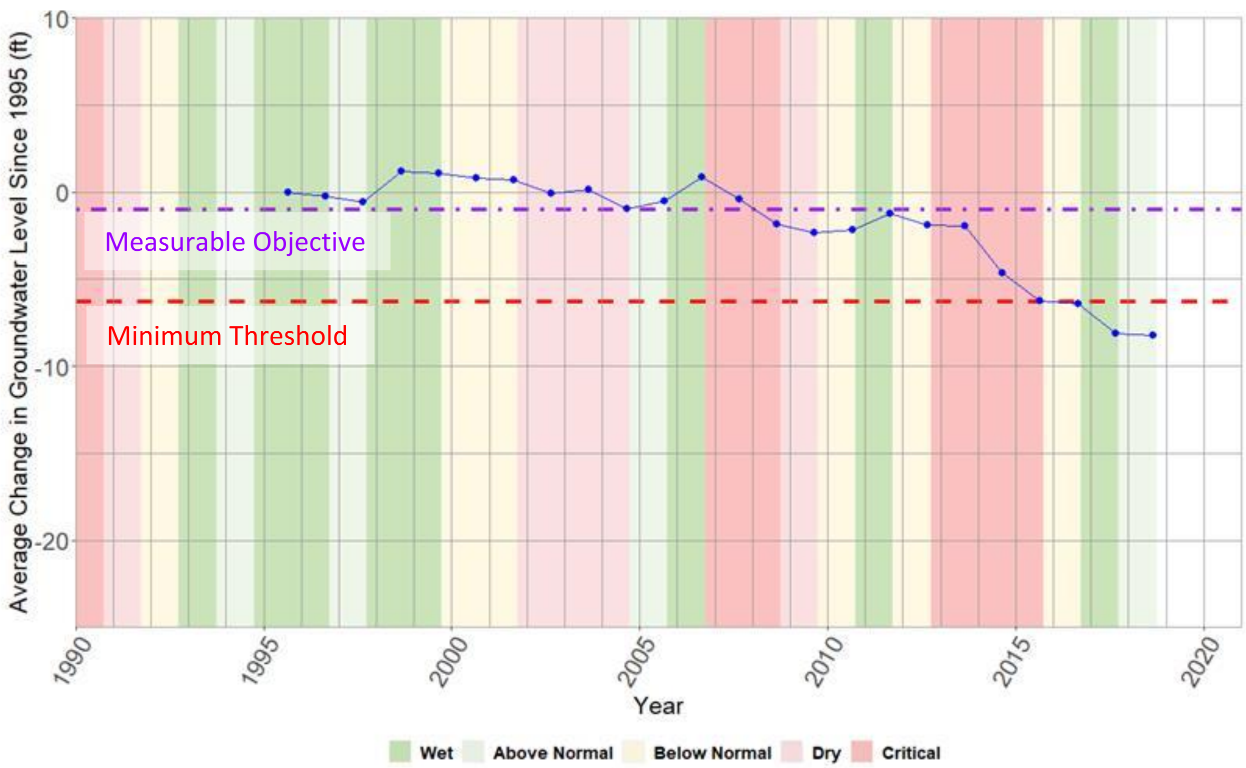
- Historical water level data from the selected RMS wells, each of which has a long-term historical water level record;
- Proximity to the seawater intrusion extent for consideration of seawater intrusion impacts;
- Minimum thresholds or levels of management established in the adjacent subbasins; and
- Well construction information.

As discussed in the preceding sections, the potential effects of undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion. The observed lateral extent of seawater intrusion within the Subbasin appears to have been generally stable within the 180- and 400-Foot Aquifers between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient.

Seawater intrusion has not been observed in the Deep Aquifer to date. However, groundwater elevations have been declining and are significantly below sea level. As discussed in Section 5.1.3.1, the declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPWMD#FO-10S and MPWMD#FO-11S. However, as stated in Section 5.1.3.1, the actual cause could not be confirmed due to the absence of adequate groundwater level and groundwater quality data in this area, which has been identified as a data gap and will be filled during GSP implementation. Although there is some uncertainty whether the Deep Aquifer is subject to seawater intrusion from the ocean, continued decline of groundwater elevations in the Deep Aquifers could increase the risk of seawater intrusion and may eventually cause vertical migration of saline water from overlying aquifers into the Deep Aquifers. As such, minimum thresholds for the Deep Aquifers are set to historically observed minimum groundwater elevations between 1995 and 2015, which are equivalent to the groundwater elevations observed in 2015 for most Deep Aquifer wells.

In order to evaluate the reasonableness of the proposed minimum thresholds and measurable objectives, the GSAs plotted these values on monitoring well hydrographs. They visually inspected each hydrograph to check if the minimum thresholds and measurable objectives are appropriate. If an RMS well did not have measurements from 1995 through 2015, the SMCs were established considering groundwater elevation trends in the principal aquifers and the closest year when groundwater elevation data is available.

Figure 8-8 shows the cumulative average change in groundwater levels for all RMS wells in the Marina-Ord Area since 1995. Given that groundwater elevations have been steady in the shallower aquifers since 1995, averaged downward groundwater elevations trends in the Marina-Ord Area are primarily driven by downward elevation trends in the Deep Aquifers' wells as well as MPWMD#FO-10S and MPWMD#FO-11S located in the southwestern portion of the Marina-Ord Area that are potentially connected to the Deep Aquifers.



Note: Water year type designation based on PRISM climate data for the Monterey Subbasin, obtained from https://prism.oregonstate.edu/.

Figure 8-8. Cumulative Average Groundwater Elevation Change Since 1995 with Measurable Objective and Minimum Threshold for the Marina-Ord Area

As discussed in Chapter 5, conditions in the Deep Aquifers are closely connected to those in the adjacent 180/400-Foot Aquifer Subbasin where new production wells have been installed immediately north of the Marina-Ord Area. Rates of groundwater extraction from the Deep Aquifers by MCWD have generally been consistent since extraction from this aquifer was initiated in the late 1980s. After an initial drop in groundwater elevations within the Deep Aquifers at the initiation of groundwater extraction by MCWD, groundwater elevations in this aquifer stabilized within the Monterey Subbasin through approximately 2004. However, increases in the total rate of groundwater extraction from the Deep Aquifers since 2004 have caused groundwater elevations in the Deep Aquifers to decline.

Due to the interconnectivity between the Marina-Ord Area and the 180/400-Foot Aquifer Subbasin principal aquifers, each subbasin's ability to achieve sustainability is also affected by the adjacent subbasins' ability to manage to their respective established minimum thresholds, measurable objectives, and groundwater sustainability goals. Therefore, the Subbasins have taken a coordinated approach to SMCs development. However, no monitoring wells are currently identified in the Deep Aquifers immediately north of the Marina-Ord Area in the 180/400-Foot Aquifer GSP. SVBGSA is working to fill this data gap. As it does so, the minimum thresholds for additional Deep Aquifer monitoring sites should consider conditions and SMCs in the Monterey Subbasin. In addition, the direction of groundwater gradient along the seawater intrusion front in the Marina-Ord Area will be monitored and evaluated annually (see methodology in Chapter 7). Future modification of SMCs may be required in order for both subbasins to achieve sustainability.

The information and criteria relied on to establish the minimum thresholds and measurable objectives in the Corral de Tierra Area include:

- Feedback from discussions with the Subbasin Committee on challenges and goals
- Historical groundwater elevation data and hydrographs from wells monitored by the Monterey County Water Resources Agency (MCWRA) and Seaside Basin Watermaster
- Maps of current and historical groundwater elevation data
- Analysis of the impact of groundwater elevations on domestic wells

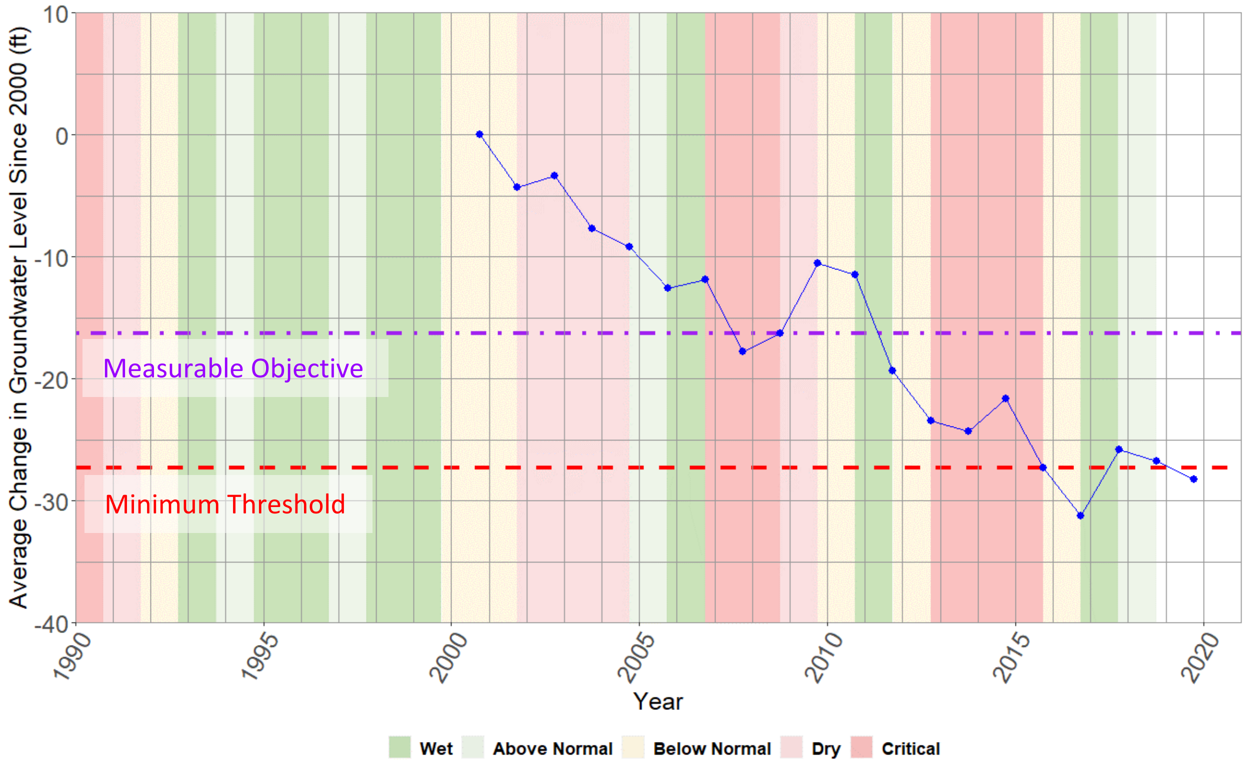
The general steps for developing minimum thresholds and measurable objectives were:

1. The Subbasin Planning Committee selected an approach and criteria for setting the groundwater elevation minimum thresholds and measurable objectives.
2. SVBGSA developed an average groundwater elevation change hydrograph to select representative years that could define minimum thresholds and measurable objectives for the Corral de Tierra Area. Groundwater elevations like those experienced during the representative climatic cycle between 2000 and 2015 were used to identify minimum thresholds and measurable objectives to ensure that they were achievable under reasonably expected climatic conditions.

The average groundwater elevation change hydrograph with minimum threshold and measurable objectives lines for the Corral de Tierra Area are shown on Figure 8-9. The average 2015 groundwater elevations in the Corral de Tierra Area are considered significant and unreasonable. When looking at the cumulative groundwater elevation changes within the representative climatic cycle (Figure 8-9), the historical lowest elevations occurred in 2016, not in 2015. To avoid this extreme low, the minimum thresholds were therefore set to 2015 groundwater elevations. The measurable objective is set to 2008 groundwater elevations, which is an achievable goal for the Subbasin under reasonably expected climatic conditions.

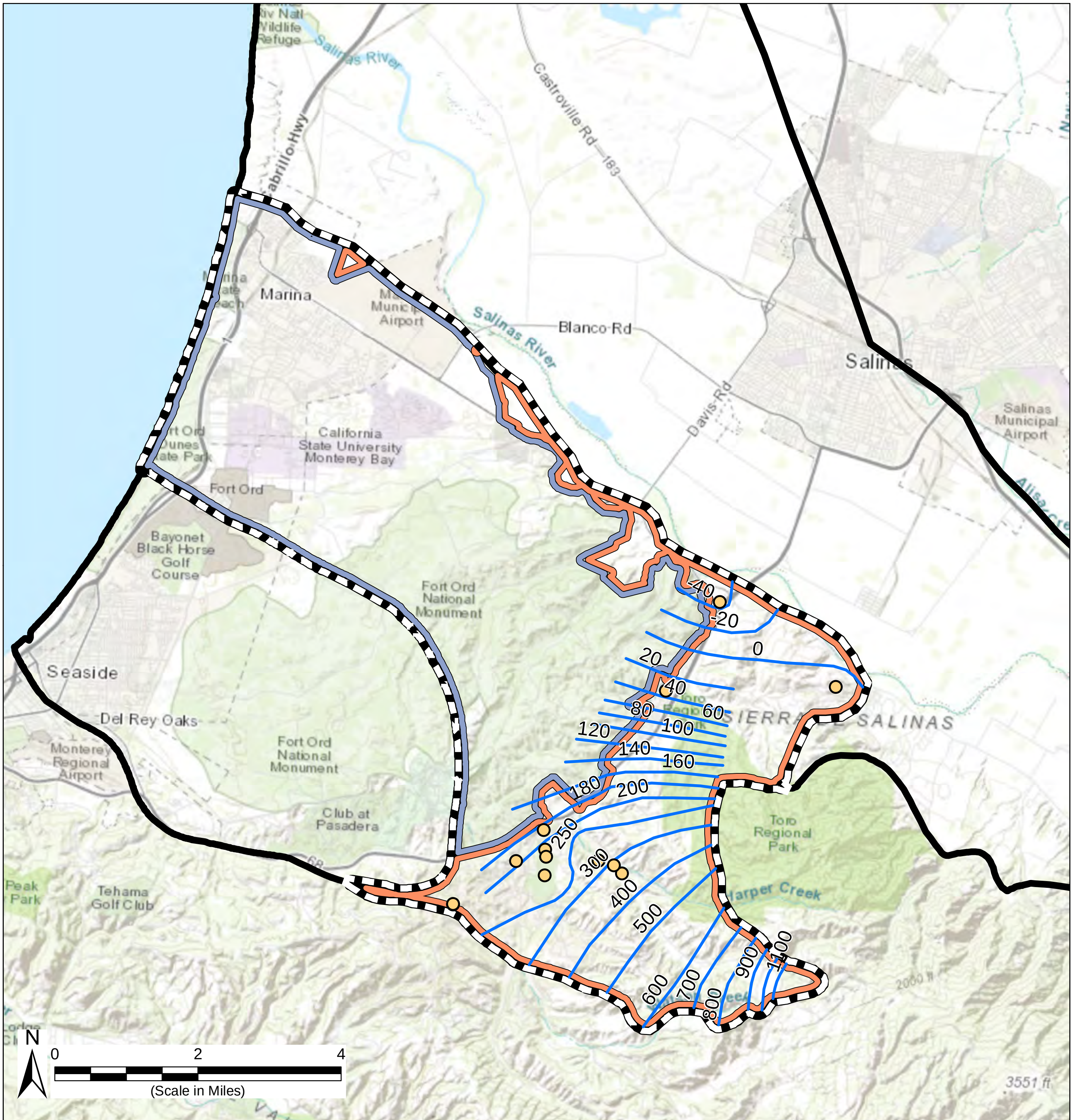
SVBGSA identified the appropriate minimum thresholds and measurable objectives on the respective monitoring well hydrographs. Each hydrograph was visually inspected to check if the minimum threshold and measurable objective were reasonable. If an RMS did not have measurements from the minimum threshold or measurable objective years, the SMCs were interpolated from the groundwater elevation contours. The RMS location was intersected with groundwater elevation contour maps to estimate the minimum thresholds and measurable objectives. Moreover, if the SMCs seemed unreasonable for an RMS, they were adjusted based on historical water levels and groundwater elevation trends seen in surrounding wells. The interpolated or adjusted minimum thresholds and measurable objectives are indicated by an asterisk in Table 8-2.

The minimum threshold contour map, along with the monitoring network wells, are shown on Figure 8-10 for the Corral de Tierra Area.



Note: Water year type designation based on PRISM climate data for the Monterey Subbasin, obtained from https://prism.oregonstate.edu/.

Figure 8-9. Cumulative Average Groundwater Elevation Change Since 2000 with Measurable Objective and Minimum Threshold for the Corral de Tierra Area



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

Groundwater Elevation Minimum Threshold Contours in the El Toro Primary Aquifer (ft NAVD 88)

Management Areas

Marina-Ord

Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 December 2021.

Abbreviations

ft = feet

NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Corral de Tierra Area: Groundwater Elevation Minimum Threshold Contour Map

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-10

Path: X:\B60094\Maps\2021\09\Fig8-10-El_Toro_MT Contour.mxd

8.7.3.2 *Minimum Thresholds Impact on Domestic Wells*

There is no known domestic use in the Marina-Ord Area. Land uses in this area are either urban, where well construction restrictions are imposed by the City of Marina and Monterey County, or open space. Additionally, groundwater elevation minimum thresholds in the shallower Dune Sand and 180-Foot Aquifers have been defined within their historical range of groundwater elevations, which has been steady for more than two decades. Therefore, minimum thresholds for groundwater elevation in the Marina-Ord Area are unlikely to impact domestic wells which are typically completed at shallower depths.

In the Corral de Tierra Area, groundwater elevation minimum thresholds are compared to the range of domestic well depths using DWR's Online System for Well Completion Reports (OSWCR) database. This check was done to assure that the minimum thresholds maintain operability in a reasonable percentage of domestic wells. The proposed minimum thresholds for groundwater elevation do not necessarily protect all domestic wells because it is impractical to manage a groundwater basin in a manner that fully protects the shallowest wells. The average computed depth of domestic wells in the Subbasin is 391.8 feet using data from the OSWCR database.

While this approach is reasonable, there are some errors that add inaccuracy to the analysis. These include:

- The OSWCR database may include wells that have been abandoned or destroyed, and therefore will have no detrimental impacts from lowered groundwater elevations.
- Domestic wells drilled prior to 1995 may no longer be in use, particularly if residents switched to small water systems.
- Some domestic wells may draw water from shallow, perched groundwater that is not managed in this GSP.
- Some wells in the OSWCR database are not accurately located, and therefore the estimated depth to water may not be accurate.
- The depth to water is derived from a smoothly interpolated groundwater elevation contour map. Errors in the map may result in errors in groundwater elevation at the selected domestic wells.

Given the limitations listed above, the analysis included 19 wells that had accurate locations and were drilled after 1994 out of the total 169 domestic wells in the OSWCR database for this area. In the Corral de Tierra Area, 100% of the domestic wells should have at least 25 feet of water in them to remain operable if groundwater elevations are at minimum thresholds. Therefore, the minimum thresholds appear to be reasonably protective for domestic users.

8.7.3.3 *Relationship to Other Sustainability Indicators*

Groundwater elevation minimum thresholds can influence other sustainability indicators. The Subbasin GSAs reviewed the relationship between groundwater level minimum thresholds and the other sustainability indicators and verified that these minimum thresholds will limit undesirable results for other sustainability indicators. As discussed above, the groundwater level minimum thresholds have primarily been established to limit seawater intrusion and maintain adequate groundwater storage within the Subbasin. These groundwater level minimum thresholds are also consistent with minimum thresholds established for:

- depletion of interconnected surface waters in wells proximate to such areas, and
- subsidence, as they are set above historical groundwater levels.

In this subbasin, there is no clear correlation between groundwater levels and groundwater quality.

8.7.3.4 Effects of Minimum Threshold between Management Areas

The minimum thresholds for each management area have been developed in a coordinated matter through discussions within the Subbasin Technical Committee. Because the minimum thresholds in each management area are defined at levels generally representative of 2015 conditions in all areas where water levels are declining, they will not cause undesirable results in the other management area.

8.7.3.5 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north; and
- The Seaside Subbasin to the south.

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of minimum thresholds and measurable objectives for the 180-Foot Aquifer and the 400-Foot Aquifer within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. Due to the interconnectivity between the Marina-Ord Area and the 180/400-Foot Aquifer Subbasin principal aquifers, the groundwater elevation minimum thresholds for the Marina-Ord Area are established to be consistent with the 180/400-Foot Aquifer Subbasin GSP and are based on the assumption that SMCs will be met in the adjacent subbasin. However, the 180/400-Foot Aquifer Subbasin GSP does not establish minimum thresholds or measurable objectives for the Deep Aquifers. The establishment of SMCs for the Deep Aquifers will be conducted following the completion of a Deep Aquifers Study. The impact of the Monterey Subbasin's minimum thresholds on the Deep Aquifers in the 180/400-Foot Aquifer Subbasin will be assessed after the Deep Aquifer SMCs are established. Continued GSA coordination of these SMCs is critical, as each subbasin's ability to achieve sustainability is affected by the adjacent subbasins' minimum thresholds, measurable objectives, and the ability to manage towards these SMCs.

The Seaside Subbasin is an adjudicated basin and not subject to SGMA. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the

Monterey Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements, including the occurrence of “Material Injury” (as defined in the Seaside Basin adjudication decision) in the Laguna Seca subarea due to lowered groundwater levels.

8.7.3.6 Effects on Beneficial Users and Land Uses

The groundwater elevation minimum thresholds may have several effects on beneficial users and land uses in the Subbasin and adjacent subbasins.

Urban land uses and users. The groundwater elevation minimum thresholds may reduce the amount of groundwater pumping in the Subbasin or adjacent subbasins, or result in obtaining alternative sources of water within the Monterey Subbasin or through regional efforts. This may result in higher water costs for water users.

Domestic land uses and users. The groundwater elevation minimum thresholds are intended to protect most domestic wells along with small state and small local system wells. Therefore, the minimum thresholds will likely have an overall beneficial effect on existing domestic land uses by protecting the ability to pump from domestic wells or be supplied by small systems. However, extremely shallow domestic wells may become dry as many have during extended dry periods, requiring owners to drill deeper wells. Additionally, the groundwater elevation minimum thresholds may limit the number of new domestic wells or small state and small local system wells that can be drilled to limit future declines in groundwater elevations as a result of additional pumping that would come into production. Further, higher minimum thresholds would require additional projects and management actions to raise groundwater levels, and therefore it would place an even higher financial burden on domestic users to contribute to projects.

Agricultural land uses and users. The groundwater elevation minimum thresholds prevent continued lowering of groundwater elevations in the Subbasin. This may have the effect of limiting the amount of groundwater pumping in the Subbasin. Limiting the amount of groundwater pumping may limit the amount and type of crops that can be grown in the Subbasin. The groundwater elevation minimum thresholds could therefore limit the expansion of the Subbasin’s agricultural economy. This could have various effects on beneficial users and land uses:

- Agricultural land currently under irrigation may become more valuable as bringing new lands into irrigation becomes more difficult and expensive.
- Agricultural land not currently under irrigation may become less valuable because it may be too difficult and expensive to irrigate.

Ecological land uses and users. Groundwater elevation minimum thresholds may limit the amount of groundwater pumping in the Subbasin and may limit both urban and agricultural growth. This outcome may benefit ecological land uses and users by curtailing the conversion of native vegetation to agricultural or domestic uses, and by reducing pressure on existing ecological land caused by declining groundwater elevations.

8.7.3.7 *Relevant Federal, State, or Local Standards*

No federal, state, or local standards exist for chronic lowering of groundwater elevations.

8.7.3.8 *Method for Quantitative Measurement of Minimum Thresholds*

Groundwater elevation minimum thresholds will be directly measured from the RMS network in accordance with the monitoring plans outlined in Chapter 7. Furthermore, groundwater elevation monitoring will meet the requirements of the technical and reporting standards included in the GSP Emergency Regulations.

As noted in Chapter 7, the current groundwater elevation RMS network in the Subbasin across aquifers includes 35 wells. Data gaps were identified in Chapter 7 and will be resolved during implementation of this GSP.

8.7.4 Measurable Objectives

The measurable objectives for chronic lowering of groundwater levels ("groundwater elevation measurable objectives") represent target groundwater elevations that are higher than the minimum thresholds. These measurable objectives provide operational flexibility to ensure that the Subbasin can be managed sustainably over a reasonable range of hydrologic and climatic variability. Groundwater elevation measurable objectives are summarized in Table 8-2. The measurable objectives are also shown on the maps for each RMS in Appendix 8-A and Figures 8-1 through 8-7 above.

8.7.4.1 *Methodology for Setting Measurable Objectives*

In the Marina-Ord Area, groundwater elevation measurable objectives are defined as follows:

> *Groundwater elevations observed in 2004 in the Dune Sand, 180-Foot, 400-Foot, and Deep Aquifers, prior to the decline of groundwater levels in the southwestern portion of the Marina-Ord Area.*

In the Marina-Ord Area, these measurable objectives are primarily set to further limit the potential for seawater intrusion within the Subbasin. Data collected by the Seaside Watermaster has shown a recent increase in chloride concentrations in MPWMD#FO-10S in the Monterey Subbasin, and MPWMD#FO-09S, a coastal Paso Robles Aquifer well located within the Seaside Subbasin[49]. These recent increases in chloride concentration indicate that groundwater elevations in the southwestern portion of the Marina-Ord Area may induce seawater intrusion in the 400-Foot and/or Deep Aquifers of the Monterey Subbasin and the Paso Robles Aquifer of the

[49] Chloride concentration measured from MPWMD#FO-10S and MPWMD#FO-09S in September 2020 were 89.9 mg/L and 90.4 mg/L, respectively. However, an investigation performed by MPWMD into the cause of this in mid-2021 concluded that there was leakage in the upper portion of the casing causing increases in chloride readings in MPWMD#FO-09S. As part of GSP implementation, the Subbasin GSAs will investigate possible seawater intrusion near MPWMD#FO-10S in collaboration with the Seaside Watermaster.

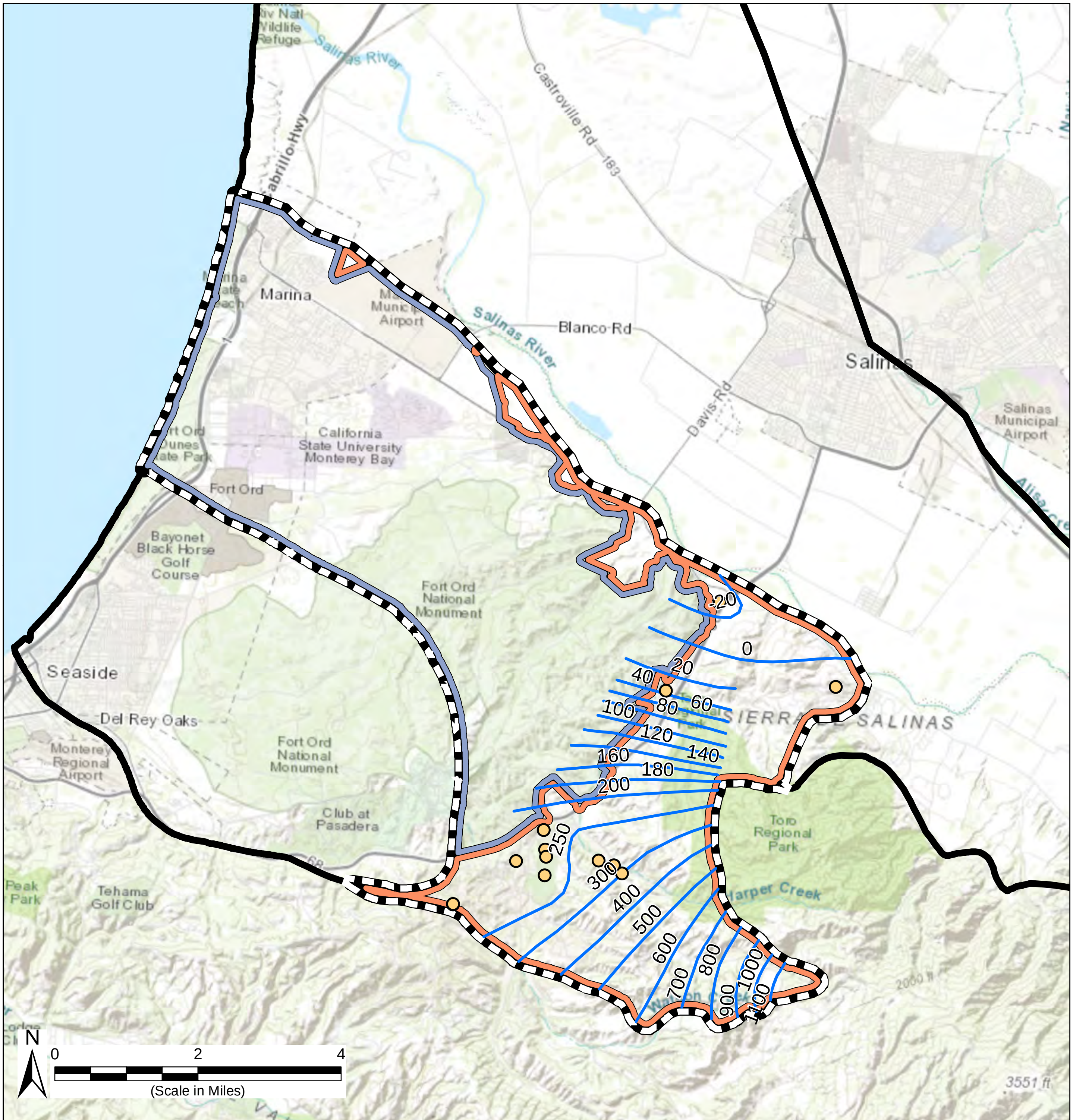
Seaside Subbasin. As discussed earlier in Chapters 4 and 5, there is uncertainty regarding hydrostratigraphy and the cause of groundwater elevation declines within this area. However, for this GSP, the representative year of 2004 is selected for measurable objectives, which is prior to recent groundwater declines in the Marina-Ord Area as shown on Figure 8-8.

These measurable objectives are generally consistent with those set for the 180- and 400-foot aquifers in the neighboring 180/400-Foot Aquifer Subbasin. Measurable objectives in the 180/400-Foot Aquifer Subbasin are set at 2003 levels. Measurable objectives for the Deep Aquifers have not been established within the 180/400-Foot Aquifer Subbasin.

In the Corral de Tierra Area, groundwater elevations from 2008 were selected as the measurable objectives to ensure that the objectives are achievable. Therefore, groundwater elevation measurable objectives in the Corral de Tierra Area are defined as follows:

Groundwater elevations observed in 2008 in the El Toro Primary Aquifer System.

The measurable objective contour maps along with the monitoring network wells are shown on Figure 8-11 for the Corral de Tierra Area.



Path: X:\B60094\Maps\2021\09\Fig8-11-El_Toro_MO Contour.mxd

Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations
- Groundwater Elevation Measurable Objective Contours in the El Toro Primary Aquifer (ft NAVD 88)

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 December 2021.

Abbreviations

ft = feet
NAVD 88 = North American Vertical Datum of 1988

Notes

1. All locations are approximate.
2. Groundwater contours are in ft NAVD 88.

Corral de Tierra Area: Groundwater Elevation Measurable Objective Contour Map

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-11

8.7.4.2 Interim Milestones

Chapter 9 identifies projects and management actions to address the Subbasin's overdraft conditions and meet measurable objectives established herein. These projects and management actions are early in their planning phases and will require coordination with adjacent subbasins and collaborating partners. As such, time will be required to implement these projects and management actions, and begin monitoring for the expected benefits. Groundwater interim milestones are established to reflect the timeline for project implementation, and realization of project benefits over time.

Within the Monterey Subbasin, for wells in the 400-Foot Aquifer, Deep, and El Toro Primary Aquifer System Aquifers where groundwater levels have been declining, groundwater elevation interim milestones are defined based on a trajectory informed by current (fourth quarter of 2020) groundwater levels, historical groundwater elevation trends[50], and measurable objectives. This trajectory allows for and assumes a continuation of historical groundwater elevation trends during the first 5-year period of GSP implementation, a deviation from that trend over the second 5-year period, and a recovery towards the measurable objectives in the third and fourth (last) 5-year period. An example of the trajectory is shown on Figure 8-12 with a Marina-Ord well. As discussed below in Section 8.8.3.1, there are large volumes of freshwater in the Subbasin that provide additional time and flexibility to reach identified SMCs while projects and management actions are implemented. The temporary use of stored groundwater in the 400-Foot Aquifer, Deep, and El Toro Primary Aquifer Systems Aquifers are reflected in these groundwater elevation interim milestones.

Groundwater elevation interim milestones for wells in the Dune Sand, 180-Foot, and 400-Foot Aquifers, with stable groundwater elevations, are set at their respective measurable objectives. Groundwater elevation interim milestones for wells that have already exceeded their measurable objective also use the measurable objective in place of the interim milestones.

Interim milestones for groundwater elevations are shown in Table 8-3. Hydrographs showing minimum thresholds, measurable objectives, and interim milestones for each RMS are included in Appendix 8-B.

[50] Calculated based on fourth quarter measurements over the historical period (i.e., 2004 to 2018).

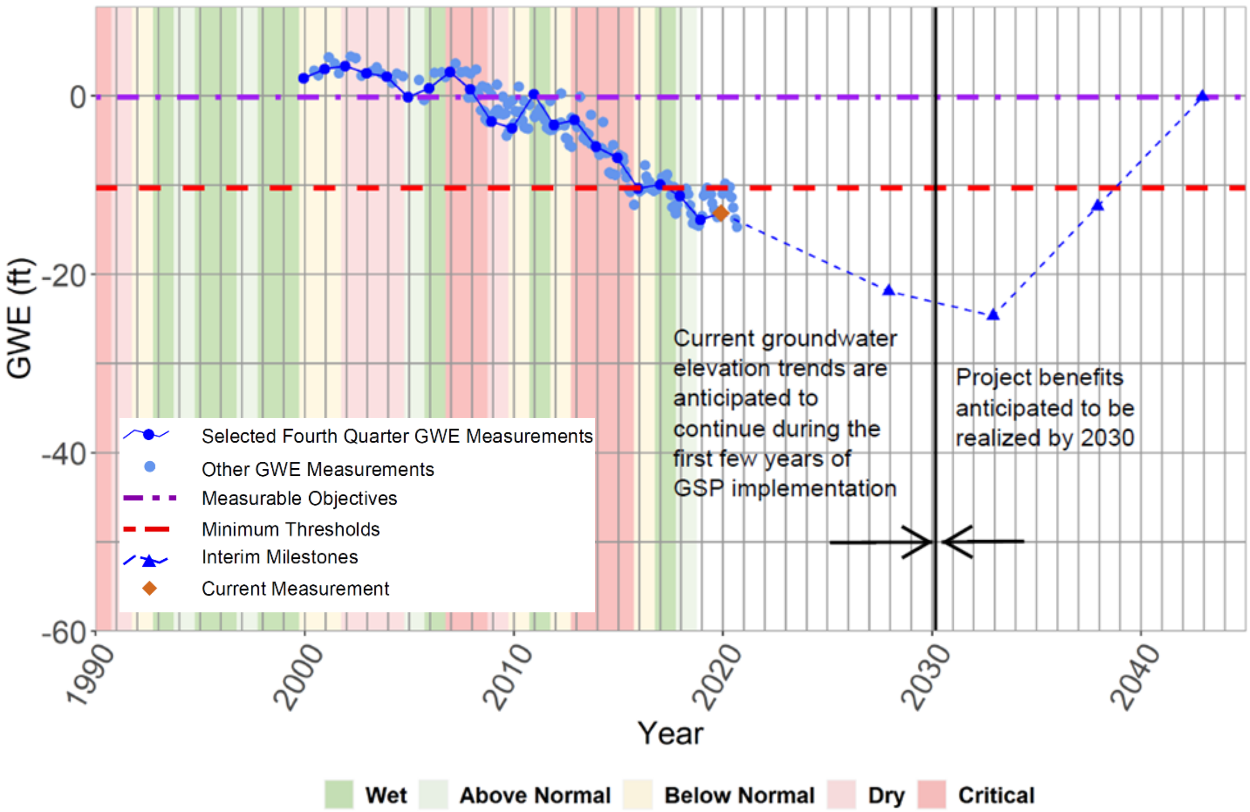


Figure 8-12. Example Trajectory for Groundwater Elevation Interim Milestones

Table 8-3. Groundwater Elevation Interim Milestones

Monitoring Site	Aquifer	Current Groundwater Elevation ft NAVD88 (assume at 2020)	Interim Milestone at Year 2027 (ft NAVD88)	Interim Milestone at Year 2032 (ft NAVD88)	Interim Milestone at Year 2037 (ft NAVD88)	Measurable Objective (ft NAVD88) (goal to reach at 2042)
Marina-Ord Area						
MW-BW-28-A	Dune Sand Aquifer	64.4 (a)	70.3	70.3	70.3	70.3
MW-BW-49-A	Dune Sand Aquifer	11.9 (a)	11.3	11.3	11.3	11.3
MW-BW-81-A	Dune Sand Aquifer	11 (a)	10.0	10.0	10.0	10
MW-BW-82-A	Dune Sand Aquifer	10.5 (a)	9.5	9.5	9.5	9.5

Monitoring Site	Aquifer	Current Groundwater Elevation ft NAVD88 (assume at 2020)	Interim Milestone at Year 2027 (ft NAVD88)	Interim Milestone at Year 2032 (ft NAVD88)	Interim Milestone at Year 2037 (ft NAVD88)	Measurable Objective (ft NAVD88) (goal to reach at 2042)
MW-OU2-13-A	Dune Sand Aquifer	89.3 (a)	94.4	94.4	94.4	94.4
MW-OU2-32-A	Dune Sand Aquifer	8.1 (a)	8.1	8.1	8.1	8.1
MW-OU2-34-A	Dune Sand Aquifer	7.1 (a)	6.6	6.6	6.6	6.6
CDM MW-1 Beach	Upper 180-Foot Aquifer	4.8 (a)	3.3	3.3	3.3	3.3
MW-02-05-180	Upper 180-Foot Aquifer	7.5 (a)	8.4	8.4	8.4	8.4
MW-02-10-180	Upper 180-Foot Aquifer	7.6 (a)	7.3	7.3	7.3	7.3
MW-02-13-180M	Upper 180-Foot Aquifer	7.5 (a)	6.8	6.8	6.8	6.8
MW-02-13-180U	Upper 180-Foot Aquifer	7.7 (a)	7.3	7.3	7.3	7.3
MW-12-07-180	Upper 180-Foot Aquifer	8.1 (a)	7.0	7.0	7.0	7
MW-B-05-180	Upper 180-Foot Aquifer	-2.3 (a)	-3.4	-3.4	-3.4	-3.4
MW-BW-55-180	Upper 180-Foot Aquifer	-4.2 (a)	-5.7	-5.7	-5.7	-5.7
MW-OU2-29-180	Upper 180-Foot Aquifer	-6.3 (a)	-7.2	-7.2	-7.2	-7.2
MW-12-12-180L	Lower 180-Foot Aquifer	4 (a)	3.8	3.8	3.8	3.8
MW-BW-04-180	Lower 180-Foot Aquifer	-8.2 (a)	-11.0	-11.0	-11.0	-11
MW-OU2-66-180	Lower 180-Foot Aquifer	-7.3 (a)	-9.2	-9.2	-9.2	-9.2
TEST2	Lower 180-Foot Aquifer	-8.5 (a)	-10.6	-10.6	-10.6	-10.6
MP-BW-42-295	Lower 180-Foot, 400-Foot Aquifer	-6.9 (a)	-8.1	-8.1	-8.1	-8.1
MP-BW-50-289	Lower 180-Foot, 400-Foot Aquifer	-7.9 (a)	-7.1	-7.1	-7.1	-7.1
MPWMD#FO-10S	400-Foot Aquifer	-13.1 (a)	-20.4	-22.7	-12.9	-3.0

Monitoring Site	Aquifer	Current Groundwater Elevation ft NAVD88 (assume at 2020)	Interim Milestone at Year 2027 (ft NAVD88)	Interim Milestone at Year 2032 (ft NAVD88)	Interim Milestone at Year 2037 (ft NAVD88)	Measurable Objective (ft NAVD88) (goal to reach at 2042)
MPWMD#FO-11S	400-Foot Aquifer	-29.8 (a)	-44.4	-49.0	-27.7	-6.4
MW-OU2-07-400	400-Foot Aquifer	-3.1 (a)	-4.2	-4.2	-4.2	-4.2
014S001E24L002M	Deep Aquifers	-30.3	-34.9	-36.6	-28.7	-20.8
014S001E24L003M	Deep Aquifers	-12.3	-18.9	-21.2	-8.9	3.5
014S001E24L004M	Deep Aquifers	-32.3	-41.6	-44.9	-33.0	-21.1
014S001E24L005M	Deep Aquifers	-25.6	-39.7	-44.8	-25.4	-6.0
14S02E33E01	Deep Aquifers	-53.7	-69.9	-75.6	-52.5	-29.3
14S02E33E02	Deep Aquifers	-20.8	-22.6	-23.3	-18.6	-13.9
MPWMD#FO-10D	Deep Aquifers	-12.7 (a)	-18.7	-20.5	-12.2	-3.8
MPWMD#FO-11D	Deep Aquifers	-9.7 (a)	-15.7	-17.6	-7.2	3.3
PZ-FO-32-910	Deep Aquifers	-44.3	-65.6	-73.2	-46.4	-19.7
Sentinel MW #1	Deep Aquifers	-29.9 (a)	-37.8	-40.3	-29.5	-18.8
Corral de Tierra Area						
15S/02E-25C01	El Toro Primary Aquifer System	22	21	21	26	33.0
15S/03E-18P01	El Toro Primary Aquifer System	-50.4	-53	-53	-42.9	-28.4
15S/03E-20R50	El Toro Primary Aquifer System	36.5	37	37.5	38	39.0
16S/02E-01M01	El Toro Primary Aquifer System	293.6	295.3	297.2	299	301.5
16S/02E-02G01	El Toro Primary Aquifer System	298.5	299.2	300.8	302.6	304.9
16S/02E-02H01	El Toro Primary Aquifer System	279.5	282	284	286.1	288.9
16S/02E-03A01	El Toro Primary Aquifer System	206.9	188	188	206.3	232
16S/02E-03F50	El Toro Primary Aquifer System	215.9	211	211	217.2	225.7
16S/02E-03H01	El Toro Primary Aquifer System	211.7	213.6	215.5	217.4	220.1
16S/02E-03H02	El Toro Primary Aquifer System	215	205	205	214	226.5
16S/02E-03J50	El Toro Primary Aquifer System	211.8	210.1	210.1	210.1	210.1

Monitoring Site	Aquifer	Current Groundwater Elevation ft NAVD88 (assume at 2020)	Interim Milestone at Year 2027 (ft NAVD88)	Interim Milestone at Year 2032 (ft NAVD88)	Interim Milestone at Year 2037 (ft NAVD88)	Measurable Objective (ft NAVD88) (goal to reach at 2042)
Robley Deep (South)	El Toro Primary Aquifer System	165.13	160.5	160.5	170	183.5
Robley Shallow (North)	El Toro Primary Aquifer System	238.64	230.7	230.7	240.8	255.2
(a) These current groundwater levels were taken in the fourth quarter of 2019 due to the lack of measurements in fourth quarter of 2020.						

8.8 Reduction in Groundwater Storage SMC

8.8.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable conditions in groundwater storage in the Subbasin are those that:

- Lead to chronic, long-term reduction in groundwater storage, or
- Interfere with other sustainability indicators

These significant and unreasonable conditions were determined based on input collected during MCWD stakeholder meetings, SVBGSA Subbasin Committee meetings, and discussions with GSA staff during Subbasin Technical Committee meetings.

8.8.2 Undesirable Results

8.8.2.1 Criteria for Defining Reduction in Groundwater Storage Undesirable Results

The criteria used to define undesirable results for reduction of groundwater storage are based on minimum thresholds established for chronic lowering of groundwater levels and seawater intrusion.

The undesirable result for reduction of groundwater storage is defined to be consistent with groundwater elevation and seawater intrusion undesirable results, as identified below:

> *Over the course of any one year, exceedance of more than 20% of the groundwater level minimum thresholds in either:*
>
> a. *both the Dune Sand Aquifer and Upper 180-Foot Aquifer, or*
> b. *both the Lower 180 Foot and 400 Foot aquifer, or*
> c. *the Deep Aquifers, or*
> d. *the El Toro Primary Aquifer System.*

OR

a. Exceedance of seawater intrusion minimum thresholds.

Since the GSP addresses long-term groundwater sustainability, exceedances of groundwater level minimum thresholds during a drought do not constitute an undesirable result. Pursuant to SGMA Regulations (California Water Code §10721(w)(1)), "Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods." Therefore, groundwater levels may temporarily exceed minimum thresholds during droughts, and do not constitute an undesirable result, as long as groundwater levels rebound.

Within the Subbasin, groundwater elevations are typically well above production well screen elevations and therefore there is limited concern regarding available groundwater storage to withstand future droughts. The critical limiting factor associated with groundwater availability in the Subbasin is further seawater intrusion and chronic decline in groundwater levels that can lead to seawater intrusion. As such, it is not necessary to define unique SMCs for reduction of groundwater storage.

There is adequate fresh groundwater in storage for beneficial uses and users within the Subbasin to withstand droughts when:

(a) groundwater elevations are equivalent to minimum thresholds established for chronic lowering of groundwater levels, and

(b) the extent of seawater intrusion, defined by the 500 mg/L chloride concentration isocontour, is equivalent to established seawater intrusion minimum thresholds.

Therefore, SMCs established for (a) chronic lowering of groundwater levels and (b) seawater intrusion are reasonable proxies for protection of groundwater storage.

8.8.2.2 Potential Causes of Undesirable Results

Reduction of groundwater storage is directly correlated to chronic lowering of groundwater levels and seawater intrusion. Therefore, the potential causes of undesirable results due to reduction of groundwater storage are the same as the potential causes listed for undesirable results due to chronic lowering of groundwater levels and seawater intrusion in Sections 8.7.2.2 and 8.9.2.2, respectively. As such, an undesirable result for reduction of groundwater storage will not occur as long as undesirable results are avoided with regard to the chronic lowering of groundwater levels and seawater intrusion indicators.

8.8.2.3 Effects on Beneficial Users and Land Use

The undesirable result is designed to avoid dropping below the level of groundwater in storage during 2015 for long-term use. Therefore, the primary potential effect of this undesirable result is generally beneficial for the groundwater uses and users in the Subbasin.

8.8.3 Minimum Thresholds

The undesirable results definition for reduction of groundwater storage refers to a decrease in storage caused by (1) water levels declining below groundwater elevation minimum thresholds or (2) high salinity groundwater migrating beyond seawater intrusion minimum thresholds. It is logical to tie these sustainability indicators together, because the amount of groundwater in storage is directly related to groundwater elevations and the extent of seawater intrusion. The minimum thresholds for chronic lowering of groundwater level and seawater intrusion, therefore, will be used as proxies for reduction of groundwater storage.

8.8.3.1 Information and Methodology Used to Establish Minimum Thresholds

Pursuant to the GSP Emergency Regulations and as further described in the DWR Sustainable Management Criteria BMP (DWR, 2017), minimum thresholds for reduction of groundwater storage may be set by using groundwater levels as a proxy if it is demonstrated that a correlation exists between the two metrics. One approach to using groundwater levels as a proxy, described in the DWR Sustainable Management Criteria BMP, is to demonstrate that minimum thresholds for chronic lowering of groundwater levels are sufficiently protective to ensure prevention of significant and unreasonable occurrences of the Sustainability Indicator in question.

This GSP has adopted and extended this approach to use minimum thresholds defined for both the chronic lowering of groundwater level indicator and the seawater intrusion indicator as a proxy. As discussed above, the amount of groundwater in storage is directly related to groundwater elevations and the extent of seawater intrusion. As demonstrated in the calculation below, groundwater elevation and seawater intrusion minimum thresholds are sufficiently protective of the groundwater storage indicator. As shown in Table 8-4, the estimated fresh groundwater storage volume is calculated based on:

- The area of each principal aquifer outside its seawater intrusion minimum threshold;
- The saturated thickness of each principal aquifer[51];
- An estimated specific yield ranging between 0.1 and 0.2, based on typical values for sandy aquifers.

[51] Saturated thickness is estimated by either (1) the difference between groundwater elevations in Fall 2015 and the bottom of the aquifer, or (2) the thickness of the aquifer, whichever is smaller. This method conservatively assumes that the confined storage within each aquifer is negligible compared to the drainable porosity.

Table 8-4. Estimated Fresh Groundwater Storage in the Marina-Ord Area

Principal Aquifer	Estimated Fresh Groundwater Storage (AF)	
	Lower Range (Specific Yield at 0.1)	Upper Range (Specific Yield at 0.2)
Marina-Ord Area		
Dune Sand Aquifer	30,000	60,000
Upper 180-Foot Aquifer	50,000	100,000
Lower 180-Foot Aquifer	44,000	88,000
400-Foot Aquifer	134,000	268,000
Deep Aquifers	1,544,000	3,088,000

This calculation represents a theoretical estimate of the total volume of fresh groundwater that exists within the principal aquifers within the Subbasin. It should be noted, however, that not all fresh groundwater in storage can be practically accessed or used. Chronic declines in groundwater levels and the potential for increased seawater intrusion are the critical limiting factors associated with usable groundwater storage in the Subbasin. As such, minimum thresholds established for seawater intrusion and groundwater elevations are appropriate proxies for this sustainability indicator. However, the existence of such groundwater storage within the Subbasin provides additional time and flexibility to reach identified SMCs for chronic lowering of groundwater levels. Groundwater can temporarily be removed from storage until local and/or regional projects and/or management actions can be implemented. The temporary use of stored groundwater is reflected in interim milestones established for chronic lowering of groundwater levels within the Deep Aquifers, where no seawater intrusion has yet been identified. However, there is currently insufficient data to determine the vertical or lateral (i.e., seaward) location of the seawater intrusion front within the Deep Aquifers. This information has been identified as a data gap within Section 5.3.3 of the GSP, and will ultimately be used to determine the extent to which such temporary withdrawals of groundwater from storage can continue and water level elevation SMCs must be achieved.

8.8.3.2 Relationship to Other Sustainability Indicators

As discussed above, the groundwater storage minimum thresholds are set at a level consistent with groundwater elevation and seawater intrusion minimum thresholds, which are also consistent with other sustainability indicators, as described in Sections 8.7.3.3 and 8.9.3.2.

8.8.3.3 Effects of Minimum Threshold between Management Areas

The minimum thresholds for each management area have been developed in a coordinated manner through discussions within the Subbasin Technical Committee. Because the minimum thresholds in each management area are defined similarly based on groundwater elevation and seawater intrusion minimum thresholds, they will not cause undesirable results in the other management area.

8.8.3.4 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north;
- The Seaside Subbasin to the south

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of the minimum thresholds and measurable objectives within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. Because the minimum thresholds in both the Monterey Subbasin and 180/400-Foot Aquifer Subbasin have been developed by the same GSAs in a coordinated fashion, the minimum thresholds do not conflict with each other.

The Seaside Subbasin is an adjudicated basin and not subject to the Sustainable Groundwater Management Act's minimum threshold requirements. Because the minimum thresholds are set to avoid dropping below recent levels of storage, it is likely that the minimum thresholds will not prevent the Seaside Subbasin from meeting its adjudication requirements. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements.

8.8.3.5 Effect on Beneficial Uses and Users

Because the groundwater storage minimum thresholds are defined based on groundwater elevation and seawater intrusion minimum thresholds, the effects of groundwater storage minimum threshold on beneficial uses and users are similar to those described in Sections 8.7.3.6 and 8.9.3.4.

8.8.3.6 Relation to State, Federal, or Local Standards

No federal, state, or local standards exist for reductions in groundwater storage.

8.8.3.7 Method for Quantitative Measurement of Minimum Threshold

Because the groundwater elevation and seawater intrusion minimum thresholds will be used as a proxy for reduction of groundwater storage, the measurement of change in groundwater storage will be measured directly from the groundwater elevation and seawater intrusion monitoring networks described in Chapter 7.

8.8.4 Measurable Objectives

Because the close relationship between the reduction of groundwater storage and the chronic lowering of groundwater level and seawater intrusion sustainability indicators, the groundwater elevation and seawater intrusion measurable objectives serve as proxies for reduction of groundwater storage.

8.8.4.1 Method for Setting Measurable Objectives

This methodology is designed to represent groundwater in storage when groundwater elevations and the seawater intrusion extent are maintained at their respective measurable objectives. As stated above, the measurable objectives for chronic lowering of groundwater levels and seawater intrusion provide an adequate margin of operational flexibility.

8.8.4.2 Interim Milestones

The groundwater elevation and seawater intrusion interim milestones described respectively in Table 8-3 and Section 8.9.4.2 will serve as a proxy for reduction of groundwater storage.

8.9 Seawater Intrusion SMC

8.9.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable seawater intrusion in the Subbasin is defined as follows:

- Expansion of the 2015 seawater intruded area in the Subbasin, identified based upon the 500 mg/L chloride concentration isocontour.

The seawater intrusion SMCs apply to the whole Subbasin, as shown in Figure 8-13 and Figure 8-14.

These significant and unreasonable conditions were determined based on input collected during MCWD stakeholder meetings, SVBGSA Subbasin Committee meetings, and discussions with GSA staff during Subbasin Technical Committee meetings.

8.9.2 Undesirable Results

8.9.2.1 Criteria for Defining Seawater Intrusion Undesirable Results

The seawater intrusion undesirable result is a quantitative combination of chloride concentrations minimum threshold exceedances. As discussed below, there is one minimum threshold for each of the four principal aquifers within the Marina-Ord Area and Reservation Road portion of the Corral de Tierra Area where the hydrogeologic setting is the same as the Marina-Ord Area. Because even localized expansion of the seawater intrusion front is not acceptable, the undesirable result of seawater intrusion is:

Any exceedance of the minimum threshold is considered as an undesirable result.

This undesirable result may be modified as the projects and actions to address seawater intrusion are refined during implementation of this GSP.

8.9.2.2 Potential Causes of Undesirable Results

Conditions that may lead to an undesirable result for seawater intrusion include the following:

- **Decreases in groundwater levels near the coast in Monterey Subbasin and/or adjacent coastal subbasins (the adjudicated Seaside Subbasin and 180/400-Foot Aquifer Subbasin).** Decreases in groundwater levels near the coast could lead to further migration of seawater inland into the Monterey Subbasin.
- **Sea level rise**. Increase in sea level increases the driving force for seawater intrusion and can lead to further migration of seawater inland.

8.9.2.3 Effects on Beneficial Users and Land Use

The primary detrimental effect on beneficial users and land uses from allowing seawater intrusion to continue or occur in the future is that the pumped groundwater may become saltier and thus impact groundwater supply wells (i.e., MCWD production wells or agricultural wells) and associated land uses. This may force production wells to move to further inland or to deeper aquifers, which will cause increased groundwater production costs, and reduce water supply reliability.

Allowing seawater intrusion to continue or occur in the future may also impact agriculture. Chloride moves readily within soil and water and is taken up by the roots of plants. It is then transported to the stems and leaves. Sensitive berry rootstocks can tolerate only up to 120 mg/L of chloride, while grapes can tolerate up to 700 mg/L or more (University of California Agriculture and Natural Resources, 2002).

Limiting seawater intrusion will benefit groundwater users because it will protect groundwater production wells within the Marina-Ord Area and Reservation Road portion of the Corral de Tierra Area, and maintain adequate storage in the Subbasin. However, limitations on groundwater extraction and/or development of alternative water supplies may be required to achieve minimum thresholds, which will cause increased water production costs or a reduction in water supplies.

8.9.3 Minimum Thresholds

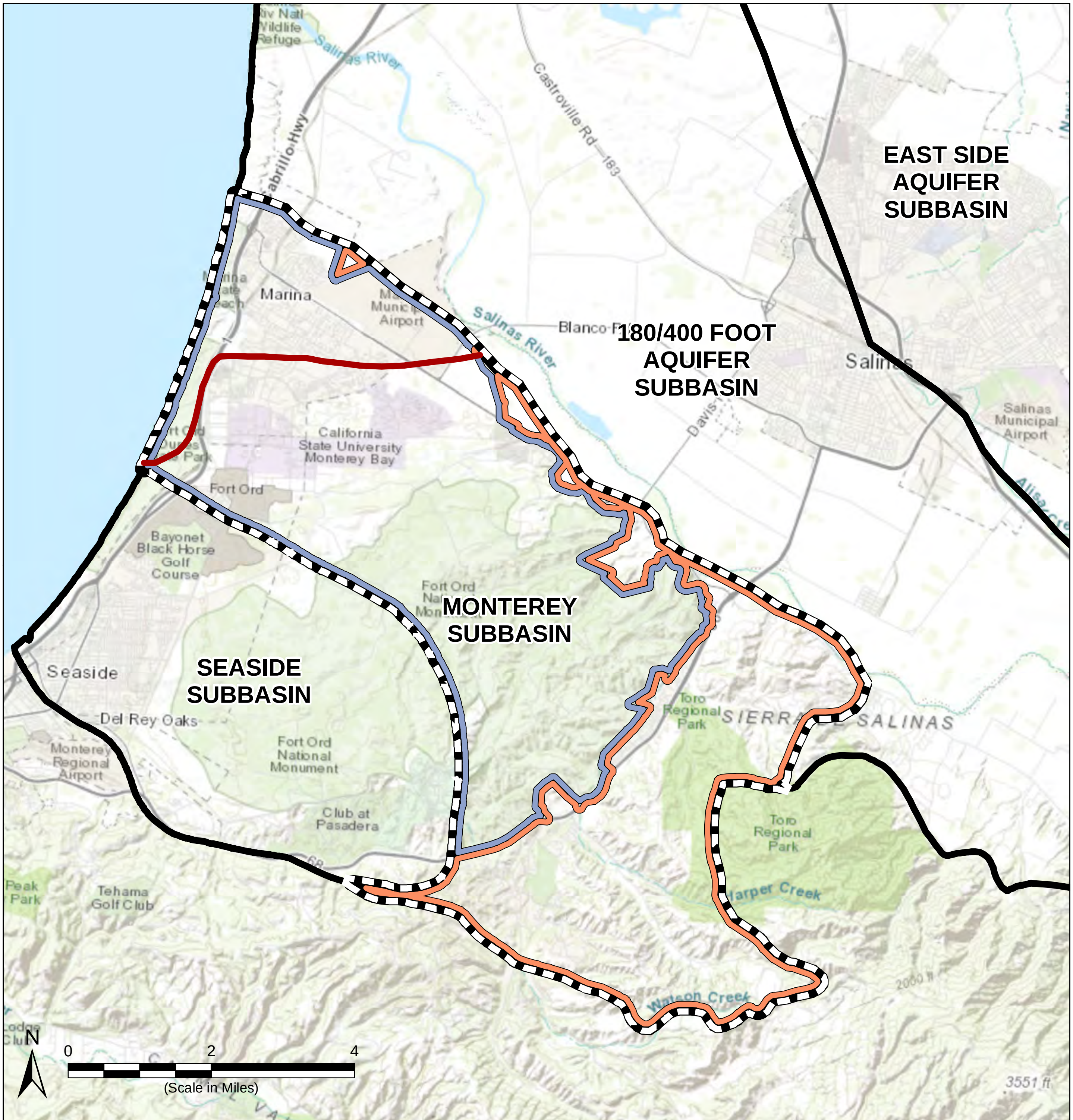
Pursuant to GSP Emergency Regulations §354.28, the seawater intrusion minimum threshold is defined by a chloride concentration isocontour for each principal aquifer.

Because further expansion of the seawater intruded area is significant and unreasonable, the seawater intrusion minimum threshold is defined as:

> *The approximate location in 2015 of the 500 mg/L chloride concentration isocontour in the lower 180-Foot and 400-Foot Aquifers;*
>
> *Approximately 3,500 feet from the coast in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers. This distance is generally consistent with the location of Highway 1 in the Monterey Subbasin and seaward of groundwater extraction in the Subbasin.*

The approximate line of Highway 1 is determined as the seawater intrusion minimum threshold in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers, as there is very limited seawater intrusion observed in these aquifers currently. The intent of this is minimum threshold is to limit seawater from intruding into these aquifers. Such seawater intrusion could occur from the ocean and/or through vertical migrations from underlying or overlying aquifers which are currently seawater intruded.

Figure 8-13 presents the minimum threshold for seawater intrusion in the lower 180-Foot and 400-Foot Aquifers. Figure 8-14 presents the minimum threshold for seawater intrusion in the Dune Sand, upper 180-Foot, and Deep Aquifers.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Minimum Thresholds Boundary

Management Areas

- Marina-Ord
- Corral de Tierra

Notes

1. All locations are approximate.
2. The minimum thresholds for seawater intrusion in the Lower 180-Foot and 400-Foot Aquifers are set at the current seawater intrusion boundaries.

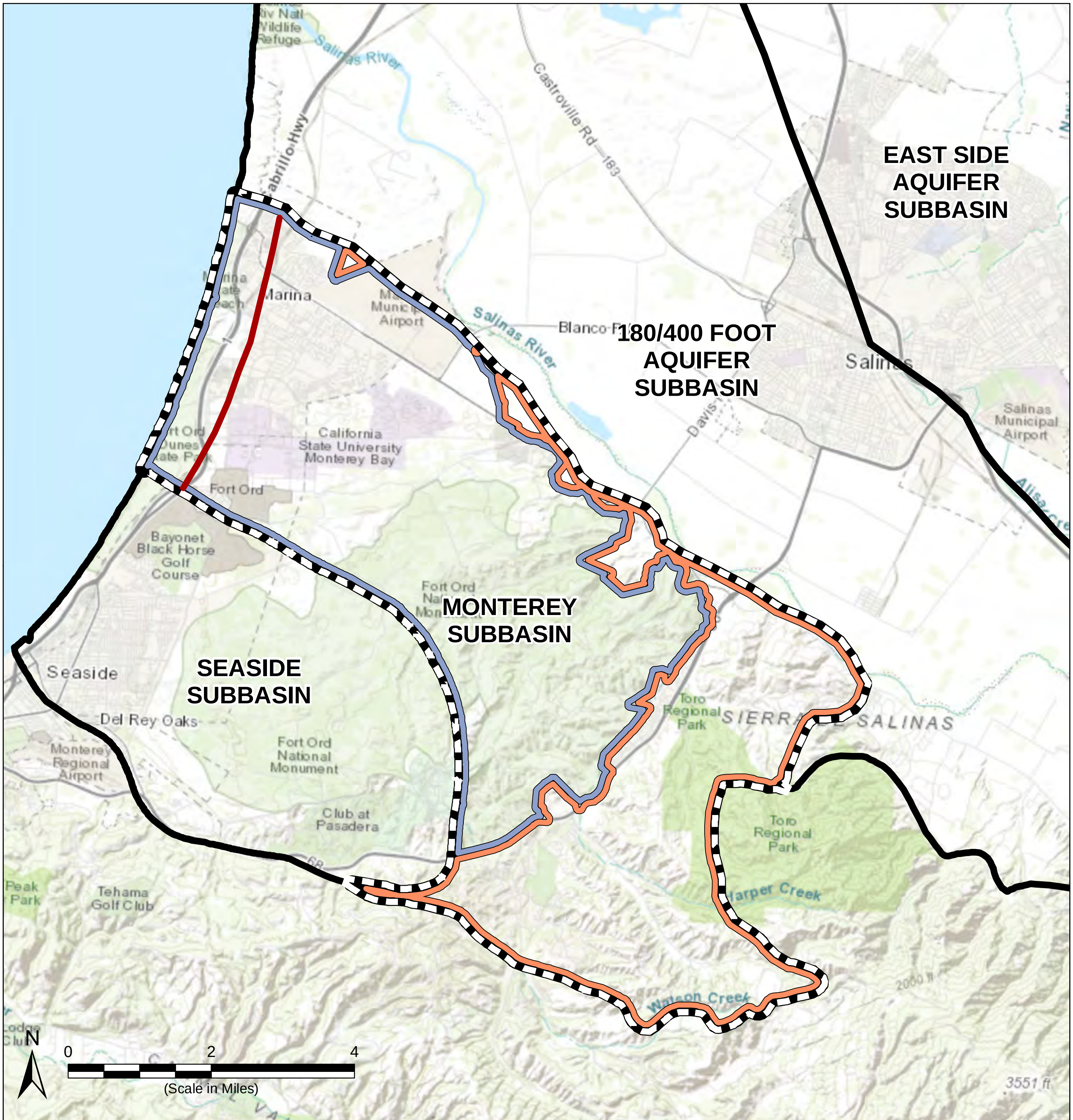
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021

Minimum Thresholds for Seawater Intrusion in the Lower 180-Foot and 400-Foot Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-13



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Management

Marina-Ord

Corral de Tierra

Minimum Thresholds

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021

Notes

1. All locations are approximate.
2. The minimum thresholds for seawater intrusion in the Dune Sand, Upper 180-Foot and Deep Aquifers are set at Highway 1.

Minimum Thresholds for Seawater Intrusion in the Dune Sand, Upper 180-Foot and Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-14

Path: X:\B60094\Maps\2021\09\Fig8-14_SWI_Deep.mxd

8.9.3.1 *Information and Methodology Used to Establish Minimum Thresholds and Measurable Objectives*

Consistent with GSP Emergency Regulations §354.28 (c), the definition of minimum thresholds for seawater intrusion is based on maps and cross-sections of the chloride concentration isocontour and how minimum thresholds will be affected by current and projected sea levels.

The seawater intrusion minimum thresholds are developed based on seawater intrusion maps and cross-sections included in Chapter 5 of this GSP. The maps identify the extent of seawater intrusion as the estimated location of the 500 mg/L chloride concentration isocontour line. The maps are developed through analysis of TDS and chloride measurements collected from monitoring wells near the coast, geophysical data, and the hydrogeological setting.

8.9.3.2 *Relationship to Other Sustainability Indicators*

As discussed above, minimum thresholds for seawater intrusion have been considered in the development of SMCs for related sustainability indicators including:

- groundwater level elevations SMCs, and
- depletion of groundwater storage SMCs.

Seawater intrusion is the primary driver used to set SMCs for these other sustainability indicators, which are also consistent with minimum thresholds established for:

- depletion of interconnected surface waters in wells proximate to such areas, and
- subsidence, as they are set above historical groundwater levels.

No conflict exists between seawater intrusion and degraded groundwater quality SMCs, beyond that caused by seawater intrusion itself, which increases chloride, sodium and TDS concentrations in groundwater wells (e.g., chloride, TDS).

8.9.3.3 *Effect of Minimum Threshold on Neighboring Basins and Subbasin*

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north;
- The Seaside Subbasin to the south

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of the minimum thresholds and measurable objectives within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. Minimum thresholds for seawater intrusion are established consistent with the 180/400-Foot Aquifer Subbasin GSP.

The Seaside Subbasin is an adjudicated basin and not subject to SGMA. Because the minimum thresholds in the Monterey Subbasin are established to prevent expansion of the seawater intruded area in the Subbasin, it is likely that the minimum thresholds will not prevent the Seaside Subbasin from meeting its adjudication requirements. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements.

8.9.3.4 Effects on Beneficial Users and Land Uses

Urban land uses and users. The seawater intrusion minimum thresholds will prevent high salinity levels from impacting the water supply of urban land uses and users, along with agricultural uses and users. However, the seawater intrusion minimum threshold may (a) reduce the amount of allowable groundwater pumping within the Subbasin, or (b) require implementation of local or regional projects and/or management actions to augment existing water supplies within the Subbasin. This may result in higher water costs for water users.

Agricultural land uses and users. The seawater intrusion minimum thresholds generally provide positive benefits to the Subbasin's agricultural water users. Preventing additional seawater intrusion ensures that a supply of usable groundwater will exist for beneficial agricultural use.

On-farm domestic land uses and users. There are no known on-farm domestic groundwater users in the Marina-Ord Area, where SMCs are developed for seawater intrusion.

Ecological land uses and users. Although the seawater intrusion minimum threshold does not directly benefit ecological uses, it can be inferred that the seawater intrusion minimum thresholds generally provide positive benefits to the Subbasin's ecological water uses. Preventing seawater intrusion into the Subbasin will help prevent unwanted high salinity levels from impacting ecological groundwater uses.

8.9.3.5 Relevant Federal, State, or Local Standards

No federal, state, or local standards exist for seawater intrusion.

8.9.3.6 Method for Quantitative Measurement of Minimum Threshold

Chloride concentrations are measured in groundwater samples collected from the seawater intrusion monitoring network identified in Chapter 7. These samples are used to develop the approximate location of the 500 mg/L chloride isocontour. The methodology and protocols for collecting samples and developing the 500 mg/L concentration isocontour are detailed in Appendix 7-C through Appendix 7-E.

8.9.4 Measurable Objectives

In the Monterey Subbasin, the measurable objectives for the seawater intrusion are the same as the minimum thresholds:

> *The approximate location in 2015 of the 500 mg/L chloride concentration isocontour in the lower 180-Foot and 400-Foot Aquifers;*

> *Approximately 3,500 feet from the coast in the Dune Sand Aquifer, upper 180-Foot Aquifer and Deep Aquifers. This distance is generally consistent with the location of Highway 1 in the Monterey Subbasin and seaward of groundwater extraction wells in the Subbasin.*

8.9.4.1 Method for Setting Measurable Objectives

As described above, measurable objectives are set to be identical to the minimum thresholds for the respective principal aquifers and therefore follow the same method as detailed in Section 8.9.3.1.

8.9.4.2 Interim Milestones

The interim milestones for seawater intrusion are the same as the measurable objective.

8.10 Degraded Water Quality SMC

8.10.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable changes in groundwater quality resulting from direct GSA action in the Subbasin are increases in a chemical constituent that either:

- Increase in number of potable supply wells in which concentrations of constituents of concern exceed Title 22 California Code of Regulations (Title 22) drinking water standards (i.e., maximum contaminant levels (MCLs) or secondary maximum contaminant levels (SMCLs), or
- Increase in the number of agricultural supply wells in which constituents of concern exceed concentrations that may lead to reduced crop production.

These significant and unreasonable conditions were determined based on input collected during MCWD stakeholder meetings, SVBGSA Subbasin Committee meetings, and discussions with GSA staff during Subbasin Technical Committee meetings.

8.10.2 Undesirable Results

8.10.2.1 Criteria for Defining Undesirable Results

The degradation of groundwater quality becomes an undesirable result when a quantitative combination of groundwater quality minimum thresholds is exceeded. For the Subbasin, the exceedance of minimum thresholds is unacceptable as a direct result of GSP implementation. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities, nor GSA management, they do not constitute an undesirable result. Additionally, SGMA states that GSAs are not responsible for addressing water quality degradation that was present before January 1, 2015 (California Water

Code §10727.2(b)(4)). Therefore, the degradation of groundwater quality reaches an undesirable result when:

> *Future or new minimum thresholds exceedances are caused by a direct result of GSA groundwater management action(s), including projects or management actions and regulation of groundwater extraction.*

The groundwater level SMC is designed and intended to help protect groundwater quality. Setting the groundwater level minimum thresholds at or above historical lows assures that no new depth dependent constituents of water quality concern are mobilized. The GSAs may pursue projects or management actions to ensure that groundwater levels do not fall below groundwater levels minimum thresholds.

This undesirable result recognizes there is an existing regulatory framework in the form of the California Porter Cologne Act and the federal Clean Water Act that addresses water quality management; and considers existing federal, state, and local groundwater quality standards, which were used in the development of minimum thresholds in the GSP. The GSAs are not responsible for enforcing drinking water requirements or for remediating violations of those requirements that were caused by others (Moran and Belin, 2019). The existing regulatory regime does not require nor obligate the SVBGSA or MCWD GSA to take any affirmative actions to manage or control existing groundwater quality. However, SVBGSA and MCWD GSA are committed to monitoring and disclosing changes in groundwater quality and ensuring its groundwater management actions do not cause drinking water or irrigation water to be unusable.

SVBGSA and MCWD GSA will work closely with the Central Coast Regional Water Quality Control Board and other entities that have regulatory authority over water quality. SVBGSA will lead the Water Quality Coordination Group, as described in Chapter 9, which includes meeting annually with these partner agencies to review the status of water quality data and discuss any action needed to address water quality degradation.

If the GSAs have not implemented any groundwater management actions in the Subbasin, including projects, management actions, or pumping management, no such management actions constitute an undesirable result. If minimum thresholds are exceeded after the GSAs have implemented actions in the Subbasin, the GSAs will review groundwater quality and groundwater gradients in and around the project areas to assess if the exceedance resulted from GSAs actions to address sustainability indicators, or was independent of GSAs activities. Both the implementation of actions and assessment of exceedances will occur throughout the GSP timeframe of 50 years as required by SGMA. The general approach to assess if a minimum threshold exceedance is due to GSAs action will include:

- If no projects, management actions, or other GSP implementation actions have been initiated in a subbasin, or near the groundwater quality impact, then the impact was not caused by any GSAs action.

- Many projects will likely include a new monitoring network. If data from the project-specific monitoring network do not show groundwater quality impacts, this will suggest that the impact was not caused by any GSAs actions.
- If a GSA undertakes a project that changes groundwater gradients, moves existing constituents, or results in the exceedance of minimum thresholds, SVBGSA and MCWD GSA will undertake a more rigorous technical study to assess local, historical groundwater quality distributions, and the impact of the GSAs activity on that distribution.

For SGMA compliance, undesirable results for groundwater quality are not caused by (1) lack of action; (2) GSA required reductions in pumping; (3) exceedances in groundwater quality minimum thresholds that occur, if there are fewer exceedances than if there had been a lack of management; (4) exceedances in groundwater quality minimum thresholds that would have occurred independent of projects or management actions implemented by the GSAs; (5) past harm.

In the Corral de Tierra Area specifically, arsenic is a naturally occurring constituent. Elevated arsenic levels in drinking water are a concern for local stakeholders, especially if they relate to declining groundwater elevations. Currently, there is not sufficient data that shows a relationship between declining groundwater elevations and elevated arsenic levels. During GSP implementation, SVBGSA will work to collect and analyze data to better understand if such a relationship exists described further in Chapter 9.

8.10.2.2 Potential Causes of Undesirable Results

As shown in Chapter 5, the known groundwater quality issues within the Marina-Ord Area are caused by legacy Fort Ord contamination. To date, no constituents of concern are detected above drinking water standards in any Marina-Ord Area groundwater supply wells (i.e., MCWD production wells). The U.S. Army is responsible for remediation of groundwater contamination associated with historical releases at the former Army base. This remediation is being conducted under the oversight of the US Armed Forces, US EPA, and the CCRWQCB.

High arsenic concentrations are known to occur within the El Toro Primary Aquifer System within the Corral de Tierra Area; these concentrations are naturally occurring. There is also no clear correlation that can be established between groundwater levels and groundwater quality at this time.

The potential for harming water quality will be considered in the process to select projects and management actions. If needed, additional project-specific groundwater quality monitoring networks may be established to ensure projects do not harm water quality. Conditions that may lead to an undesirable result in the Marina-Ord-Area or the Corral de Tierra Area include the following:

- **Required Changes to Subbasin Pumping**. If the location and rates of groundwater pumping change as a result of projects implemented under the GSP, these changes could alter hydraulic gradients and associated flow directions, and cause movement of constituents of concern towards a supply well at concentrations that exceed relevant standards. However, as noted above, quality changes from GSA-required reductions in pumping do not constitute an undesirable result.
- **Groundwater Recharge**. Active recharge of imported water or captured runoff could modify groundwater gradients and move constituents of concern towards a supply well in concentrations that exceed relevant limits.
- **Recharge of Poor-Quality Water**. Recharging the Subbasin with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result.

County Ordinance No. 04011 (see Section 3.4) restricts well construction in areas that may interfere with contamination plumes at the former Fort Ord. Therefore, the potential for GSP projects to impact legacy contamination at Fort Ord within the Marina-Ord Area is unlikely.

8.10.2.3 Effects on Beneficial Users and Land Use

Avoiding groundwater quality degradation at potable and agricultural wells due to actions directly resulting from GSP implementation will positively affect beneficial users as it will limit the need for potential groundwater treatment. However, this SMC will limit implementation of selected projects and in the vicinity of Fort Ord until legacy contaminants have been remediated. Remediation of legacy Ford Ord contamination is required pursuant to the Records of Decision, entered into by the Army and overseeing regulatory agencies.

8.10.3 Minimum Thresholds

The minimum threshold for degraded water quality (“water quality minimum threshold”) for the Monterey Subbasin is defined as:

> *No additional exceedances of Title 22 drinking water standards in potable supply wells or Basin Plan water quality objectives in agricultural supply wells as a result of GSP implementation.*

Minimum thresholds for DDW public water system supply wells and ILRP on-farm domestic wells are based on Title 22 drinking water standards (i.e., MCLs and SMCLs). Minimum thresholds for agricultural supply wells are based on the water quality objectives listed in the Basin Plan (CCRWQCB, 2019) (Agricultural Water Quality Objectives). These drinking water and agricultural water quality criteria are jointly defined herein as “Regulatory Water Quality Standards”. The minimum threshold values for constituents of concern identified for each management area are provided in Table 8-5. The selection criteria for constituents of concern are detailed in Section 8.10.3.1.

Because the minimum thresholds reflect no additional exceedances of Regulatory Water Quality Standards, the minimum thresholds are set to the number of existing exceedances. Surpassing the number of existing exceedances of Regulatory Water Quality Standards for any of the listed constituents as a result of GSP implementation will lead to an undesirable result. There are no current exceedances of Title 22 drinking water standards in Marina-Ord Area water supply wells. Additionally, as shown in Table 8-5, no constituents of concern exceed Agricultural Water Quality Objectives in agricultural supply wells in the Corral de Tierra Area. The Subbasin GSAs will continue to monitor water quality in the water quality monitoring network to ensure future exceedances are not due to GSP implementation. Not all wells in the monitoring network are sampled for every constituent of concern.

Table 8-5. Groundwater Quality Minimum Thresholds and Measurable Objectives

Constituent of Concern	Minimum Threshold/ Measurable Objective – Number of Wells Exceeding Regulatory Water Quality Standard (based on most recent sample)
Marina-Ord Area	
DDW Public Water System Supply Wells	
Carbon Tetrachloride	0
Trichloroethane	0
Corral de Tierra Area	
DDW Public Water System Supply Wells	
Arsenic	7
Benzo(a)Pyrene	1
Chromium	2
1,2 Dibromo-3-chloropropane	2
Dinoseb	3
Iron	13
Hexachlorobenzene	1
Manganese	11
Nickel	1
Specific Conductance	2
1,2,3-Trichloropropane	1
Total Dissolved Solids	2
Vinyl Chloride	3
Zinc	1
ILRP On-Farm Domestic Wells	
Total Dissolved Solids	1

8.10.3.1 Information and Methodology Used to Establish Water Quality Minimum Thresholds and Measurable Objectives

The powers granted to GSAs to effect sustainable groundwater management under SGMA generally revolve around managing the quantity, location, and timing of groundwater pumping. SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the SWRCB Division of Drinking Water and Monterey County, because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities.

Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur. Constituents of concern must meet two criteria:

1. They must have a Regulatory Water Quality Standard.
2. They must have been detected in groundwater within the Subbasin at levels above the Regulatory Water Quality Standard.

Based on the review of groundwater quality data discussed in Chapter 5, the constituents of concern that exceed Title 22 drinking water standards and may affect drinking water supply wells in the Marina-Ord Area include:

- Trichloroethylene (TCE)
- Carbon Tetrachloride (CT)
- TDS
- Chloride

TCE and CT are being remediated by the Army at the former Fort Ord. Although currently not detected above their respective MCLs within Marina-Ord Area water supply wells, these compounds are identified as constituents of concern because they are detected above their respective MCLs in groundwater monitoring wells in the vicinity of water supply wells. TDS and chloride are also detected in groundwater above their respective SMCLs in the Marina-Ord Area primarily as a result of seawater intrusion.

Minimum thresholds are established so that no exceedance of Title 22 drinking water standards for these constituents of concern in water supply wells occur as a result of GSP implementation.

Other constituents and associated beneficial uses within the Marina-Ord Area are managed through existing management and regulatory programs under the U.S. Army, CCRWQCB, and SWRCB. New projects and management actions that could impact groundwater quality will require associated monitoring and permitting by the SWRCB and RWQCB.

There are no domestic or agricultural wells within the Marina Ord-Area. However, there is one ILRP on-farm domestic well with a TDS concentration that exceeded Title 22 drinking water standards between 2013-2019 in the Reservation Road portion of the Corral de Tierra Area, which is in the same hydrogeologic setting as the Marina-Ord Area. There were no exceedances of Agricultural Water Quality Objectives in ILRP irrigation wells in this area.

Based on the review of groundwater quality in Chapter 5 the constituents of concern (COCs) that may affect drinking water supply wells in the Corral de Tierra Area include (Table 8-5):

- Arsenic
- Benzo(a)Pyrene
- Chromium

- 1,2 Dibromo-3-chloropropane
- Dinoseb
- Iron
- Hexachlorobenzene
- Manganese
- Nickel
- Specific Conductance
- 1,2,3-Trichloropropane
- Total Dissolved Solids
- Vinyl Chloride
- Zinc

As discussed in Chapter 7, wells for three separate water quality monitoring networks were reviewed and used for developing SMCs:

- Public water system supply wells regulated by the SWRCB Division of Drinking Water.
- On-Farm Domestic wells monitored as part of ILRP. This dataset was obtained from the SWRCB through the GeoTracker GAMA online portal. The ILRP data were separated into two data sets, one for domestic wells and the other for agricultural wells (discussed below) for purposes of developing initial draft minimum thresholds and measurable objectives for each type of well. The monitoring well network for the ILRP will change in 2020 once monitoring is established and results are published under Ag Order 4.0. At that time, the new ILRP on-farm domestic monitoring network will be incorporated into this GSP, replacing the current network, for water quality monitoring.
- Irrigation supply wells monitored as part of ILRP. As mentioned above, this dataset was obtained from the SWRCB through the GeoTracker GAMA online portal. Like the on-farm domestic well dataset, the IRLP irrigation monitoring well network will change with the finalization of Ag Order 4.0.

Each of these well networks are monitored for a different set of water quality parameters. Furthermore, some groundwater quality impacts are detrimental to only certain networks. For example, high nitrates are detrimental to public water system supply wells and domestic wells but are not detrimental to agricultural irrigation wells. The constituents monitored in each well network are indicated by an X in Table 8-6. An X does not necessarily indicate that the constituents have been found above the Regulatory Water Quality Standard for that monitoring network.

Table 8-6. Monitored Constituents in Monitoring Well Networks

Constituent	Public Water System Supply	On-Farm Domestic[1]	Agricultural Supply
Chloride	X	X	X
Nitrate + Nitrite (sum as nitrogen)		X	X
Sulfate	X	X	X
Total Dissolved Solids	X	X	X
Nitrite	X	X	
Nitrate (as nitrogen)	X	X	
Specific Conductance	X	X	
Silver	X		
Aluminum	X		
Alachlor	X		
Arsenic	X		
Atrazine	X		
Boron	X		
Barium	X		
Beryllium	X		
Lindane	X		
Di(2-ethylhexyl)phthalate	X		
Bentazon	X		
Benzene	X		
Benzo(a)Pyrene	X		
Toluene	X		
Cadmium	X		
Chlordane	X		
Chlorobenzene	X		
Cyanide	X		
Chromium	X		
Carbofuran	X		
Carbon Tetrachloride	X		
Copper	X		
Dalapon	X		
1,2 Dibromo-3-chloropropane	X		
1,1-Dichloroethane	X		
1,2-Dichloroethane	X		
1,2-Dichlorobenzene	X		
1,4-Dichlorobenzene	X		
1,1-Dichloroethylene	X		
cis-1,2-Dichloroethylene	X		

Constituent	Public Water System Supply	On-Farm Domestic[1]	Agricultural Supply
trans-1,2-Dichloroethylene	X		
Dichloromethane (a.k.a. methylene chloride)	X		
1,2-Dichloropropane	X		
Dinoseb	X		
Diquat	X		
Di(2-ethylhexyl)adipate	X		
Ethylbenzene	X		
Endrin	X		
Fluoride	X		
Trichlorofluoromethane	X		
1,1,2-Trichloro-1,2,2-Trifluoroethane	X		
Iron	X		
Foaming Agents (MBAS)	X		
Glyphosate	X		
Hexachlorocyclopentadiene	X		
Hexachlorobenzene	X		
Heptachlor	X		
Mercury	X		
Manganese	X		
Molinate	X		
Methyl-tert-butyl ether (MTBE)	X		
Methoxychlor	X		
Nickel	X		
Oxamyl	X		
1,1,2,2-Tetrachloroethane	X		
Perchlorate	X		
Polychlorinated Biphenyls	X		
Tetrachloroethene	X		
Pentachlorophenol	X		
Picloram	X		
Antimony	X		
Selenium	X		
2,4,5-TP (Silvex)	X		
Simazine	X		
Styrene	X		
1,1,1-Trichloroethane	X		
1,1,2-Trichloroethane	X		
1,2,4-Trichlorobenzene	X		
Trichloroethene	X		
1,2,3-Trichloropropane	X		

Constituent	Public Water System Supply	On-Farm Domestic[1]	Agricultural Supply
Thiobencarb	X		
Thallium	X		
Toxaphene	X		
Vinyl Chloride	X		
Xylenes	X		
Zinc	X		

[1]Basin plan states domestic wells are monitored for Title 22 constituents; however, GeoTracker GAMA only provides data for the constituents listed above.

8.10.3.2 Relationship to Other Sustainability Indicators

Preventing degradation of groundwater quality may affect other sustainability indicators or may limit activities needed to avoid exceeding minimum thresholds for other sustainability indicators. For example, groundwater quality minimum thresholds could influence the types and locations of projects needed to attain groundwater elevation minimum thresholds and seawater intrusion minimum thresholds by

- limiting the types of water that can be used for recharge to raise groundwater elevations, and
- limiting the locations where such recharge can occur due to legacy Fort Ord contamination.

8.10.3.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The anticipated effect of the degraded groundwater quality minimum thresholds on each of the neighboring subbasins is addressed below.

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north;
- The Seaside Subbasin to the south

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of the minimum thresholds and measurable objectives within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. The groundwater quality minimum threshold defined herein are consistent with the minimum threshold defined in the 180/400-Foot Aquifer Subbasin GSP.

The Seaside Subbasin is an adjudicated basin and not subject to SGMA. Because the minimum threshold in the Monterey Subbasin is no additional exceedance of regulatory standards, it is likely that the minimum thresholds will not prevent the Seaside Subbasin from meeting its adjudication requirements. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements.

8.10.3.4 Effect on Beneficial Uses and Users

Urban land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's urban water users. Preventing any GSA actions that would result in additional drinking water supply wells exceeding MCLs or SMCLs ensures adequate groundwater quality for public water system supplies.

Agricultural land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's agricultural water users. Preventing any GSA actions that would result in additional agricultural supply wells from exceeding levels that could reduce crop production ensures that a supply of usable groundwater will exist for beneficial agricultural use.

Domestic land uses and users. The groundwater quality minimum thresholds generally provide positive benefits to the Subbasin's domestic water users. Preventing any GSA actions that would result in constituents of concern in additional drinking water supply wells from exceeding MCLs or SMCLs ensures adequate groundwater quality for domestic supplies.

Ecological land uses and users. Although the groundwater quality minimum thresholds do not directly benefit ecological uses, it can be inferred that the degradation of groundwater quality minimum thresholds provide generally positive benefits to the Subbasin's ecological water uses. Preventing any GSA actions that would result in constituents of concern from migrating will prevent unwanted contaminants from impacting ecological groundwater uses.

8.10.3.5 Relation to State, Federal, or Local Standards

The groundwater quality minimum thresholds are set at the Subbasin's water supply wells and specifically incorporate state and federal standards for drinking water.

8.10.3.6 Method for Quantitative Measurement of Minimum Thresholds

Degradation of groundwater quality minimum thresholds will be directly measured from existing public water system supply wells, domestic wells, or agricultural supply wells. Groundwater quality will be measured through existing monitoring programs.

- Exceedances of MCLs and SMCLs in public water system wells will be monitored from annual water quality reports submitted to the California Division of Drinking Water and the County of Monterey.
- Exceedances of MCLs and SMCLs in on-farm domestic wells will be monitored from the ILRP data as discussed in Chapter 7. Exceedances of Agricultural Water Quality Objectives for crop production will be monitored from the ILRP data as discussed in Chapter 7.

Initially, a review of data relative to MCLs, SMCLs, and Agricultural Water Quality Objectives will be centered around the constituents of concern identified above. If during the review of the water quality data additional constituents appear to exceed MCLs, SMCLs, or Agricultural Water Quality Objectives minimum thresholds and measurable objectives will be developed for these additional constituents.

8.10.4 Measurable Objectives

The measurable objectives for degradation of groundwater quality represent target groundwater quality distributions in the Subbasin. SGMA does not mandate the improvement of groundwater quality. Therefore, measurable objectives have been set to be identical to the minimum thresholds, as defined in Table 8-5.

8.10.4.1 Method for Setting Measurable Objectives

As described above, measurable objectives are set to be identical to the minimum thresholds and therefore follow the same method as detailed in Section 8.10.3.1.

8.10.4.2 Interim Milestones

Interim milestones show how the GSAs anticipate the Subbasin will gradually move from current conditions to meeting the measurable objectives over the next 20 years of implementation. Interim milestones are set for each five-year interval following GSP adoption.

There is no anticipated degradation of groundwater quality during GSP implementation that results from the implementation of projects and actions as described in Chapter 9. Therefore, the expected interim milestones are identical to minimum thresholds and measurable objectives, which represent current conditions.

8.11 Subsidence SMC

8.11.1 Locally Defined Significant and Unreasonable Conditions

Locally defined significant and unreasonable subsidence in the Subbasin is defined as follows:

- Any inelastic land subsidence that is caused by lowering of groundwater elevations occurring in the Subbasin is significant and unreasonable.

Subsidence can be elastic or inelastic. Elastic subsidence is the small, reversible lowering and raising of the ground surface. Inelastic subsidence is generally irreversible. This set of SMCs only concerns inelastic subsidence.

8.11.2 Undesirable Results

8.11.2.1 Criteria for Defining Undesirable Results

By regulation, the ground surface subsidence undesirable result is a quantitative combination of subsidence minimum threshold exceedances. For the Monterey Subbasin, no long-term subsidence is acceptable. Therefore, the ground surface subsidence undesirable result is:

> *Any exceedances of minimum thresholds during any one year due to lowered groundwater elevations is considered as an undesirable result.*

As discussed below, the subsidence minimum thresholds allow for measurement error in the InSAR data of 0.1 foot per year. Should potential subsidence be observed, the Subbasin GSAs will first assess whether the subsidence may be due to elastic subsidence. If the subsidence is not elastic, the GSAs will undertake a program to assess whether the subsidence is caused by lowered groundwater elevations. The first step in the assessment will be to check if groundwater elevations have dropped below historical lows. If groundwater elevations remain above historical lows, the GSAs shall assume that any observed subsidence was not caused by lowered groundwater levels. If groundwater levels have dropped below historical lows, the GSAs will attempt to correlate the observed subsidence with measured groundwater elevations.

8.11.2.2 Potential Causes of Undesirable Results

As shown in Chapter 5, no land subsidence has been observed within the Subbasin. It is unlikely that land subsidence will occur within the Subbasin because of its proximity to the ocean. However, the GSAs have established SMCs for this sustainability indicator and will continue to monitor InSAR data.

8.11.2.3 Effects on Beneficial Users and Land Use

The undesirable result for subsidence does not allow any subsidence to occur in the Subbasin. Therefore, there is no negative effect on any beneficial uses and users.

8.11.3 Minimum Thresholds

The minimum threshold for subsidence is defined as:

> *Zero net long-term subsidence, with no more than 0.1 foot per year of measured vertical displacement between June of one year and June of the subsequent year to account for InSAR measurement errors.*

8.11.3.1 Information Used and Methodology for Establishing Subsidence Minimum Thresholds

The minimum threshold was established using InSAR data available from DWR. The minimum threshold is no long-term irreversible subsidence in the Subbasin. The InSAR data provided by DWR, however, is subject to measurement error. DWR stated that, on a statewide level, for the total vertical displacement measurements between June 2015 and June 2019, the errors are as follows (Brezing, personal communication):

1. The error between InSAR data and continuous GPS data is 16 mm (0.052 feet) with a 95% confidence level.
2. The measurement accuracy when converting from the raw InSAR data to the maps provided by DWR is 0.048 feet with a 95% confidence level.

By adding errors 1 and 2, the combined error is 0.1 foot. While this methodology is not a robust statistical analysis, it does provide an estimate of the potential error in the InSAR maps provided by DWR.

Additionally, the InSAR data provided by DWR reflects both elastic and inelastic subsidence. While it is difficult to compensate for elastic subsidence, visual inspection of monthly changes in ground elevations suggests that elastic subsidence is largely seasonal. To minimize the influence of elastic subsidence on the assessment of long-term, permanent subsidence, changes in ground level will only be measured annually from June of one year to June of the following year.

8.11.3.2 Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators

The subsidence minimum threshold has little or no impact on other minimum thresholds as there has been no observed subsidence observed to date. Therefore, the SMCs for subsidence should not trigger greater extraction or the implementation of any projects and/or management actions in the Subbasin which could affect other sustainability indicators.

8.11.3.3 Effect of Minimum Thresholds on Neighboring Basins and Subbasins

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north;
- The Seaside Subbasin to the south

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of the minimum thresholds and measurable objectives within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. The land subsidence minimum threshold defined herein is consistent with the minimum threshold defined in the 180/400-Foot Aquifer Subbasin GSP.

The Seaside Subbasin is adjudicated not subject to SGMA. Because the minimum threshold in the Monterey Subbasin is zero subsidence, it is likely that the minimum thresholds will not prevent the Seaside Subbasin from meeting its adjudication requirements. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey

Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements.

8.11.3.4 Effects on Beneficial Uses and Users

The subsidence minimum threshold is set to prevent any long-term inelastic subsidence. Available data indicate that there is currently no long-term subsidence occurring in the Subbasin, and pumping limits are already required by minimum thresholds for other sustainability indicators. Therefore, the subsidence minimum threshold does not require any additional reductions in pumping and there is no negative impact on any beneficial user.

8.11.3.5 Relation to State, Federal, or Local Standards

There are no federal, state, or local regulations related to subsidence.

8.11.3.6 Method for Quantitative Measurement of Minimum Threshold

Minimum thresholds will be assessed using DWR-supplied InSAR data.

8.11.4 Measurable Objectives

The measurable objective for ground surface subsidence represents target subsidence rates in the Subbasin. Because the minimum threshold of zero net long-term subsidence is the best achievable outcome, the measurable objective is identical to the minimum threshold.

8.11.4.1 Method for Setting Measurable Objectives

The measurable objective will be assessed using DWR-supplied InSAR data.

8.11.4.2 Interim Milestones

The subsidence measurable objective is set at zero net long-term subsidence, which is consistent with current conditions. Therefore, there is no change between current conditions and sustainable conditions and interim milestones are identical to current conditions.

8.12 Depletion of Interconnected Surface Water SMC

Areas with interconnected surface water occur where shallow groundwater may be connected to the surface water system. This set of SMCs only applies to locations of potential interconnected surface water, as shown on Figure 5-35 and Figure 5-36.

8.12.1 Locally Defined Significant and Unreasonable Conditions

The Monterey Subbasin generally does not have large areas where interconnected surface water occurs. As shown in Chapter 5, four potential locations of interconnected surface water are identified in the Subbasin: the Marina vernal ponds, the lower reaches of El Toro Creek, and two stretches of the Salinas River. The Salinas River supports surface water rights holders and has ecological flow requirements. Additionally, all surface water bodies identified are located within areas of potential groundwater dependent ecosystems (GDEs). Therefore, the management of interconnected surface water within the Monterey Subbasin is also focused on managing groundwater impacts on GDEs.

Locally defined significant and unreasonable depletion of interconnected surface water in the Subbasin is defined as:

- Depletions that would result in an unreasonable impact on other beneficial uses and users of surface water, such as groundwater dependent ecosystems.

These significant and unreasonable conditions were determined based on input collected during MCWD stakeholder meetings, SVBGSA Subbasin Committee meetings, and discussions with GSA staff during Subbasin Technical Committee meetings.

8.12.2 Undesirable Results

8.12.2.1 Criteria for Defining Undesirable Results

By regulation, the depletion of interconnected surface water undesirable result is a quantitative combination of minimum threshold exceedances. Shallow groundwater elevations near the locations of potentially interconnected surface water will be used as a proxy for minimum thresholds and measurable objectives. Since there is likely to be a limited number of shallow groundwater wells by each location of interconnected surface water, more than one minimum threshold exceedance by a location of interconnected surface water would cause an undesirable result.

Therefore, for the Monterey Subbasin, the undesirable result for depletion of interconnected surface water is:

> *Any minimum threshold exceeded in a shallow groundwater well near any location of interconnected surface water for more than two consecutive years.*

The undesirable result is established based on historically observed hydrologic conditions observed between 1995 and 2015 during which period no significant or unreasonable depletion of interconnected surface water had occurred.

Within this subbasin, there are only a few instances of potential ISW: the Marina Ponds, the two locations of the Salinas River, and Lower Toro Creek. Currently, there is no extraction near the Marina Ponds, and thus no cause for concern for extraction-induced depletion. There is uncertainty regarding the connectivity to the principal aquifer in the two areas where the Salinas River dips into the Subbasin, as it may or may not be underlain by the Salinas Valley Aquitard. There is the potential for interconnection along Lower Toro Creek, which is considered a perennial stream, as described in Chapter 4. However, the flows recorded at the USGS gage from 1961 to 2001 indicate flow only occurred in 60% of the years of record. During the other 30% of the time, surface water users saw no flow, as is typical for this creek. Therefore, one year of no flow is not reflective of an undesirable result for this surface water body and the undesirable result consists of two consecutive years of minimum threshold exceedance. Thus, this undesirable result is reasonable and reflective of this Subbasin.

Future climate change and extreme droughts may cause shallow groundwater elevation declines and further depletions of interconnected surface water irrespective of groundwater pumping. The exceedance of minimum thresholds near locations of interconnected surface water due to naturally occurring, extreme drought conditions may not be considered an undesirable result. Additionally, the GSAs will continue to evaluate the effects of future climate change on groundwater conditions and may reevaluate SMCs when more information is available.

8.12.2.2 Potential Causes of Undesirable Results

Depletion of interconnected surface water is generally correlated to chronic lowering of groundwater levels in an interconnected groundwater aquifer system.

Conditions that may lead to an undesirable result for the depletion of interconnected surface waters in the Marina-Ord Area include the following:

- **Potential projects that would create groundwater declines in shallow groundwater.** There is currently no groundwater extraction in the Dune Sand Aquifer or the underlying 180-Foot Aquifer near locations of interconnected surface water within the Marina-Ord Area However, future projects near interconnected surface water bodies within the Monterey Subbasin or adjacent subbasins could reduce shallow groundwater elevations.

Conditions that may lead to an undesirable result for the depletion of interconnected surface waters in the Corral de Tierra Area include the following:

- **Localized pumping increases**. Even if the Subbasin is adequately managed at the Subbasin scale, increases in localized pumping of shallow groundwater near interconnected surface water bodies could reduce shallow groundwater elevations.
- **Expansion of riparian water rights**. Riparian water rights holders often pump from wells adjacent to streams. Pumping by these riparian water rights holder users is not regulated under this GSP. Additional riparian pumpers near interconnected reaches of rivers and streams may result in excessive localized surface water depletion.
- **Departure from the GSP's climatic assumptions, including extensive, unanticipated drought**. Minimum thresholds were established based on anticipated future climatic conditions. Departure from the GSP's climatic assumptions or extensive, unanticipated droughts may lead to excessively low groundwater elevations that increase surface water depletion rates.
- **Changes in Nacimiento and San Antonio Reservoir Releases.** Since the Salinas River is dependent on reservoir releases for sustained summer flows, when diversions are at the highest level, any decrease in reservoir flows during that time could affect interconnected

surface waters by increases in depletions and could cause undesirable results to beneficial users.

8.12.2.3 Effects on Beneficial Users and Land Use

Potential effects of undesirable results of depletion of interconnected surface water in the Marina-Ord Area may include reduced surface water to support GDEs.

Potential effects of undesirable results of depletion of interconnected surface water in the Corral de Tierra may include reduced surface water flows to support downstream or in-stream uses, and to support riparian habitat or associated GDEs.

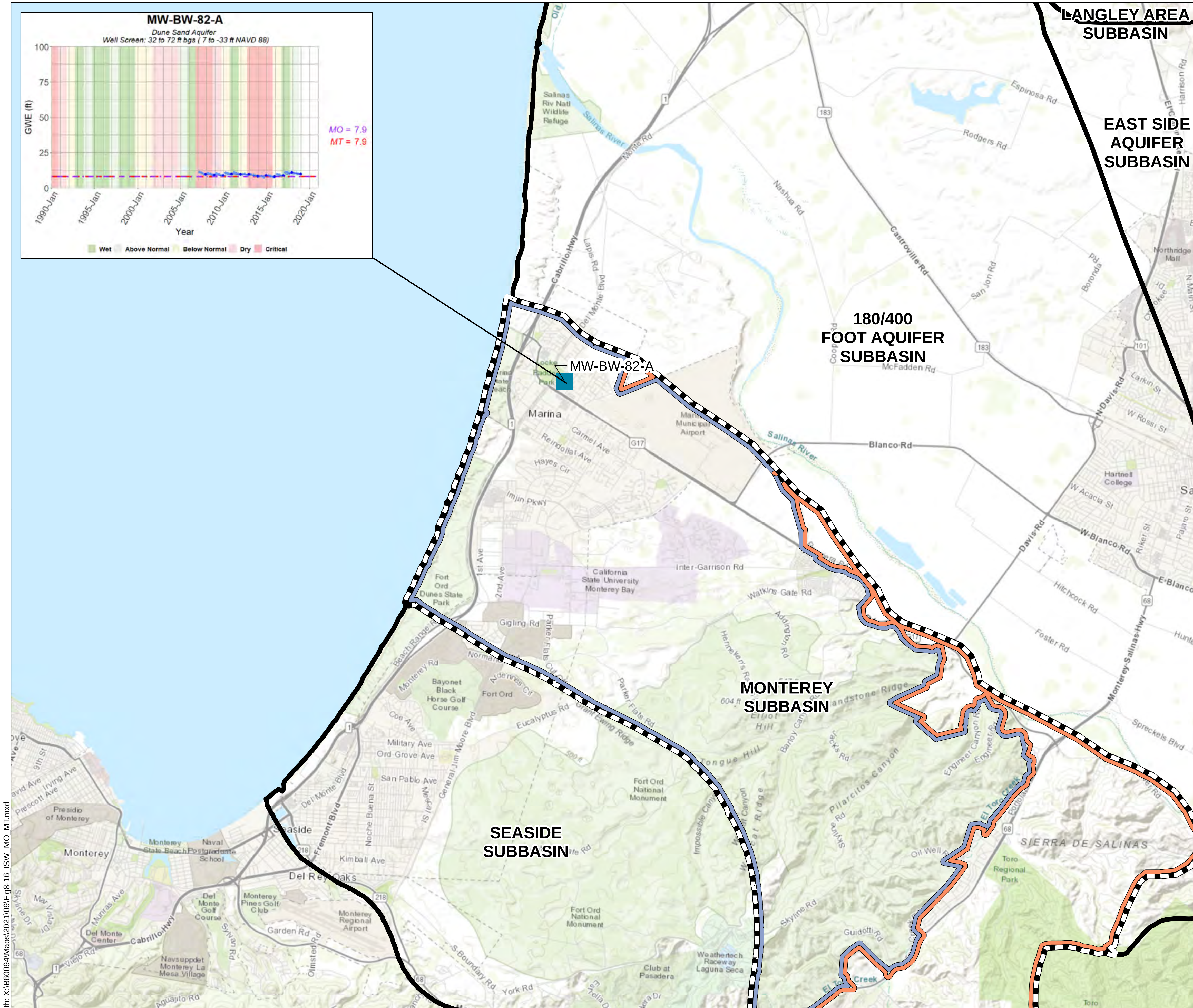
The depletion of interconnected surface water undesirable result is to have no net change in surface water depletion during average hydrologic conditions and over the long-term, as determined by shallow groundwater elevations. Therefore, during average long-term hydrologic conditions, the undesirable result will not have a negative effect on the beneficial users and uses of groundwater. However, pumping of shallow groundwater during dry years could temporarily increase rates of surface water depletions. Therefore, there could be short-term impacts on all beneficial users and uses of the surface water during dry years.

8.12.3 Minimum Thresholds

The minimum threshold for depletion of interconnected surface water is set to:

> *Minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of interconnected surface water.*

Figure 8-15 shows locations of interconnected surface water and shallow groundwater level minimum thresholds established in the Marina-Ord Area. As mentioned in Chapter 7, SVBGSA is planning to install a new interconnected surface water monitoring well in the Corral de Tierra Area along El Toro Creek. SMCs for the new well will be determined using interpolated values from the groundwater elevation contour maps.



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Interconnected Surface Water

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Representative Monitoring Sites

- Selected Fourth Quarter GWE Measurements
- Other GWE Measurements
- MO
- MT

Abbreviations

DWR	= California Department of Water Resources
ft	= foot
GWE	= groundwater elevation
MO	= Measurable Objectives
MT	= Minimum Thresholds
NAVD 88	= North American Vertical Datum of 1988

Notes

1. Selected fourth quarter measurements are measurements closest to December 1st of the year.
2. Groundwater elevations are in ft NAVD 88.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 15 September 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

N 0 1.5 3 (Scale in Miles)

Marina-Ord Area: Interconnected Surface Water Minimum Thresholds and Measurable Objectives

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-15

Path: X:\B60094\Maps\2021\09\Fig8-16_ISW_MO_MT.mxd

8.12.3.1 *Information Used and Methodology for Establishing Depletion of Interconnected Surface Water Minimum Thresholds*

8.12.3.1.1 *Establishing Groundwater Elevations as Proxies*

The GSP Emergency Regulations §354.28(d) states that: "an Agency may establish a representative minimum threshold for groundwater elevation to serve as the value for multiple sustainability indicators, where the Agency can demonstrate that the representative value is a reasonable proxy for multiple individual minimum thresholds as supported by adequate evidence."

The evaluation of ISW in the Salinas Valley Groundwater Basin is based on an approach recommended by the Environmental Defense Fund (EDF, 2018) that uses groundwater elevations as surrogates for streamflow depletion rates caused by groundwater use. Basic hydraulic principles state that groundwater flow is proportional to the difference between groundwater elevations at different locations along a flow path. Using this basic principle, groundwater flow to a stream, or conversely seepage from a stream to the underlying aquifer, is proportional to the difference between water elevation in the stream and groundwater elevations at locations away from the stream. Assuming the elevation in the stream is relatively stable, changes in interconnectivity between the stream and the underlying aquifer are determined by changes in groundwater levels in the aquifer. Thus, the change in hydraulic gradient between stream elevation and surrounding groundwater elevations is representative of change in interconnection between surface water and groundwater. Monitoring the hydraulic gradient in the aquifer adjacent to the stream monitors the interconnectivity between stream and aquifer. Therefore, the gradient can be monitored by measuring and evaluating groundwater elevations at selected shallow monitoring wells near streams. No existing estimations of the quantity and timing of depletions of ISW exist, nor data available to make estimations, so the hydraulic principles provide the best available information.

8.12.3.1.2 *Review of Beneficial Uses and Users of Surface Water*

The various beneficial uses and users of surface waters were addressed when setting interconnected surface water depletion minimum thresholds. The classes of beneficial uses and users that were reviewed include riparian rights holders, appropriative rights holders, ecological surface water users, and recreational surface water users. This evaluation is not a formal analysis of public trust doctrine, but provides a reasonable review of all uses and users in an attempt to balance all interests. This evaluation does not assess what constitutes a reasonable beneficial use under Article X, Section 2 of the California Constitution.

The minimum thresholds for depletion of interconnected surface waters are developed using the definition of significant and unreasonable conditions described above, public information about critical habitat, public information about water rights described below, and the Subbasin water budget analysis.

Riparian water rights holders

There are no active riparian water rights holders within the Subbasin, including riparian water rights holders for the sections of the Salinas River where it enters the Subbasin. The diversion data were obtained from queries of the SWRCB eWRIMS water rights management system.

The SVBGSA is not aware of any current riparian water rights litigation or water rights enforcement acts along the Salinas River in the Subbasin. Therefore, SVBGSA assumes that the current level of depletion has not injured any riparian water rights holders in the Subbasin.

Appropriative water rights holders

There are no appropriative water rights holders within the Subbasin.

Ecological surface water users

Within the Marina-Ord Area, groundwater elevations within the shallow-most aquifer, the Dune Sand Aquifer, have been stable for over two decades. In 2020, the City of Marina determined that the groundwater dependent ecosystems associated with the Marina vernal ponds are in "good condition". Given the stable groundwater patterns in the Dune Sand Aquifer and the good condition of the groundwater dependent ecosystems, there is no significant and unreasonable depletion of interconnected surface water under current conditions.

There are no known flow prescriptions on the El Toro Creek or any tributaries in the Corral de Tierra Area. Therefore, the current level of depletion has not violated any ecological flow requirements. This conclusion is not meant to imply that depletions do not impact potential species living in or near surface water bodies in the Corral de Tierra Area. However, any impacts that may be occurring have not risen to a level that triggers regulatory intervention. Therefore, the impacts from current rates of depletion on ecological surface water users adjacent to the El Toro Creek are not unreasonable.

A review of MCWRA's Nacimiento Dam Operation Policy and MCWRA's water rights indicates MCWRA operates the Dam in a manner that meets downstream Salinas River demands and considers ecological surface water users. Since the reservoir operations consider ecological surface water users and reflect reasonable existing surface water depletion rates, this GSP infers that stream depletion from existing groundwater pumping is not unreasonable. If further river management guidelines are developed to protect ecological surface water users, the SMC in this GSP will be revisited.

Recreational surface water users

No recreational activities such as boating regularly occur on surface water bodies in the Subbasin.

As shown by the analysis above, the current rate of surface water depletion is not having an unreasonable impact on the various surface water uses and other users in the Subbasin. Therefore, the minimum thresholds are set based on historical minimum groundwater elevations observed between 1995 and 2005.

8.12.3.2 <u>Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators</u>

The minimum threshold for depletion of surface water is set near the locations of interconnected surface water above historical and current groundwater elevations. The minimum thresholds reference the same historical years with consideration of fluctuations in aquifers that has steady groundwater elevations over the past two decades. Therefore, no conflict exists between minimum thresholds measured at various locations within the Subbasin.

As discussed above, SMCs for depletion of interconnected surface water minimum threshold are consistent with those established for chronic lowering of groundwater levels, change in groundwater storage, and seawater intrusion SMCs. There is no known relationship between these SMCs and groundwater quality or subsidence.

8.12.3.3 <u>Effect of Minimum Thresholds on Neighboring Basins and Subbasins</u>

The Monterey Subbasin has two neighboring subbasins within the Salinas Valley Groundwater Basin:

- The 180/400-Foot Aquifer Subbasin to the north;
- The Seaside Subbasin to the south

The GSAs coordinating the Monterey Subbasin GSP are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin. The GSAs have been coordinating the development of the minimum thresholds and measurable objectives within the 180/400-Foot Aquifer Subbasin GSP, which was submitted to DWR in January 2020. Because the minimum thresholds in both the Monterey Subbasin and 180/400-Foot Aquifer Subbasin have been developed by the same GSAs in a coordinated fashion, the minimum thresholds do not conflict with each other.

The Seaside Subbasin is an adjudicated basin and not subject to SGMA. Because there are no interconnected surface water bodies that cross the Monterey and the Seaside Subbasin, it is likely that the minimum thresholds will not prevent the Seaside Subbasin from meeting its adjudication requirements. The Subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside Subbasin from meeting its adjudication requirements.

8.12.3.4 <u>Effect on Beneficial Uses and Users</u>

Table 3-9 of the Salinas River Long-Term Management Plan (MCWRA, 2019) includes a list of 18 different designated beneficial uses on certain reaches of the river. In general, the major beneficial uses on the Salinas River are:

- Surface water diversions for agricultural, urban/industrial and domestic supply
- Groundwater pumping from recharged surface water
- Freshwater habitat

- Rare, threatened or endangered species, such as the Steelhead Trout
- CSIP diversions

The depletion of surface water minimum thresholds may have varied effects on beneficial users and land uses in the Subbasin.

Urban land uses and users. The depletion of surface water minimum threshold prevents lowering of shallow groundwater elevations adjacent to groundwater dependent ecosystems and certain parts of streams. This may limit the amount of urban pumping near these areas, which could limit urban growth in these areas and implementation of projects that extract groundwater from these shallow aquifers. Also, if pumping is limited, municipalities may have to obtain alternative sources of water to achieve urban growth goals. If this occurs, this may result in higher water costs for municipal water users.

Domestic land uses and users. The depletion of surface water minimum threshold may benefit existing domestic land users and uses by maintaining shallow groundwater elevations near streams and groundwater dependent ecosystems protecting the operability of relatively shallow domestic wells. However, these minimum thresholds may limit the number of new domestic wells that can be installed near such areas to limit the additional drawdown from the new wells.

Agricultural land uses and users. The depletion of surface water minimum threshold prevents lowering of shallow groundwater elevations adjacent to certain parts of streams and groundwater dependent ecosystems. This has the effect of limiting the amount of groundwater pumping in these areas. Limiting the amount of groundwater pumping may limit the quantity and type of crops that can be grown in these adjacent to streams and rivers.

Ecological land uses and users. The depletion of surface water minimum thresholds likely benefits ecological uses and users by preventing further degradation of ecological impacts from groundwater pumping. Additionally, by setting future groundwater levels at or above recent lows, there should be less impact to GDEs than has been seen to date. Therefore, GDEs are protected from future significant and unreasonable impacts due to low groundwater levels, regardless of the GDE location.

8.12.3.5 Relation to State, Federal, or Local Standards

The minimum thresholds are developed in accordance with NMFS streamflow requirements. There are no NMFS streamflow requirements and known water rights litigation and enforcement complaints for the non-Salinas River surface water bodies within the Monterey Subbasin.

8.12.3.6 Method for Quantitative Measurement of Minimum Threshold

Groundwater elevations measured in shallow wells adjacent to potentially interconnected surface water bodies will serve as the primary approach for monitoring depletion of surface water. The Monterey Subbasin Model will serve as the secondary approach for monitoring depletion of surface water when it becomes available. At a minimum, the model will be updated every 5 years and the amount of surface water depletion that occurred in the previous 5 years will be estimated.

As discussed in Chapter 7, one shallow groundwater well is included in the monitoring network within the Marina-Ord Area. In the event that future groundwater activities in the Subbasin or the adjacent 180/400-Foot Aquifer Subbasin may influence the condition of these vernal ponds, the GSAs will work with project proponents to install additional shallow groundwater monitoring well. New projects or management actions that could impact groundwater conditions near the coastal areas of the City of Marina will require associated permitting by the City of Marina, the County of Monterey, and the California Coastal Commission per land use restrictions discussed in Chapter 3.

No shallow groundwater wells are currently identified in the Corral de Tierra Area. As discussed in Chapter 7, SVBGSA will incorporate one existing shallow well along Toro Creek near the USGS gauge into the interconnected surface water monitoring network and will work with USGS to reactivate the stream gauge along Toro Creek during GSP implementation for conjunctive data collection.

8.12.4 Measurable Objectives

The measurable objective for depletion of interconnected surface water is the same as the minimum threshold.

8.12.4.1 Method for Setting Measurable Objectives

Depletion of interconnected surface water measurable objectives are set at conditions identified with the historical minimum shallow groundwater elevations between 1995 and 2015. Therefore, there is no need to set a measurable objective different than the minimum threshold.

Discussions with GSA staff and stakeholders suggested that stakeholders acknowledge El Toro Creek is the mainstream that drains into the neighboring 180/400-Foot Aquifer Subbasin. The Corral de Tierra Area generally does not have large areas where interconnected surface water potentially occurs; however, further analyses and model results are needed to establish this relationship. Therefore, there is no need to set a measurable objective different than the minimum threshold.

Salinas River flows are meant in part to intentionally recharge the groundwater basin. Therefore, there is no need to set a measurable objective different than the minimum threshold.

8.12.4.2 Interim Milestones

Depletion of interconnected surface water minimum thresholds and measurable objectives are set at conditions identified with the historical minimum shallow groundwater elevations between 1995 and 2015; there is no anticipated increase or decrease in surface water depletion during GSP implementation. The expected interim milestones are identical to the minimum threshold and measurable objectives shown on Figure 8-15. Figure 8-15 shows the identified historical minimum shallow groundwater elevations observed between 1995 and 2015.

9 PROJECTS AND MANAGEMENT ACTIONS

This chapter describes the projects and management actions that will allow the Subbasin to attain sustainability in accordance with §354.42 and §354.44 of the Groundwater Sustainability Plan (GSP) Regulations.

The term "projects" generally refers to activities that require infrastructure or physical changes to the environment to support groundwater sustainability. The term "groundwater management actions" generally refers to activities that support groundwater sustainability without infrastructure.

The Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) and Marina Coast Water District (MCWD) are developing an Implementation Agreement that is anticipated to be adopted before completion of this Groundwater Sustainability Plan (GSP). The Implementation Agreement will address the responsibilities of each agency and identify coordination mechanisms to facilitate GSP implementation, including the filling of data gaps, monitoring, and implementation of projects and management actions identified in the GSP. It is anticipated that MCWD will lead the planning and implementation of projects within the Marina-Ord Area, and that SVBGSA will lead the planning and implementation of projects in the Corral de Tierra Area. Several projects identified in this chapter will require multi-basin coordination and will be facilitated by MCWD, SVBGSA, and other relevant parties.

9.1 Goals and Objectives of Projects and Management Actions

Per the GSP Emergency Regulations, GSPs must include projects and management actions to address any existing or potential future undesirable results for the identified relevant sustainability indicators. Therefore, the goal of the projects and management actions discussed herein is to address significant and unreasonable results related to the relevant sustainability indicators in each management area. As discussed in Chapter 8, existing and potential future undesirable results in the Subbasin are identified for the (1) chronic lowering of groundwater levels sustainability indicator in the Marina-Ord and Corral de Tierra Management Areas, and (2) seawater intrusion sustainability indicator in the Marina-Ord Area. In addition, the reduction of groundwater storage indicator is directly correlated with groundwater elevations and seawater intrusion.

Earlier chapters of this GSP highlighted the hydraulic connection between the Monterey Subbasin and both the adjacent critically overdrafted 180/400-Foot Aquifer Subbasin and Seaside Subbasin. Reaching sustainability and achieving measurable objectives within the Monterey Subbasin will be affected by groundwater conditions and management within these adjacent subbasins and the greater Salinas Valley Basin. Therefore, projects, management actions, and implementation actions will need to be coordinated between subbasins to achieve sustainability. Regional coordination projects and multi-subbasin projects are included when they have the potential to directly benefit this Subbasin. Therefore, the Subbasin Groundwater Sustainability Agencies (GSAs) have developed a California Sustainable Groundwater Management Act (SGMA) implementation approach that includes regional coordination actions, participating in regional, multi-basin projects, in addition to implementing local projects and management actions.

This GSP is developed as part of an integrated effort to achieve groundwater sustainability in all six subbasins of the Salinas Valley. Therefore, the projects and actions included in this GSP are part of a larger set of integrated projects and actions for the entire Valley.

9.1.1 Process for Developing Projects and Management Actions

Projects and management actions presented in this chapter were developed through reviews of publicly available information, gathering feedback during public meetings, conducting hydrogeologic analysis, consulting with MCWD and SVBGSA staff, coordinating through the MCWD/SVBGSA Subbasin Technical Committee and the SVBGSA Monterey Subbasin Planning Committee, and meeting with each GSA's governing body members.

Developing projects and management actions for this GSP involved building on, revising, and adding to the projects and management actions developed for the entire Valley as part of the 180/400-Foot Aquifer Subbasin GSP and other draft 2022 Salinas Valley Basin GSPs. The initial list of projects in the 180/400-Foot Aquifer Subbasin GSP was developed with stakeholder input, including a brainstorming workshop for stakeholders to propose and discuss their ideas. The list of projects and actions were then narrowed down for inclusion in the 180/400-Foot Aquifer Subbasin GSP based on feasibility, likelihood of stakeholder acceptance, and ability to address groundwater conditions.

Building off the previously identified projects, the GSAs undertook an iterative process at the Subbasin level to develop the projects and management actions in this GSP.

Within the Marina-Ord Area, project planning was built on foundational supply planning efforts conducted by MCWD prior to GSP development. A list of local projects for the Marina-Ord Area were developed by consulting with MCWD staff and reviewing prior MCWD feasibility assessments of water supply augmentation and recharge projects. Inclusion of multi-subbasin projects in this GSP was developed through the Subbasin Technical Committee. MCWD and SVBGSA staff assessed multi-subbasin projects included in the 180/400-Foot Aquifer Subbasin GSP and other draft 2022 Salinas Valley Basin GSPs that could potentially provide supply augmentation to the Monterey Subbasin and tailored those projects for this GSP. After the initial list of local and multi-basin projects were developed, the identified projects and management actions were presented during stakeholder workshops, MCWD Board Meetings, and were discussed with stakeholders.

Within the Corral de Tierra Area, an overview of the purpose and types of projects and management actions was presented by SVBGSA to the Subbasin Planning Committee, and initial ideas were solicited. Committee members completed a survey for feedback and further solicitation of ideas. After these ideas were gathered, a list of potential projects and management actions specific to the management area was presented to the Subbasin Committee and discussed.

Special workshops and meetings were held with the purpose of considering pumping reductions. Potential projects and management actions were also discussed in terms of meeting the Sustainable Management Criteria (SMCs) outlined in Chapter 8.

9.1.2 Conditions and Assumptions

The projects and management actions included in this chapter outline a framework for achieving sustainability, however, many details must be negotiated before any of the projects and management actions can be implemented. Project costs will be additional to the agreed-upon funding to sustain the operational costs of Subbasin GSAs, and funding needed for monitoring and reporting.

The projects and management actions are based on existing infrastructure and assume continued operation of that infrastructure at current capacity. If current infrastructure is operated differently or other projects are implemented within the Valley that affect groundwater conditions, the GSAs will adapt their consideration of projects and management actions accordingly.

Discussions and decisions regarding specific projects will continue throughout GSP implementation and be part of the adaptive management of the Subbasin. Members of the GSAs and stakeholders in the Subbasin should view these projects and management actions as a starting point for more detailed discussions. Where appropriate, details that must be agreed upon are identified for each project or management action.

The specific design for implementing management actions and projects will provide individual landowners and public entities flexibility in how they manage water and how the Subbasin achieves groundwater sustainability. Not all projects and management actions necessarily need to be implemented. The GSAs will work collaboratively as detailed in the Implementation Agreement to determine which projects and management actions to implement in order to attain sustainability in the Monterey Subbasin.

9.2 Overview of Projects and Management Actions

354.44 (a)(1) A list of projects and management actions proposed in the Plan with a description of the measurable objective that is expected to benefit from the project or management action. The list shall include projects and management actions that may be utilized to meet interim milestones, the exceedance of minimum thresholds, or where undesirable results have occurred or are imminent.

The projects and management actions for this GSP are summarized in Table 9-1 and include these major categories based on the leading agency and focused area:

- **Multi-subbasin Projects** – Projects that provide supply augmentation to the Monterey Subbasin that require infrastructure or rely on a supply source outside the Monterey Subbasin. These projects are generally identified in multiple Salinas Valley Subbasin GSPs and expand upon how the project would be applied in the Monterey Subbasin.

- **Marina-Ord Area Local Projects and Management Actions** – Projects and management actions to be led by MCWD (or Marina-Ord Area agencies) that will primarily benefit the Marina-Ord Area.
- **Corral de Tierra Area Local Projects and Management Actions** – Projects and management actions to be led by SVBGSA that will primarily benefit the Corral de Tierra Area.

This GSP focuses on the projects that have direct benefits to the Subbasin's water supply or groundwater conditions. However, implementation actions that support GSP implementation in other Salinas Valley subbasins that may benefit the Monterey Subbasin and reduce the need for additional Subbasin specific projects and management actions are also identified in Section 9.5.

Table 9-1. Summary of Projects and Management Actions

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
Multi-basin Projects					
R1	Seasonal Release with ASR and Direct Delivery	Direct delivery to Marina Ord	Release flows from reservoirs during the winter/spring when there's less water loss to the stream channels. Divert these flows and any additional Permit 11043 water available for diversion at the SRDF during winter/spring months. Flows released during winter/spring will be treated and then injected into the 180/400-Foot Aquifer Subbasin for CSIP users' extraction during the peak irrigation season and/or delivered for direct municipal use.	Reduced pumping in the principal aquifers resulting in an in-lieu recharge benefit. Potential direct benefit to Marina Ord/ Monterey Subbasin ranges from **1,600 acre-feet per year (AFY) currently up to 4,500 AFY by 2040** based on existing and projected MCWD winter/spring water demands (6 months).	Multi-subbasin Capital Cost: **$181 million** Unit Cost for 12,900 AFY ASR: **$1,450/ acre-foot (AF)** Unit Cost for 3,600 AFY direct delivery: **$1,100/AF** *(distribution of benefits across subbasins will be determined through a benefits assessment)*
R2	Regional Municipal Supply	Direct delivery to Marina-Ord and Corral de Tierra	Build a regional desalination plant that would treat brackish water extracted from the seawater intrusion barrier and supply drinking water to municipalities in the	Estimated regional production at **15,000 AFY** that will augment groundwater supplies. Portion of this benefiting the Marina-Ord/Monterey Subbasin has yet to be determined.	Multi-subbasin capital cost: **$385 million** Unit cost for 15,000 AFY production: **$2,900/AF** *(capital and unit costs do not include cost of the extraction*

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
			Monterey Subbasin and other subbasins.		*barrier itself, which adds another **$1,200/AF**)*
R3	Multi-benefit Stream Channel Improvements	Direct recharge to Corral de Tierra	Prune native vegetation and remove non-native vegetation, manage sediment, and enhance floodplains for recharge. Includes 3 components: 1. Stream Maintenance Program 2. Invasive Species Eradication 3. Floodplain Enhancement and Recharge	Component 1: Multi-subbasin benefits not quantified Component 2: Multi-subbasin benefit of **2,790 to 20,880 AFY** of increased recharge Component 3: Multi-subbasin benefit of **1,000 AFY** from 10 recharge basins	Component 1 Multi-subbasin Cost: **$150,000** for annual administration and **$95,000** for occasional certification; **$780,000** for the first year of treatment on 650 acres, and **$455,000** for annual retreatment of all acres Component 2 Multi-subbasin Average Cost: **$16,500,000** Unit Cost: **$60 to $600/AF** Component 3 Multi-subbasin Cost: **$11,160,000** Unit Cost: **$930/AF**
Marina-Ord Area Local Projects and Management Actions					
M1	MCWD Demand Management Measures	Management Action	Provides in-lieu recharge through reducing groundwater demands.	Equivalent to a 2,500 AFY in-lieu recharge benefit at the current population.	$350,000 to $450,000 annually
M2	Stormwater Recharge Management	Direct recharge	Existing policies will facilitate and result in additional stormwater catchment and infiltration over time as redevelopment occurs	Under the existing urban development footprint approximately 550 AFY of stormwater is generated and infiltrated west of Highway 1. Groundwater modeling indicates that stormwater recharge catchment and recharge will increase to 1,100 AFY on average as further projected	No additional cost to implement

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
				development occurs which will increase net subbasin infiltration rates by 200 AFY to 500 AFY.	
M3	Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse	Direct and in-lieu recharge	Direct non-potable irrigation use and/or injection of advanced treated water from Monterey One Water (M1W) and extraction using existing MCWD wells or new production wells.	Approximately 2,200 AFY to 5,500 AFY advance treated recycled water available to MCWD based on current and projected wastewater flows.	Investments have already been made to deliver 1,427 AFY for landscape irrigation. Unit cost: **$2,400/AF** Approximately 2,400 AFY recharge through IPR: Capital cost: **$65 million** Unit cost: **$3,300/AF** Costs per AF would likely decrease at higher production capacities due to economies of scale.
M4	Monitoring Well(s)	Data Gaps Filling	Installation of 400-Foot Aquifer and Deep Aquifer monitoring wells near the Seaside Subbasin boundary.	Would fill critical data gaps on hydrostratigraphy, seawater intrusion, and groundwater recharge mechanisms for the 400-Foot Aquifer and Deep Aquifers. It would also provide critical information for the design of recycled water reuse through IPR as described in M3.	Approximately $1,100,000 includes cost of collection of soil cores and performance of hydraulic and geochemical analyses and bench scale pilot testing associated with the recycled water reuse through IPR as described in M3.

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
Corral de Tierra Area Local Projects and Management Actions					
C1	Pumping Allocation and Control	Management Action	Proactively determine how extraction should be fairly divided and controlled	Decreased extraction; range of potential benefits	$500,000 for establishment of pumping allocations and controls
C2	Check Dams	Direct recharge	Construct check dams to slow surface water to increase recharge	On average, 150 AFY of streamflow recharged	Capital Cost: **$5,143,000** Unit Cost: **$2,830/AF**
C3	Recharge from Surface Water Diversions	Direct recharge	Build a diversion facility(ies) that would divert water for recharge when streamflow is high	On average, 160 AFY of excess streamflow available for recharge.	Capital Cost: **$5,950,000** Unit Cost: **$3,050/AF**
C4	Wastewater Recycling for Reuse	In-lieu recharge	Upgrade existing wastewater treatment plant and pipelines to expand beneficial reuse through irrigation and recharge	232 AFY	Capital Cost: **$28,635,000** Unit Cost: **$11,750/AF**, with potential additional cost savings
C5	Decentralized Residential In-Lieu Recharge Projects	In-lieu recharge	Small-scale projects initiated by homeowners and business owners, including rooftop rainwater harvesting, rain gardens, and graywater systems	If 75 households install 5000-gallon rain barrels, up to 5.3 AFY rainwater harvested, and 0.97 AFY from graywater systems installed by 75 houses	Cost to GSA (not for homeowner implementation or incentives): $50,000 for 5 workshops on rainwater harvesting and $50,000 for 5 workshops on graywater reuse
C6	Decentralized Stormwater Recharge Projects	Direct recharge	Medium scale bioswales and recharge basins on non-agricultural land	If 1% of the Subbasin is converted from an area of runoff to an area of recharge, 182 AFY	Cost to GSA (not for implementation or incentives): $150,000 - $200,000 to encourage projects through outreach,

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
					site assessments, and assistance with planning
C7	Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley (Artesian Well)	Direct delivery	Construct extraction well in the Upper Corral de Tierra Valley and pipe water down to Lower Corral de Tierra for direct use by water system in lieu of current extraction.	160 AFY	Capital Cost: **$13,275,000** Unit Cost: **$6,550/AF**
Implementation Actions					
I1	Support Implementation of the 180/400-Foot Aquifer Subbasin GSP and Seaside Watermaster Actions	Implementation Action			Not estimated at this time
I2	Deep Aquifers Investigation	Data Gaps Filling	Support completion of study of the Deep Aquifers to enable better management of groundwater and seawater intrusion.	Increased understanding of Deep Aquifers	$1,000,000[52]
I3	Support Restrictions on Additional Wells	Implementation Action	Collaborate and provide input to Monterey County as it finalizes	Reduce rates of groundwater elevation decline in the Deep Aquifers and prevent potential seawater intrusion	Not estimated at this time

[52] Reflects total multi-basin cost.

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
	in the Deep Aquifers		proposed modifications to the well construction ordinance.		
I4	Adopt 2022/2023 Priority Actions for Deep Aquifers in Absence of New Well Construction Ordinance if Conditions Threaten Sustainability in Near Term	Implementation Action	To be determined (TBD). Priority actions will be developed based on findings reported from the Deep Aquifers study.	Reduce rates of groundwater elevation decline in the Deep Aquifers and prevent potential seawater intrusion	Not estimated at this time
I5	Seawater Intrusion Working Group	Implementation Action	Participate in working group that is pulling together the best available science, data, and understanding of local seawater intrusion causes and potential resolutions.	An agreed-to approach for managing seawater intrusion	$50,000 - $75,000[53] per year
I6	Seawater Intrusion Modeling	Implementation Action	Develop seawater intrusion model for the Monterey Subbasin.	Increased ability to understand impact of potential projects and management actions on seawater intrusion	Not estimated at this time
I7	Incorporate Monterey Subbasin Model into the Salinas	Implementation Action	Refine construction and calibration of the SVIHM in the Monterey Subbasin using inputs developed	Produce an analytical tool that is capable of analyzing benefits and impacts of multi-subbasin projects	Not estimated at this time

[53] Reflects total multi-basin cost.

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
	Valley Integrated Hydrologic Model (SVIHM)		for the Monterey Subbasin Model.		
I7	Well Registration	Implementation Action	Register all production wells, including domestic wells.	Better informed decisions, more management options	Not estimated at this time
I8	Groundwater Extraction Management System (GEMS) Expansion and Enhancement	Data Gaps Filling	Update current GEMS program by collecting groundwater extraction data from wells in areas not currently covered by GEMS and improving data collection.	Better informed decisions	Not estimated at this time
I9	Dry Well Notification System	Implementation Action	Develop a system for well owners to notify the GSA if their wells go dry. Refer those owners to resources to assess and improve their water supplies. Form a working group if concerning patterns emerge.	Support affected well owners with analysis of groundwater elevation decline	Not estimated at this time
I10	Water Quality Coordination Group	Implementation Action	Form a working group for agencies and organizations to collaborate on addressing water quality concerns.	Improve water quality	Not estimated at this time
I11	Land Use Jurisdiction Coordination Program	Implementation Action	Review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially	Join land use planning with water use planning	Not estimated at this time

P/MA #	Name	Project Type / Water Supply	Description	Project Benefits / Quantification of Benefits	Cost
			create risks to groundwater quality or quantity.		
I12	Arsenic Implementation Action	Implementation Action	Provides for additional analysis on the relationship between arsenic and groundwater conditions in the Corral de Tierra Area.	Affirm relationship between groundwater elevations and arsenic in the El Toro Primary Aquifer System.	Not estimated at this time

9.3 General Provisions

This section summarizes general provisions that are applicable to all proposed projects. These general provisions include certain permitting and regulatory processes and public noticing requirements. This section also identifies the methodology used in the GSP to evaluate project benefits and estimate costs. Further project specific details are included within each project description in Section 9.4.

9.3.1 Permitting and Regulatory Processes

Permitting and regulatory requirements vary for the different projects and management actions depending on whether they are infrastructure projects, recharge projects, or demand reduction management actions.

Projects of a magnitude capable of having a demonstrable impact on groundwater within the Monterey Subbasin will require a California Environmental Quality Act (CEQA) environmental review process. Projects will require either an Environmental Impact Report, Negative Declaration, or a Mitigated Negative Declaration. Additionally, any project that coordinates with federal facilities or agencies may require NEPA documentation.

Projects that utilize alternative sources of water to augment groundwater supply may require new permits or changes to existing surface water rights permits (e.g., Permit 11043) administered by the State Water Resources Control Board or by the Central Coast Regional Board regarding stormwater capture or recharge, recycled water use, and waste discharge.

Projects that are related to operations on the Salinas River will require conforming with California Division of Safety of Dams regulations, flow restrictions, and the County's Habitat Conservation Plan (HCP).

There will be a number of local, county and state permits, right of ways, and easements required depending on pipeline alignments, stream crossings, and project type.

Projects with wells will require a Monterey County Department of Health well construction permit.

Specific currently-identified permitting and regulatory requirements for projects and management actions are described in each project description in Section 9.4. Upon implementation, the regulatory and permitting requirements of the project or management action will be re-examined.

9.3.2 Public Noticing

Public notice requirements vary for the different projects and management actions listed above. Some projects that involve infrastructure improvements may not require specific public noticing (other than that related to CEQA and construction). Certain other management actions that involve, for example, imposition of fees by Subbasin GSAs, may require public noticing pursuant to Proposition 218 or Proposition 26. In general, projects and management actions being considered for implementation will be discussed during regular Board Meetings which are open to the public. Additional stakeholder outreach efforts will be conducted prior to and during project implementation, as required by law.

9.3.3 Evaluation of Benefits

The primary expected benefit of projects and management actions identified herein relate to water quantity, e.g., AFY. The way in which a project or management action benefits are evaluated/quantified depends on its type. The following are the major types of projects and management actions that are included herein to supplement the Monterey Subbasin's groundwater supplies:

- Direct recharge through recharge basins or injection/dry wells
- In-lieu recharge through direct delivery of non-potable or potable water to replace groundwater pumping
- Demand management
- Reoperation of reservoir releases to achieve greater or more regular surface water flows available for recharge or direct delivery

For those projects that involve direct recharge or delivery, the benefit is quantified directly through measurement of those flows. For projects that involve indirect recharge or supply augmentation through, for example, reoperation of reservoir releases and delivery flexibility, quantification of the benefit will require a comparison of the observed water supply condition (e.g., total delivered water) against a hypothetical condition where the project was not in place. For management actions that involve water demand reduction, the benefit will be evaluated by comparison of the observed water demand condition (e.g., reported pumping by municipal systems) against a hypothetical condition where the management action was not in place. Because it is not possible to determine with certainty what the condition without the project or management action would be like, quantification of the benefits is inherently uncertain.

The goals and objectives of projects and management actions implementation are not necessary to achieve a certain water budget outcome, but rather to ensure that undesirable results for relevant sustainability indicators are avoided by the end of the SGMA implementation period (i.e., by 2042). For this reason, ultimately the success of the collective implementation of projects and management actions will be determined by whether the SMCs are achieved, which will be monitored through the monitoring networks described in Chapter 7.

9.3.4 Cost assumptions used in developing projects

Assumptions used to develop projects and cost estimates are provided in Appendix 9-A. Assumptions and issues for each project need to be carefully reviewed and revised during the pre-design phase of each project. Project designs, and therefore costs, could change considerably as more information is gathered.

The cost estimates included for each project are order of magnitude estimates. These estimates were made with little to no detailed engineering data. The expected accuracy range for such an estimate is within +50 percent or -30 percent. The cost estimates are based on the GSAs' perception of current conditions at the project location. They reflect our professional opinion of costs at this time and are subject to change as project designs mature.

The capital costs of infrastructure projects include major infrastructure components, such as pipelines, pump stations, customer connections, turnouts, injection wells, recharge basins, and storage tanks. Capital costs also include a 30% contingency for plumbing appurtenances, 15% increase for general conditions, 15% for contractor overhead and profit, and 9.25% for sales tax. Engineering, legal, administrative, and project contingencies were assumed as 30% of the total construction cost and included within the capital cost. Land acquisition at $45,000/acre was also included within capital costs.

Annual operations and maintenance (O&M) fees include the costs to operate and maintain new project infrastructure. O&M costs also include any pumping costs associated with new infrastructure. O&M costs do not include O&M or pumping costs associated with existing infrastructure, such as existing Salinas Valley Reclamation Plant (SVRP) costs, because these are assumed to be part of water purchase costs. Water purchase costs are assumed to include repayment of loans for existing infrastructure; however, these purchase costs will need to be negotiated. The terms of such a negotiation could vary widely.

Capital costs were annualized over 25 years and added with annual O&M costs and water purchase costs to determine an annualized dollar per acre-foot $/AF) cost for each project. The cost per acre-foot is the amortized cost of the project divided by the annual yield. It provides a means to compare projects, however, it is not the cost of irrigation nor the domestic cost of drinking water for households on water systems. More refined cost analyses and future benefit analyses will be completed during GSP implementation.

9.4 Projects Descriptions

The projects and management actions that are planned to reach sustainability were the most reliable, implementable, cost-effective, and acceptable to stakeholders. Descriptions of these project and management actions are included below and are not in order of priority. Generalized costs are also included for planning purposes. Components of these projects and actions may change in future analyses, including facility locations, recharge mechanisms, and other details. Therefore, each of the projects and management actions described in this GSP should be treated as a generalized project representative of a range of potential project configurations. Projects and management actions are to be implemented consistent with the Implementation Agreement between the GSAs.

Multi-subbasin Projects

9.4.1 R1 – Seasonal Releases from Reservoirs

This project entails modifying reservoir releases for the MCWRA's Conservation Program and Salinas River Diversion Facility (SRDF) diversions to maximize annual diversions at the SRDF. Reservoir release water will be diverted at the SRDF during winter/spring, treated at a new water treatment plant, and (1) injected through Aquifer Storage and Recovery (ASR) injection wells when not needed for irrigation, and later extracted during peak irrigation season demands for use through the CSIP system and/or (2) delivered directly to municipalities as supply augmentation. The winter/spring release and storage will reduce or eliminate the need for Conservation Program summer releases for CSIP and increase annual carryover in the reservoirs, allowing for more consistent annual releases. However, a benefits assessment will be prepared to assess different levels of benefits.

Some potential project constraints exist including: clarifying water rights, establishing compliant reservoir operation rules, altering the permit from the Division of Safety of Dams to allow the SRDF diversion structure to operate outside its current window of April-October, and possibly modifying the diversion infrastructure to operating during higher flow events. The SRDF is funded by a Proposition 218 Special Assessment that identified special benefits. This zone of benefit covers the majority of the Monterey Subbasin (see Zone 2C under Section 3.2.2.2). Lands within MCWD have been paying Zones 2, 2A and now 2C assessments since the 1990s. Use of this structure will require additional analysis of rights and technical operations.

ASR in the 180/400-Foot Aquifer Subbasin

Under the ASR component, water released from Nacimiento and San Antonio Reservoirs will be diverted from the Salinas River using the existing SRDF at a maximum flow rate of 36 cubic feet per second (cfs) during off-irrigation months. Water will then be pumped to a 23 million gallons per day (MGD) surface water treatment plant where it will be treated during off-irrigation months to meet the water quality standards necessary for groundwater injection, and conveyed to new injection wells in the 180/400-Foot Aquifer Subbasin. If operated at full capacity for 6 months such a plant could generate up to 12,900 AFY. The existing SRDF facilities have a maximum diversion flow of 36 cfs, or 16,000 gpm. Based on an injection rate of 1,000 gpm per injection well, 16 new injection wells will be installed. New injection well facilities will include wells completed in both the 180- and 400-Foot Aquifers, back-flush facilities including back wash pumps and percolation basins for water disposal into the vadose zone, electrical and power distribution, and motor control facilities.

Direct Delivery for Municipal Use

In addition to an ASR component, seasonal releases could be used for direct delivery for municipal supply. Under direct delivery use, this water would act as in-lieu recharge by reducing the need for winter/spring pumping from municipal wells, resulting in less winter/spring groundwater demand. The water not pumped by municipal wells during this season and left in the aquifers through this in-lieu recharge would aid the Monterey Subbasin and other subbasins in achieving SMCs. As with ASR injection, seasonally released surface water would need to be treated prior to delivery for municipal uses. However, direct delivery of seasonal releases would likely be a less expensive option to utilize surface water because no construction or operation of injection or extraction wells would be necessary.

A more expansive version of this direct delivery for municipal use option was described in MCWRA's 2008 filing by its attorneys, Downey Brand, with the SWRCB seeking an extension of the time to put water under Permit 11043 to beneficial use (RMC, 2008). MCWD now owns the vacant parcel on the Armstrong Ranch property within one mile of the SRDF, where a regional surface water treatment plant could be constructed to treat seasonal release water and any additional Permit 11043 water available for diversion at the SRDF. Treated water would be conveyed through pipelines to the municipal users, e.g., MCWD, Castroville and the City of Salinas. This treatment plant could serve as a joint treatment plant for both ASR and direct delivery operations. Based on existing and projected water demands, approximately 1,600 to 4,500 AFY of MCWD's water demand between January and June could be met through direct delivery.

9.4.1.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation measurable objective** - The project releases more water in dry years than under current reservoir operations. These dry-year releases will add more water to the shared principal aquifers in the Monterey and 180/400-Foot Aquifer Subbasins, and help maintain adequate groundwater elevations during dry years.
- **Groundwater storage measurable objective** - The project releases more water in dry years than under current reservoir operations. These dry-year releases will add more water to the principal aquifers in dry years, increasing the amount of groundwater in storage throughout the greater Salinas Valley Basin. In-lieu recharge and/or injection through ASR wells will directly increase storage in the shared principal aquifers as well.
- **Seawater intrusion measurable objective** – Increasing both groundwater elevations and groundwater storage will help re-establish natural hydraulic gradients and reduce or reverse seawater intrusion.
- **Interconnected surface water measurable objective** - Increasing winter/spring releases from the reservoirs will be adding more surface water in the river during the winter/spring, when environmental flow needs are the greatest. While it may not decrease the annual rate of ISW depletion from groundwater extraction, the additional winter surface water flows will better support environmental surface water users during the periods of the year when they need water.

9.4.1.2 Expected Benefits and Evaluation of Benefits

Groundwater storage benefits are in the process of being estimated for the Monterey Subbasin using the Salinas Valley Integrated Hydrologic Model (SVIHM). Subbasin-specific estimates will be refined during the preparation of the Habitat Conservation Plan (HCP). While the HCP is not scoped to estimate groundwater recharge, this project does need to work in accordance with the HCP.

The main groundwater-related benefits for the Monterey Subbasin include:

- Reduced pumping in the principal aquifers including the 180-Foot, 400-Foot, and Deep Aquifers. This reduced pumping will leave more water in the aquifers, thereby reducing the decline of groundwater elevations and storage.

In addition, this project provides regional groundwater improvements for the 180-Foot, 400-Foot, and Deep Aquifers such as:

- Improve the ability to maximize annual diversions at the SRDF. Diversions at the SRDF no longer rely on large peak irrigation season reservoir releases, of which less than 10% get to the SRDF. Winter/spring releases can be coordinated with environmental releases.
- More water available for CSIP and/or other beneficial users. The consistent diversions under the ASR component provide a more reliable supply to CSIP. Under the direct delivery component, reduced municipal pumping during the winter/spring should benefit CSIP pumping during the peak irrigation season from the same principal aquifers.
- A reduction in, or reversal of, seawater intrusion. Providing more water for extractors reduces seawater intrusion. The groundwater from natural recharge that occurs in addition to the injection and/or in-lieu recharge may be able to mitigate seawater intrusion by minimizing native groundwater extraction and altering the hydraulic gradients to reverse inland flow of saline waters.

The main groundwater-related expected benefits for the greater Salinas Valley Basin include:

- Increased annual carryover in the reservoirs, allowing for more consistent annual releases. Eliminating most peak-irrigation season reservoir releases will allow more water to be retained in Nacimiento and San Antonio reservoirs. This increased amount of water in the reservoirs can be used to ensure more consistent annual releases during droughts, with higher volume releases as a result of increased storage.
- Reduced peak-irrigation season water supporting invasive species in riparian zones. Eliminating most peak-irrigation season reservoir releases will result in less shallow water supporting invasive species such as arundo or tamarisk.

The intended benefit of this project for the Salinas Valley Basin is reservoir reoperation that allows for more regular, annual releases, including during dry years. Initial simulations are being run to quantify the regular annual releases and their respective groundwater recharge benefits to the Basin as well as the Monterey Subbasin. This simulation reduces peak-irrigation season releases in order to increase carryover in the reservoirs for subsequent regular annual releases.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater levels will be measured with a network of wells that is monitored by MCWRA. Land subsidence will be measured using InSAR data provided by the Department of Water Resources. When data gaps are filled, interconnected surface waters will be measured through shallow groundwater wells and river flow.

9.4.1.3 Circumstances for Implementation

If selected, this project will be implemented in coordination with MCWRA and will require agreements between MCWRA and SVBGSA under the ASR component and between MCWRA and the municipal water agencies under the direct delivery component.

This project will likely be subject to new flow restrictions and reservoir operations resulting from the planned HCP. This project will not proceed until the water rights and flow prescriptions from the HCP have been determined.

9.4.1.4 Permitting and Regulatory Process

This project requires close coordination with the MCWRA to modify reservoir releases and SRDF diversions. Permits that might be required for diverting winter/spring reservoir releases at the SRDF include:

> ***State Water Resources Control Board (SWRCB)*** –A modification to MCWRA's existing water right or re-diversion permit may be necessary. MCWRA's Licenses 7543 and 12624 and Permit 21089, storage water rights, were amended in 2008 to authorize Zone 2C as the authorized place of use, to add Underground Storage, and to add the SRDF as an authorized point of rediversion. However, MCWRA's Permit 11043 is a direct diversion right on the Salinas River. MCWRA could petition the SWRCB to add the SRDF as an additional point of diversion, to designate the entire Zone 2C as the authorized place of use of water, and to authorize underground storage under the permit. Water used under Permit 11043 for diversion at the SRDF could be made subordinate to the two existing projects described in the permit. However, diversion of water at the SRDF under Permit 11043 if implemented first would enable MCWRA to show the SWRCB that it is putting water under Permit 11043 to beneficial use to avoid revocation of the permit.
>
> ***Division of Safety of Dams (DOSD)*** – The existing DOSD permit may need to be modified to allow the SRDF diversion structure to operate outside its current window of April-October.
>
> ***National Marine Fisheries Service (NMFS)*** – Projects that potentially affect flows in any surface water under NMFS jurisdiction must get approval from NMFS. NMFS may set

conditions that will be included in the State Water Resources Control Board water rights.

California Department of Fish and Wildlife (CDFW) – Any project that diverts water from a river, stream, or lake, or that has the potential to affect fish and wildlife resources, must obtain a Land and Streambed Alteration Agreement from CDFW.

The project will require a CEQA review process. Additionally, any project that coordinates with federal facilities or agencies may require NEPA documentation.

There will be a number of local, county, and state permits, right of ways, and easements required depending on pipeline alignments, stream crossings, and project type, such as:

State Water Resources Control Board (SWRCB) – Construction that disturbs one acre of more of land and that discharges stormwater requires a General Construction Stormwater Permit (Water Quality Order No. 2009-0009-DWQ)

City of Marina – An encroachment permit is required when working within the City of Marina right-of-way or on City of Marina property. This may be needed if pipelines are required in roadways to connect to MCWD's distribution system.

ASR in the 180/400-Foot Aquifer Subbasin

Permits that might be required for the ASR component include:

Environmental Protection Agency (EPA) – All ASR projects must register with the EPA's Underground Injection Control program.

State Water Resources Control Board (SWRCB) – All ASR projects must submit an Underground Storage Supplement as part of the application to receive either a Temporary Permit, a Standard Permit, or a Streamlined Permit from SWRCB.

Regional Water Quality Control Board (RWQCB) – General Waste Discharge Requirements paperwork must be filed with RWQCB to comply with its General Order that governs the injection of water to recharge aquifers.

Monterey County Health Department (MCHD) – Well construction permits must be obtained from MCHD.

Direct Delivery for Municipal Use

Permits that might be required for the direct delivery component include:

State Water Resources Control Board (SWRCB) – A permit to operate a public water system is required from SWRCB's Division of Drinking Water. For existing water systems, such the MCWD public water system, an amendment to the existing permit is required for addition of a new water source.

9.4.1.5 Implementation Schedule

If this project is selected, the annual implementation schedule after initial agency agreements and any permitting or water rights alterations is presented on Figure 9-1.

Task Description	Year 1	Year 2	Year 3	Year 4	Year 5	Annually
Phase I – Agreements, CEQA, Permitting	■	■	■			
Phase II – Treatment Facilities, Pipeline, and/or ASR well Construction			■	■	■	
Phase III – Seasonal Releases						■

Figure 9-1. Implementation Schedule for Seasonal Releases from Reservoirs

9.4.1.6 Legal Authority

The GSA has the right to divert and store water once it has the right to utilize the appropriate water rights. Section 10726.2 (b) of the California Water Code (CWC) provides GSAs the authority to, "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency" (CWC, 2014). MCWRA is the legal authority for some of this project's facilities, therefore the GSAs will work collaboratively to use existing structures and water rights.

MCWRA operates the dams at Nacimiento and San Antonio pursuant to the terms and conditions of the permits and licenses for the two dams, and the flow prescriptions required by NMFS.

9.4.1.7 Estimated Cost

Costs for the injection and/or direct delivery of seasonal flows from the SRDF were estimated based upon the assumption that the diversion will take advantage of the existing SRDF facilities at an original calculated rate of 12,900 AFY.

ASR in the 180/400-Foot Aquifer Subbasin

Capital costs are estimated to be $181,134,000 for the construction of an ASR injection well field consisting of 16 wells, construction of a 4-mile conveyance pipeline between the SRDF site and the injection well system, and a surface water treatment plant that includes filtration and disinfection. These costs include engineering, overhead, and contingencies. Most of the costs associated with the ASR component are for the construction of the injection wells.

Annual O&M costs are estimated at $5,223,000 for the operation of the surface water treatment plant and the ASR injection well field, including a 20% contingency. Total annualized cost is $19,393,000. Based on the calculated project yield of 12,900 AFY, the unit cost of water for ASR is $1,500/AF. This unit cost does not include additional benefits received from recharge from the Salinas River within the Salinas Valley. This unit cost is not the cost of the project to stakeholders in the Monterey Subbasin as it focuses on the delivery of water to CSIP water users within the 180/400 Foot Subbasin. As part of this project, benefits analysis will be undertaken to determine the zones of benefit and assessments.

Direct Delivery for Municipal Use

For cost estimating purposes, it is assumed that approximately 3,600 AFY of the project capacity will be delivered to MCWD to meet winter/spring municipal demands. Unit capital and operating costs of surface water treatment for direct delivery are assumed to be similar to those estimated for the ASR option above. A conveyance pipeline between the SRDF site and the treatment plant, and a conveyance pipeline between the treatment plant and the MCWD water distribution system will be constructed. Should, for example, the City of Salinas and Castroville participate in the project, then cost for the conveyance pipelines needed to serve them would be determined.

Capital plus soft costs for direct delivery at an assumed 3,600 AFY of delivery to MCWD are estimated to be approximately $42,700,000. Annual O&M costs are estimated at $500,000. Based on the assumed delivery to MCWD, the unit cost of water for direct delivery is $1,100/AFY. These costs include engineering, overhead, and contingencies. Depending upon the municipal participants, this Project would directly benefit water users within the 180/400-Foot Aquifer Subbasin and the Monterey Subbasin. As part of this project, benefits analysis will be undertaken to determine the zones of benefit and assessments.

9.4.1.8 Public Noticing

Stakeholder engagement is a critical aspect of developing a successful and implementable project. Key coordinating agencies and stakeholders for this project include the MCWRA, CSIP water users, municipalities receiving water from the project, as well as the public. The MCWD GSA and SVBGSA intend to engage stakeholders early in project development.

Before any project initiates construction, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board and the MCWRA Board in publicly noticed meetings. This assessment will include:
    - A description of the undesirable result(s) that may occur if action is not taken
    - A description of the proposed project
    - An estimated cost and schedule for the proposed project
    - Any alternatives to the proposed project
- The SVBGSA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project and to approve an agreement with MCWRA on the use of MCWRA's water rights and SRDF, and notify the public if approved via an announcement on the SVBGSA website and mailing lists. The boards will work cooperatively moving forward with this project.

The permitting and implementation of change to releases from the reservoirs will require notification of stakeholders, beneficiaries, water providers, member lands adjacent to the river, and subbasin committee members as well as all permit and regulatory holding agencies such as DWR, CEQA, NOAA, USACE, and others.

9.4.2 R2 – Regional Municipal Supply Project

This project is not a stand-alone project but rather a potential supplement to the seawater intrusion extraction barrier project. This project would construct a regional desalination plant to treat the brackish water extracted from the proposed seawater intrusion barrier in the 180/400-Foot Aquifer Subbasin (Priority Project 6 in Chapter 9 of the 180/400-Foot Aquifer GSP). It delivers water for direct potable use to municipal systems in the Monterey Subbasin and other subbasins within Salinas Valley. This project provides in-lieu recharge to the groundwater system through reduced extraction by municipal systems. If the plant produced more water than could be used for direct potable use, excess water could be used for irrigation or reinjected into the 180-Foot or 400-Foot Aquifer. This water will be available year-round.

Further analysis and scoping are needed to determine the exact location of the desalination plant, end uses, and desalination technology. Depending on the desalination plant selected, the source water pipeline would consist of approximately 11 miles of source water pipeline to convey up to 22,000 gpm (32 mgd or 35,500 AFY) of flow to the plant from the seawater intrusion extraction barrier. The pipeline would range from 18” to 36” in diameter. The plant will produce approximately 15,000 AFY of potable water for use. The distribution of that water is yet to be determined. Rough estimates of piping and needed pump stations to provide water to the main municipal areas are included in the cost estimate and will be refined during GSP implementation.

9.4.2.1 Relevant Measurable Objectives

The measurable objectives benefiting from the desalination plant include:

- **Groundwater elevation measurable objective** - By reducing groundwater extraction through in-lieu recharge, there will be more water left in the principal aquifers. This will either raise groundwater elevations or reduce the rate of groundwater elevation decline over time.
- **Groundwater storage measurable objective** - Using desalinated water reduces groundwater extraction, which will either increase groundwater storage or reduce the rate of storage loss.
- **Land subsidence measurable objective** - Increasing both groundwater elevations and groundwater storage will have the benefit of reducing any potential for land subsidence caused by groundwater depletion.
- **Seawater intrusion measurable objective** – Seawater intrusion has advanced a few miles inland in the Monterey Subbasin. Providing water for in-lieu use will reduce the pumping-induced gradient that drives seawater intrusion.

9.4.2.2 Expected Benefits and Evaluation of Benefits

The proposed plant would produce up to 15,000 AFY of desalinated water for the Salinas Valley. A portion of that would go to the Monterey Subbasin. This would reduce groundwater extraction by that amount, increase the Subbasin's groundwater storage (or lessen the decline), and reduce the risk of seawater intrusion. This will benefit all groundwater users in the Subbasin to some degree. If desalinated water is delivered to the City of Marina, the pumping reductions and groundwater elevation benefits would occur in the locations of MCWD's production wells. Specific quantification of the groundwater benefit for the Monterey Subbasin is unable to be determined prior to determining the distribution of available desalinated water.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Benefits to groundwater storage will be monitored using delivery volumes measurements as well as calculations with groundwater elevations measurements. Land subsidence will be measured using InSAR data provided by the Department of Water Resources. Seawater intrusion will be measured using select Representative Monitoring Sites wells. A direct correlation between providing desalinated water to the Subbasin and changes in groundwater levels, subsidence, or seawater intrusion will depend in part on the suite of management actions and projects implemented concurrently in the Subbasin.

9.4.2.3 Circumstances for Implementation

This project is not a stand-alone project, but is a potential supplement to the seawater intrusion extraction barrier project. This project will only be implemented if and when a brackish water extraction barrier is built to control seawater intrusion. A more detailed cost/benefit analysis will be completed before any work begins on this project. Further analysis and comparison of desalination technologies, stakeholder deliberations on the distribution of desalinated water, and identification of project sites still need to be completed. This project will only be implemented if it is cost-effective and politically feasible when compared to other projects.

9.4.2.4 Permitting and Regulatory Process

Permits from the following government organizations that may be required for this project include:

- ***Monterey Bay National Marine Sanctuary (MBNMS)*** – All Regional Water Quality Control Board (RWQCB) 404 permits, Section 10 permits, and National Pollutant Discharge Elimination System (NPDES) permits must be reviewed by MBNMS.
- ***United States Fish and Wildlife Service (USFWS)*** – A Migratory Bird Treaty Act Permit (16 U.S. Code §703-711) may be required from the USFWS. Other federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act. Interagency coordination is also required by the Fish and Wildlife Coordination Act (16 U.S. Code §661-667e).

- ***National Oceanic & Atmospheric Administration (NOAA)*** – Section 7 of the Endangered Species Act requires other federal agencies to consult with NOAA's National Marine Fisheries Service (NMFS) if threatened or endangered species could be affected by this project. NMFS also monitors compliance with Section 305b of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S. Code §1855b) which protects essential fish habitats.
- ***United States Army Corps of Engineers (USACE) –*** Under the Rivers and Harbor Act, a Section 10 permit (33 U.S. Code §403) is required for the construction of any structure in or over any navigable water of the United States. Under the Clean Water Act, a Section 404 permit (33 U.S. Code §1341) is required to discharge dredge or fill materials into "waters of the United States".
- ***State Water Resources Control Board (SWRCB)*** – A permit to operate a public water system is required from SWRCB's Division of Drinking Water. Construction that disturbs one acre or more of land and that discharges stormwater requires a General Construction Stormwater Permit (Water Quality Order No. 2009-0009-DWQ). Certification to discharge dredged or fill material is required by Section 401 of the Clean Water Act and by the Porter-Cologne Water Quality Control Act (California Water Code §13000 et seq.). Discharge of brine or other pollutants requires a National Pollutant Discharge Elimination System (NPDES) permit under Section 402 of the Clean Water Act (33 U.S. Code §1342).
- ***California Department of Fish and Wildlife (CDFW)*** – Projects that may result in the take of a threatened or endangered species require an Incidental Take Permit (California Endangered Species Act Title 14, §783.2). A Streambed Alteration Agreement (California Fish and Game Code Section 1602) is required if the project may substantially adversely affect fish and wildlife resources.
- ***California Coastal Commission (CCC)*** – Construction within the Coastal Zone requires a Coastal Development Permit (Public Resources Code 30000 et seq.). Under the Coastal Zone Management Act (16 U.S.C. §1456), the CCC will ensure that federal authorized work is consistent with the enforceable policies of California's Coastal Management Program. Consistency between federal and state laws in coastal areas is also required by the Federal Consistency Regulations (15 Code of Federal Regulations, Part 930, Subpart D). The County may have initial jurisdiction to issue any required permit, but that would be appealable to the full Commission.
- ***California Department of Transportation (Caltrans)*** – Work that may obstruct a State highway requires an Encroachment Permit.
- ***California Department of Toxic Substances Control (DTSC)*** – If the project encroaches into the Fort Ord area, there will be hazardous waste management and disposal requirements concerning Soluble Threshold Limit Concentrations and Total Threshold Limit Concentrations (22 California Code of Regulations §66261.24).

- ***California State Lands Commission (CSLC)*** – A New Land Use Lease is required for the subsurface slant wells located below mean high tide and an Amended Land Use Lease for use of the Monterey One Water outfall and diffuser (California Public Resources Code §1900).
- ***California Department of Parks and Recreation*** – If the project encroaches into Fort Ord Dunes State Park, an easement, right of entry, and/or lease negotiation is required. Federal agencies involved in this project are required to consult with the Department of Parks and Recreation's State Historic Preservation Officer in accordance with Section 106 of the National Historic Preservation Act (16 U.S. Code §470).
- ***California Public Utilities Commission (CPUC)*** – A Certificate of Public Convenience and Necessity (California Public Utilities Code §1001 et seq.) is required to show that the project will benefit society.
- ***Various Entities with Jurisdiction on the Former Fort Ord*** – If the project encroaches into the Fort Ord area, it must comply with any applicable land use regulations of the entities with jurisdiction on the former Fort Ord.
- ***Monterey County*** – If the project encroaches onto any county-maintained road, an Encroachment Permit (Monterey County Code Chapter 14.04) is required from the County. Removal of 3 or fewer trees can be handled by a standalone Tree Removal Permit (Monterey County Code Chapter 16.60). Removal of more than 3 trees should be included in a County Use Permit and/or Coastal Development Permit.
- ***Monterey County Health Department*** – If there will be 55 gallons (liquid), 500 pounds (solid), or 200 cubic feet (compressed gas) of hazardous materials onsite at any one time, a Hazardous Materials Business Plan and a Hazardous Materials Inventory Statement (California Health and Safety Code Chapter 6.95) must be submitted to the Monterey County Health Department's Environmental Health Bureau. Other required permits include a Well Construction Permit (Monterey County Code Chapter 15.08) and permits to construct and operate a desalination treatment facility (Monterey County Code Chapter 10.72).
- ***Monterey County Department of Planning and Building Services*** – The project will require a Coastal Development Permit, which may be submitted to Monterey County Department of Planning and Building Services. If the project will extend inland beyond the Coastal Zone, a Use Permit (Monterey County Code (MCC) Chapter 21.72 Title 21) is also required. A Grading Permit (MCC Code Chapter 16.08) is required if total disturbance onsite equals or exceeds 100 cubic yards. If the project encroaches on the Fort Ord area, an excavation permit is required for disturbances that equal or exceed 10 cubic yards (Monterey County Code Chapter 16.10). An erosion control plan (Monterey County Code Chapter 16.12) is required if there is a risk of accelerated (human-induced) erosion that could lead to degradation of water quality, loss of fish habitat, damage to property, loss

of topsoil or vegetation cover, disruption of water supply, or increased danger from flooding.

- ***Monterey One Water*** – A Sewer Connection Permit is required to connect to the regional sewer system.
- ***Monterey Bay Air Resources District (MBARD)*** – If the project may release or control air pollutants, an Authority to Construct and Permit to Operate is required (MBARD Rule 200).
- ***Monterey Peninsula Water Management District (MPWMD)*** – An expansion/extension permit is required to expand the current water system (MPWMD Ordinance 96).
- ***Cal Am, CalWater, Alco, and other local water agencies*** – The project will require contracts with local water agencies that plan to buy and deliver the desalinated water.
- ***Transportation Agency for Monterey County (TAMC)***– An easement for access to and use of the project site may need to be negotiated with TAMC.
- ***Seaside Groundwater Basin Watermaster*** – A permit may be needed to inject and/or extract groundwater.
- ***Local jurisdictions*** – Permits may also be required by a local jurisdiction depending on location of desalination plant, including but not limited to: land use permits, building permits, public health permits, public works permits, tree removal permits, and encroachment permits.

9.4.2.5 Implementation Schedule

If this project is selected, the implementation schedule is presented on Figure 9-2. This project would take approximately 11 years to implement, assuming the seawater intrusion barrier is already in place.

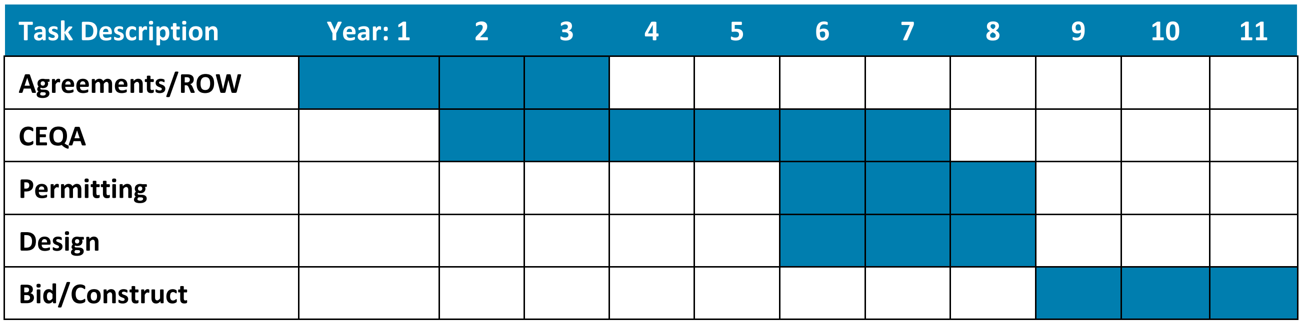


Figure 9-2. Implementation Schedule for Regional Municipal Supply Project

9.4.2.6 Legal Authority

Pursuant to California Water Code sections 10726.2 (a) and (b), the SVBGSA has the right to acquire and hold real property, appropriate and acquire surface water or groundwater, acquire water rights, and to divert and store water once it has acquired any necessary real property or appropriative water rights. Some rights in real property (whether fee title, easement, license, leasehold or other) may be required to implement the project.

9.4.2.7 Estimated Cost

An initial estimate analyzed the cost to treat 15,000 AFY and deliver that desalinated water to municipalities throughout the coastal region of the Salinas Valley Basin, including the Monterey Subbasin. The estimated capital cost for the pipeline from the wells to the desalination plant and desalination plant is $309,387,000. The estimated capital cost for the distribution network ranges from $65,257,000 to $84,315,000 depending on how many communities receive water. It currently is only scoped to provide water to the portion of the Corral de Tierra adjacent to the 180/400-Foot Aquifer Subbasin; however, it could be expanded with additional piping and pumping which would increase the cost. Annual operations and maintenance are projected to cost about $13,300,000. If the total cost of the project is annualized over a 25-year term, and if production is 15,000 AFY, the unit cost for the desalination plant and distribution network is approximately $2,900/AF.

It should be noted that this cost does not include cost of constructing and operating the seawater extraction barrier, which is a precursor to this project. The cost of the seawater extraction barrier is equivalent to $1,200/AF when divided by this project’s estimated capacity at 15,000 AFY.

9.4.2.8 Public Noticing

Before SVBGSA initiates construction on this project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board in a publicly noticed meeting. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed project
  - An estimated cost and schedule for the proposed project
  - Any alternatives to the proposed project
- The SVBGSA Board will notice stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project.

In addition to the public noticing detailed above, all projects will follow the public noticing requirements required by CEQA. In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA.

After approval, SVBGSA will provide annual notification via an announcement on the SVBGSA website and mailing lists.

9.4.3 R3 – Multi-benefit Stream Channel Improvements

Over the past half a century, the Salinas River has been impacted by the construction of the San Antonio and Nacimiento Dams and flood control levees intended to move water away from agricultural fields. These have changed natural river geomorphology, resulting in sediment build up and vegetation encroachment on the historically dynamic channels of the Salinas River. This alteration of natural floodplains and geomorphology has increased flood risk, decreased direct groundwater recharge, and contributed to increased evapotranspiration through vegetation build-up. Targeted, geomorphically-informed stream maintenance and floodplain enhancement can improve stream function both morphologically and biologically.

This project takes a three-pronged approach to stream channel improvements. First it removes dense vegetation and reduces the height of sediment bars that impede streamflow in designated maintenance channels. Second, the project removes the invasive species *Arundo donax* (arundo) and *Tamarix sp.* (tamarisk) throughout the Salinas River watershed. Third, it enhances the recharge potential of floodplains along the Salians River.

This three-pronged approach increases flow by removing dense native and non-native vegetation, provides vegetation-free channel bottom areas for infiltration, stabilizes stream banks and earthen levees by reducing downstream velocities, and reduces flood risk. This program's activities also benefit native species throughout the river ecosystem by removing competition from encroached non-native species. Invasive species such as arundo can take up to four times as much water as native riparian species thereby negatively impacting both river flows as well as infiltration into the subsurface through the streambed (Cal-IPC, 2011). Infiltration through the streambed accounts for a significant portion of the groundwater budget (Cal-IPC, 2011). River maintenance activities enhance groundwater recharge efforts through the streambed by providing additional open channel bed for infiltration, and floodplain enhancement can further recharge potential of high flows. By improving geomorphological function through vegetation and sediment removal activities, the coordinated efforts allow native species to reestablish in areas where invasive species have become dominant.

Surface water flows, and notably flood flows, can be impacted by the density of vegetation and whether the vegetation is comprised of native or non-native species. Native riparian species allow for dynamic action that scours the riverbed and resorts sediment in a manner that encourages natural infiltration and conveyance of floodwaters in the broader active flood terraces in the river. This wider use of the floodplain by floodwaters slows velocities and distributes floodwaters over a broader spatial area of the river channel.

Stream channel vegetation removes water from the river through evapotranspiration (ET). Water loss through ET from invasive species such as arundo can take up between 3.1 and 23.2 AFY per acre, whereas ET from native vegetation can take up to 4 AFY per acre (Melton and Hang, 2021; Cal-IPC, 2011). This illustrates the difference in water consumption between vegetation types and how these water consumptions can have major impacts on water in the river (Cal-IPC, 2011). The Salinas River is characterized by a braided channel in some areas of the floodplain and a confined channel in other areas. Plants can take root in channel locations that adversely impact the flow of water, resulting in either a channelized river or in creating directional velocities that can cause localized damages including levee failure. Poorly functioning sedimentation can also negatively impact water flow in drought and flood conditions, as well as impeded proper infiltration to the subsurface. Geomorphological processes are important to managing a natural riverbed and floodplain to enhance recharge, groundwater levels, and groundwater storage.

This program is not meant to restore the Salinas River to historical conditions, but rather to enhance geomorphological function through targeted maintenance sites for flood risk reduction and floodplain enhancement for increased recharge. The Monterey County Water Resources Agency (MCWRA) has developed a science-based approach to river management that recognizes the value of critical habitat, environmental resources, cost to landowners, and coordination among stakeholders (MCWRA, 2016). A key feature of this modified management approach is providing protection for critical habitats and water quality (MCWRA, 2016). One of the important functions of a river is to provide habitat for native species. In a poorly functioning river, invasive species have more opportunities to crowd out native species and in turn, further degrade the river conditions. Therefore, this program will result in flood risk reduction, increased recharge, and a multitude of benefits that address critical functions of the Salinas River.

This program includes four main types of tasks: vegetation maintenance, non-native vegetation removal, sediment management, and floodplain enhancement and recharge.

- **Vegetation Maintenance** – Vegetation, both native and non-native, will be removed within designated maintenance areas using a scraper, mower, bulldozer, excavator, truck or similar equipment to remove the vegetation above the ground and finishing by ripping roots to further mobilize the channel bottom. Vegetation maintenance includes pruning up to 25 percent of canopy cover and removing dead mass. Maintenance activities will not include disturbance of emergent wetland vegetation that provides suitable habitat for threatened California red-legged frogs or for the endangered tidewater gobies. In instances where native vegetation needs to be removed for site-specific conditions or tie-ins, these impacts can be compensated with replanting and revegetation in other areas as a form of mitigation offset for stream channel maintenance. Native trees will be planted during the rainy season to enhance their rate of success.

- **Non-Native Vegetation Removal –** Non-native vegetation removal primarily focuses on the arundo present in the region but may include tamarisk shrubs as well. Arundo is a grass that was introduced to the Americas in the 1800s for construction material and for erosion control purposes (Cal-IPC, 2011). In 2011, the California Invasive Plant Council determined that the Salinas Watershed had the second largest invasion with approximately 1500 infested acres. While arundo thrives near water, such as wetlands and rivers, it grows in many habitats and soil types. It requires a substantial amount of water, previously estimated making it one of the thirstier plants in a given region and outpacing the water demands of native vegetation. To manage this invasive species, arundo biomass is typically sprayed, sometimes mowed or hand cut if needed, and then treated with multiple applications of herbicide over several years. Permits allow arundo removal in the entire riparian corridor, including along the low-flow channel.
- **Sediment Management** – Sediment management includes channel bed grading and sediment removal. Sediment grading and removal may occur exclusively, or after vegetation maintenance activities described above. Sediment removal and grading activities help reestablish proper gradients to allow for improved drainage downstream, encourage preferential flow into and through secondary channels, and minimize resistance to flow (until dunes form) (MCWRA, 2016). Sediment removal will follow best practices to protect native species while producing maximum benefit for flood reduction and groundwater recharge.
- **Floodplain Enhancement and Recharge** – Floodplain enhancement restores areas along the River, creeks, and floodplains to slow and sink high flows and encourage groundwater recharge. Restored floodplain and riparian habitat can slow down the velocity of the River and creeks and encourage greater infiltration. Due to agricultural and urban encroachment, streams have become more highly channelized, and flow has increased in velocity, particularly during storm events. This flow has resulted in greater erosion and loss of functional floodplains. Floodplain restoration efforts could be focused on lands directly adjacent to creeks, so as to not interfere with active farming. In addition, efforts to restore creeks and floodplains could be extended to the foothills to slow water closer to its source.

Program Components

This multi-benefit stream channel improvements program is implemented through various program components. These build off existing programs and permits to undertake the four main types of tasks. During GSP implementation, these components may be modified as needed to most efficiently accomplish the program goals.

Component 1: Stream Maintenance Program

The first component continues the Salinas River Stream Maintenance Program (SMP), which maintains the river corridor to reduce flood risk and minimize bank and levee erosion, while maintaining and improving ecological conditions for fish and wildlife consistent with other priorities for the Salinas River (MCWRA, 2016). It is a coordinated Stream Maintenance Program that includes MCWRA, the Resource Conservation District of Monterey County (RCDMC), and the Salinas River Management Unit Association currently representing approximately 50 landowner members along the river corridor. Project benefits include increased water availability, flood risk reduction, reduced velocities during high flows to lessen bank and levee erosion, and enhanced infiltration by managing vegetation and sediment throughout the river and its tributaries.

The Salinas River Stream Maintenance Program occurs along the area of the Salinas in Monterey County. The 92-miles of the river in Monterey County is broken into seven River Management Units from San Ardo in the south to Highway 1 in the north. The management activities are focused on the secondary channels of the Salinas River located outside of the primary low flow channel and are preferentially aligned with low-lying undeveloped areas that are active during times of higher flow (MCWRA, 2016). The SMP includes three main activities as part of stream maintenance: vegetation maintenance, non-native vegetation removal, and sediment management.

Component 2: Invasive Species Eradication

The second Component supports and/or undertakes removal of arundo and tamarisk done by the Resource Conservation District of Monterey County (RCDMC). RCDMC is the lead agency on an estimated 15 to 20-year effort to fully eradicate arundo from the Salinas River Watershed, working in a complementary manner with the SMP. This project focuses on removal of woody invasive species such as arundo, tamarisk, and tree tobacco (Nicotiana glauca) along the Salinas River, as well as retreatments needed to keep it from coming back. It includes three distinct phases: initial treatment, re-treatment, and ongoing monitoring and maintenance treatments. As of April 2021, estimated arundo under treatment was 850 acres. Original mapped acreage had expanded by 20%, leaving 900 arundo acres remaining to be treated. The initial treatment phase includes mechanical and/or chemical treatment in all areas of the river that have yet to be treated. The re-treatment phase includes re-treatment of the approximately 850 acres that have already had an initial treatment and re-treatment of the remaining 900 acres done in stages, with each area treated over a three-to-five-year period following initial treatment. The final phase is the ongoing monitoring and maintenance treatment phase. This phase requires monitoring for regrowth of the invasive species or new invasive species and chemical treatment every three to five years.

Component 3: Floodplain Enhancement and Recharge

The third component complements the first two by enhancing and restoring floodplains to enable high flows to be slowed and directed toward areas where it can infiltrate into the ground. For this component, SVBGSA will partner with the Integrated Regional Water Management (IRWM) Group, Central Coast Wetlands Group, and other organizations that are already undertaking creek and floodplain restoration efforts and encourage inclusion of features that would enhance recharge.

Restored floodplain and riparian habitat along creeks can slow down the velocity of creeks and encourage greater infiltration. Due to agricultural and urban encroachment, streams have become more highly channelized, and flow has increased in velocity, particularly during storm events. This flow has resulted in greater erosion and loss of functional floodplains.

9.4.3.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation measurable objective -** Removing the invasive species, better managing streams, and directing high flows into restored floodplains will facilitate more water infiltrating and percolating into the subsurface to raise groundwater elevations. This has the effect of adding water to the principal aquifers. Adding water to the principal aquifers will ultimately increase groundwater elevations or decrease their decline.
- **Groundwater storage measurable objective -** Adding water to the principal aquifers will ultimately have the effect of increasing groundwater in storage.
- **Land subsidence measurable objective -** Increasing both groundwater elevations and groundwater storage will have the added benefit of preventing any potential land subsidence. Maintaining and adding water in the subsurface will keep pore spaces saturated with positive pressure and inhibit land surface collapse associated with groundwater depletion.
- **Interconnected surface water measurable objective -** By removing vegetation pathways for evapotranspiration, less interconnected groundwater and less surface water will be depleted, leaving more water available in the river for flows as well as for connection to the principal aquifers.

9.4.3.2 Expected Benefits and Evaluation of Benefits

The groundwater-related expected benefits are increased groundwater elevations in the vicinity of the river channel due to increased infiltration and percolation to the principal aquifers, increased groundwater in storage, decreased depletion of interconnected surface water, and protection against any potential land subsidence due to groundwater extractions. In addition, the project reduces flood risk.

Increased storage of floodwaters can increase groundwater elevations in the vicinity of the Salinas River. This typically will be seen as groundwater mounding subparallel to the river corridor. However, as more water infiltrates into the subsurface, more water will flow laterally, thereby expanding the zone of influence from the river outward and raising groundwater elevations laterally. Additionally, water stored underground is not subject to evapotranspiration in the same way water stored above ground is. With the annual removal of arundo, evapotranspiration will decrease over time, allowing for more water to remain in the system. Arundo removal is coupled with identified native species removal where native species have encroached in high flow channels where they may not typically grow; however, there is significant uncertainty in the recharge benefits, as arundo and many native species draw both surface and groundwater.

Removal of arundo on 900 acres along the Salinas River will decrease evapotranspiration by 2,790 to 20,880 AFY throughout the Salinas Valley. This will enhance recharge from the Salinas River within its reach in the Monterey Subbasin and leave more water in the River to get down to the Castroville Seawater Intrusion Project, where surface water is used in lieu of groundwater to help address seawater intrusion and declining groundwater elevations. With this reduction of non-productive water consumption, less water may be released from the reservoirs to get the same amount of water downstream, which results in indirect recharge as removal reduces groundwater use by the plants. It also increases the Valley's overall sustainable yield and drought resilience.

Component 3 of this project includes various floodplain enhancement features and restoration activities. Preliminary project scoping includes the development of 10 recharge basins within the greater Salinas Valley Basin, each with a recharge capacity of about 100 AFY. However, greater analysis is needed to determine the exact number, size, and type of features. The combined benefit of the four recharge basins is expected to be 1,000 AFY in increased recharge.

This program will also enhance streamflow by returning patterns of flow to a more natural state. Arundo infestation decreases the natural channel migration and complexity of sandy-bottomed streams by confining the channel to an armored, single stem with faster flowing water, which then becomes susceptible to erosion and incision. A narrowing channel with reduced capacity also heightens flood risk. Removing arundo will allow greater normalization of natural geomorphic processes and sediment transport by de-armoring low-flow channel banks and adjacent floodplain areas to enable channel migration and braiding.

Stream channel improvements will provide many additional ecosystem benefits, including:

Habitat restoration: This project will help restore riparian habitat. Results from four years of plant community monitoring of arundo sites initially treated in 2016 show that diversity and abundance of native plants have increased over this time period and this trend is expected to continue. Field biologists conducting pre-activity surveys have also observed increased wildlife activity post-arundo removal.

Increased connectivity for wildlife: Within the Central Coast region there are several mountain ranges, coastal areas, valley floors, and upland habitats that need to be connected to allow for the wildlife movement necessary for gene flow and healthy populations (Thorne *et al.*, 2002). The Salinas River riparian area is an important linkage for wildlife movement between upland habitat via tributaries. Removal of dense arundo stands will reduce physical impediments to movement for wildlife species such as mountain lion, bobcat, deer, and American badger. RCDMC has documented this through wildlife camera monitoring, which has shown increased detections of large mammals such as deer, bobcat, and coyote after arundo removal. This project will promote habitat use and movement of wildlife by increasing availability of food and nesting resources.

Flood risk reduction: Stream maintenance has the societal benefit of reducing flood risk to neighboring lands, which are mostly agricultural fields. Arundo's dense structure creates increased surface roughness, thus backing up water and causing flooding during high flow events. When agricultural fields are flooded with river water, farmers lose crops and thus considerable income, and must leave their fields fallow for months after flooding due to food safety concerns. Flooding can also damage levees which then have to be repaired and bring weed seeds and propagules (including arundo) into fields which then have to be controlled.

Enhanced Conveyance and Infrastructure Protection: The work conducted in the SMP improves conveyance of storm, flood, and nuisance waters by keeping water in the stream channel and flowing freely rather than being blocked by the invasive species. The SMP protects city infrastructure by keeping water more in the channel rather than blocked and rerouted by arundo, which reduces the cost of infrastructure repairs to nearby cities.

Project benefits will be measured using the monitoring networks described in Chapter 7. Groundwater levels will be measured with a network of wells that is monitored by MCWRA. Land subsidence will be measured using InSAR data provided by the Department of Water Resources. When data gaps are filled, interconnected surface waters will be measured through shallow groundwater wells and river flow.

The expected benefits to groundwater in the Monterey Subbasin will be defined through further investigation.

9.4.3.3 <u>Circumstances for Implementation</u>

The SMP and invasive species eradication are ongoing projects with MCWRA, the RCDMC, and the Salinas River Management Unit Association. Program administration is provided by the RCDMC and the Salinas River Management Unit Association. Landowners currently pay for all maintenance activities in the maintenance channels and for associated biological monitoring and reporting. SVBGSA could support the program, become an administrative partner in the program with other program partners, or fund maintenance and monitoring activities.

Floodplain enhancement will be implemented if additional water is required to reach sustainability. A number of agreements and rights must be secured before individual projects are implemented. Primarily, a more formal cost/benefit analysis must be completed to determine how many site options are preferable. Water diversion rights may need to be secured to divert stormwater, which may take many years.

9.4.3.4 Permitting and Regulatory Process

For Components 1 and 2, the permitting process has already been initiated by MCWRA and RCDMC and permits are in place until 2025 for the program. Invasive species eradication will be continued under existing permits. All participants in the SMP must enter into an agreement with MCWRA and comply with all terms, conditions, and requirements of the permits and Program Guidelines.

Component 3 may require a CEQA environmental review process, and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). Additionally, permits from a variety of state and federal agencies may be necessary, and any project that coordinates with federal facilities or agencies may require National Environmental Policy Act (NEPA) documentation.

Permits for all 3 components are detailed below.

Component 1 Permits:

- **U.S. Army Corps of Engineers (USACE) -** The Department of the Army Regional General Permit (RGP) 20 for the Salinas River Stream Maintenance Program, Corps File No. 22309S, was executed on September 28, 2016 by the USACE. The RGP is authorized under Section 404 of the Clean Water Act (33 U.S.C. Section 1344) through November 15, 2021. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) concurred with the USACE determination that the project was not likely to adversely affect the federally endangered San Joaquin kit fox (Vulpes macrotis mutica) and the federally threatened California tiger salamander (Ambystoma californiense), Monterey spineflower (Chorizanthe pungens var. pungens) and its critical habitat, the yellow-billed cuckoo (Coccyzus americanus), and the South-Central Coast (S-CCC) steelhead (Oncorhynchus mykiss). The USFWS issued a Biological Opinion on August 22, 2016 for the federally endangered least Bell's vireo (Vireo bellii pusillus) and tidewater goby (Eucyclogobius newberryi) and its critical habitat and the federally threatened California red-legged frog (Rana draytonii).
- **National Oceanic and Atmospheric Administration (NOAA) –** The RCDMC also has a letter of concurrence in which NOAA supports USACE's decision that the SMP "is not likely to adversely affect species listed as threatened or endangered or critical habitats designated under the Endangered Species Act."
- **State of California Regional Water Quality Control Board -** The Clean Water Act Section 401 Water Quality Certification for Discharge of Dredged and/or Fill Materials, Certification No. 32716WQ02, was approved on August 31, 2016, and is set to expire on November 30, 2025. The Central Coast Water Board staff will assess the implementation

and effectiveness of the SMP after five years and consider modifications to this Certification for the second five years of the permit term.

- **California Department of Fish & Wildlife -** The SMP is authorized under a Routine Maintenance Agreement (RMA) 1600-2016-0016-R4, approved October 14, 2016, and held by the RCDMC. The RMA was amended and restated on June 16, 2017 and subsequently amended on April 10, 2018. The RMA covers all impacts under the program from the original date of approval through December 31, 2026.
- **California Natural Resources Agency –** An Environmental Impact Report was completed in compliance with the CEQA.

Component 2 Permits:

- ***California Department of Fish & Wildlife*** – The invasive species eradication is authorized under a Routine Maintenance Agreement (RMA) 1600-2012-0154-R4, approved April 11, 2014 and held by the RCDMC. The RMA was amended on September 30, 2014. It covers all impacts under the program from the original date of approval through April 10, 2026.
- ***Environmental Protection Agency*** – National Pollutant Discharge Elimination System (NPDES) permit CAG990005 allows the Salinas River Arundo Control Program to apply pesticides to waterways.
- In addition, the Salinas River Arundo Control Program filed a CEQA Mitigated Negative Declaration, received a technical assistance letter from NOAA NMFS, completed a U.S. Fish and Wildlife Service No Take Request, and received a technical assistance letter from U.S. Fish and Wildlife Service.

Component 3 Permits that may be required for floodplain enhancement include:

- **United States Army Corps of Engineers (USACE) –** A Regional General Permit may be required if there are impacts to wetlands or connections to waters of the United States.
- **California Department of Fish and Wildlife (CDFW) –** A Standard Agreement is required if the project could impact a species of concern.
- **Environmental Protection Agency (EPA) Region 9 –** National Environmental Policy Act (NEPA) documentation must be submitted for any project that coordinates with federal facilities or agencies. Additional permits may be required if there is an outlet or connection to waters of the United States.
- **National Marine Fisheries Service (NMFS) –** A project may require authorization for incidental take, or another protected resources permit or authorization from NMFS.
- **California Natural Resources Agency –** Projects of a magnitude capable of having a demonstrable impact on the environment will require a CEQA environmental review

process. Projects will require either an Environmental Impact Report, Negative Declaration, or a Mitigated Negative Declaration.

9.4.3.5 Implementation Schedule

The components of this program may be implemented on different schedules. The annual implementation schedule for Component 1 is outlined on Figure 9-3. About 40 new acres could be added to the program each year, taking about 10 years to add the remaining acres. Annual maintenance needs to be continued indefinitely. For Component 2, up to 100 of the remaining 900 acres of uncontrolled arundo can begin treatment each year, as shown on Figure 9-4. For Component 3, it is contingent on the first two components, but may be initiated shortly after Component 2. This schedule is shown on Figure 9-5.

Task Description	Dec 1	Mar 31	Sep 1	Nov 30
Phase I – Annual RMU report, Work Plan, and noticing	■	■		
Phase II – Pre-maintenance surveys		■		
Phase III – Maintenance activities			■	■

Figure 9-3. Annual Implementation Schedule for Stream Maintenance

	Year												
Task Description	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Treat and retreat first 100 acres	■	■		■		■			■			■	
Treat and retreat second 100 acres		■	■		■		■			■			■
Treat and retreat third 100 acres			■	■		■		■			■		
Treat and retreat fourth 100 acres				■	■		■		■			■	
Treat and retreat fifth 100 acres					■	■		■		■			■
Treat and retreat sixth 100 acres						■	■		■		■		
Treat and retreat seventh 100 acres							■	■		■		■	
Treat and retreat eighth 100 acres								■	■		■		■
Treat and retreat ninth 100 acres									■	■		■	

Figure 9-4. Implementation Schedule for Invasive Species Eradication

	Year				
Task Description	**1**	**2**	**3**	**4**	**5**
Studies/Preliminary Engineering Analysis	■				
Agreements/Right of Way (ROW)	■	■			
CEQA		■	■		
Permitting		■	■		
Design			■	■	
Bid/Construct				■	■

Figure 9-5. Implementation Schedule for Floodplain Enhancement and Recharge

9.4.3.6 Legal Authority

MCWRA has legal authority over the Component 1 SMP for program administration and permitting. Private landowners and local cities who conduct maintenance in the permitted work areas must agree to permit conditions and execute an agreement annually with each agency. Private landowners and local cities currently pay for all maintenance activities including heavy equipment work and biological monitoring and reporting.

For Component 2 invasive species removal, the RCDMC has legal authority for program administration and permitting. The RCDMC obtains Landowner Access Agreements with property owners or managers (tenants) to allow them to do the work or to allow the RCDMC to oversee landowner-conducted work.

For floodplain restoration activities, the SVBGSA has the right to divert and store water once it has access to the appropriate water rights. Section 10726.2 (b) of the California Water Code provides GSAs the authority to, "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency" (CWC, 2014).

9.4.3.7 Estimated Cost

Component 1 program permits have been completed and are operational through 2026. Renewal of the 401 Certification with the Central Coast Regional Water Control Board will include a cost of $95,000 in the timeframe of 2024 to 2026. The annual administrative cost of Component 1 of this program is approximately $150,000. This cost does not include stream maintenance activities, required biological monitoring, and reporting, which are currently paid by program participants. These costs vary from year to year based on the number of participants and work site conditions. This program could cover the costs of stream maintenance activities, biological monitoring, and/or reporting in order to reach higher participation rates from landowners and therefore increased project benefit. The cost for the vegetation management is approximately $1,200/acre for the first year and $700/acre for annual maintenance thereafter. This does not include the cost of sediment management, which can be costly. The cost estimate for stream maintenance activities, required biological monitoring, and reporting is included in Appendix 9-A, which may continue to be paid by participants, be funded by the GSA, or be funded through a different source. The table shows the cost estimates for the primary subbasins where the Salinas River flows. The presence of two reaches of Salinas River in the Monterey Subbasin may adjust this table with further analysis.

Table 9-2. Cost Estimate of Vegetation Management

	Acres	First year of vegetation management ($1,200/acre)	Subsequent years of vegetation management ($700/acre)
Already treated	254	-	$177,800
Upper Valley	250	$300,000	$175,000
Forebay	263	$315,600	$184,100
180/400-Foot Aquifer and Monterey Subbasins	137	$164,400	$95,900
Subtotal		**$780,000**	**$632,800**

For Component 2, the estimated capital cost is estimated at between $14,536,943 and $18,871,239. Annual O&M costs are anticipated to be approximately $165,200. The indirect projected yield for the invasive species eradication project is estimated at between 3.1 AFY and 23.2 AFY per acre of invasive species removed. With the range of costs and range of project benefits, the amortized cost of water for this project is estimated to range between $60/AF and $740/AF. See Appendix 9-A for cost estimate.

Component 3 includes the construction of 10 recharge basins near the Salinas River in the greater Salinas Valley Basin, each with an expected benefit of 100 AFY and a capital cost of $1,116,000 each, for a total of $4,464,000. Spread over 25 years and assuming a 6% discount rate, the annualized cost is $83,300 per recharge basin, including annual maintenance. The unit cost is $930/AF. These costs were estimated assuming that only one recharge basin would be built, but there may be economies of scale that lower the cost if more are built. These costs are approximate; exact costs will depend onsite specifics.

9.4.3.8 Public Noticing

Component 1 implementation and permitting require annual notification of potential program participants and this notification is announced via direct mail to program participants as well as announced on the MCWRA website. Program-related annual reporting as required and is published on the MCWRA website.

Component 2 public noticing practices and requirements of the existing RCDMC invasive species eradication programs will be continued as part of this project. This includes reaching out to specific landowners and tenants in areas of potential work and completing annual permit reports that are posted to the RCDMC website.

Component 3 public noticing will be conducted prior to any project initiates construction to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board in a publicly noticed meeting. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed project
  - An estimated cost and schedule for the proposed project
  - Any alternatives to the proposed project
- The SVBGSA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project, and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

In addition to the process detailed above, all projects will follow the public noticing requirements per CEQA or NEPA.

Marina-Ord Area Local Projects & Management Actions

9.4.4 M1 – MCWD Demand Management Measures

In the past two decades, MCWD has made significant strides in reducing its per capita potable water demand above and beyond targets delineated by the Water Conservation Act. Conservation reductions have come primarily from water conservation retrofits as well as from behavioral changes driven by increasing water rates, drought awareness, and public education programs. During the twenty-year period of 1999 through 2020, per capita water demand within the MCWD service area decreased from 144 gallons per capita per day (GPCD) to 80 GPCD, a decrease of approximately 44% (Schaaf & Wheeler, 2021). At the current population of 30,480 served by MCWD, this decrease in per capita water use provides an approximately 2,500 AFY of in-lieu recharge benefits[54].

Following the 2014-2016 drought, the State of California developed the "Making Water Conservation a California Way of Life" framework to address the long-term water use efficiency requirements called for in executive orders issued by Governor Brown. In May of 2018, Assembly Bill (AB) 1668 and Senate Bill (SB) 606 went into effect, which built upon the executive orders implementing new urban water use objectives for urban retail water suppliers.

---

[54] Without these decreases in per capita water use, water demand for MCWD's current population at 30,480 would be approximately 2,500 AFY higher than its current water demand. This reduced demand on groundwater extraction by MCWD creates an in-lieu recharge benefit to the Monterey Subbasin.

SB 606 and AB 1668 establish guidelines for efficient water use and a framework for the implementation and oversight of the new standards, which must be in place by 2022. The bills call for creation of new urban efficiency standards for indoor use, outdoor use, and water loss, as well as any appropriate variances for unique local conditions. These water use standards will be adopted by the State Water Resources Control Board (SWRCB) by regulation no later than June 30, 2022. Using the adopted standards, each urban retail water agency will annually, beginning January 1, 2024, calculate its own objective.

MCWD plans to continue to implement conservation efforts within its service area to meet and exceed new legislative requirements as part of the "Making Water Conservation a California Way of Life" framework. Potable water demand reductions will be achieved through the following strategies.

- MCWD has adopted design standards and guidelines for new construction that exceed the State's plumbing code requirements for water-conserving features, codified in Section 3.36 of the District Ordinances.
- MCWD will implement demand management measures discussed in Section 7 of its 2020 UWMP.
- Phased redevelopment of the Ord Community will include the replacement of a significant amount of water distribution system that is over 50-years old. These replacements should reduce system water losses.

In addition, MCWD plans on using recycled water to offset non-potable uses or augment groundwater production (see Project M3: M3 – Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse in Section 9.4.6).

9.4.4.1 Relevant Measurable Objectives

The measurable objective benefiting from demand management measures includes:

- **Groundwater elevation measurable objective –** demand management measures will result in less demand on groundwater pumping and higher groundwater levels, particularly near the location of production wells.
- **Groundwater storage measurable objective –** Reducing pumping from the principal aquifers will ultimately have the effect of increasing groundwater in storage.
- **Seawater intrusion measurable objective –** Seawater intrusion has advanced a few miles inland in Monterey Subbasin. Increasing groundwater storage and groundwater elevation will support the natural hydraulic gradient that pushes back against the intruding seawater.

9.4.4.2 Expected Benefits and Evaluation of Benefits

Continued implementation and expansion of demand management efforts will reduce demand on groundwater resources from the Monterey Subbasin and provide in-lieu recharge to the

Subbasin. As described above, the decrease in per capita water use historically provided up to 2,500 AFY of in-lieu recharge benefits. As the population expands, these in-lieu recharge benefits will increase.

Pursuant to Section 7.3 of MCWD's 2020 UWMP:

> *The District will continue to track per capita demand rates to assess overall savings, in addition to comparing water consumption of new residential development against older households and households which have been retrofitted with conservation devices. The District will continually reassess rebate programs to address saturation rates and emerging technologies.*

9.4.4.3 Circumstances for implementation

Implementation of demand management measures is ongoing. No additional circumstances for implementation are necessary.

9.4.4.4 Public Noticing

MCWD's UWMP is updated every five years and documents historical and planned implementation of demand management measures. The plan is adopted by MCWD following a public hearing and is publicly available.

Beginning January 1, 2024, MCWD is anticipated to calculate its urban water use objectives pursuant to SB 606 and AB 1668 and report its water use according to the water use objectives.

9.4.4.5 Permitting and Regulatory Process

As detailed above, MCWD is implementing demand management measures to meet and/or exceed the following legislative requirements:

- **Water Conservation Act -** With the adoption of the Water Conservation Act of 2009, also known as SB x7-7, the state is required to reduce urban water use by 20% by the year 2020. Each urban retail water supplier was required to develop a baseline daily per capita water use ("baseline water use") in their 2010 Urban Water Management Plan (UWMP) and establish per capita water use targets for 2015 and 2020 to help the state achieve the 20% reduction. Per the 2020 UWMP, MCWD's 2020 per capital water demand (or 80 GPCD) was approximately 32% lower than its per capita water use target for 2020 (117 GPCD).
- **SB 606 and AB 1668 water use objectives -** Following the 2014-2016 drought, the State of California developed the "Making Water Conservation a California Way of Life" framework to address the long-term water use efficiency requirements called for in executive orders issued by Governor Brown. In May of 2018, AB 1668 and SB 606 went into effect, which built upon the executive orders implementing new urban water use objectives for urban retail water suppliers.

SB 606 and AB 1668 establish guidelines for efficient water use and a framework for the implementation and oversight of the new standards, which must be in place by 2022. The bills call for creation of new urban efficiency standards for indoor use, outdoor use, and water loss, as well as any appropriate variances for unique local conditions. These water use standards will be adopted by the State Water Resources Control Board (SWRCB) by regulation no later than June 30, 2022. Using the adopted standards, each urban retail water agency will annually, beginning January 1, 2024, calculate its own objective.

- **California plumbing code and design standards -** As discussed above, MCWD has adopted design standards and guidelines for new construction that exceed the State's requirements, including the California Green (CALGreen) Building Code Standards and Model Water Efficient Landscape Ordinance (MWELO).

  CALGreen requires installation of water-efficient fixtures and equipment in new buildings and retrofits. CalGreen includes prescriptive indoor provisions for maximum water consumption of plumbing fixtures and fittings in new and renovated properties. It also allows for an optional performance path to compliance, which requires an overall aggregate 20% reduction in indoor water use from a calculated baseline using a set of worksheets provided with the CalGreen guidelines.

  The MWELO establishes a structure for planning, designing, installing, maintaining and managing water-efficient landscapes in new construction and rehabilitated projects. It promotes low-water use landscaping through more efficient irrigation systems, greywater usage, onsite stormwater capture, and limiting the portion of landscapes that can be covered in turf.

9.4.4.6 Legal Authority

This action is implemented pursuant to MCWD's authority as a public water system. Plumbing standards are adopted in Section 7 of the Marina Coast Water District Code.

9.4.4.7 Implementation Schedule

Implementation of demand management measures is ongoing and will be carried throughout GSP implementation.

9.4.4.8 Estimated Cost

MCWD has increased its conservation program budget in recent years, from a total expense of $336,553 in fiscal year 2018-19 to an estimated budget of $438,000 for fiscal year 2021-22[55]. The major change in conservation program budget over the past five years reflects increases in

[55] MCWD, 2020. Budget Summary of the FY 2020–2021 Draft Budget Memorandum, dated 15 June 2020.

MCWD's educational outreach efforts and resultant demand for rebates and retrofits. It is anticipated that MCWD will maintain its current level of conservation spending.

9.4.5 M2 – Stormwater Recharge Management

The Cities of Marina and Seaside, the two major municipalities within the Marina-Ord Area, have policies that will facilitate additional stormwater catchment and infiltration beyond existing efforts as development and redevelopment occurs.

The City of Marina has historically relied on onsite infiltration as a means of stormwater management and continues to implement policies for onsite infiltration. The City of Marina storm drain design standards specify retention of stormwater runoff from new development or redevelopment sites and require that no runoff from a project site to flow to public streets.

The portion of the City of Seaside within the Monterey Subbasin similarly relies on onsite infiltration of stormwater. Although the City of Seaside historically had not required onsite infiltration of stormwater, the city manages stormwater runoff in accordance with its National Pollutant Discharge Elimination System (NPDES) permit, which is through requirement of Best Management Practices that encourages onsite infiltration or other methods of reducing stormwater runoff. Furthermore, the City of Seaside's recent General Plan update includes policies to promote groundwater recharge by implementing stormwater infiltration.

As discussed in Section 3.5.1.4, redevelopment at the former Fort Ord was governed by the Fort Ord Base Reuse Plan, which was later incorporated into each individual jurisdictional area's land use plans. The 1997 Fort Ord Base Reuse Plan called for eliminating all ocean stormwater discharges and infiltrating all stormwater runoff east of Highway 1. Pursuant to this Plan, most stormwater outfall pipes that historically extended into Monterey Bay has been removed and several percolation basins were constructed west of Highway 1. In addition, the US Army Garrison Presidio of Monterey (USAGPOM) is currently developing plans to decommission a 66-inch diameter stormwater outfall located within the Fort Ord Dunes State Park, anticipated to occur by 2025. The percolation basins were considered temporary with the long-term objective to percolate all stormwater on the east side of Highway 1 as part of the redevelopment of the former Fort Ord. The Fort Ord Storm Water Master Plan (Creegan + D'Angelo, 2005) was prepared to provide guidelines for meeting the obligation for onsite infiltration.

The current and planned urbanized areas within the Marina-Ord Area overlies well-drained, highly permeable dune sands. Infiltration basins or subsurface infiltration systems are effective stormwater disposal methods. It is anticipated that as future development and redevelopment within the Marina-Ord Area occur, additional stormwater from urbanized areas and construction sites will be captured and infiltrated, providing recharge to the groundwater basin.

9.4.5.1 Relevant Measurable Objectives

The measurable objective benefiting from demand management measures includes:

- **Groundwater elevation measurable objective** – Promoting and requiring stormwater infiltration will percolate more water into the subsurface, which will raise groundwater elevations and add water to the principal aquifer(s).
- **Groundwater storage measurable objective** – Adding water to the groundwater system will ultimately have the effect of increasing groundwater in storage.
- **Seawater intrusion measurable objective** – Increasing groundwater storage and groundwater elevations will support the creation of seaward hydraulic gradients that push back against the intruding seawater.

9.4.5.2 Expected Benefits and Evaluation of Benefits

Managed stormwater recharge is expected to increase sustainable yield and groundwater elevations. Runoff occurs when the rate of rainfall exceeds the soil infiltration rate. This project captures and infiltrates this runoff, which would otherwise flow to the ocean, and facilitates recharge to principal aquifer(s). Based on land use, stormwater catchment area, and precipitation data gathered for the Monterey Subbasin Groundwater Flow Model (MBGWFM), it estimated that approximately 540 AFY of stormwater runoff is generated within the current urbanized areas in the Marina-Ord Area. A significant portion of this volume is infiltrated via existing stormwater catchment facilities. The MBGWFM indicates the amount of runoff capture and re-infiltration will increase to approximately 1,100 AFY over time as future development occurs under the existing guidelines. The MBGWFM indicates that net infiltration rates[56] within the Subbasin will increase by approximately 200 AFY to 500 AFY as a result of stormwater catchment and re-infiltration within the Subbasin.

Benefits of stormwater recharge on attaining applicable measurable objectives will be measured using the monitoring networks described in Chapter 7.

9.4.5.3 Circumstances for implementation

Stormwater management policies implemented by the Cities of Marina and Seaside are ongoing. No additional circumstances for implementation are necessary.

9.4.5.4 Public Noticing

No additional public noticing is required.

9.4.5.5 Permitting and Regulatory Process

The Cities of Marina and Seaside comply with the Central Coast Regional Water Quality Control Board's Regional Municipal Stormwater Permit (i.e., Phase II NPDES Permit for Small MS4

[56] Net infiltration is the difference between infiltration that occurs as a result of urban catchment and re-infiltration and naturally occurring infiltration under non-urban conditions.

systems). Both cities are member entities of the Monterey Regional Stormwater Management Program (MRSWMP). The regional program was developed to respond to SWRCB's implementation of the Phase II NPDES Stormwater Program. The purpose of the Phase II NPDES Stormwater Program is to implement and enforce Best Management Practices (BMPs) to reduce the discharge of pollutants from municipal separate storm sewer systems. The municipalities are responsible for conducting their stormwater management program in accordance with the terms of the regional program.

No additional permitting or regulatory process is required of this action.

9.4.5.6 Legal Authority

This action is implemented by local municipalities. Chapter 8.46 of the City of Marina's municipal code and Chapter 8.46 of the City of Seaside's municipal code respectively provide these municipalities the legal authority to manage stormwater discharge within their jurisdictional limits.

9.4.5.7 Implementation Schedule

Implementation of stormwater recharge management is ongoing and will be carried throughout GSP implementation.

9.4.5.8 Estimated Cost

There are no additional costs to implement this project.

9.4.6 M3 – Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse

The project consists of recycled water reuse through landscape irrigation and/or indirect potable reuse (IPR) within MCWD's service area. As described below, the source water for both of these options is recycled water from the Monterey One Water (M1W) Regional Treatment Plant (RTP), which would undergo advanced treatment to meet criteria under Title 22 of the California Code Regulations (CCR) for subsurface applications of recycled water. Advanced treated recycled water is non-potable. Reuse of this water through IPR involves injection into a groundwater aquifer and recovery through an appropriately permitted Groundwater Replenishment Reuse Project (GRRP), which provides seasonal storage and generates potable water that can meet a larger portion of MCWD's water demand beyond irrigation and non-potable needs.

Recycled Water Generation, Collection and Treatment

MCWD operates two wastewater collection systems serving the City of Marina and the Ord Community (i.e., communities within the former Fort Ord). Wastewater is conveyed to the Monterey One Water (M1W) Regional Treatment Plant (RTP) north of Marina. The RTP treats wastewater collected from multiple communities in Monterey County, from Pacific Grove to Moss Landing along the coast and inland to the City of Salinas. In 2020, municipal wastewater flows to the RTP were 19,000 AF, with MCWD contributing 2,170 AF, or 11%. Wastewater is treated to secondary treatment standards at the RTP facilities. That water not designated for further treatment and recycling is discharged via an ocean outfall. Water designated for further treatment is conveyed to either the Salinas Valley Reclamation Plant (SVRP) or the Advanced Water Purification Facility (AWPF), as discussed below.

The SVRP is capable of producing an average of 33,000 AFY of tertiary-treated recycled water. It currently produces about 14,000 AFY of tertiary-treated recycled water meeting the standards of unrestricted reuse under Title 22 of the California Code of Regulations. The majority of the recycled water is delivered to the Castroville Seawater Intrusion Project (CSIP), irrigating farmland in the greater Castroville area and reducing demands on Salinas Valley groundwater. As agricultural demands are seasonal, this capacity cannot be fully utilized year-round.

In 2020, M1W completed the AWPF with a capacity to supply advanced treated water to the Seaside Subbasin for IPR and to meet MCWD's recycled water demand.[57]

In 1989, MCWD entered into an annexation agreement with Monterey Regional Water Pollution Control Agency (MRWPCA; now M1W) for wastewater treatment. This agreement established MCWD's first right to receive tertiary treated wastewater from the SVRP. MCWD has the right to obtain treated wastewater from M1W's RTP equal in volume to that of the volume of MCWD wastewater treated by M1W and additional quantities not otherwise committed to other uses. MCWD's sewer flows will increase over time as MCWD's water demand increases and could be used as source water for a MCWD expansion of the AWPF. Based on MCWD's projected 2040 water demand of 9,574 AFY, it is anticipated that 6,130 AFY of sewer flows will be generated within MCWD's service area. Such wastewater flows could provide 5,500 AFY of net advanced treated water from MCWD[58].

Landscape Irrigation

On April 8, 2016, MCWD and M1W entered into the Pure Water Delivery and Supply Project Agreement, as amended by the 2017 First Amendment, wherein the Product Water Conveyance Facilities were designed, constructed, owned, and operated by MCWD with a capacity sufficient to convey a minimum of 5,127 AFY of advanced treated water, including the 3,700 AFY capacity for M1W and a total of 1,427 AFY capacity for MCWD. Both the 2016 Agreement and the 2017 Amendment are provided in Appendix 9-B. The Product Water Conveyance Facilities include a regional advanced treated water transmission line through Marina, the Ord Community, and into

---

[57] MCWD has the right to utilize up to and including a net 1,427 AFY of the AWPF treatment capacity to serve the Ord Community to implement the recycled water portion of the Regional Urban Water Augmentation Program (RUWAP). The wastewater stream for the MCWD portion of the project is MCWD's own municipal wastewater, which was originally slated for tertiary treatment, in addition to a 650 AFY contribution to RUWAP by MCWRA through M1W during May through August.

[58] During 2020, MCWD generated approximately 2,170 AF of wastewater, which represents approximately 64% of MCWD's total water production of 3,367 AF in 2020. Assuming a similar wastewater flow to water production ratio, MCWD's projected water demand of 9,574 AFY by 2040 would generate approximately 6,130 AFY of wastewater. A total of 6,650 gross sewer flow is available from MCWD for treatment at the AWPF with the additional 650 AFY of gross wastewater flow contributed by MCWRA and M1W.

the City of Seaside and allow delivery of advanced treated water from the AWPF for landscape irrigation within these communities and IPR in the Seaside Subbasin.

The regional transmission line was completed in 2019 and placed in operation in 2020 as part of the Pure Water Monterey Project. With completion of the AWPF and the transmission line, MCWD is currently constructing a recycled water distribution system to allow delivery of its 600 AFY of advanced treated water for landscape irrigation by 2022 (RBF, 2003). This distribution system could increase deliveries for landscape irrigation to as much as 1,427 AFY or more in the future through expansion of the AWPF. MCWD's right to purchase recycled water has a contractual upper limit in the summer months, so providing 1,427 AFY of recycled water supply requires the commitment of summertime flows from M1W and MCWRA. The recycled water distribution system currently under construction and the regional transmission line are shown on Figure 9-7.

Landscape irrigation use of recycled water reduces groundwater demand and thus functions as an in-lieu groundwater recharge project.

IPR in Monterey Subbasin

MCWD conducted a joint, regional three-party study with FORA and M1W for water supply planning for redevelopment of the former Fort Ord (2020 Water Supply Augmentation Study) (EKI, 2020). The 2020 Water Supply Augmentation Study conceptualized various groundwater augmentation and direct supply options for screening and systematic evaluation. The recommended option under the Study was IPR through expansion of the AWPF, injection of advanced treated water into 180/400 Foot Aquifers and/or the Deep Aquifers, and extraction with new and existing MCWD production wells (EKI, 2020).

Advanced treated recycled water is non-potable unless it is injected into a groundwater aquifer and recovered as part of an appropriately permitted Groundwater Replenishment Reuse Project (GRRP). A GRRP provides seasonal storage capacity and generates potable water that can meet a larger portion of MCWD's water demand beyond irrigation and non-potable needs.

As described above, MCWD's sewer flows will increase over time as MCWD's water demand increases and could be used as source water for a MCWD expansion of the AWPF. As described above, based upon projected water demands and sewer flows, approximately 5,500 AFY of net advanced treated water could be generated for IPR by MCWD (minus that used directly for landscape irrigation) by 2040. The majority of this water is more likely to be available during winter/spring months when CSIP is not operational and therefore is more compatible with IPR than landscape irrigation.

The recommended water supply alternative in the 2020 Water Supply Augmentation Study identified three options for IPR injection/extraction of the advanced treated water. These options include:

- Injection into and extraction from the 180/400-Foot Aquifers near existing MCWD 180/400-Foot Aquifer production wells;

- Combined injection/extraction from both 180/400-Foot Aquifer and Deep Aquifer; and
- Injection into and extraction from the Deep Aquifer, near existing MCWD Deep Aquifer wells

The current operation frequency of MCWD's production wells generally ranges from 10% to 40%. These operation frequencies are low and, barring other constraints (e.g., concerns regarding seawater intrusion), could likely be increased to an operational frequency of up to 70% to capture injected water. Additional production wells might need to be constructed to provide additional extraction capacity, depending on the volume and rate of injection. The 2020 Water Supply Augmentation Study evaluated two potential production capacities for the IPR project including 973 AFY and 2,400 AFY. The project could be readily expanded to facilitate injection of additional advanced treated water as it becomes available.

9.4.6.1 Relevant Measurable Objectives

The measurable objective benefiting from recycled water use through landscape irrigation or a IPR project includes:

- **Groundwater elevation measurable objective** – The project provides either in-lieu groundwater recharge by eliminating irrigation demand and direct recharge through IPR. This has the effect of adding water to the principal aquifer(s). Adding water to the principal aquifer will ultimately increase groundwater elevations or decrease their decline.
- **Groundwater storage measurable objective** – Adding water to the groundwater system will ultimately have the effect of increasing groundwater in storage.
- **Seawater intrusion measurable objective** – Increasing groundwater storage and groundwater elevations will support the natural hydraulic gradient that pushes back against the intruding seawater. The option of injection/extraction into the 180/400-Foot Aquifer may provide additional benefits of creating a barrier near MCWD's existing production wells against seawater intrusion.

9.4.6.2 Expected benefits and evaluation of benefits

The primary benefit from recycled water use is to provide an alternative water supply to address the current overdraft in the Subbasin and supply future redevelopment of the former Fort Ord. Using recycled water for landscape irrigation reduces groundwater demand, which provides an in-lieu recharge benefit and is expected to increase groundwater elevations near groundwater productions. IPR application directly recharges the groundwater aquifers, thereby increasing the Subbasin's sustainable yield and groundwater elevations. Based on current and projected wastewater flows, approximately 2,200 AFY to 5,500 AFY advanced treated water may be available to MCWD for landscape irrigation and/or IPR.

The option of injection/extraction into the 180/400-Foot Aquifer may provide additional benefits of protecting MCWD's existing production wells from seawater intrusion and contaminant migration from the former Fort Ord. However, siting of this location is constrained by Fort Ord's Groundwater Protection Zone. Additional modeling and long-term monitoring are required to assess impacts on contaminants migration and seawater intrusion.

Project deliveries will be quantified directly through volumetric measurements of delivered or injected advanced treated water. Benefits towards attaining applicable measurable objectives will be measured using the monitoring networks described in Chapter 7.

9.4.6.3 Circumstances for implementation

As discussed above, MCWD is currently constructing its recycled water distribution system to allow delivery of 600 AFY of recycled water for landscape irrigation by 2023. No additional circumstances for implementation are necessary.

Project planning for AWPF expansion for IPR use is currently ongoing. Permitting, design, and construction efforts will be initiated as soon as funds become available.

9.4.6.4 Public Noticing

Stakeholder engagement is a critical aspect of developing a successful and implementable project. Key stakeholders include the U.S. Army, local governments and adjacent municipalities, as well as the public. MCWD intends to engage stakeholders early in project development.

Before any project initiates construction, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built.

In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA.

9.4.6.5 Permitting and Regulatory Process

Landscape Irrigation

The regulatory requirements for recycled water use for landscape irrigation are defined in California Code of Regulations, Title 22, Article 3. M1W and MCWD have existing permits with the RWQCB to produce, transmit, and distribute advanced treated water for landscape irrigation.

Production of disinfected, advanced treated recycled water at M1W facilities is regulated under Waste Discharge Requirements (WDR) permit Order No. R3-2017-0003. Transmission and distribution of advanced treated water from the M1W AWPF are regulated under Order No. WQ 2016-0068-DDW (General Permit). The General Permit allows MCWD's distribution of advanced treated recycled water for non-residential irrigation use in accordance with its Title 22 Engineering Report approved by the SWRCB in April 2020. The report detailed specific uses and the use area requirements for the advanced treated recycled water produced by M1W. The

General Permit will need to be modified if significant changes are made to the transmission, distribution, storage, or use, and/or the volume or character of the recycled water applied within MCWD's service area.

IPR in Monterey Subbasin

Major permitting processes required for an Advanced Water Treatment Plant (AWTP) expansion and IPR use include CEQA, SWRCB permitting, and RWQCB permitting.

- **California Environmental Quality Act (CEQA) Compliance:** The project will be required to comply with CEQA requirements likely by preparing an environmental impact report (EIR). It is assumed that the EIR would build upon the Pure Water Monterey EIR, and thus may take the form of a supplemental EIR, rather than a standalone EIR.
- **State Water Resources Control Board (SWRCB) Permitting:** Regulations for subsurface application of recycled water are included in CCR Title 22, Division 4, Chapter 3, Article 5.2. These regulations include minimum treatment requirements for full advanced treatment at the AWPF, as well as requirements to demonstrate adequate retention time within the aquifer. The SWRCB Division of Drinking Water (DDW) oversees permitting of such a project.

  Detailed descriptions of all regulatory requirements for the advanced treatment of wastewater as well as implementation of a GRRP are included in Section 2 of the Pure Water Monterey Final Engineering Report (Nellor et. Al., 2017).
- **Regional Water Quality Control Board (RWQCB) permitting:** The Regional Water Quality Control Board is responsible for waste discharge requirements and water recycling requirements for wastewater treatment plants and thus oversees the general water quality effects of discharging treated wastewater into groundwater basins.

  M1W has an existing WDR permit for the Pure Water Monterey project, which applies to both the AWPF, as well as injection of the purified recycled water into the Seaside Subbasin. In order for MCWD to inject the purified recycled water into the Monterey Subbasin, the Pure Water Monterey WDR would either need to be modified to explicitly include this use, or a new WDR would need to be issued by the Central Coast RWQCB.

Additional construction permits are required prior to construction, including but not limited to, City of Marina encroachment permit, grading permit, and building permit, and County approval of use permitting, grading permit, and well construction permit.

9.4.6.6 Legal Authority

This project will be implemented pursuant to MCWD's authority as a water district.

9.4.6.7 Implementation Schedule

Landscape Irrigation

MCWD owns and operates the regional transmission line from the AWPF and is currently constructing a recycled water distribution system that will allow distribution of up to 1,427 AFY to customers. MCWD anticipating delivering its current 600 AFY of advanced treated water available to customers by 2022. MCWD's 2020 UWMP estimates that 950 AFY of landscape irrigation demand can be met by recycled water by 2030 and 1,270 AFY by 2040.

IPR in Monterey Subbasin

MCWD is currently conducting a Recycled Water Feasibility Study to further assess the possibility of implementing an IPR project. The Recycled Water Feasibility Study includes analysis of IPR alternatives using a groundwater flow model and the development of a conceptual design. MCWD anticipates conducting preliminary investigations recommended in the Water Supply Augmentation Study during the first or second year of GSP implementation.

If selected, the IPR project is likely to take between 5 and 7 years from the initiation of additional groundwater investigations through completion of tracer study that is required to be performed within the first year of GRRP operations (Figure 9-6).

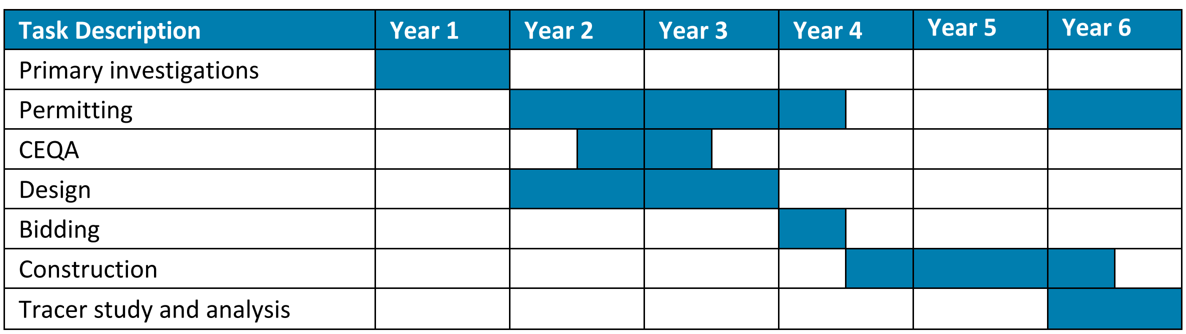


Figure 9-6. Implementation Schedule for MCWD Indirect Potable Reuse

9.4.6.8 Estimated Cost

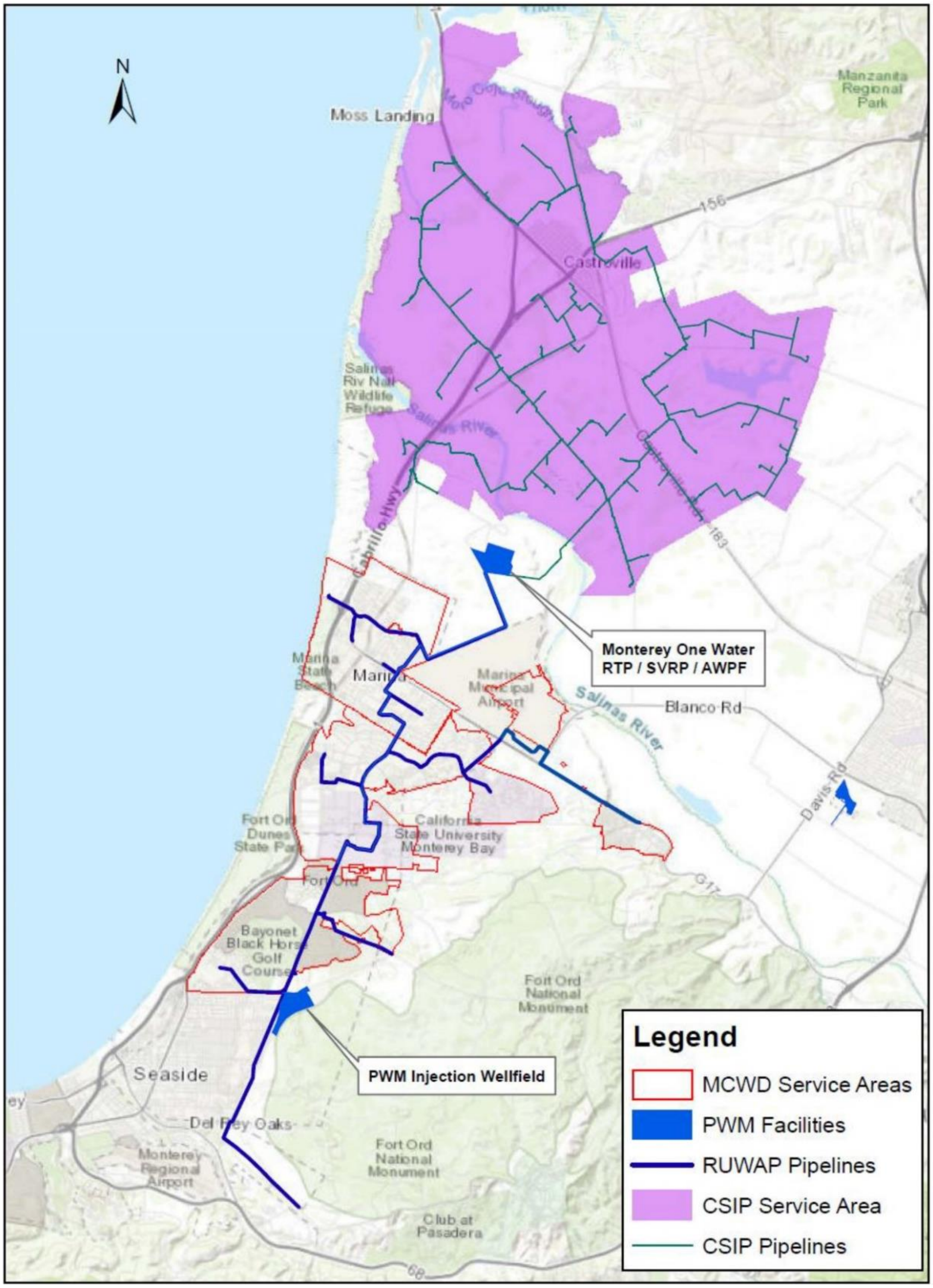
Landscape Irrigation

Infrastructure needed to treat and deliver 1,427 AFY of advanced treated water for landscape and other non-potable uses within MCWD has already been constructed and funded with State Revolving Fund loans and various grants. The estimated unit cost to MCWD of the advanced treated water is approximately $2,400/AFY.

IPR in Monterey Subbasin

Conceptual costs for the IPR option are evaluated as part of the Water Supply Augmentation Study (EKI, 2020) and adjusted to conform with GSP cost assumptions as described in Section 9.3.4. The project includes an AWPF expansion and a new transmission main from M1W to a small injection wellfield in Marina (Figure 9-7). The water would be injected using new wells and extracted using new and existing MCWD production wells. Property or pipeline easement acquisition costs were not included in these estimates. It is assumed that the source water and finished water are available and rights to these sources can be obtained.

Capital plus soft costs (planning environmental, permitting, engineering, legal, mitigation etc.) for IPR use at an assumed 2,400 AFY project capacity are estimated to be approximately $65 million. Annual O&M costs are estimated at $3,110,000 for operation of the AWPF, injection wells, and additional production wells. Total annualized cost is $7,820,000. Based on the assumed project capacity of 2,400 AFY, the unit cost of water is $3,300/AF. Project per unit cost may decrease with economies of scale. Detailed cost estimates and assumptions are included as Appendix 9-A.



Note: The RUWAP pipeline extends to near South Boundary Road in General Jim Moore Boulevard. The extension of the RUWAP pipeline down South Boundary Road (the portion that heads east at the southern part shown herein) is planned but not yet constructed.

Figure 9-7. MCWD Recycled Water System

9.4.7 M4 – Drill and Construct Monitoring Wells

This project includes drilling and construction of monitoring wells screened in the 400-Foot Aquifer and the Deep Aquifers near the southwestern portion of the Subbasin. Additional monitoring wells are needed to fulfill monitoring network data gaps identified in Chapter 7 (Figures 7-7 and 7-8), and investigate several data gaps related to groundwater conditions identified in this area, including

1) Extent of seawater intrusion in the 400-Foot Aquifer and Deep Aquifers,
2) Connectivity between the 400-Foot Aquifer and the Deep Aquifers;
3) The cause of the groundwater depression observed in monitoring wells MPWMD#FO-10S and MPWMD#FO-11S; and
4) The source of elevated chloride detections in monitoring well MPWMD#FO-10S.

The project is assumed to include three monitoring wells in two locations: one cluster of two wells north of monitoring well MPWMD#FO-10, with separate wells in the 400-ft Aquifer and the Deep Aquifers, and one well near the coast screened in the 400-ft Aquifer.

During well drilling and construction, MCWD will collect geological information at the well sites including soil cores and water samples at selected depths, as well as borehole geophysical logs. Collected data will be analyzed to evaluate the quality and movement of groundwater in the 400-Foot and Deep Aquifers in this area. Findings of the hydrogeological analyses will be integrated into future updates of this GSP. Annual induction logging of the Deep Aquifer monitoring well will also provide additional information regarding potential vertical migration of seawater in this area.

In addition, the project may include geochemical analysis and pilot testing of core and groundwater samples to aid in the design of recycled water injection into the southwestern portion of the Subbasin. As discussed in Project M3 M3 – Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse (Section 9.4.6), MCWD is planning to expand its recycled water use for injection into the 400-foot Aquifer and/or Deep Aquifers. The monitoring wells proposed herein are located seaward of production wells in Monterey and Seaside Subbasins. Therefore, groundwater injection in this area may have the additional benefit of protecting production wells in both Subbasins from seawater intrusion. The geochemical work will inform future feasibility studies and site selection of the recycled water project.

General steps for the Project would include:

- Preparation of project scope;
- Identification of field locations and (if needed) negotiation for long-term access to the planned well locations;
- Preparation of bid specifications and a request for proposals ("RFP"); a bid walk with potential drilling contractors; and eventually selection of a drilling contractor and negotiation of contracts;

- Preparation and permitting for drilling and well construction with the local agency (Monterey County Health Department); health and safety planning for the project;
- Site walk with the drilling contractor to identify layout, hazards, traffic, and particular constraints such as the need for sound walls or other mitigation measures at each well location; marking and clearing for buried utilities and other hazards;
- Preliminary well and annular materials design;
- Mobilization of the rig and crew to the wellsite, borehole drilling, collection of soil cores and water samples at selected depths, sampling and logging of drilled materials, and downhole geophysical logging (e.g., induction logging, spinner tests);
- Laboratory analysis of soil hydraulic, mineralogical, and potential contaminant leaching properties;
- Laboratory analysis of water quality constituents,;
- Geochemical compatibility modeling/bench scale pilot studies of potential water quality impacts from recycled water injection;
- Final design of each well and filter pack based on encountered conditions, interpreted geology, and geophysical data, including indications of general water quality and saline conditions;
- Well construction, including casing, filter pack, transition seal, grout, and surface completion;
- Surveying to determine coordinates and elevation of the wells and water level measurement reference points; and
- Development of the wells after at least 72 hours for grout curing; and
- Sampling and water-level gauging of the wells.

9.4.7.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from construction of new monitoring wells described herein include:

- **Groundwater elevation measurable objective –** The proposed monitoring wells will be added to the Subbasin's groundwater elevation monitoring network. After a period of initial monitoring, the GSAs will establish groundwater elevation SMCs at these wells that are consistent with the Subbasin's sustainable goal. Data collected from these wells will inform groundwater elevation measurable objectives in their vicinity and within the Subbasin.
- **Groundwater storage measurable objective –** The proposed monitoring wells will be added to the Subbasin's groundwater storage monitoring network. Groundwater storage

SMCs are defined in this Subbasin using groundwater elevation and seawater intrusion measurements as proxies.

- **Seawater intrusion measurable objective –** The proposed monitoring wells will be added to the Subbasin's seawater intrusion monitoring network. Data collected from this project will fill the existing data gap of seawater intrusion extent near the Monterey-Seaside Subbasin boundary. The GSAs will evaluate initial water quality data collected from these wells and establish additional seawater intrusion SMCs. Annual induction logging will also be performed in the Deep Monitoring well to assess potential vertical migration of the seawater intrusion front. Data collected from these wells will provide additional data regarding seawater intrusion in their vicinity and within the Subbasin.

9.4.7.2 Expected Benefits and Evaluation of Benefits

This project would fill critical data gaps regarding hydrostratigraphy, seawater intrusion, and groundwater recharge mechanisms for the 400-Foot Aquifer and Deep Aquifers that would benefit management towards the abovementioned measurable objectives. The hydrogeologic investigations conducted as part of this project will be incorporated into the hydrogeologic conceptual model of future GSP updates. Data from these monitoring wells will help inform the need, placement, and performance of projects to address potential seawater intrusion into the Monterey Subbasin and the northern Seaside Subbasin.

The proposed monitoring wells will be added to the Subbasin's groundwater elevation, groundwater storage, and seawater intrusion monitoring networks. The GSAs intend to establish additional SMCs at these locations after an initial period of monitoring. Progress towards attaining measurable objectives at these locations will be evaluated pursuant to protocols described in Chapter 7.

9.4.7.3 Circumstances for Implementation

This project will be implemented immediately upon GSP adoption and as soon as easements or right-of-way for access are secured.

9.4.7.4 Permitting and Regulatory Process

Drilling permits from Monterey County Health Department (MCHD) will be required for the project. Final Well Construction Reports after completion of the well must be submitted to the California Department of Water Resources (DWR).

9.4.7.5 Implementation Schedule

After approval and access to the well sites are obtained, project implementation may require 6 - 12 months to complete.

9.4.7.6 Legal Authority

Legal access to the well sites may require negotiation if the sites are on private land. An easement or right-of-way may be required to ensure access to the wells over the timeframe required by SGMA of at least 20 years.

9.4.7.7 Estimated Cost

Based on monitoring well construction and geological analysis conducted for the Pure Water Monterey project the Seaside Subbasin, estimated capital costs of this project are approximately $1,100,000. This cost includes constructing three monitoring wells at two locations as well as geochemical analysis and modeling to evaluate groundwater impacts from injecting AWPF treated water into areas near the monitoring wells.

9.4.7.8 Public Noticing

As with all SGMA projects and management actions, stakeholder input and involvement are crucial for long-term success in sustainable management of groundwater. Normal notification and updates to the project schedule will be implemented as part of regular public meetings and publications.

Corral de Tierra Area Local Projects & Management Actions

9.4.8 C1 – Pumping Allocations and Controls

Pumping allocations are one demand-side approach to managing and controlling pumping. Given limited supply-side options in the Monterey Subbasin, pumping allocations provide a management action to proactively determine how extraction should be fairly divided and controlled if needed.

Pumping allocations divide up the sustainable yield among beneficial users. Pumping allocations are not water rights and cannot determine water rights. Instead, they are a way to determine each extractor’s pro-rata share of groundwater extraction and regulate groundwater extraction. They can be used to:

- Underpin management actions that manage pumping
- Generate funding for projects and management actions
- Incentivize water conservation and/or recharge projects

Pumping allocations can take many forms if it is needed now or in the future. Allocations can be developed based on various criteria. After a Valley-wide workshop on pumping allocations, Subbasin committee members and other stakeholders completed a survey on their preferences for a pumping allocation structure. At the January and both March 2021 Monterey Subbasin Planning Committee meetings, members discussed whether and what type of pumping allocation structure would be appropriate in the Corral de Tierra Area portion of the Monterey Subbasin.

Subbasin committee members passed a motion for an allocations-based demand management, and the criteria that form the basis for the Subbasin's allocations structure would be based on a per connection allocation for small parcels and a per acreage for large parcels. This provides a starting point for the development of an allocation structure within GSP implementation; however, a different allocation structure could be selected at that point.

The hybrid per connection/per acreage allocation structure estimates *de minimis* extraction and subtracts it from the overall sustainable yield. Under this allocation structure, extractors with parcels larger than 5 acres receive an allocation based on acreage, and extractors with parcels smaller than 5 acres receive an allocation on a per connection basis, assuming one connection per parcel. Allocations for municipal water systems would be on a per connection basis. To reduce pumping to meet the sustainable yield, all users would reduce water usage by the same percentage, except for *de minimis* users. Unless *de minimis* users are incorporated into the allocation structure, the total amount estimated for *de minimis* use would be preset and remain the same, thus increasing the portion of the sustainable yield used by *de minimis* users.

Including pumping allocations in the GSP shows that allocations are a management tool that can be further developed during implementation, but it will not establish pumping allocations nor pumping controls. During GSP implementation period, a full stakeholder engagement process and in-depth analysis needs to be undertaken into potential impacts and additional data that needs to be collected. Stakeholder engagement will include outreach to water systems, homeowners, and landowners so that those interested can participate in the establishment of the selected allocation structure.

Developing the selected allocations structure in order to be feasible and effective requires good groundwater extraction data. Two implementation actions that can help are GEMS Expansion and Well Registration.

Pumping allocations could also be used as the basis for pumping fees, which could raise funds for projects and management actions. For example, a fee structure could be defined such that each extractor has a pumping allowance that is based on their allocation, and a penalty or disincentive fee is charged for extraction over that amount. If the sustainable yield is lower than current extraction, a transitional pumping allowance could be developed to transition from a groundwater user's actual historical pumping amounts (estimated or measured) to their allowance based on the sustainable yield. The purpose of this transitional allowance is to ensure that no pumper is required to immediately reduce their pumping, but rather pumpers have an opportunity to reduce their pumping over a set period. Transitional pumping allowances could then be phased out until total pumping allowances in each subbasin are less than or equal to the calculated sustainable yield.

9.4.8.1 Relevant Measurable Objectives

The measurable objectives benefiting from pumping allowance and controls include:

- **Groundwater elevation measurable objective -** Pumping allocations and controls that promote less pumping that will result in higher groundwater levels.
- **Groundwater storage measurable objective -** Reducing pumping from the principal aquifers will ultimately have the effect of increasing groundwater in storage.
- **Land subsidence measurable objective -** Pumping allocations and controls that reduce the pumping stress on the principal aquifers and thereby reduce any potential for groundwater reduction-induced subsidence.
- **Seawater intrusion measurable objective -** Seawater intrusion has advanced a few miles inland in Monterey Subbasin. Conserving groundwater through an allocations structure will support the natural hydraulic gradient that pushes back against the intruding seawater.

9.4.8.2 Expected Benefits and Evaluation of Benefits

The primary benefit expected for this project is that it is another demand-side management tool that would help manage the sustainable yield and help reduce further decline of groundwater elevations. Working within a groundwater budget allows the Subbasin to bring extraction in line with the sustainable yield and mitigate overdraft.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Groundwater storage will be monitored using groundwater extraction measurements. Land subsidence will be measured using InSAR data provided by the Department of Water Resources. Seawater intrusion will be measured using selected Representative Monitoring Sites wells.

9.4.8.3 Circumstances for implementation

SVBGSA will work with the Subbasin stakeholders to collect data needed to establish pumping allocations and undertake additional stakeholder outreach prior to establishing pumping allocations. As part of establishing pumping allocations, SVBGSA will determine whether to implement pumping controls immediately or to establish a trigger based on groundwater conditions, after which controls are implemented.

9.4.8.4 Permitting and Regulatory Process

The GSA Board of Directors will need to authorize the establishment of pumping allocations and controls. The development and implementation of pumping controls is a regulatory activity and would be embodied in a GSA regulation. The regulation could be established to provide for automatic implementation upon existence of specific criteria or to require the vote of the Board to implement.

9.4.8.5 Legal Authority

California Water Code §10726.4(a)(2) provides GSAs the authorities to control groundwater extractions by regulating, limiting, or suspending extractions from individual groundwater wells or extractions from groundwater wells in the aggregate (CWC, 2014). Imposition of pumping allocations and controls will require a supermajority plus vote of the SVBGSA Board of Directors.

9.4.8.6 Implementation Schedule

If selected, the proposed implementation schedule is shown on Figure 9-8. After the establishment of pumping allocations is initiated for the Monterey Subbasin, pumping controls will be implemented only when needed.

Task Description	Year 1	Year 2	Year 3	Year 4	Years 5+
Phase I – Data collection and stakeholder outreach					
Phase II – Establishment of allocation structure					
Phase III – Pumping controls, when needed					

Figure 9-8. Implementation Schedule for Pumping Management

9.4.8.7 Estimated Cost

Development of a pumping allocation structure and pumping controls is approximately $400,000. This includes outreach meetings to engage stakeholders, analysis of potential allocation structures, facilitation of stakeholder dialogues, refinement according to specific situations, and legal analysis. When pumping controls are enacted, there will be additional administrative costs associated with implementation.

9.4.8.8 Public Noticing

As part of the approval of the establishment of pumping allocations in the Monterey, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on it. The general steps in the public notice process will include the following:

- GSA staff will bring an assessment of the need for allocations to the SVBGSA Board in a publicly noticed meeting. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed management action
  - An estimated cost and schedule for the proposed management action
  - Any alternatives to the proposed management action

- The SVBGSA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project, and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

Imposition of pumping allocations and controls may also require a CEQA review process and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). All projects will follow the public noticing requirements per CEQA or NEPA.

9.4.9 C2 – Check Dams

Check dams are small, sometimes temporary dams constructed across streams or rivers to reduce or slow flow. Especially when streambeds have high recharge potential, check dams can increase recharge by holding back water while infiltration occurs, rather than running off in the stream. Most streams in the Corral de Tierra Area are intermittent, flowing less than 25% of the year as a result of generally high infiltration rates and low precipitation rates. A check dam will slow this flow down in order to facilitate the additional infiltration of water and increase recharge to the principal aquifer. Two potential sites for this project have been identified downstream of the confluence of Watson Creek and Calera Canyon. The headwaters of Watson Creek at this location are part of a subwatershed that is approximately 20.5 square miles; this subwatershed is part of the larger El Toro Creek Subwatershed, which drains north to the Salinas River. Alternative sites could be identified during GSP implementation.

At the assumed location along Watson Creek, the creek bed is relatively wide (approximately 50-60 feet) and has significant bank erosion. For the purposes of the cost estimate, an inflatable rubber dam is assumed to serve as a check dam. An inflatable rubber dam has the advantage of remote, automatic control of the dam height promoting operational safety and passage of higher streamflows. A similar, but larger, inflatable dam system is installed along the Salinas River as part of the Salinas River Diversion Facility. Alternative types of check dams, such as more permanent structures built of rock or other materials, may be possible and will be analyzed as part of project design if this project is selected for implementation.

The scoped check dam will be approximately 70 feet in length and approximately 7.5 feet at maximum height. The rubber dam will require a concrete structure that includes both a foundation and transition walls. Housing a compressed air system, power supply and controls will require a control building nearby. Rock slope protection will be installed both upstream and downstream of the facility to address existing areas of eroded streambank and ensure long-term stability. This project also includes a stilling basin and fish passage for the rubber dam for preliminary consideration. This project assumes acquiring ten acres of land for construction of the check dam structure and associated control facilities.

The check dam will detain low streamflows and create a detention volume of approximately 3 AF when runoff is present. The 2-year return interval flow rate for this point of the creek is approximately 218 cfs based on the flow gage measurements from the (United States Geological Survey) USGS gauge that collected data through 2006 (USGS, 2012). The runoff volume for a 2-year, 24-hour rainfall event is estimated to be approximately 250 AF.

The benefit of this project is dependent on the recharge rate from the creek bed into the underlying aquifers. There is hydraulic connectivity between the alluvial sediments in the stream beds and the underlying El Toro Primary Aquifer System. However, the extent of this connectivity is currently unquantified and may be inconsistent with the presence of clay deposits in the subsurface.

9.4.9.1 Relevant Measurable Objectives

The measurable objectives benefiting from outreach and education include:

- **Groundwater elevation measurable objective** - By slowing stormwater and runoff in designated areas along the streambed, there will be more water added to the principal aquifer. This water will be slowed down and allowed to infiltrate, which has the effect of addition water to the aquifer. Adding water into the principal aquifer will raise groundwater elevations over time.
- **Groundwater storage measurable objective** - Furthermore, adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage. Groundwater storage is also calculated from measured groundwater elevations. By raising groundwater elevations, the calculation of change in storage will be less negative, or even positive over time.
- **Land subsidence measurable objective** - Increasing both groundwater elevations and groundwater storage will have the added benefit of preventing any potential land subsidence. Maintaining and adding water in the subsurface will keep pore spaces saturated with positive pressure and inhibit land surface collapse associated with groundwater depletion.

9.4.9.2 Expected Benefits and Evaluation of Benefits

This project will increase sustainable yield and groundwater elevations through enhanced recharge of stormwater and runoff. Runoff occurs when the rate of rainfall exceeds the soil infiltration rate. This runoff then flows over the land surface before accumulating into washes and streams as measurable streamflow. In the initial phases of overland flow, this water often infiltrates into the soils, which enhances soil moisture and can recharge the aquifer. The benefits to increased soil moisture go beyond increased opportunity for recharge. The primary benefit from this project is increased groundwater elevations and storage that results from increased infiltration of stormwater and runoff. The project benefit is anticipated to be 150 AFY

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Various volumetric measurement methods may be installed with this facility to assist in calculating increases in groundwater storage. Land subsidence will be measured using InSAR data provided by the Department of Water Resources.

9.4.9.3 Circumstances for Implementation

The check dam project will be implemented if stakeholders determine it is necessary to reach or maintain sustainability. A number of agreements and rights must be secured before the project is implemented. In particular, access agreements and surface water rights will be pivotal to the project implementation, as detailed below. A more formal cost/benefit analysis must be completed to determine if the check dam will provide quantifiable benefits to the principal aquifer. Site specific analyses will help determine the potential recharge benefit.

9.4.9.4 Permitting and Regulatory Process

Projects described in this section may require a CEQA review process and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). Additionally, permits from a variety of state and federal agencies may be necessary, and any project that coordinates with federal facilities or agencies may require National Environmental Policy Act (NEPA) documentation.

In addition, permits from the following government organizations that may be required for the check dam project include:

- ***Monterey Bay National Marine Sanctuary (MBNMS)*** – All Regional Water Quality Control Board (RWQCB) 404 permits, Section 10 permits, and National Pollutant Discharge Elimination System (NPDES) permits must be reviewed by MBNMS.
- ***United States Fish and Wildlife Service (USFWS)*** – Federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act. Interagency coordination is also required by the Fish and Wildlife Coordination Act (16 U.S. Code §661-667e; the Act of March 10, 1934; ch. 55; 48 stat. 401).
- ***National Oceanic & Atmospheric Administration, Fisheries (NOAA)*** – Federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act.
- ***United States Army Corps of Engineers (USACE) –*** Under the Rivers and Harbor Act, a Section 10 permit (33 U.S. Code §403) is required for the construction of any structure in or over any navigable water of the United States. Under the Clean Water Act, a Section 404 permit (33 U.S. Code §1341) is required to discharge dredge or fill materials into waters of the United States.
- ***State Water Resources Control Board (SWRCB)*** – Construction that disturbs one acre or more of land and that discharges stormwater requires a General Construction

Stormwater Permit (Water Quality Order No. 2009-0009-DWQ). Water quality certification may be required by Section 401 of the Clean Water Act and by the Porter-Cologne Water Quality Control Act (California Water Code §13000 et seq.). Diversion and use require an appropriative water right permit per Water Code §1200 et seq.

- ***California Department of Fish and Wildlife (CDFW)*** – Projects that may result in the taking of a threatened or endangered species require an Incidental Take Permit (California Endangered Species Act Title 14, §783.2). A Streambed Alteration Agreement (California Fish and Game Code Section 1602) is required if the project may substantially adversely affect fish and wildlife resources.
- ***Monterey County*** – If the project encroaches onto any county-maintained road, an Encroachment Permit (Monterey County Code Chapter 14.04) is required from the County. Removal of 3 or fewer trees can be handled by a standalone Tree Removal Permit (Monterey County Code Chapter 16.60). Removal of more than 3 trees should be included in a County Use Permit and/or Coastal Development Permit.
- ***Monterey County Health Department*** – Other required permits include a Well Construction Permit (Monterey County Code Chapter 15.08), permits to construct and operate a desalination treatment facility (Monterey County Code Chapter 10.72), and a variation on Monterey County Noise Ordinance (MCC 10.60.030).
- ***Monterey County Department of Planning and Building Services*** – This project will require a Use Permit (MCC Chapter 21.72 Title 21). A Grading Permit (Monterey County Code Chapter 16.08) is required if total disturbance onsite equals or exceeds 100 cubic yards. An erosion control plan (Monterey County Code Chapter 16.12) is required if there is risk of accelerated (human-induced) erosion that could lead to degradation of water quality, loss of fish habitat, damage to property, loss of topsoil or vegetation cover, disruption of water supply, or increased danger from flooding.
- ***Local jurisdictions*** – Permits may also be required by a local jurisdiction depending on location, including but not limited to: land use permits, building permits, public health permits, public works permits, tree removal permits, and encroachment permits
- ***Landowners*** –Land lease/sale, easements, and/or encroachment agreements may be required.

9.4.9.5 Implementation Schedule

If selected, it will follow the implementation schedule presented on Figure 9-9. The schedule begins after any SWRCB permits are secured. The schedule may vary if a different type of check dam is implemented.

Task Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Phase I – Location and agreements secured						
Phase II – CEQA						
Phase III – Permitting						
Phase IV – Design						
Phase V – Bid/Construct						
Phase VI – Start Up						

Figure 9-9. Implementation Schedule for Check Dams

9.4.9.6 Legal Authority

The SVBGSA will use the legal authority and partnerships for this modified project contained in existing distribution, irrigation, and partnership programs. California Water Code §10726.2 provides GSAs the authority to purchase, among other things, land, water rights, and privileges. This project would be developed in accordance with all applicable groundwater laws and respect all groundwater rights. Section 10726.2 (b) of the California Water Code provides GSAs the authority to, "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency" (CWC, 2014).

The County also has the power to impose charges on a parcel or acreage basis under the County Service Area provisions of the Government Code (beginning with Section 25210). These provisions give the County the authority to provide extended services within a specified area, which may be countywide, and to fix and collect charges for such extended services. Miscellaneous extended service for which county service areas can be established include "water service, including the acquisition, construction, operation, replacement, maintenance, and repair of water supply and distribution systems, including land, easements, rights-of-way, and water rights."

9.4.9.7 Estimated Cost

Capital costs were estimated at $5,143,000. On an annualized basis, assuming a 6% discount rate, and 25-year term, this amounts to $402,300. Including an annual operations and maintenance cost of $22,000 generates a total annualized cost of $424,300. Assuming a yield of 150 AFY, the unit cost for water stored is estimated at $2,830/AFY

9.4.9.8 Public Noticing

Before SVBGSA initiates construction on this project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board and the MCWRA Board in publicly noticed meetings. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed project
  - An estimated cost and schedule for the proposed project
  - Any alternatives to the proposed project
- The SVBGSA Board and the MCWRA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

The permitting and implementation of the check dam will require notification of stakeholders, beneficiaries, water providers, member lands adjacent to the river, and subbasin committee members as well as all permit and regulatory holding agencies such as DWR, NOAA, USACE, and others. In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA or NEPA.

9.4.10 C3 – Recharge Basins from Surface Water Diversions

Surface water in the El Toro Creek watershed can be diverted from the small tributaries, and rerouted to recharge basins to enhance storage, infiltration, and recharge opportunities in this management area. While many of the streambeds have high recharge potential, the topographic relief of the many canyons is too steep and flow in these smaller streams is too intermitted to allow for more storage or recharge. Diverting runoff from these smaller tributaries to recharge basins may allow for increased recharge of the principal aquifer system by increasing the time the water is in contact with permeable sediments in a more stable location.

Four potential locations for recharge basins were identified. El Toro Lake was selected for the development of the cost analysis; however, the other locations, as well as additional locations not yet identified, remain viable options for this project. This project diverts water from Watson Creek downstream of its confluence with Calera Canyon and conveys it to a recharge basin located at El Toro Lake.

El Toro Lake is located in a 0.6 square mile watershed, separate from the watershed for Watson Creek, which drains 20.5 square miles and contributes to El Toro Creek. In this watershed, the two-year, 24-hour storm event with a rainfall depth of 2.31 inches yields a runoff volume of 7.4 AF. However, El Toro Lake has reportedly not filled to its capacity during recent wet weather seasons. Therefore, the watershed contribution is neglected for the initial cost estimate, and it is assumed that diversion and associated pipeline infrastructure from Watson Creek will be required to deliver water to the recharge basin for it to reach storage capacity.

Based on LIDAR topographical data, the storage capacity of El Toro Lake is approximately 32 AF assuming a maximum depth of 4.5 feet and allowing a minimum of 2 feet of freeboard around the perimeter of the lake (NOAA, 2010). Additional surface runoff captured from the Toro Lake subwatershed, or other subwatersheds nearby and retained in the Toro Lake recharge basin may lessen the quantity of water required to be diverted from Watson Creek to maintain a fuller capacity.

The project will require construction of a diversion structure and pump station located downstream of the confluence of Calera Canyon and Watson Creeks, and accessible from Corral de Tierra Road via a new access drive. The diversion structure will include a concrete weir structure set at an elevation to divert flows above a designated flow rate. This structure will include a debris screen, concrete weir, sluice gate, and a gravity pipeline for conveying water to a pump station that will be sized for pumping at a rate of 1,500 gpm (approximately 3.5 cfs). The two-year return interval flow rate for this point of the creek is approximately 218 cfs. The pump station will include a control building for power supply and controls. Water will be conveyed 3,200 linear feet from the diversion pump station to the El Toro Lake recharge basin. The cost estimate also includes a new inlet structure at El Toro Lake for water discharged from the conveyance pipeline.

This project will also acquire 15.7 acres of land that includes El Toro Lake. Easements will be established to allow installation of the new diversion structure and construction of the conveyance pipeline.

9.4.10.1 Relevant Measurable Objectives

The measurable objectives benefiting from outreach and education include:

- **Groundwater elevation measurable objective** - By routing stormwater and runoff into El Toro Lake, there will be more water added to the principal aquifer. This water will be stored in the recharge basin and allowed to infiltrate, which has the effect of addition water to the aquifer. Adding water into the principal aquifer will raise groundwater elevations over time.
- **Groundwater storage measurable objective** - Furthermore, adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage. Groundwater storage is also calculated from measured groundwater elevations. By raising groundwater elevations, the calculation of change in storage will be positive.
- **Land subsidence measurable objective** - Increasing both groundwater elevations and groundwater storage will have the added benefit of preventing any potential land subsidence. Maintaining and adding water in the subsurface will keep pore spaces saturated with positive pressure and inhibit land surface collapse associated with groundwater depletion.

9.4.10.2 Expected Benefits and Evaluation of Benefits

This project will increase sustainable yield and groundwater elevations through enhanced infiltration of diverted stormwater and runoff. Runoff occurs when the rate of rainfall exceeds the soil infiltration rate. This runoff then flows over the land surface before accumulating into washes and streams as measurable streamflow. The benefits to increased soil moisture go beyond increased opportunity for recharge. The primary benefit from this project is increased groundwater elevations and storage that results from increased infiltration of stormwater and runoff. The project benefit is anticipated to be 250 AFY.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Various volumetric measurement methods may be installed with this facility to assist in calculating increases to groundwater storage. Land subsidence will be measured using InSAR data provided by the Department of Water Resources.

9.4.10.3 Circumstances for Implementation

If selected, the creek diversion project will be implemented if stakeholders determine it is necessary to reach or maintain sustainability. A number of agreements and rights must be secured before the project is implemented. Primarily, a more formal cost/benefit analysis must be completed to determine if the creek diversion will provide quantifiable benefits to the principal aquifer. Site specific analyses will help determine the potential recharge benefit.

9.4.10.4 Permitting and Regulatory Process

Projects described in this section may require a CEQA review process and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). Additionally, permits from a variety of state and federal agencies may be necessary, and any project that coordinates with federal facilities or agencies may require National Environmental Policy Act (NEPA) documentation.

In addition, permits from the following government organizations that may be required for the recharge from surface water diversion project include:

- ***United States Army Corps of Engineers (USACE)*** – A Regional General Permit may be required if there are impacts to wetlands or connections to waters of the United States.
- ***California Department of Fish and Wildlife (CDFW)*** – A Standard Agreement is required if the project could impact a species of concern.
- ***Environmental Protection Agency (EPA) Region 9*** – National Environmental Policy Act (NEPA) documentation must be submitted for any project that coordinates with federal facilities or agencies. Additional permits may be required if there is an outlet or connection to waters of the United States.

- ***National Marine Fisheries Service (NMFS)*** – A project may require authorization for incidental take, or another protected resources permit or authorization from NMFS.
- ***State Water Board Stormwater Pollution Prevention Plan (SWPPP)*** – A General Permit to Discharge Stormwater may be required depending on how stormwater is rerouted.
- ***California Department of Transportation (Caltrans)*** – An Encroachment Permit is required if any state highway will be obstructed.
- ***Monterey County*** – A Use Permit may be required. A Grading Permit is required if 100 cubic yards or more of soil materials are imported, moved, or exported. An Encroachment Permit is required if objects will be placed in, on, under, or over any County highway.
- ***Landowners*** –Land lease/sale, easements, and/or encroachment agreements may be required.

9.4.10.5 <u>Implementation Schedule</u>

If selected, this project will follow the implementation schedule that is presented on Figure 9-10. Implementation Schedule for Surface Water Diversions, after any SWRCB permits are secured.

Task Description	Year 1	Year 2	Year 3	Year 4	Year 5
Studies/Preliminary Engineering Analysis	■				
Agreements/ROW	■	■			
CEQA		■	■		
Permitting		■	■		
Design			■	■	
Bid/Construct				■	■

Figure 9-10. Implementation Schedule for Surface Water Diversions

9.4.10.6 <u>Legal Authority</u>

Pursuant to California Water Code sections 10726.2 (a) and (b), the SVBGSA has the right to acquire and hold real property, and to divert and store water once it has acquired any necessary real property or appropriative water rights. Some rights in real property (whether fee title, easement, license, leasehold or other) may be required to implement a recharge project. A diversion permit or a SWRCB 5-year temporary permit is required for the authority to divert water.

9.4.10.7 <u>Estimated Cost</u>

Capital costs were estimated at $5,477,000. On an annualized basis, assuming a 6% discount rate, and 25-year term, this amounts to $428,500. Including an annual operations and maintenance cost of $21,000 generates a total annualized cost of $449,500. Assuming a yield of 250 AFY, based on operation 40 days of the year the unit cost for water stored is estimated at $1,800/AFY.

9.4.10.8 Public Noticing

Before SVBGSA initiates construction on this project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board and the MCWRA Board in publicly noticed meetings. This assessment will include:
    - A description of the undesirable result(s) that may occur if action is not taken
    - A description of the proposed project
    - An estimated cost and schedule for the proposed project
    - Any alternatives to the proposed project
- The SVBGSA Board and the MCWRA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

The permitting and implementation of the diversion will require notification of stakeholders, beneficiaries, water providers, member lands adjacent to the river, and subbasin committee members as well as all permit and regulatory holding agencies such as DWR, NOAA, USACE, and others. In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA or NEPA.

9.4.11 C4 – Wastewater Recycling for Indirect Potable Use

This project will reclaim up to 232 AFY of treated wastewater. This water will be disinfected at tertiary levels for beneficial reuse within the Corral de Tierra Planning Area. Wastewater flow volumes totaling 232 AFY from the California Utility Service (CUS) wastewater treatment plant are available to serve the Toro Park Subdivision and parts of Corral de Tierra Area, as well as potential non-irrigation water uses not served by public water purveyors.

An estimated annual demand of 168.5 AFY from the local golf course and 23.3 AFY from area parks, amount to an approximate total demand of 192 AFY This assumes the golf course's full demand would be utilized by recycled water, which may be an over assumption as golf courses may not utilize recycled water to irrigate their greens. An additional 40 AFY to 80 AFY of demand will need to be identified to completely allocate the treated wastewater for beneficial reuse; there may be additional demand within the community's landscaped open spaces found in the public right of way, private developments, or schools not considered at this time. However, this project assumes the project benefit is equivalent to the entire 232 AFY.

The project assumes construction of a tertiary filtration and disinfection system at the CUS-owned wastewater treatment plant (WWTP). The plant is rated for a design flow of 0.30 MGD and sends its secondary-treated effluent to approximately 112 acres for disposal.

This project will retrofit the existing treatment plant to produce tertiary-disinfected recycled water. A new membrane bioreactor system and ultraviolet (UV) disinfection system is needed, and treatment costs may be lessened depending on the degree to which the existing unit processes may be retained and/or retrofitted. Treated water will be stored within a 300,000-gallon treated water storage tank and ultimately conveyed to the southwest toward open space parks and the golf course located in Corral de Tierra Area. A recycled water pump station rated for a peak flow of 1 MGD will be installed at the plant and 30,900 linear feet (LF) of 10” pipe will deliver the water to the reuse sites. No changes to the plant headworks or equalization storage were assumed for the retrofit.

Project costs associated with onsite storage could be reduced if alternative storage is identified offsite at reuse sites, such as at golf course ponds or recharge basins, which allows the plant to pump recycled water as it is produced to those sites. There may also be an opportunity to re-purpose one of the wet-weather storage ponds at the WWTP as a treated effluent storage pond. The feasibility of each of the different treated water storage alternatives would have to be refined in subsequent planning and design phases.

The pipelines will be installed in the public right-of-way where feasible. Otherwise, temporary construction and permanent access easements will be recorded where the pipelines cross private lands. This project will require easements on 3.25 acres of land. Costs to retrofit the irrigation piping at the parks and golf course to accommodate the recycled water and a small equalization tank and pump station at the golf course are not included at this time. At this conceptual planning stage, the costs for pipeline installation are generic, and do not delineate varying costs for paved and unpaved areas or areas inside or outside the public right of way. In the next phase of planning, pipeline costs can be further reduced by analyzing alignment routes in unpaved and undeveloped areas where costs associated with traffic control, utility crossings, pavement demolition and restoration, and other installation considerations would be reduced. Because the project retrofits existing facilities for treatment and reuse, and proposed pipelines will largely remain in the public right of way, the associated environmental permitting costs for this project may be lower than those for other green field projects. An adjustment to reflect these lower environmental permitting costs may be warranted in future cost estimates for this project.

9.4.11.1 Relevant Measurable Objectives

The measurable objectives benefiting from outreach and education include:

- **Groundwater elevation measurable objective -** By using recycled water instead of pumping groundwater, there will be more water maintained in the principal aquifer. This has the effect of adding water to the principal aquifer. Adding water into the principal aquifer will either raise groundwater elevations or reduce the rate of groundwater elevation decline. Furthermore, using recycled water instead of pumped groundwater passively increases the groundwater elevations by not diminishing them.

- **Groundwater storage measurable objective -** Furthermore, adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage. Groundwater storage is also calculated from measured groundwater elevations. By raising groundwater elevations, the calculation of change in storage will be positive.
- **Land subsidence measurable objective -** Increasing both groundwater elevations and groundwater storage will have the added benefit of preventing any potential land subsidence. Maintaining and adding water in the subsurface will keep pore spaces saturated with positive pressure and inhibit land surface collapse associated with groundwater depletion.

9.4.11.2 Expected Benefits and Evaluation of Benefits

The primary benefit from this project is increased groundwater elevations and storage that results from reduced groundwater extraction. The existing treatment plant will produce approximately 232 AF/yr. of tertiary recycled water for distribution, and therefore, up to that amount of reduced groundwater extraction will be reduced assuming the timing of water delivery aligned with irrigation needs. The exact location of groundwater elevation impacts would depend on where current extraction is reduced, which would need to be determined during the project design phase.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Land subsidence will be measured using InSAR data provided by the Department of Water Resources. Seawater intrusion will be measured using select Representative Monitoring Sites wells.

9.4.11.3 Circumstances for Implementation

If selected, the Toro WWTP project will be implemented if stakeholders determine it is necessary to reach or maintain sustainability. This project retrofits existing facilities for treatment and reuse, and proposed pipelines will largely remain in the public right of way, the associated environmental permitting costs for this project may be lower than those for other green field projects. The upgrades need to be designed, permits and CEQA completed, and recycled water recipients identified before this project can be funded and implemented.

9.4.11.4 Permitting and Regulatory Process

Projects described in this section may require a CEQA review process and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). Additionally, permits from a variety of state and federal agencies may be necessary, and any project that coordinates with federal facilities or agencies may require National Environmental Policy Act (NEPA) documentation.

In addition, permits from the following government organizations that may be required for the check dam project include:

- ***United States Fish and Wildlife Service (USFWS)*** – A Migratory Bird Treaty Act Permit (16 U.S. Code §703-711) may be required from the USFWS. Other federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act. Interagency coordination is also required by the Fish and Wildlife Coordination Act (16 U.S. Code §661-667e).
- ***State Water Resources Control Board (SWRCB)*** – A permit to operate a public water system is required from SWRCB's Division of Drinking Water. Construction that disturbs one acre or more of land and that discharges stormwater requires a General Construction Stormwater Permit (Water Quality Order No. 2009-0009-DWQ).
- ***California Department of Fish and Wildlife (CDFW)*** – Projects that may result in the taking of a threatened or endangered species require an Incidental Take Permit (California Endangered Species Act Title 14, §783.2).
- ***California Department of Transportation (Caltrans)*** – Work that may obstruct a State highway requires an Encroachment Permit.
- ***California Public Utilities Commission (CPUC)*** – A Certificate of Public Convenience and Necessity (California Public Utilities Code §1001 et seq.) is required to show that the project will benefit society.
- ***Monterey County*** – If the project encroaches onto any county-maintained road, an Encroachment Permit (Monterey County Code Chapter 14.04) is required from the County. Removal of 3 or fewer trees can be handled by a standalone Tree Removal Permit (Monterey County Code Chapter 16.60). Removal of more than 3 trees should be included in a Use Permit (see Monterey County Department of Planning and Building Services).
- ***Monterey County Health Department*** – If there will be 55 gallons (liquid), 500 pounds (solid), or 200 cubic feet (compressed gas) of hazardous materials onsite at any one time, a Hazardous Materials Business Plan and a Hazardous Materials Inventory Statement (California Health and Safety Code Chapter 6.95) must be submitted to the Monterey County Health Department's Environmental Health Bureau.
- ***Monterey County Department of Planning and Building Services*** – This project will require a Use Permit (MCC Chapter 21.72 Title 21). A Grading Permit (Monterey County Code Chapter 16.08) is required if total disturbance onsite equals or exceeds 100 cubic yards. An erosion control plan (Monterey County Code Chapter 16.12) is required if there is risk of accelerated (human-induced) erosion that could lead to degradation of water quality, loss of fish habitat, damage to property, loss of topsoil or vegetation cover, disruption of water supply, or increased danger from flooding.

- ***Monterey One Water*** – A Sewer Connection Permit is required to connect to the regional sewer system.
- ***Monterey Bay Air Resources District (MBARD)*** – If the project may release or control air pollutants, an Authority to Construct and Permit to Operate is required (MBARD Rule 200).
- ***Monterey Peninsula Water Management District (MPWMD)*** – An expansion/extension permit is required to expand the current water system (MPWMD Ordinance 96).
- ***Transportation Agency for Monterey County (TAMC)***– An easement for access to and use of the project site may need to be negotiated with TAMC.
- ***Local jurisdictions*** – Permits may also be required by a local jurisdiction depending on location of scalping plant, including but not limited to: land use permits, building permits, public health permits, public works permits, tree removal permits, and encroachment permits.

9.4.11.5 Implementation Schedule

The annual implementation schedule is presented on Figure 9-11.

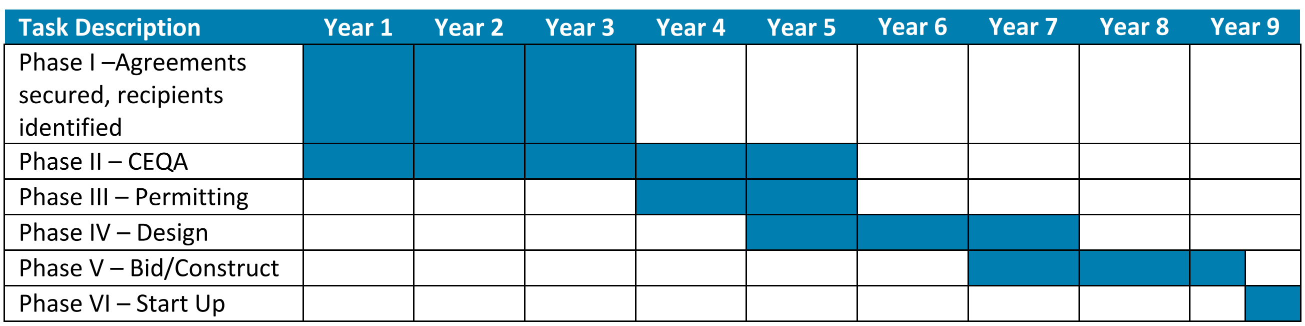


Figure 9-11. Implementation Schedule for Toro WWTP

9.4.11.6 Legal Authority

The SVBGSA will use the legal authority and partnerships for this modified project contained in existing distribution, irrigation, and partnership programs. California Water Code §10726.2 provides GSAs the authority to purchase, among other things, land, water rights, and privileges. This project would be developed in accordance with all applicable groundwater laws and respect all groundwater rights. Section 10726.2 (b) of the California Water Code provides GSAs the authority to, "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency" (CWC, 2014).

The County also has the power to impose charges on a parcel or acreage basis under the County Service Area provisions of the Government Code (beginning with Section 25210). These provisions give the County the authority to provide extended services within a specified area, which may be countywide, and to fix and collect charges for such extended services. Miscellaneous extended service for which county service areas can be established include "water service, including the acquisition, construction, operation, replacement, maintenance, and repair of water supply and distribution systems, including land, easements, rights-of-way, and water rights."

9.4.11.7 Estimated Cost

Capital costs were estimated at $28,635,000. On an annualized basis, assuming a 6% discount rate, and 25-year term, this amounts to $2,240,100. Including an annual operations and maintenance cost of $486,000 generates a total annualized cost of $2,726,100. Assuming a yield of 232 AFY, the unit cost for water delivered is estimated at $11,750/AF.

These costs do not include the wastewater collection system or the distribution system for treated water to be delivered.

9.4.11.8 Public Noticing

Before SVBGSA initiates construction on this project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board and the MCWRA Board in publicly noticed meetings. This assessment will include:
    - A description of the undesirable result(s) that may occur if action is not taken
    - A description of the proposed project
    - An estimated cost and schedule for the proposed project
    - Any alternatives to the proposed project
- The SVBGSA Board and the MCWRA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

The permitting and implementation of the diversion will require notification of stakeholders, beneficiaries, water providers, member lands adjacent to the river, and subbasin committee members as well as all permit and regulatory holding agencies such as DWR, CEQA, NOAA, USACE, and others. In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA or NEPA.

9.4.12 C5 – Decentralized Residential In-Lieu Recharge Projects

This project is a set of initiatives that incentivize homeowners to install decentralized in lieu recharge projects, such as rainwater harvesting, graywater reuse, and recharge features on their properties. Harvested rainwater can be used for residential landscaping and domestic animal water purposes and reduce groundwater pumping, thereby functioning as in-lieu recharge. The two main types of in-lieu recharge are rooftop rainwater harvesting and graywater reuse. Decentralized rainwater capture at the residential scale, or graywater use from a laundry-to-landscape system, can assist property owners with outdoor landscaping watering needs, which is typically a significant portion of an individual household's water use. By substituting rainwater or graywater for outdoor irrigation, less groundwater will be pumped and the Corral de Tierra Area benefits from in-lieu recharge. Water used for landscaping is mostly lost to evapotranspiration and is not available to be returned to the groundwater system. Alternatively, rain gardens can be designed to capture rainwater.

This project will engage property owners through outreach, help identify opportunities for residential-scale rainwater harvesting or graywater reuse systems. This project primarily includes workshops to do outreach and education for homeowners, but could also help install or incentivize installation in the future. For example, it could also include the development of a fund to provide financial incentives to help bring down individual costs associated with rainwater harvesting or graywater systems. This could also be expanded to include other residential-scale conservation efforts, such as xeriscaping or lawn buy-back efforts.

Rain Barrels and Cisterns

Residential rainwater harvesting in rain barrels or cisterns can provide water for outdoor irrigation, and offset the pumping, treatment of, and delivery of groundwater. Appropriately sized cisterns for 2,500 square foot rooftops range from approximately 600 gallons up to 5,000 gallons. Since more of the rain falls in the winter months, having enough storage to last over the summer months is an important factor in sizing cisterns for outdoor irrigation purposes. Use of rainwater for landscaping typically does not require pumping, treatment, or complex delivery systems. Rainwater harvesting at the residential level could be further enhanced with drip-irrigation systems and timers included with the cistern installations.

Rain Gardens

Rainwater could be captured in small, residential rain gardens to enhance use of rainwater to irrigate landscapes rather than groundwater. Rain gardens are vegetated basins installed at residences to capture and detain rainfall runoff while providing an aesthetic landscaping benefit to landowners. The rain garden temporarily holds water, thereby allowing it to infiltrate the soil and provide moisture for plant roots. Rain gardens include grassed swales, rock lined swales (dry creek beds), and bioswales. Bioswales are typically sized for larger catchments than residential scale. Grassed and rock-lined swales, which are shallow channels designed to convey, filter, and infiltrate runoff, are more often used at the residential scale.

Rain gardens are installed at natural low points on the property and are typically planted with native, water-tolerant plants that are able to thrive in saturated soil conditions. They can be installed in a variety of soils, from clays to sands, but are best suited for soils with high infiltration capacities.

Graywater Systems

Graywater reuse systems can provide additional residential in-lieu water use. These systems direct gently used water from showers or laundry onto landscapes to water plants instead of extracted groundwater. For example, Laundry to Landscape systems and are often installed with dual drainage plumbing that enables the water to be directed to either the landscape or wastewater system. Monterey County has developed and approved its own set of graywater guidelines for discharging graywater onto landscapes.

9.4.12.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation measurable objective** – Rainwater harvesting, rain gardens, and graywater reuse will increase rainwater used for irrigation in lieu of pumped groundwater, thereby decreasing groundwater extraction. By pumping less water, it has a similar effect of adding water to the principal aquifer. Adding water into the principal aquifer, it will raise groundwater elevations over time.
- **Groundwater storage measurable objective** – Adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage.

9.4.12.2 Expected Benefits and Evaluation of Benefits

The primary benefit from this project is increased use of rainwater in lieu of groundwater. The Corral de Tierra Area of the Monterey Subbasin is generally characterized by low density or rural density development, covering approximately 11,500 acres with around 3,100 dwellings. A very simplified calculation of potential benefits is applied to the number of dwellings based on a satellite imagery and parcel analysis: there are roughly 2,000 square feet per rooftop receiving 19 inches of rain per year yielding approximately 225 AFY of water potentially available for capture and use. If 75 households implemented rooftop rainwater harvesting, this would yield approximately 5.3 AFY of in-lieu recharge. However, this quantity may be less if rain barrels fill up only once per year in the rainy season. Expected benefits resulting from rain garden installations would be in addition to those described above for rooftop rainwater harvesting. More detailed analyses of land cover and runoff generation are required for refining the evaluation of both rooftop rainwater harvesting systems and rain gardens. During the implementation period, these numbers will be refined that will demonstrate the variation between dry, wet, and normal years. Additionally, these numbers will be refined as more residents implement rainwater capture infrastructure over time.

Increased capture of rainwater will potentially increase groundwater elevations by reducing the amount of residential demand for water for outdoor irrigation. This in-lieu use will yield dividends over a longer period as more residents install rainwater harvesting features, and subsequently use less groundwater for landscaping purposes.

Implementing a laundry-to-landscape program has an expected annual benefit of 0.97 AFY if 75 households in the Corral de Tierra Area installed systems. This is based on an expected water availability of approximately 4,100 gallons per household per April through October season. These values come from assuming a 4-person household, a high efficiency washer that uses 15 gallons per load, and that laundry to landscape water replaces all irrigation water used. Since water for outdoor irrigation takes up a large portion of a household's water use, this would present a significant in-lieu water savings during the hottest and driest months. If the laundry to landscape system was used year-round, the benefits would be higher.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater levels will be measured with a network of wells that is monitored by MCWRA. A direct correlation between groundwater recharge and changes in groundwater levels is unlikely to be observed unless many individual projects are implemented in the same area; however, the program will ask workshop participants about the projects they have implemented and will use that information to estimate reduced extraction.

9.4.12.3 Circumstances for Implementation

Decentralized residential recharge projects can be initiated at any time. Agencies and organizations in the region are already engaged in efforts to promote rainwater harvesting, rain gardens, and graywater reuse systems, and their efforts could be leveraged to expand these projects throughout the Subbasin.

9.4.12.4 Permitting and Regulatory Process

Individuals implementing residential recharge projects are responsible for any required permitting. Due to the small-scale and decentralized nature of these projects, it is not anticipated that these projects are of a magnitude capable of having a demonstrable impact on the environment that would require a California Environmental Quality Assurance (CEQA) review process; however, an applicable permit process will make that determination. Any storage tank sized 5,000 gallons or more will require a permit (WAC, 2021).

For the installation of greywater systems, California Code allows for greywater use from showers, bathtubs, and washing machines, but not from kitchen sinks or dishwashers. The California Plumbing Code Chapter 15 facilitates water conservation, relieves stress on private septic systems, makes legal compliance easily achievable, and provides guidelines for avoiding potentially unhealthful conditions. The Code requires a construction permit for greywater systems that make changes to a home's drain/waste plumbing connected to clothes washers, showers, bathtubs, and bathroom sinks. The Code allows residential greywater landscape irrigation from washing machines to be installed without a construction permit if the system meets all performance guidelines in the Code. For such systems in the unincorporated area of Monterey County on properties containing wells and/or septic systems, residents should apply at the Monterey County Planning Department using the graywater permit template. Applications will be routed to the Monterey County Environmental Health Bureau's Environmental Health Review Services (EHRS) for review to ensure that the graywater system observes required setbacks from onsite wastewater treatment system and wells, if present. City and unincorporated County residents that do not use a well or septic system should contact their Building Department to apply for a graywater permit using the graywater permit template (Central Coast Greywater Alliance, 2020).

9.4.12.5 Implementation Schedule

If this project is selected, the implementation schedule is presented on Figure 9-12. It is anticipated that Phase I will take 2 years. Phase II will overlap with Phase I and take 2 years and be extendable if the project is expanded. Phase III and IV, implementation and ongoing maintenance by residents, will begin in Year 2 and continue into the future.

Task Description	Year 1	Year 2	Year 3	Years 4+
Phase I – Planning and discussions with residents	■	■		
Phase II – Education and outreach		■	■	
Phase III – Implementation by residents		■	■	■
Phase IV – Ongoing maintenance by residents		■	■	■

Figure 9-12. Implementation Schedule for Recharge of Rainwater Initiatives

9.4.12.6 Legal Authority

No legal authority is needed to promote decentralized residential in-lieu recharge projects.

9.4.12.7 Estimated Cost

The success of this project depends on homeowner participation. An important first step is education and outreach. The GSA will host 5 workshops on rainwater harvesting and 5 workshops on graywater reuse for a total cost of $50,000.

Construction costs will be the responsibility of the homeowners with possible incentives from the GSA. A complete rainwater harvesting system for a typical single-family home will generally cost between $4,000 and $10,000, with the largest cost being the storage tank (WAC, 2021). Many of the other costs are the gutters, downspouts, and irrigation distribution systems. At $10,000 for a 5,000- gallon tank and respective system, that equates to an annual cost of $800 and a unit cost of $8,800/AF.

For laundry-to-landscape systems, the costs include dual drainage plumbing, labor, materials, and the irrigation distribution system. These costs are shown in Table 9-3. If each household system costs $2,100 and yields 4,100 gallons from April to October, this equates to an annual cost of $200 and a unit cost of $9,180/AF.

Table 9-3. Costs of a Laundry to Landscape System for one Household

Item	Cost
Dual drainage plumbing	$500
2-3 hours of labor	$400
Materials	$200
Irrigation distribution system	$1,000
Total	**$2,100**

9.4.12.8 Public Noticing

As part of the approval of the program, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on it. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board in a publicly noticed meeting. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed project
  - An estimated cost and schedule for the proposed project
  - Any alternatives to the proposed project
- The SVBGSA Board will notice stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote on whether to approve design and construction of the project.

In addition to the public noticing detailed above, if CEQA is applicable, the public noticing requirements will be followed.

9.4.13 C6 – Decentralized Stormwater Recharge Projects

This project promotes the installation of stormwater collection features in neighborhood locations downstream of typical flooding spots for the purpose of groundwater recharge. These projects are typically larger than the household-scale projects and have greater potential for the water to reach the local principal aquifers because as more water is captured, larger basins are more able to harness the power of gravity to saturate the subsurface all the way to the aquifer. Secondary benefits are potential improvement to surface water quality and flood hazard mitigation.

Anticipated climate change may bring more frequent and extreme precipitation events to this subbasin. When rainfall is concentrated in a short time period rather than spread out, more stormwater runs off rather than infiltrates, which reduces recharge to the principal aquifers. Runoff flows out of the Subbasin, but recharge features can capture and recharge a portion of the stormwater. By using proactive stormwater diversion, collection, and infiltration management techniques, groundwater conditions can improve in this Subbasin.

For this project, SVBGSA will engage in outreach, identify opportunities for neighborhood-scale stormwater routing and collection features, and potentially establish a fund to provide financial incentives to encourage their installation in residential areas. For new urban developments, Monterey County has adopted Post-Construction Requirements that require projects to implement low impact development techniques to better enable water infiltration before it becomes runoff. SVBGSA's efforts could be done in conjunction with other rainwater and floodwater efforts scaled to and applied at different locations for a variety of benefits and recharge impacts.

These decentralized stormwater recharge projects include a range of features, such as bioswales, small surface recharge basins, drywells, or other specific capture structures for enhanced infiltration and recharge purposes. This water can also be captured and used for irrigation in lieu of groundwater. Projects may require additional infrastructure and/or maintenance costs.

Bioswales

The routed stormwater could be collected in a series of swales, or into a small recharge basin, or a combination of both depending on land availability and permissions from landowners and neighborhood groups. The 3 primary types of swales are grassed swales, rock lined swales (dry creek beds), and bioswales. Vegetation in the swales slows stormwater, allows sediments to filter out, and can help remove nutrients. Bioswales are vegetated swales that use engineered media beneath the swale to reduce runoff volume and peak runoff rates. Bioswales have a greater capacity for water retention, nutrient removal, and pollutant removal.

Small Surface Recharge Basins

Stormwater could be diverted and captured in small, surface retention basins where it can infiltrate and provide decentralized, indirect recharge opportunities. These small basins can help reduce peak flooding on streets and prevent erosion or damage to the roadways from storms.

Soils greatly influence the extent of groundwater recharge and where recharge projects would be most beneficial. Infiltration of precipitation into the subsurface is dependent on a number of factors such as soil texture, soil organic content, slope, root zone depth, and salinity. High slopes through much of the Subbasin increase run-off and decrease infiltration. According to the Soil Survey Geographic Database (SSURGO), the Corral de Tierra Area has a roughly even mix of high and low infiltration rate soils. The soils with the highest designated recharge potential are generally located near the center of the Corral de Tierra Area, and along canyon bottoms where alluvial sediments have accumulated (Figure 4-7).

Dry Wells

Recharge basins can be coupled with dry wells that direct water into the subsurface, thus helping water infiltrate into the unsaturated region above the water table. Dry wells can also help circumvent locations with a lot of clay near the surface by providing screens in more permeable sediments. Site-specific analyses would be required to properly design and install these features for maximum benefit to the principal aquifer.

In Lieu Reuse

Stormwater can also be routed for retention and reuse to irrigate common areas within residential communities, medians, parks, and large building landscaping. This functions as in-lieu recharge, as it reduces the amount of groundwater needed for irrigation.

9.4.13.1 Relevant Measurable Objectives

Relevant measurable objectives benefiting from this project include:

- **Groundwater elevation measurable objective** - Using decentralized stormwater projects will increase water that recharges the principal aquifer, or if used in lieu of pumped groundwater for irrigation will decrease groundwater extraction. By pumping less water, it has a similar effect of adding water to the principal aquifer. Adding water into the principal aquifer through direct recharge or in-lieu use will raise groundwater elevations over time.
- **Groundwater storage measurable objective** - Adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage.

9.4.13.2 Expected Benefits and Evaluation of Benefits

The primary benefit from this project is increased groundwater recharge. The Corral de Tierra Area covers an area of approximately 11,500 acres, with multiple small drainages interspersed throughout. The number of small drainages is unknown; however, if 1% of the acreage of the management area is utilized for stormwater capture, that would allow for 115 acres receiving roughly 19 inches of precipitation annually to generate 182 AFY of stormwater runoff to be routed and captured, assuming the applications are large enough to capture all stormwater during rain events. This water can be routed and captured in small neighborhood bioswales, basins, drywells, or even sent directly to agricultural lands. During the implementation period, these numbers will be refined with flood studies that are more location specific and accurate; that will demonstrate the variation between dry, wet, and normal years. Additionally, these numbers will be refined as various neighborhoods implement stormwater capture infrastructure over time.

Increased storage of runoff will potentially increase groundwater elevations in the vicinity of the stormwater capture facilities. This typically will be seen as groundwater mounding. However, as more water is emplaced in the subsurface, more water will flow laterally, thereby expanding the zone of influence from each stormwater capture basin outward and raising groundwater elevations laterally. Additionally, proper maintenance can minimize recharge system losses, and maximize potential infiltration and subsequent storage.

Changes in groundwater elevation will be measured with the groundwater level monitoring program detailed in Chapter 7. A direct correlation between floodwater recharge and changes in groundwater elevations may be possible if located close enough to existing monitoring wells. Additionally, various volumetric measurement methods will be installed along with either recharge basins or dry wells to assist in calculating increases to groundwater storage.

9.4.13.3 Circumstances for Implementation

Decentralized stormwater recharge projects can be initiated at any time. Agencies and organizations in the region are already engaged in efforts to promote stormwater recharge, and their efforts could be leveraged. Among other organizations, the Monterey County Public Works Department (MCPWD) are both engaged in efforts to manage runoff and have set the stage for consideration integrated solutions of runoff and infiltration in these watersheds. Site specific analyses are required to determine the potential recharge benefit.

9.4.13.4 Permitting and Regulatory Process

Projects described in this section may require a CEQA review process and may require an Environmental Impact Report or a Mitigated Negative Declaration (the review could also result in a Negative Declaration or Notice of Exemption). Additionally, permits from a variety of state and federal agencies may be necessary, and any project that coordinates with federal facilities or agencies may require National Environmental Policy Act (NEPA) documentation.

There may be a number of local, county, and state permits, rights of way, and easements required depending on bioswale or conveyance alignments and retention basins. Projects with dry wells will require a well construction permit.

9.4.13.5 Implementation Schedule

If this project is selected, it will follow the implementation schedule presented on Figure 9-13. It is anticipated that Phase I will take 2 years. Phase II will overlap with Phase I and take 2 years. Phase III, site selection and construction, will occur in years 3 and 4. Ongoing maintenance will continue in Year 4 and beyond.

Task Description	Year 1	Year 2	Year 3	Year 4	Years 5+
Phase I - Planning and discussions with neighborhoods					
Phase II - Surveying of top selected sites					
Phase III - Site selection and construction					
Phase IV - Ongoing maintenance					

Figure 9-13. Implementation Schedule for Recharge of Stormwater Capture Initiatives

9.4.13.6 Legal Authority

No legal authority is needed to promote decentralized stormwater recharge projects. For the implementation of projects, pursuant to California Water Code sections 10726.2 (a) and (b), the SVBGSA has the right to acquire and hold real property, and to divert and store water once it has acquired any necessary real property or appropriative water rights. Some rights in real property (whether fee title, easement, license, leasehold or other) may be required to implement a recharge project. A permit to appropriate water may not needed to infiltrate stormwater if constructed on a parcel without a USGS blue line stream. If a blue line stream crosses the parcel, SVBGSA will evaluate whether a permit is needed. SVBGSA recognizes that this process takes several years to complete. If a permit is needed, SVBGSA will pursue a SWRCB 5-year temporary permit under the Streamlined Permit Process while it applies for the diversion permit.

9.4.13.7 Estimated Cost

The construction cost for the decentralized stormwater recharge projects is unable to be estimated until specific projects are scoped. This project is designed as a program that encourages developers, municipalities, homeowners' associations, and landowners to install stormwater recharge projects and assists with initial planning costs. The program costs approximately $150,000-$200,000 for strategic outreach, assistance with site assessments, assessment of recharge potential, and help securing grant funds. This amount would fund cone penetration tests to assess recharge potential for 4 to 6 sites. If needed to increase implementation of stormwater recharge projects, SVBGSA could provide monetary incentives or fund and implement the projects themselves. Each site-specific project will have its own associated costs based on the level of complexity of the stormwater capture technique. These span from non-vegetated basin to capture and infiltrate stormwater to recharge basins coupled with dry wells. The project-specific construction costs will be estimated based on initial site assessments and feasibility studies.

9.4.13.8 Public Noticing

Before SVBGSA initiates construction on any project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board in a publicly noticed meeting. This assessment will include:
  - A description of the undesirable result(s) that may occur if action is not taken
  - A description of the proposed project
  - An estimated cost and schedule for the proposed project
  - Any alternatives to the proposed project

- The SVBGSA Board will notice stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote on whether to approve design and construction of the project.

In addition to the public noticing detailed above, all projects will follow any public noticing requirements required by CEQA. If projects are undertaken by other public agencies or private entities or persons, the implementing agency or private entity or person will be responsible for obtaining the appropriate permit (if any) and undertaking required public noticing.

9.4.14 C7 – Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley

This project undertakes additional groundwater production in the Upper Corral de Tierra Valley for distribution in the Lower Corral de Tierra Valley for supplementary water supply. Although additional sites may be identified in the future, this project is scoped for locating the extraction at the artesian well in Watson Creek, with delivery to El Toro Lake, where it can be picked up by a water system to be used in lieu of groundwater extraction or recharged. The existing artesian well supplies water to local water systems in the near vicinity, and reportedly can supply more than the existing demand. However, well yield data is not available. This project includes the construction of a new extraction well at the artesian well location and a conveyance pipeline to El Toro Lake, approximately 3.4 miles to the northwest of the site. Water systems may connect to the conveyance pipeline at El Toro Lake, or the water could be temporarily stored there and recharged, depending on the recharge potential.

Although further site scoping and project design are needed, this project would likely require a surge tank, conveyance pipeline, and connection to water systems that would treat the water prior to use. Due to artesian well conditions, a pump was excluded from the conceptual estimate. Easements may be needed to allow for the installation of the new well, construction of the conveyance pipeline, and storage or recharge site.

9.4.14.1 Relevant Measurable Objectives

The measurable objectives benefiting from outreach and education include:

- **Groundwater elevation measurable objective** - By routing excess artesian groundwater from one location to a recharge basin, there will be more water added to the El Toro Primary Aquifer System nearby areas of groundwater elevation decline. This water will be used in lieu of pumping or allowed to infiltrate at Toro Lake, both of which have the effect of adding water to the aquifer. Adding water into the principal aquifer will raise groundwater elevations over time.
- **Groundwater storage measurable objective** - Furthermore, adding water to the principal aquifer will ultimately have the effect of increasing groundwater in storage. Groundwater

storage is also calculated from measured groundwater elevations. By raising groundwater elevations, the calculation of change in storage will be positive.

- **Land subsidence measurable objective** - Increasing both groundwater elevations and groundwater storage will have the added benefit of preventing any potential land subsidence. Maintaining and adding water in the subsurface will keep pore spaces saturated with positive pressure and inhibit land surface collapse associated with groundwater depletion.

9.4.14.2 Expected Benefits and Evaluation of Benefits

This project will increase sustainable yield and groundwater elevations through capturing and routing excess artesian groundwater to Lower Corral de Tierra Valley. Artesian conditions occur when the pressure of groundwater is greater than the ground surface elevation, and this groundwater is allowed to easily find the surface. Utilizing excess artesian groundwater presents an opportunity to offset groundwater pumping elsewhere without negatively impacting the current demands on the artesian source. The primary benefit from this project is increased groundwater elevations and storage in the Lower Corral de Tierra Valley that results from in lieu use or increased infiltration of this excess artesian groundwater in El Toro Lake. The project benefit is anticipated to be 160 AFY.

Benefits will be measured using the monitoring networks described in Chapter 7. Groundwater elevations will be measured with a network of wells that is monitored by MCWRA. Various volumetric measurement methods may be installed with this facility to assist in calculating increases to groundwater storage. Land subsidence will be measured using InSAR data provided by the Department of Water Resources.

9.4.14.3 Circumstances for Implementation

If selected, the artesian well project will be implemented if stakeholders determine it is necessary to reach or maintain sustainability. A number of agreements and rights must be secured before the project is implemented. Primarily, a more formal cost/benefit analysis must be completed to determine if the artesian well will provide quantifiable benefits to the principal aquifer. Site specific analyses will help determine the potential recharge benefit.

9.4.14.4 Permitting and Regulatory Process

Permits from the following government organizations that may be required for this project include:

- ***United States Fish and Wildlife Service (USFWS)*** – Federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act. Interagency coordination is also required by the Fish and Wildlife Coordination Act (16 U.S. Code §661-667e).

- ***National Oceanic & Atmospheric Administration, Fisheries (NOAA)*** – Federal agencies involved in the permitting process for this project may need to consult with USFWS in compliance with Section 7 of the Endangered Species Act.
- ***State Water Resources Control Board (SWRCB)*** – A permit to operate a public water system is required from SWRCB's Division of Drinking Water (California Health and Safety Code §116525). Construction that disturbs one acre or more of land and that discharges stormwater requires a General Construction Stormwater Permit (Water Quality Order No. 2009-0009-DWQ). Diversion and use require an appropriative water right permit per Water Code §1200 et seq.
- ***California Department of Parks and Recreation*** – Federal agencies involved in this project are required to consult with the Department of Parks and Recreation's State Historic Preservation Officer in accordance with Section 106 of the National Historic Preservation Act (16 U.S. Code §470).
- ***California Public Utilities Commission (CPUC)*** – A Certificate of Public Convenience and Necessity (California Public Utilities Code §1001 et seq.) is required to show that the project will benefit society.
- ***Monterey County Health Department*** – If there will be 55 gallons (liquid), 500 pounds (solid), or 200 cubic feet (compressed gas) of hazardous materials onsite at any one time, a Hazardous Materials Business Plan and a Hazardous Materials Inventory Statement (California Health and Safety Code Chapter 6.95) must be submitted to the Monterey County Health Department's Environmental Health Bureau. Other required permits include a Well Construction Permit (Monterey County Code Chapter 15.08) and a variation on Monterey County Noise Ordinance (Monterey County Code 10.60.030).
- ***Monterey County Department of Planning and Building Services*** – This project will require a Use Permit (Monterey County Code Chapter 21.72 Title 21). A Grading Permit (Monterey County Code Chapter 16.08) is required if total disturbance onsite equals or exceeds 100 cubic yards. An erosion control plan (Monterey County Code Chapter 16.12) is required if there is risk of accelerated (human-induced) erosion that could lead to degradation of water quality, loss of fish habitat, damage to property, loss of topsoil or vegetation cover, disruption of water supply, or increased danger from flooding.
- ***Monterey County*** – If the project encroaches onto any county-maintained road, an Encroachment Permit (Monterey County Code Chapter 14.04) is required from Monterey County's Public Works & Facilities division. Removal of 3 or fewer trees can be handled by a standalone Tree Removal Permit (Monterey County Code Chapter 16.60). Removal of more than 3 trees should be included in a Use Permit (see Monterey County Department of Planning and Building Services).
- ***Monterey County Water Resource Agency (MCWRA)*** – Participation/ easements/ purchase agreements

- ***Transportation Agency for Monterey County (TAMC)***– An easement for access to and use of the project site may need to be negotiated with TAMC.
- ***Local jurisdictions*** – Permits may also be required by a local jurisdiction depending on location of scalping plant, including but not limited to: land use permits, building permits, public health permits, public works permits, tree removal permits, and encroachment permits
- ***Landowners*** –Land lease/sale, easements, and/or encroachment agreements may be required.

9.4.14.5 Implementation Schedule

The annual implementation schedule is presented on Figure 9-14.

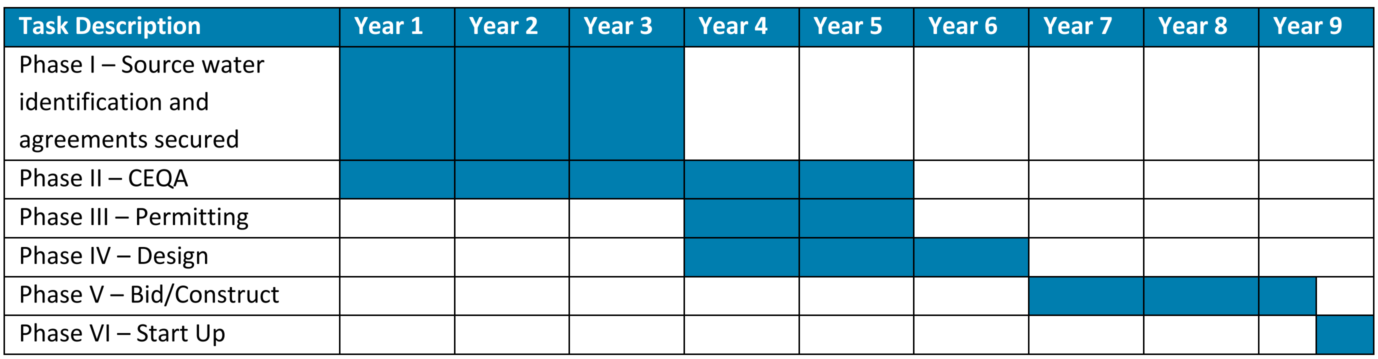


Figure 9-14. Implementation Schedule for Artesian Well

9.4.14.6 Legal Authority

The SVBGSA will use the legal authority and partnerships for this modified project contained in existing distribution, irrigation, and partnership programs. California Water Code §10726.2 provides GSAs the authority to purchase, among other things, land, water rights, and privileges. This project would be developed in accordance with all applicable groundwater laws and respect all groundwater rights. Section 10726.2 (b) of the California Water Code provides GSAs the authority to, "Appropriate and acquire surface water or groundwater and surface water or groundwater rights, import surface water or groundwater into the agency, and conserve and store within or outside the agency" (CWC, 2014). Some rights in real property (whether fee title, easement, license, leasehold or other) may be required to implement the project.

The County also has the power to impose charges on a parcel or acreage basis under the County Service Area provisions of the Government Code (beginning with Section 25210). These provisions give the County the authority to provide extended services within a specified area, which may be countywide, and to fix and collect charges for such extended services. Miscellaneous extended service for which county service areas can be established include "water service, including the acquisition, construction, operation, replacement, maintenance, and repair of water supply and distribution systems, including land, easements, rights-of-way, and water rights."

9.4.14.7 Estimated Cost

Capital costs were estimated at $13,275,000. On an annualized basis, assuming a 6% discount rate, and 25-year term, this amounts to $1,038,500. Including an annual operations and maintenance cost of $9,000 generates a total annualized cost of $1,047,500. Assuming a yield of 160 AFY, the unit cost for water stored is estimated at $6,550/AFY.

9.4.14.8 Public Noticing

Before SVBGSA initiates construction on this project, it will go through a public notice process to ensure that all groundwater users and other stakeholders have ample opportunity to comment on projects before they are built. The general steps in the public notice process will include the following:

- SVBGSA staff will bring an assessment of the need for the project to the SVBGSA Board and the MCWRA Board in publicly noticed meetings. This assessment will include:
    - A description of the undesirable result(s) that may occur if action is not taken
    - A description of the proposed project
    - An estimated cost and schedule for the proposed project
    - Any alternatives to the proposed project
- The SVBGSA Board and the MCWRA Board will notify stakeholders in the area of the proposed project and allow at least 30 days for public response.
- After the 30-day public response period, the SVBGSA Board will vote whether or not to approve design and construction of the project and notify the public if approved via an announcement on the SVBGSA website and mailing lists.

The permitting and implementation of the diversion will require notification of stakeholders, beneficiaries, water providers, member lands adjacent to the river, and subbasin committee members as well as all permit and regulatory holding agencies such as DWR, NOAA, USACE, and others. In addition to the public noticing detailed above, all projects will follow the public noticing requirements per CEQA or NEPA.

9.5 Implementation Actions

Implementation actions include actions that contribute to groundwater management and GSP implementation but do not directly help the Subbasin reach or maintain sustainability.

9.5.1 I1 – 180/400-Foot Aquifer Subbasin GSP Implementation and Seaside Watermaster Actions

Due to the interconnectivity between the Monterey Subbasin and the adjacent critically overdrafted 180/400-Foot Aquifer Subbasin, sustainable groundwater management will need to be achieved jointly within these subbasins. The 180/400-Foot Aquifer Subbasin GSP establishes minimum thresholds, measurable objectives, and groundwater sustainability goals for this subbasin. The primary goal of this implementation action is to assist attaining sustainable management of the Monterey Subbasin through support of regional planning and project implementation efforts that have been selected for the 180/400-Foot Aquifer Subbasin.

This action includes MCWD's continued support of projects implemented in the 180/400 Subbasin and in the larger Salinas Valley Basin, particularly those that address regional seawater intrusion, provides recharge or alternative water supplies to coastal areas, and/or improve Deep Aquifer conditions near the Monterey-180/400 Subbasin boundary. Such projects are identified in the 180/400 Subbasin GSP including:

- CSIP Optimization
- M1W Winter Modification
- CSIP Expansion
- Maximum State Disaster Response Fund (SDRF) Diversion

As mentioned in Chapter 8, the Subbasin GSAs are working to fill monitoring network data gaps in the Deep Aquifers immediately north of the Marina-Ord Area. As it does so, SMCs for minimum thresholds for additional Deep Aquifer monitoring sites will be established. MCWD will work with SVBGSA to take a coordinated approach to SMCs development and project implementation that considers conditions and management goals in both of these subbasins.

In addition to SGMA implementation efforts, the Subbasin's water users support regional water planning conducted the MCWRA through contribution to zones of benefit. The majority of the Subbasin is included in MCWRA Zones 2C, 2Y, and 2Z as discussed in Section 3.2.2.2.

The Seaside Subbasin is an adjudicated basin not subject to SGMA, and as such does not follow the same management structure or goals as the Monterey Subbasin. However, the two subbasins are hydrologically connected, and actions to meet adjudication goals in the Seaside Subbasin will have an impact on the Monterey Subbasin. The Seaside Watermaster Board is currently discussing adding protective groundwater elevations to their original pumping reductions goals in an effort to move towards a more sustainable management approach. These conversations are ongoing and will include the active collaboration with the GSAs in order to decide on protective elevations that are analogous to the established groundwater elevation SMCs outlined in Chapter 8 of this GSP.

9.5.2 I2 – Deep Aquifers Investigation

The Deep Aquifers underlying portions of the Salinas Valley Basin are a critical groundwater resource that is highly valued but minimally understood. Over the decades, as seawater intrusion has advanced into the 180-Foot and 400-Foot aquifers of the 180/400-Foot Aquifer Subbasin, agricultural landowners and drinking water providers have drilled wells deeper to access freshwater. The need for additional studies about the Deep Aquifers has been identified in the context of stopping seawater intrusion and effectively managing groundwater sustainability.

The 180/400-Foot Aquifer Subbasin GSP Section 9.3.6 Priority Management Action 5: Support and Strengthen Monterey County Restrictions on Additional Wells in the Deep Aquifers, calls for the SVBGSA to support the County extending ordinance 5303 to prevent any new wells from being drilled into the Deep Aquifers until more information is known about the Deep Aquifers' sustainable yield. The plan was to complete the study of the Deep Aquifers over the subsequent years, when funding became available. While the ordinance has expired, the plan for the study of the Deep Aquifers has developed.

To address seawater intrusion in the 180/400-Foot Aquifer, the SVBGSA created the Seawater Intrusion Working Group (SWIG), as detailed in Section 9.5.5 below. The SWIG membership comprises nine agencies and municipalities and multiple stakeholders to develop consensus on the current understanding of seawater intrusion in the Subbasin and adjacent subbasins subject to seawater intrusion, identify data gaps, and develop a broad-based plan for controlling seawater intrusion. Working together with a Technical Advisory Committee (TAC), the SWIG identified key tasks that could be included in the Deep Aquifers Study. GSA staff began to meet with stakeholders and partner agencies to determine if there was a reasonable and equitable path forward for securing funding to initiate this study.

A Cooperative Funding Proposal has been developed for the Deep Aquifers Study. The Study will focus on describing the geology, hydrogeology, and extents of the Deep Aquifers, the Deep Aquifers water budgets, and addressing the economic and administrative constraints on extracting from the Deep Aquifers. The study will include guidance on management issues and also propose and initiate a Deep Aquifers Monitoring Program. The Study is expected to begin in 2022 and take one to two years to complete. The GSAs will incorporate findings of the Deep Aquifers Study into future GSP updates to ensure that the study and the development of future regulations will promote groundwater sustainability of the Deep Aquifers as defined in this GSP.

Particularly within the Monterey Subbasin, MCWD GSA and SVBGSA will facilitate data collection and share information during the study process. Such data collection efforts and information will include:

- Deep Aquifer information collected to date within the Monterey Subbasin, such as lithologic, geophysical, groundwater elevation, and water quality data;
- Completion of additional Deep Aquifer groundwater monitoring wells to address data gaps in the southwestern portion of the Monterey Subbasin (see Project M4: M4 – Drill and Construct Monitoring Wells in Section 9.4.7);

- Annual induction logging of Deep Aquifer wells in the Monterey Subbasin;
- Participating in the Seawater Intrusion Working Group (see Section 9.5.5),
- Attending coordination meetings stakeholders, providing comments to draft study work products, and incorporating its findings into understanding of Basin Setting in the Monterey Subbasin.

9.5.3 I3 – Support Monterey County's Final Well Construction Ordinance to Protect Deep Aquifers

Due to identified concerns regarding the risk of seawater intrusion into the Deep Aquifers the Monterey County Board of Supervisors adopted Ordinance No. 5302 in May 2018, pursuant to Government Code Section 65858. The ordinance was an Interim Urgency Ordinance, which took effect immediately upon adoption. The ordinance prohibited the acceptance or processing of any applications for new Deep Aquifers Wells beneath areas impacted by seawater intrusion, with stated exceptions including municipal wells and replacement wells. The ordinance was originally only effective for 45 days, but at the June 26, 2018 Monterey County Board of Supervisors meeting, the Board of Supervisors extended the ordinance to May 21, 2020, by adoption of Ordinance No. 5303. The Ordinance also required that all new wells in the Deep Aquifers meter groundwater extractions, monitor groundwater elevations and quality, and submit all data to MCWRA and the Groundwater Sustainability Agency with jurisdiction.

A new County Ordinance that placed a 90-day moratorium on new well construction permit applications was adopted in December 2020. The moratorium was adopted so the County could study the impact of the California Supreme Court's decision on August 27, 2020 in the case Protecting Our Water and Environmental Resources et al., v. County of Stanislaus, et al., (10 Cal.5th 479 (2020); "Protecting Our Water"). The decision may require environmental review, pursuant to CEQA, when the County considers applications to construct, repair, or destroy water wells if the decision to issue the permit involves the exercise of discretion by the decision-making authority. The County has not yet completed proposed modifications to the well construction ordinance and the moratorium on well construction permit applications has expired since March 2021. Well construction applications for the Deep Aquifers are currently being reviewed and permitted on a case-by-case basis.

As shown in Chapter 5, dramatic groundwater elevation declines of over five feet per year have been observed in MCWD's Deep Aquifers wells and in the Cooper & Nashua Road area in the 180/400 Subbasin. These declines are due to increases in production from the Deep Aquifers. Deep Aquifers groundwater elevations in MCWD wells and Cooper & Nashua Road area are 50 to 100 feet below sea level. They are also 50 to 100 feet below groundwater elevations in the 400-Foot Aquifer, leading to a significant risk of vertical migration of seawater intrusion from this aquifer to the Deep Aquifer. This indicates that current levels of pumping in the Deep Aquifers have already created the conditions which result in undesirable groundwater elevations as defined in Chapter 8, and may also result in undesirable seawater intrusion in the future. SVBGSA and MCWD will continue to collaborate and provide input to Monterey County as they finalize the proposed modifications to the well construction ordinance.

9.5.4 I4 – Adopt 2022/2023 Priority Actions for Deep Aquifers in Absence of New Well Construction Ordinance if Conditions Threaten Sustainability in Near Term

Priority management actions for the Deep Aquifers will be developed based on findings reported from the Deep Aquifers study. Resulting priority management actions will promote groundwater sustainability as defined in this GSP.

9.5.5 I5 – Seawater Intrusion Working Group

SVBGSA established a Seawater Intrusion Working Group (SWIG) as part of GSP implementation in the 180/400-Foot Aquifer Subbasin. The SWIG membership comprises nine agencies and municipalities and multiple stakeholders to develop consensus on the current understanding of seawater intrusion in the Subbasin and adjacent subbasins subject to seawater intrusion, identify data gaps, and develop a broad-based plan for controlling seawater intrusion. Additionally, the SWIG provides a platform for understanding Deep Aquifers issues that accompanies seawater intrusion in the coastal Subbasins. The SWIG advises SVBGSA staff and is not a legislative body subject to the Brown Act open meeting law.

The SWIG and its Technical Advisory Committee (TAC) were established by SVBGSA in August 2020. The purpose of the TAC is to provide technical information in support of the SWIG's policy direction and decision-making. SVBGSA and MCWD have been participating in the SWIG and SWIG TAC, each meeting monthly.

As part of GSP implementation, the Subbasin GSAs will continue convening and participating in the SWIG and SWIG TAC, to work towards the ultimate goal of developing a path to address seawater intrusion. See discussion under Section 9.5.1 above.

9.5.6 I6 – Future Modeling of Seawater Intrusion and Projects

Neither the SVIHM nor the Monterey Subbasin Groundwater Flow Model (Monterey Subbasin Model or MBGWFM) is variable density flow models, which is needed to adequately simulate seawater intrusion and model the impacts of proposed projects. Addressing seawater intrusion is a critical piece of sustainable groundwater management in the Monterey Subbasin, and a model that can project how it will change in response to projects and management actions is needed to identify a strategy to reduce seawater intrusion impacts. Upon completion of the Monterey Subbasin model, SVBGSA will develop a variable density flow model for the Monterey Subbasin, working together with MCWD and MCWRA. The model will use three-dimensional variable density modeling code that is compatible with the MODFLOW modeling platform, such as SEAWAT or MODFLOW-USG. Development of this model will include compiling all the concentration data available and mapping it to determine initial conditions and boundary conditions, calibrating to water levels and concentration (i.e., seawater intrusion), and developing predictive scenarios. It is anticipated that this model may be expanded to include the coastal area of the 180/400 Foot Subbasin and will aid in evaluating the potential effects of regional projects on seawater intrusion and groundwater levels in the Monterey Subbasin.

A number of multi-subbasin projects has been proposed as part of integrated management in the Salinas Valley Basin, including those identified in Section 9.4 above as well as projects proposed in the 180/400-Foot Aquifer Subbasin GSP that may affect subbasin boundary conditions. As part of project planning, the anticipated benefits and impacts of these projects will need to be assessed with a numerical model that covers multiple subbasins.

Neither the SVIHM nor the Monterey Subbasin Model is currently capable of simulating conditions across the Monterey and adjacent subbasins. The Monterey Subbasin Model, which was used to develop water budget information in this GSP, has a model area that focuses primarily on the Monterey Subbasin. The SVIHM encompasses the entire Salinas Valley Groundwater Basin. However, the SVIHM does not accurately reflect hydrologic conditions within the Monterey Subbasin or the Seaside Subbasin[59].

The MCWD GSA and SVBGSA will incorporate information from the Monterey Subbasin Model into the SVIHM and/or the seawater intrusion model so that projects can be modeled for the entire Salinas Valley Groundwater Basin, inclusive of the Monterey Subbasin. This action was envisioned during development of the Monterey Subbasin Model, as the model was developed from the MODFLOW family of groundwater model software tools to ensure that it will be compatible with the regional SVIHM.

9.5.7 I7 – Well Registration

All groundwater production wells, including wells used by *de minimis* pumpers, will be required to be registered with the SVBGSA. Well registration is intended to establish a relatively accurate count of all the active wells in the Subbasin. This implementation action will help gain a better understanding of the wells in active use, verses those that have been decommissioned. Well registration will collect information on active wells, such as type of well meter, depth of well, and screen interval depth. Well metering is intended to improve estimates of the amount of groundwater extracted from the Subbasin. A GSA may not require *de minimis* users (as defined) to meter or otherwise report annual extraction data. Other public agencies such as the County or Water Resources Agency may have such authority. The details of the well registration program, and how it integrates with existing ordinances and requirements, will be developed during the first 2 years of GSP implementation.

9.5.8 I8 – GEMS Expansion and Enhancement

SGMA requires Groundwater Sustainability Agencies to manage groundwater extractions within a basin's sustainable yield. Accurate extraction data is fundamental to this management. The

[59] A detailed discussion of the models' current construction and calibration results can be found in technical memorandum presented to the SVBGSA Advisory Committee on April 2, 2021.

MCWRA GEMS collects groundwater extraction data from certain areas in the Salinas Valley. The system was enacted in 1993 under Ordinance 3663 and was later modified by Ordinances 3717 and 3718. The MCWRA provides the SVBGSA annual GEMS data that can be used for groundwater management.

Most of the Monterey Subbasin's estimated groundwater extraction data is derived from MCWRA's GEMS Program, which is only implemented in Zones 2, 2A, and 2B[60]. There are limited data on groundwater extraction within the Corral de Tierra Area outside of MCWRA Zones 2, 2A and 2B.

SVBGSA will work with MCWRA to expand the existing GEMS Program to cover the entire Monterey Subbasin, which would capture all wells that have at least a 3-inch internal diameter discharge pipe. Program revisions will consider and not contradict related state regulations. Alternatively, SVBGSA could implement a new groundwater extraction reporting program that collects data outside of MCWRA Zones 2, 2A, and 2B. The groundwater extraction information will be used to report total annual extractions in the Subbasin and assess progress on the groundwater storage SMCs as described in Chapter 8. Additional improvements to the existing MCWRA groundwater extraction reporting system may include some subset of the following:

- Developing a comprehensive database of extraction wells
- Expanding reporting requirements to all areas of the Salinas Valley Groundwater Basin
- Including all wells with a 2-inch discharge or greater
- Requiring automatically reporting flow meters
- Comparing flow meter data to remote sensing data to identify potential errors and irrigation inefficiencies.

9.5.9 I9 – Dry Well Notification System

The GSAs could develop or support the development of a program to assist well owners (domestic or state small and local small water systems) whose wells go dry due to declining groundwater elevations. The program could include a notification system whereby well owners can notify the GSAs or relevant partner agencies if their well goes dry, such as the Household Water Supply Shortage System (DWR, 2021). The information collected through this portal is intended to inform state and local agencies on drought impacts on household water supplies. It could also include referral to assistance with short-term supply solutions, technical assistance to assess why it went dry, and/or long-term supply solutions. For example, the GSAs could set up a trigger system whereby it would convene a working group to assess the groundwater situation if the number of wells that go dry in a specific area cross a specified threshold. A smaller area trigger

[60] Zones 2 and 2A were later superseded by Zone 2C, see Chapter 3 Section 3.2.2.2.

system would initiate action independent of monitoring related to the groundwater level SMCs. The GSAs could also support public outreach and education.

9.5.10 I10 – Water Quality Coordination Group

The Water Quality Coordination Group will include the CCRWQCB, local agencies and organizations, water providers, domestic well owners, technical experts, and other stakeholders. The purpose of the Coordination Group is to coordinate amongst and between agencies that regulate water quality directly and the GSAs, which have an indirect role to monitor water quality and ensure their management does not cause undesirable water quality results.

Numerous agencies at the local and state levels are involved in various aspects of water quality. The SWRCB and CCRWQCBs are the principal state agencies with primary responsibility for the coordination and control of water quality for the health, safety, and welfare of the people of the state pursuant to the Porter-Cologne Water Quality Control Act 1969 (California Water Code Division 7 Section 13001). There are many efforts to address water quality by the SWRCB. For example, at the State level, the Department of Drinking Water's Safe and Affordable Funding for Equity and Resilience (SAFER) program is designed to meet the goal of safe drinking water for all Californians. In addition, at the local level, the County of Monterey Health Department Drinking Water Protection Service is designed to regulate and monitor water systems and tests water quality for new building permits for systems with over 2 connections.

Locally based GSAs established pursuant to SGMA are required to develop and implement GSPs to avoid undesirable results (including an undesirable result related to water quality) and mitigate overdraft in the groundwater basin within 20 years. MCWDGSA and SVBGSA will coordinate with the appropriate water quality regulatory programs and agencies in the Subbasin to understand and develop a process for determining when groundwater management and extraction are resulting in degraded water quality in the Subbasin.

Both the State and Monterey County have committed to a Human Right to Safe Drinking Water. SGMA outlines a specific role for GSAs related to beneficial users of groundwater including drinking water, which is to manage groundwater according to the 6 sustainability indicators. The Coordination Group will help define the unique role for the GSAs, not related to specific sustainability metrics. Under this implementation action, the GSAs will play a convening role by developing and coordinating a Water Quality Coordination Group.

The Coordination Group will review water quality data, identify data gaps, and coordinate agency communication. The Coordination Group will convene at least annually to share groundwater quality conditions, as assessed for the GSP annual reports, and assesses whether groundwater management actions are resulting in unsustainable conditions. The goal of the Coordination Group will include documenting agencies' actions that address water quality concerns including outlining each agency's responsibilities. An annual update to the GSAs' BOD will be provided regarding Coordination Group efforts and convenings.

This Coordination Group will also serve to collaborate with agencies on local regulations that could affect groundwater contamination, such as county or city groundwater requirements that relate to regulation of septic systems, well drilling, capping and destruction, wellhead protection and storage and/or leaking of hazardous materials.

9.5.11 I11 – Land Use Jurisdiction Coordination Program

The Land Use Jurisdiction Coordination Program outlines how the SVBGSA and MCWDGSA review land use plans and efforts to coordinate with land use planning agencies to assess activities that potentially create risks to groundwater quality or quantity. The goal is to ensure that GSAs and Land Use Jurisdiction efforts are aligned. Examples of these activities include the application of the B-8 Zoning district by the County of Monterey in areas with water supply, water quality and other constraints on development, and the consideration of recharge potential for new developments. While the SVBGSA does not have land use authority, and the Land Use Jurisdictions retain all such authority, the Coordination Program also describes how local agencies should consider adopted GSPs when revising or adopting policies, such as adopting and amending general plans and approving land use entitlements, regulations, or criteria, or when issuing orders or determinations, where pertinent. The Coordination Program will be developed immediately upon implementation of this GSP.

9.5.12 I12 – Arsenic Implementation Action

This implementation action provides for additional analysis on the relationship between arsenic and groundwater conditions in the Corral de Tierra Area. While arsenic is naturally occurring and often increases with depth, the 2007 *El Toro Groundwater Study Monterey County, California* (GeoSyntec, 2007) found that in this area, arsenic concentrations are higher in the Paso Robles Formation, which is closer to the ground surface, than in the deeper Santa Margarita Formation. Additionally, municipal water providers show a wide range and lack of trends of arsenic concentrations with respect to reported extraction (GeoSyntec, 2007). However, the available data and published reports for the Corral de Tierra Area do not have sufficient data to affirm or invalidate a relationship between arsenic, groundwater levels, and/or extraction without additional analysis.

This implementation action will provide for further analysis of the relationship between arsenic concentrations, groundwater levels, and extraction at specific locations within the Corral de Tierra. SVBGSA will work with the Monterey County Health Department and small water systems to gather existing information with which to undertake this analysis. This will help refine the groundwater management with respect to arsenic concentrations, should the data affirm a relationship with groundwater levels and extraction.

9.6 Project-Based Water Budget and Groundwater Elevation Analysis

Using the Monterey Subbasin Model, the GSAs developed two project-based scenarios to assess the effectiveness of potential water supply augmentation projects on the Subbasin's sustainable yield and groundwater elevations. The two project-based scenarios provided include:

- Marina-Ord Water Augmentation "Project" Scenario with Variable Boundary Conditions: This scenario assumes that a portion of MCWD's projected water demand will be satisfied through some form of water supply augmentation. For evaluation purposes, this projected water budget assumes that all recycled water generated by MCWD will be used to augment water supplies within its service area. This project is consistent with the *Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse* project described in Section 9.4.6, project M3. It simulates an incremental increase in augmented water supplies beginning at 600 AFY in 2023 and up to 5,495 AFY by 2040. The impacts of this Project are evaluated under variable boundary conditions along the 180/400-Foot Aquifer Subbasin, consistent with those identified in Section 6.5. These boundary conditions include:
    - Minimum Threshold (MT) Boundary Conditions
    - Measurable Objective (MO) Boundary Conditions, and
    - Seawater Intrusion (SWI) Protective Boundary Conditions.

  Each of these boundary condition scenarios is predicated on the assumption that the 180/400-Foot Aquifer Subbasin will be managed to its SMCs over the 50-year projected model, as described further in Chapter 6 period. In addition, boundary conditions for the Seaside Subbasin, which is an adjudicated subbasin, are assumed to remain stable at 2017 levels[61].

- Corral de Tierra Water Augmentation "Project" Scenario with MO Boundary Conditions: This scenario analyzes a hypothetical and extreme condition where all of Corral de Tierra Area projected water demand is met by some form of water supply augmentation. The scenario assumes Measurable Objective (MO) Boundary Conditions are achieved at the 180/400-Foot Aquifer Subbasin boundary and water levels along the Seaside Subbasin boundary remain stable at 2017 levels[62]. This scenario has been evaluated to provide insights regarding the pumping reductions that would be required to raise groundwater elevations and achieve SMCs within the Corral de Tierra Area.

---

[61] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period (see discussion in Appendix 6-B Section 2.4.2.2.2).

[62] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period (see discussion in Appendix 6-B Section 2.4.2.2.2).

For the purposes of this high-level evaluation, these augmented water supplies are modeled as "in-lieu" groundwater supplies, where direct, proportional reductions in groundwater pumping from existing wells relative to the "no project" pumping demands described in Chapter 6 (Sections 6.5.1.1 and 6.5.2.1)) are assumed.

An overview of projected water budget results and groundwater elevation trends is provided below. Additional details regarding climate and boundary condition assumptions are provided in Section 6.5.1.

9.6.1 Marina-Ord Area "Project" Scenario Results

Table 9-4 summarizes projected water budget results for the Marina-Ord Water Augmentation "Project" scenario with variable boundary conditions. The project scenario, as described above, results in an average annual pumping rate over the 50-year analog period of 4,488 AFY within the Marina-Ord Area WBZ. This average annual pumping rate is below the estimated average annual recharge within the Subbasin under all projected climate scenarios, which ranges between (6,356 AFY and 7,509 AFY)[63]. This average annual pumping rate represents a 4,279 AFY reduction in projected pumping from the "No Project" scenario (see Table 6-5).

The project scenario does not however result in a similar net annual increase in groundwater storage over the "No Project" scenario (see Section 6.5.5). Net annual changes in groundwater storage for this project only average 200 AFY more than the "No Project" scenario. The limited increase in net groundwater storage is the result of projected increases in net outflows to the 180/400-Foot Aquifer Subbasin and decreases in net inflows from the Seaside Subbasin and ocean under this "Project" scenario.

Consistent with the "No Project" scenario the projected water budget for this "Project" scenario results in a positive net increase in storage over the 50-year analog period, under all identified boundary condition and climate condition scenarios. These projected water budget results indicate that this management area will not be in overdraft under this "Project" scenario if adjacent subbasins are managed sustainably and seawater intrusion groundwater level MTs are achieved in the 180/400-Foot Aquifer Subbasin. This "Project" scenario also results in a decrease in inflows from the ocean and from the 180/400-Foot Aquifer Subbasin in the lower 180-Foot and 400-Foot Aquifers, which are seawater intruded. Therefore this "Project" scenario reduces the risk of expansion of the seawater intrusion front over the "No Project" scenario.

Figure 9-15 depicts (a) average projected changes in groundwater elevations at RMS wells in the Marina-Ord Area WBZ under the "Project" scenario with variable boundary conditions and (b) average change in water levels required to reach MTs and MOs at RMS wells in the Marina-Ord Area WBZ. As shown on this Figure, projected groundwater elevations under this "Project" scenario stabilize within the first 10 years of GSP implementation for all boundary conditions and

[63] See Tables 6A-4 and 6A-5 in Appendix 6-A.

are constant over the 30-year post-GSP implementation period during which groundwater rates of extraction are 4,376 AFY. However, the resulting average groundwater elevation varies significantly between the various boundary scenarios. The results indicate that under the "Project" scenario groundwater elevations in RMS wells within the Marina-Ord Area WBZ will:

- reach groundwater level MTs if MT Boundary Conditions are met in the 180/400-Foot Aquifer Subbasin,
- reach groundwater level MOs and MTs if MO Boundary Conditions are met in the 180/400-Foot Aquifer Subbasin; and
- reach groundwater level MOs and MTs if SWI Protective boundary conditions are met in the 180/400-Foot Aquifer Subbasin.

These results suggest, however, that even under this "Project" scenario, groundwater elevations in RMS wells will not meet MOs in the Marina-Ord Area WBZ if MO boundary conditions are not achieved in adjacent subbasins, unless additional projects are undertaken. As described in Section 8.7.4, such conditions could lead to increases in seawater intrusion within the Monterey Subbasin and lead to undesirable results. As such, a coordinated approach to sustainable groundwater management will be required between subbasins within the Salinas Valley Basin.

As discussed in Section 6.6.1, comparison of projected groundwater levels within the Marina-Ord Area WBZ under the "No Project" scenario (Section 6.5.5) and "Project" scenario with established MTs and MOs provides significant insight regarding the projected sustainable yield as defined under SGMA. As discussed above, the attainment of MTs and MOs should be considered in the estimation of sustainable yield under SGMA. As discussed in Section 6.6 and above, projected groundwater level data indicate that:

- Under the "no project" scenario groundwater levels in RMS wells stabilize and are generally higher than groundwater level MTs during non-drought periods under all identified boundary conditions and climate scenarios, and reach groundwater level MOs if SWI protective boundary conditions are achieved in adjacent subbasins.
- Under the "Project" scenario, groundwater levels stabilize and are higher than groundwater level MTs and reach groundwater level MOs in RMS wells within the Marina-Ord Area WBZ, if MT and MO boundary conditions are achieved in adjacent subbasins, respectively.

These results indicate that SMCs can likely be attained in the Subbasin under this "Project" scenario if the 180/400-Foot Aquifer Subbasin reaches its groundwater level SMCs and the Seaside Subbasin is managed consistent with its adjudication goals. 180/400-Foot Aquifer Subbasin

However, further monitoring, and modeling will be required to determine how such a project can best be implemented to confirm that SMCs can be achieved. Project implementation will also require coordination with projects and management actions implemented in adjacent subbasins.

Table 9-4. Projected Water Budget Results Under Marina-Ord Area Water Augmentation "Project" Scenario with Variable Boundary Conditions and 2030 Climate Condition

Net Annual Groundwater Flows (a) (AFY)	Projected Annual Inflows/Outflows (b) 2030 Climate Conditions		
	Minimum Threshold Boundary Conditions	Measurable Objective Boundary Conditions	Seawater Intrusion Protective Boundary Conditions
Recharge			
● Rainfall, leakage, irrigation	**6,823**	**6,823**	**6,823**
Well Pumping			
● Well Pumping (c)	**-4,488**	**-4,488**	**-4,488**
Net Inter-Basin Flow			
● Seaside Subbasin	1,776	612	-1,115
● 180/400-Foot Aquifer Subbasin	-6,833	-4,901	-1,788
● Ocean (Presumed Freshwater)	-738	-764	-806
● Ocean (Presumed Seawater)	2,617	2,047	989
	-3,178	**-3,006**	**-2,721**
Net Intra-basin Flow			
● Corral de Tierra Area (Water Budget Zone)	**898**	**1,001**	**958**
Net Surface Water Exchange			
● Salinas River Exchange	**0**	**0**	**0**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**55**	**330**	**572**

Notes:

(a) The Marina-Ord Area Zone Budget includes inflows to and outflows from the portion of Corral de Tierra that is north of Reservation Rd.
(b) Positive values indicate a net inflow and negative values indicate a net outflow.

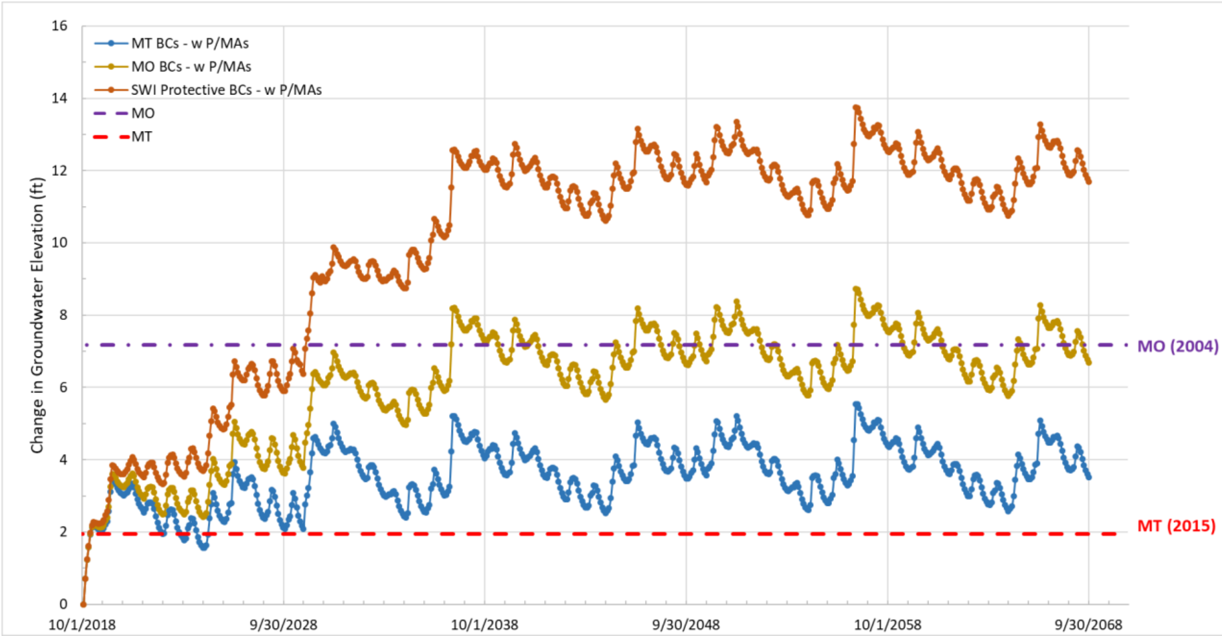


Figure 9-15. Comparison of Groundwater Elevation Changes Under Marina-Ord Water Augmentation "Project" Scenario with Various Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ

9.6.2 Corral de Tierra "Project" Scenario Results

Table 9-5 summarizes projected water budget results for the Corral de Tierra Water Augmentation "Project" scenario under MO Boundary Conditions. The project scenario, as described above, analyzes a hypothetical and extreme condition where all of Corral de Tierra Area projected future water demand (i.e., 2,188 AFY) is met by some form of water supply augmentation. The scenario assumes groundwater level Measurable Objective (MO) Boundary Conditions are achieved at the 180/400-Foot Aquifer Subbasin boundary and water levels along the Seaside Subbasin boundary remain stable at 2017 levels[64]. However, it should be noted that the 180/400-Foot Aquifer Subbasin only needs to reach its groundwater level MTs to avoid undesirable results if projects (e.g., extraction and/or injection barriers) are implemented to achieve seawater intrusion MTs.

Although this "Project" scenario reduces groundwater extraction by 2,188 AFY from the "No Project Scenario" (see Table 6-6), it only results in a net annual change in groundwater storage of 295 AFY over the No Project Scenario (see Table 9-5). This limited increase in net groundwater

[64] Or at the established MTs (i.e., based on 2015 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period (see discussion in Appendix 6-B Section 2.4.2.2.2)

storage is the result of projected increases in net inter-basin outflows to the 180/400-Foot Aquifer Subbasin and the Seaside Subbasin.

The “Project” scenario results show that the Corral de Tierra Area WBZ is projected to remain in slight overdraft over the 50-year analog period even if the 180/400-Foot Aquifer Subbasin is managed to its water level MOs and significant investments in alternative water suppliers are made.

Figure 9-16 compares (a) average projected changes in groundwater elevations at RMS wells in the Corral de Tierra Area WBZ under the “No Project” and “Project” scenarios (with MO Boundary Conditions and 2030 Climate Scenario) and (b) the average change in water levels required to reach groundwater level MTs and MOs at RMS wells in the Corral de Tierra Area WBZ under these conditions.

As shown on Figure 9-16, groundwater elevations in RMS wells within the Corral de Tierra Area WBZ appear to stabilize at levels that are approximately 15 feet higher under the “Project” scenario than under the “No Project” scenario. However, groundwater elevations under the “Project” scenario are still approximately 5 feet lower than groundwater elevation MTs and 15 feet lower than groundwater elevation MOs.

This project scenario shows that even if all pumping was replaced with alternative supplies and pumping was eliminated in the Corral de Tierra Area, the Corral de Tierra Area would still need recharge projects to reach sustainability. This project scenario shows one potential path forward to help reach sustainability; however, different sets of projects and management actions could be undertaken. Projects and management actions will be prioritized and selected early during GSP implementation.

Table 9-5. Projected Groundwater Water Budget Results under Corral de Tierra Area Water Supply Augmentation "Project" Scenario with MO Boundary Condition and 2030 Climate Condition

Net Annual Groundwater Flows (AFY) (b)	Projected Annual Inflows/Outflows Measurable Objective Boundary Conditions
Recharge	
● Rainfall, leakage, irrigation	**4,105**
Well Pumping	
● El Toro Primary Aquifer System	**0**
Net Inter-Basin Flow (Presumed Freshwater) (c)	
● Seaside Subbasin	-381
● 180/400-Foot Aquifer Subbasin	-2,728
● Ocean	0
	-3,109
Net Intra-basin Flow	
● From Marina-Ord Area WBZ	**-1,352**
Net Surface Water Exchange	
● Salinas River Exchange	**207**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-148**

Notes:

(a) The Corral de Tierra Area Zone Budget does not include inflows to and outflows from the portion of Corral de Tierra Area that is north of Reservation Rd.
(b) Positive values indicate a net inflow and negative values indicate a net outflow.
(c) Net cross boundary flows are reflective of 100% freshwater as no seawater inflows to the Subbasin reach the Corral de Tierra Area.
(d) Stream gauge data was unavailable from El Toro Creek for the historical period, and thus El Toro Creek was not directly simulated in the model. See further discussion in Section 6.4.1.1.3.

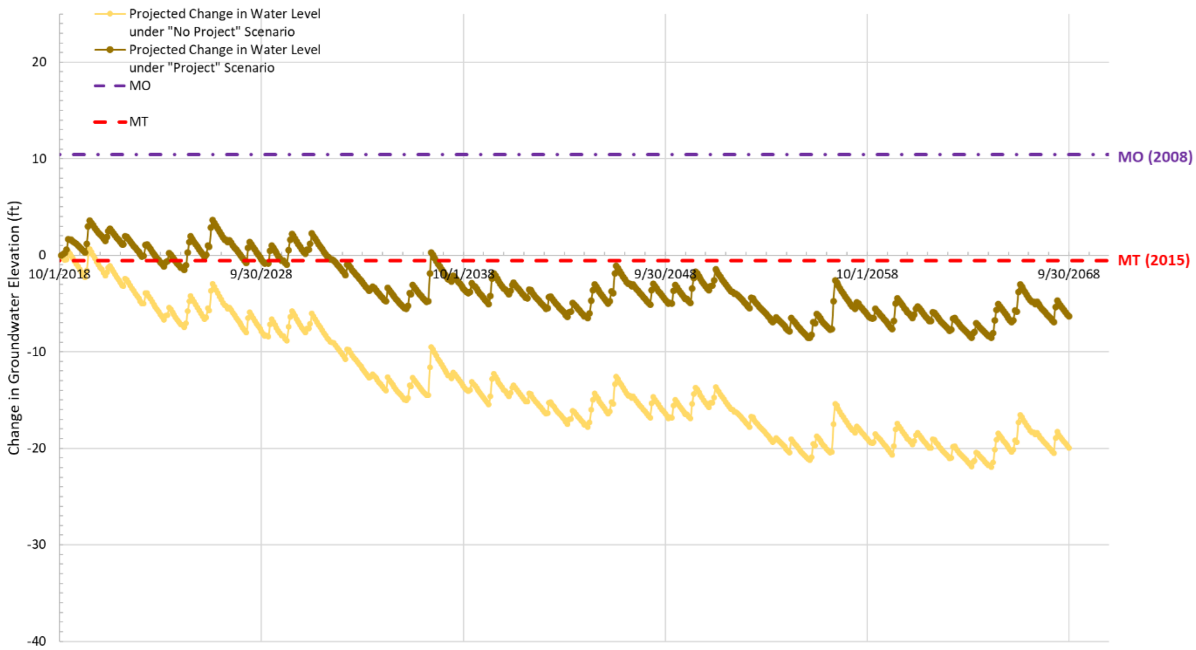


Figure 9-16. Comparison of Groundwater Elevation Changes Under Marina-Ord Water Augmentation "Project" Scenario and "No Project" Scenario, with MO Boundary Condition and 2030 Climate Condition

9.7 Addressing Overdraft Conditions

As discussed in Chapter 6 and in Section 9.6 above, projected water budget results indicate that if adjacent subbasins are managed to their respective sustainability and adjudication goals 180/400-Foot Aquifer Subbasin

- The Marina-Ord Area WBZ will not be in overdraft during the 30-year post-GSP implementation period, and
- The Corral de Tierra Area WBZ will be in minor overdraft (i.e., 89 AFY) during the 30-year post-GSP implementation period.

However, projected water level results indicate that further analysis and implementation of projects and/or management actions may be required to reach SMCs in the Marina-Ord Area WBZ and the Corral de Tierra WBZ, depending upon boundary conditions achieved in adjacent subbasins.

The potential projects presented in Chapter 9, if implemented in aggregate, are adequate to supply the entirety of the Marina-Ord Management Area's projected groundwater demand, and significantly impact the projected demand in the Corral de Tierra Area.

The MCWD GSA and SVBGSA are the same GSAs covering the adjacent 180/400-Foot Aquifer Subbasin and will be directly leading joint efforts to achieve sustainability and mitigate any residual overdraft. As described herein, regional, or multi-subbasin projects and management actions will need to be coordinated. For example, in the event that a seawater intrusion extraction barrier is constructed in the 180/400-Foot Aquifer Subbasin, impacts to groundwater levels, seawater intrusion, and cross-boundary flows will need to be assessed.

To demonstrate this future coordination, Implementation Action 1 (180/400-Foot Aquifer Subbasin GSP Implementation and Seaside Watermaster Actions) describes the GSAs' plan to support projects and actions in adjacent subbasins, particularly those that will improve groundwater conditions near Monterey Subbasin boundaries and reduce the potential for seawater intrusion and decrease cross-boundary outflows from the Monterey Subbasin. During the first five years of GSP implementation, the GSAs will perform various studies and analyses to refine project concepts into actionable projects. As part of this process, the GSAs will implement Implementation Action 6 (SVIHM Calibration and Refinement) to develop a numerical tool capable of quantifying the benefits and impacts of these projects on the Monterey Subbasin.

10 PLAN IMPLEMENTATION

This section describes the activities that will be performed by Marina Coast Water District (MCWD) and Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) as part of Groundwater Sustainability Plan (GSP) implementation within the Monterey Subbasin. The activities described herein focus on the first five years of GSP implementation (i.e., through 2027). Key GSP implementation activities to be undertaken by the Subbasin Groundwater Sustainability Agencies (GSAs) over the next five years include:

- Data collection, monitoring, and reporting;
    - Annual monitoring and reporting
    - Updating the Data Management System
    - Improving monitoring networks
    - Addressing identified data gaps in the Hydrogeologic Conceptual Model (HCM)
- Conducting intra-basin and inter-basin coordination;
- Continuing communication and stakeholder engagement;
- Conducting periodic evaluations of the GSP;
- Implementing projects and management actions and preparing grant applications; and
- Developing a funding strategy.

Each of these activities is discussed in more detail below. The implementation plan is based on the best data available regarding groundwater conditions in the Subbasin and potential management actions and projects described in Chapter 9. This plan considers management actions defined by the MCWD GSA and SVBGSA in their respective Management Areas, as well as coordinated management of the Subbasin as a whole. The level of understanding regarding subbasin conditions and proposed project and management actions will evolve over time based on future data collection, model development, and input from Subbasin stakeholders.

10.1 Implementation Agreement

MCWD GSA and SVBGSA intend to coordinate implementation of the GSP, through an Implementation Agreement. MCWD GSA will implement the GSP within the Marina-Ord Management Area and the SVBGSA will implement the GSP within the Corral de Tierra Management area. These efforts may overlap with regard to regional projects and implementation actions, and in places where Management Areas are very hydrogeologically linked such as the Reservation Road portion of the Corral de Tierra Area.

10.2 Data Collection, Monitoring, and Reporting

Successful sustainable groundwater management relies on a foundation of data to support decision making. As such, collection of data within the Subbasin will be a key part of GSP implementation. These data collection efforts include monitoring of each Sustainability Indicator from the Sustainable Groundwater Management Act (SGMA) monitoring network, as well as other data and information required for management and reporting under the SGMA, as described below.

Beginning in the first year of GSP implementation, SGMA requires submittal of annual monitoring data and development of an annual report. This annual process tracks groundwater conditions with respect to the Sustainable Management Criteria (SMCs) established in Chapter 8. The GSAs will hire consultant(s), form agreements with agencies, and/or hire staff to implement the monitoring and reporting functions. Monitoring of the six sustainability indicators will begin upon adoption of the GSP. The GSAs will coordinate on monitoring data collection and reporting.

Chapter 7 discusses the SGMA monitoring network, associated Representative Monitoring Sites (RMS) wells, and protocols that will be used in the Subbasin. Those protocols will be followed as part of GSP implementation. Most of the monitoring networks described in Chapter 7 rely on existing monitoring programs, which include quarterly or monthly monitoring of groundwater elevations and annual monitoring of seawater intrusion indicators (e.g., water quality sampling and geophysical surveying). Where possible, MCWD and SVBGSA will leverage data collection and analysis completed by existing water management agencies (e.g., Monterey County Water Resources Agency (MCWRA), Monterey Peninsula Water Management District (MPWMD), Seaside Basin Watermaster, and the U.S. Army[65]) to avoid duplication of efforts.

Data collected will be incorporated into the Subbasin's Data Management System (DMS) and will be used to support Annual Reporting (see Section 10.2.2 below). Furthermore, monitoring results will be evaluated against applicable Sustainable Management Criteria (SMCs; i.e., undesirable results, minimum thresholds, and measurable objectives) to support groundwater management decisions on management actions and projects in the Subbasin.

10.2.1 <u>Annual Monitoring and Reporting</u>

The GSAs anticipate that within the first five years of GSP implementation (i.e., in the 2022 to 2027 timeframe), the following monitoring related efforts will be performed:

- Collection and/or compilation of water level data at least on a quarterly basis at groundwater elevation RMS wells, with the potential for monitoring of additional well site(s);

[65] It is anticipated that groundwater monitoring will continue to be conducted by the U.S. Army within the former Fort Ord for the near future. MCWD plans to obtain ownership of RWS wells and potential additional wells for continued monitoring once the Army's remediation efforts terminate.

- Collection and/or compilation of water quality data at least on an annual basis at seawater intrusion RMS wells, with the potential for monitoring of additional well site(s);
- Water quality data compilation from the State Water Resources Control Board's (SWRCB) GeoTracker Groundwater Ambient Monitoring and Assessment (GAMA) groundwater information system for Division of Drinking Water (DDW) and Irrigated Lands Regulatory Program (ILRP) wells;
- InSAR data compilation from the California Department of Water Resources (DWR) SGMA Data View to assess land subsidence;
- Collection and/or compilation of quarterly water level data at the shallow RMS wells for interconnected surface waters to inform groundwater conditions near groundwater dependent ecosystems (GDEs);
- Quality assurance and quality control (QA/QC) checks;
- Data Management System (DMS) importation; and
- Data gap filling as it pertains to the monitoring network (see Section 10.2.5 below).

10.2.2 Annual Reporting

SGMA requires completion of annual reports to document Subbasin conditions relative to the SMC presented in Chapter 8. Starting on April 1, 2022, MCWD and SVBGSA will submit annual reports for the Monterey Subbasin to DWR and make them publicly available. The purpose of the reports is to provide monitoring, groundwater extraction, and total water use data to DWR, compare monitoring data to the SMCs, and adaptively manage actions and projects implemented to achieve sustainability.

Chapter 7 outlines the data collected through the monitoring programs that will be used to complete annual reports. Where possible, the GSAs will leverage data collection and analysis completed by MCWRA and Seaside Basin Watermaster to avoid duplication of efforts.

Annual reports will include, but not be limited to, the following:

- Groundwater elevation contour maps for both Spring and Fall conditions;
- Hydrographs of groundwater elevations in the groundwater elevation and interconnected surface water RMS wells;
- Seawater intrusion isocontour maps drawn using data collected in seawater intrusion RMS wells;
- Annual change in subsidence maps based on InSAR data;
- Annual groundwater extraction volumes by water use sector for the entire Basin, an explanation as to how groundwater extraction volumes were estimated, an accounting of accuracy, and an explanation as to how accuracy was determined;

- Estimates of annual change in groundwater storage. The Monterey Subbasin Groundwater Model will be updated to include new groundwater elevation data, groundwater extraction volumes, and hydrology datasets (i.e., precipitation and evapotranspiration) to estimate the annual change in groundwater storage.

10.2.3 Updating the Data Management System

The MCWD and SVBGSA have developed a DMS that is used to store, review, and upload data collected from the monitoring programs outlined above, as described in Chapter 7. A web application that reports these data is available on the SVBGSA's website for stakeholders to view. The DMS will be updated as new information is collected for annual reports, developed as part of GSP implementation, and provided by stakeholders. New data that will be added to the DMS includes, but is not limited to, the following:

- Water level data at groundwater elevation RMS wells and other potential additional monitoring well site(s);
- Groundwater water quality data at seawater intrusion RMS wells and other potential additional monitoring well site(s);
- Groundwater water quality data from the SWRCB's GeoTracker GAMA groundwater information system for DDW and ILRP wells;
- InSAR data from the DWR SGMA Data View, which will be used to assess land subsidence; and
- Water level data at shallow RMS wells for interconnected surface waters to inform groundwater conditions near groundwater dependent ecosystems (GDEs).

10.2.4 Improving Monitoring Networks

As discussed in Chapter 7, data gaps have been identified in the groundwater elevation, seawater intrusion, and interconnected surface water monitoring networks.

10.2.4.1 Groundwater Elevations

Chapter 7 identifies spatial data gaps in the groundwater level monitoring network in both the Marina-Ord Area and the Corral de Tierra Area as shown on Figures 7-7 through 7-9.

In the Marina-Ord Area, additional groundwater elevation monitoring is necessary near the ocean and subject to seawater intrusion, particularly along the central coastline in the 400-Foot and Deep Aquifers. As a first phase, MCWD plans to install two 400-Foot Aquifer monitoring wells and one Deep Aquifer monitoring well in this area to fill this data gap.

In the Corral de Tierra Area, additional groundwater monitoring is needed near areas where substantial groundwater withdrawals occur in the upper El Toro Creek area. There are four general data gaps in the groundwater level monitoring network shown on Figure 7-9 that would require at least three new monitoring wells to fill. If possible, SVBGSA will first incorporate existing wells into the monitoring network to fill this data gap. SVBGSA will contact well owners to gain permission and secure access agreements to incorporate their wells into the groundwater elevation monitoring network. All existing wells that are candidates for incorporation into the monitoring network will be inspected to (a) ensure they are adequate for monitoring, and (b) determine depth, perforated intervals, and assign an aquifer designation. If an existing well cannot be identified to fill a data gap or permission to use data from an existing well cannot be secured, then a new monitoring well will be drilled and added to the monitoring network. The GSAs will obtain required permits and access agreements before drilling new wells. The GSAs will retain the services of licensed geologists or engineers and qualified drilling companies for drilling new wells. To the extent possible, grant funds and technical assistance support services through DWR or other entities will be used for installation of new wells. Once drilled, the new wells will be tested as necessary and equipped with dedicated data loggers for monitoring. All new monitoring wells identified as RMS locations will be added to MCWRA's monitoring network for continuity and consistency in data collection.

Additionally, the SVBGSA is coordinating closely with MCWRA to expand and enhance the Groundwater Extraction Management System (GEMS) network as detailed in Chapter 9. Expanding the GEMS network will add more wells into the monitoring network, and potentially fill in currently identified data gaps.

10.2.4.2 Seawater Intrusion

Spatial data gaps within the seawater intrusion monitoring network in the Marina-Ord Area are located in the same general area as the data gaps identified within the groundwater elevation network. Therefore, the aforementioned new monitoring wells to be constructed in the Marina-Ord Area will be monitored for both groundwater elevation and seawater intrusion.

10.2.4.3 Interconnected Surface Water (ISW)

Depletion of interconnected surface water will be monitored through shallow wells adjacent to locations of interconnected surface water. There is no entity that currently monitors ISW within the Corral de Tierra Area and no existing shallow wells that can be added to the ISW monitoring network. Thus, SVBGSA plans to install a new shallow well where preliminary analysis indicate there may be interconnected surface water near El Toro Creek as shown in Figure 5-36. The ISW monitoring wells will be incorporated into MCWRA's existing monitoring network and MCWRA will make these data available to SVBGSA. A monitoring well may be paired with USGS stream gauges to evaluate groundwater gradient and effects of groundwater levels on surface water depletion. These wells will be added to MCWRA's groundwater elevation monitoring programs. This information will also help determine the extent of interconnection.

10.2.4.4 Groundwater Extraction Information

Accurate extraction data is necessary to meet SGMA requirements for reporting annual groundwater extractions within the Subbasin. The area encompassed by the current GEMS includes Zones 2, 2A, and 2B; and provides sufficient coverage of the Marina-Ord Area. However, GEMS does not cover the entire Corral de Tierra Area. The GSAs and MCWRA will work together to potentially improve the existing GEMS Program outside of these areas as outlined in Chapter 9.

As described in Chapter 9, accurate extraction data is necessary to meet SGMA requirements to manage groundwater extractions within the Subbasin's sustainable yield.

The existing publicly reported data from water systems within the Corral de Tierra Area will continue to be used until the GEMs program can be expanded, or more small systems and private wells can be included in extraction monitoring programs.

10.2.4.5 Inter-basin Monitoring Programs

Beyond filling data gaps in the SGMA monitoring network, the Subbasin GSAs will support monitoring network improvement efforts within the adjacent 180/400-Foot Aquifer and Seaside Subbasins. Although monitoring wells outside the Monterey Subbasin cannot be included as a Representative Monitoring Site (RMS) and evaluated against SMCs, data collected from these adjacent subbasins will inform groundwater elevation and seawater intrusion analyses in Annual Reports and Periodic GSP Updates, as well as multi-basin planning of projects and management actions.

Within the Seaside Subbasin, monitoring well FO-09 Shallow where casing leakage has been identified is likely to be replaced. The monitoring well is located near the coastline just south of the Seaside-Monterey Subbasin boundary. It is used to (a) monitor groundwater levels relative to seawater intrusion protective groundwater elevations and (b) monitor water quality in groundwater to detect occurrences of seawater intrusion into both Subbasins. MCWD GSA recognizes the importance of monitoring at this location and is in discussions to participate in a cost-share arrangement to destroy and replace this well per request of the Seaside Watermaster. The Subbasin GSAs will continue to evaluate and partner to improve monitoring in adjacent subbasins to the extent that such efforts benefit multi-basin groundwater management.

10.2.5 Address Identified Data Gaps in the Basin Setting

MCWD GSA and SVBGSA will prioritize and begin to fill the key data gaps identified in this GSP related to the hydrogeological conceptual model, groundwater conditions, water budgets (numerical modeling), among other things. Filling these data gaps would allow the GSAs to improve understanding of the Basin Setting and thus, the characterization of the Subbasin and the principal aquifers. Earlier chapters of this GSP have identified the following data gaps:

- Location and magnitude of recharge to the Deep Aquifers, including the connectivity with the ocean, adjacent subbasins, upper principal aquifers, and current and potential seawater intrusion;
- Limited subsurface information in the southern Marina-Ord Area, including groundwater elevation and water quality data to characterize the extent of groundwater elevation decline and seawater intrusion near MPWMD#FO-10 and MPWMD#FO-11;

- Limited subsurface information in the Corral de Tierra Area along the 180/400-Foot Aquifer Subbasin boundary;
- Limited subsurface information in the eastern Fort Ord hills area to characterize the hydrostratigraphy and the connectivity between Marina-Ord Area and the Corral de Tierra Area principal aquifers;
- Location of seawater intrusion between the front and MCWD production wells. As discussed in Section 5.3.3, no additional total dissolved solids (TDS) measurements exist between MCWD production well MCWD-30 and the cluster of wells located northwest of MCWD's production wells, where TDS concentrations exceed 10,000 mg/L.

During the first five years of GSP implementation, the GSAs will prioritize and fill key data gaps that have been identified, including:

- Installation of new 400-Foot Aquifer and Deep Aquifers monitoring wells in the southern Marina-Ord Area. A geochemical analysis and coring of the deep aquifer may be conducted concurrently with construction of the new deep monitoring well to better characterize these two aquifers and their connectivity with the Seaside Subbasin.
- Implementation of the multi-party Deep Aquifers Investigation, which will be managed by SVBGSA. As described in Section 9.5.2, the primary tasks of the study include describing the hydrogeology and extents of the multi-subbasin Deep Aquifers, completing a water budget, and initiating a Deep Aquifers monitoring program.
- Establishment of an annual induction logging program of Deep Aquifers monitoring well clusters. There are currently five monitoring well clusters within the Subbasin. Induction logging provides an effective way to profile water quality changes and signs of vertical migration of seawater intrusion into the Deep Aquifer.
- Installation of monitoring wells in the Corral de Tierra Area along the 180/400-Foot Aquifer Subbasin boundary, in northern portion along Highway 68 north of the USGS gauge, and along the boundary with the Seaside Subbasin. Data from these monitoring wells will better characterize inter-basin flows and help refine the Subbasin's water budget.
- Conducting pumping tests in the aforementioned areas to collect aquifer property information and refine groundwater modeling efforts.
- Collecting well registration and groundwater extraction information (as described in Sections 9.5.7 and 9.5.8) in the Corral de Tierra Area to refine groundwater modeling efforts and the water budget;
- Assisting DWR's airborne electromagnetic (AEM) study within the Salinas Valley and utilizing these results to refine the hydrogeological conceptual model in the eastern Fort Ord hills area.

10.3 Intra- and Inter-basin Coordination

Both intra- and inter-basin coordination will continue to be conducted between MCWD GSA and SVBGSA, which covers the Monterey Subbasin and the adjacent 180/400-Foot Aquifer Subbasin. In addition, the Subbasin GSAs have and will continue to coordinate with other entities (including the Seaside Basin Watermaster) on water management efforts that involve the larger Salinas Valley Basin.

Intra- and inter-basin coordination efforts between MCWD and SVBGSA are anticipated to include continued technical committee meetings. It is anticipated that such meetings will be held approximately monthly to facilitate regional projects planning (Section 9.4) and implementation activities (Section 9.5) and will incorporate Implementation Agreement requirements as described in Section 10.1.

10.4 Communications and Engagement

The GSAs will routinely report information to the public about GSP implementation and progress towards sustainability and the need to use groundwater efficiently, as described in Chapter 2. The GSAs' websites will be maintained as a communication tool for posting data, reports, and meeting information. An interactive mapping function for viewing Salinas Valley Groundwater Basin-wide data that were used during GSP development is hosted on the SVBGSA website.

MCWD and SVBGSA's Stakeholder Communication and Engagement Plans (SCEPs) will continue to be refined, updated, and executed during GSP implementation. Anticipated stakeholder engagement activities include, but are not limited to:

- Public meetings including GSA Board meetings, Advisory Committee meetings, subbasin planning committee meetings, and stakeholder workshops;
- One-on-one stakeholder communications;
- Posting of relevant announcements and information on the respective websites (mcwd.org and svbgsa.org) and other direct mailings, as needed;
- Interested parties list maintenance; and
- Stakeholder Communication and Engagement Plan (SCEP) evaluation and updates.

The GSAs will continue to inform the public on GSP implementation progress and implementation of projects through the stakeholder engagement activities identified above. In addition, each project or management action may be subject to specific public noticing requirements as detailed in their respective project descriptions in Chapter 9. The Annual Reports to be prepared by April 1 each year will assess progress towards sustainability and will provide an important opportunity to reengage subbasin stakeholders in its review.

10.5 Project and Management Action Implementation

To prevent potential Undesirable Results, projects and management actions are planned as part of GSP implementation. As described in Chapter 9, a portfolio of projects and management actions has been developed with the goal of proactively addressing relevant sustainability indicators.

Implementation Actions

Several of the implementation actions described in Chapter 9 involve regional coordination that are currently ongoing and will continue to be implemented post GSP adoption. These actions include supporting groundwater management in adjacent subbasins, as well as supporting the Deep Aquifer Investigation, the Seawater Intrusion Working Group, and the Deep Aquifer Well Moratorium.

A numerical modeling tool needs to be developed that can assess the impacts of proposed projects that address seawater intrusion over multiple subbasins. The SVBGSA will finish the development of a variable density flow model during the first year of GSP implementation that can be extended to cover multiple coastal subbasins of the Salinas Valley Basin. This modeling construction effort will build upon the existing Monterey Subbasin Groundwater Flow Model and be coordinated with the Salinas Valley Integrated Hydrologic Model (SVIHM) developed by the USGS and the Seaside Basin Watermaster's Seaside Basin Model.

Data collection and analysis are critical for the implementation of all GSPs. These actions, as highlighted in the sections above, are a top priority to be able to better understand the groundwater conditions and necessity of projects and management actions. Along with the expansion of monitoring networks, including updating and enhancing GEMS to improve the collection of extraction data, SVBGSA will consider registering wells to gain more information on active wells, especially de minimis users. In addition, it will begin establishing up the Dry Well Notification System within the first 2 years of GSP implementation, which will assist well owners whose access is jeopardized through declining groundwater elevations. SVBGSA plans to undertake the development of these actions within the first 2 years after GSP submittal, and fully implement them through years 3 and 4 through actively reaching out to well owners, visiting and checking wells, and inputting data.

The Water Quality Coordination Group is also a critical implementation action to coordinate with other agencies that have responsibilities affecting domestic water quality and access. After undertaking preliminary planning work in the first 2 years after implementation, SVBGSA plans to establish the Partnership in years 3 and 4.

New Water Supply and Regional Municipal Supply Projects

Chapter 9 describes projects that involve new water supplies for recharge (injection) or direct use in-lieu of groundwater extraction. These projects include:

- Two of the proposed regional projects, the Seasonal Release for Aquifer Storage and Recovery (ASR) and Direct Use project and the Regional Municipal Supply project,
- One of the proposed projects in the Marina-Ord Area (Recycled Water Reuse), and
- All six proposed projects in the Corral de Tierra Area.

Chapter 9 outlines the estimated cost and benefit for each project; however, more detailed scoping and analysis needs to be undertaken.

During the first 2 years of GSP implementation, the GSAs will undertake further scoping and analysis of potential project benefits and feasibility. The GSAs will evaluate if water rights permits are needed and take that into consideration in project selection and planning. Multiple projects may be needed to mitigate overdraft. With stakeholder input, the GSAs will determine (a) which projects to move forward first, (b) which projects to implement if the first set of projects do not reach sustainability goals, and (c) which projects should not be prioritized for implementation. After initial project selection, more detailed analyses and potential discussions with landowners will need to occur to determine project specifics, such as locations of recharge and distribution systems. During years 3 and 4, GSAs will secure access agreements, undertake permitting and CEQA, and develop funding mechanisms for projects that are selected. The GSAs will continue an iterative, ongoing process to evaluate the effectiveness of projects post implementation, including assessment of groundwater conditions, and the need for additional projects.

Other Marina-Ord Area Projects and Management Actions

Two local ongoing management actions within the Marina-Ord Area will continue to be implemented after GSP submittal. These management actions include MCWD Demand Management Measures and Stormwater Recharge Management.

The local project entitled: Drilling and Installation of Monitoring Wells is critical for filling data gaps and informing project selection and design in the southern Marina-Ord Area. MCWD GSA plans to initiate the project immediately after GSP submittal and anticipates the project will be completed within the first 2 years of GSP implementation.

Other Corral de Tierra Management Actions

Demand management provides options since supply-side projects are likely not sufficient to reach sustainability. During GSP development, the SVBGSA Monterey Subbasin Planning Committee prioritized pumping allocations and control as the top project or management action within the Corral de Tierra Area. SVBGSA will begin establishment of pumping allocations and controls immediately following GSP implementation. The establishment of pumping allocations will involve robust stakeholder input to ensure appropriate planning timelines and landowner engagement. At that time, stakeholders could also evaluate potential funding mechanisms or incentives that could be developed as part of a pumping allocations program.

The implementation of all projects and management actions will be a dynamic, adaptive process. Refinement of the projects and actions will occur simultaneously with adjustment of the funding mechanism that supports the projects and actions. A start-up budget that covers required actions such as data, monitoring, and reporting could also cover pre-financing stages of project selection and design. Projects and management actions will be approved by the respective Board of Directors and will be implemented in a coordinated manner across the entire Salinas Valley.

10.6 Periodic Evaluations of GSP

Per the GSP Emergency Regulations (23-CCR §356.4), the Subbasin GSAs will conduct a periodic evaluation of its GSP, at least every five years, and will modify the GSP as necessary to ensure that the Sustainability Goal for the Subbasin is achieved. The GSP elements that will be covered in the periodic evaluation are described below.

The 5-year update will include updating the Monterey Subbasin Groundwater Flow Model (MBGWFM) with newly collected data. Section 6.7 discussed several limitations with the MBGWFM while recognizing that the model was developed using the best available data at this time. As additional groundwater elevation, aquifer properties, and groundwater extraction data becomes available, the GSAs anticipate refining and recalibrating the MBGWFM as part of the 5-year update. Additionally, model scenarios will be updated to reflect both the additional data and refinements in project design or assumptions. It will also include a reevaluation of climate change to ensure assumptions in the GSP are still valid.

10.6.1 Sustainability Evaluation

This section will evaluate the current groundwater conditions for each sustainability indicator, including progress toward achieving interim milestones and measurable objectives.

10.6.2 Plan Implementation Progress

This section will evaluate the current implementation status of projects and management actions, along with an updated implementation schedule and any new projects and management that are not included in this GSP.

10.6.3 Reconsideration of GSP Elements

Per 23-CCR §356.4(c), elements of the GSP, including the Basin Setting, SMCs, and projects and management actions sections will be reviewed and revised if necessary.

10.6.4 Monitoring Network Description

This section will provide a description of the SGMA monitoring network, including identification of data gaps, assessment of monitoring network function with an analysis of data collected to date, identification of actions that are necessary to improve the monitoring network, and development of plans or programs to fill data gaps.

10.6.5 New Information

This section will provide a description of significant new information that has been made available since the adoption or amendment of the GSP, or the last five-year assessment, including data obtained to fill identified data gaps. As discussed above under *Reconsideration of GSP Elements*, if evaluation of the Basin Setting or SMCs definitions warrant changes to any aspect of the GSP, this new information would also be included.

10.6.6 Regulations or Ordinances

The Subbasin GSAs possess the legal authority to implement regulations or ordinances related to the GSP. This section will provide a description of relevant actions taken by the GSAs, including a summary of related regulations or ordinances, as appropriate.

10.6.7 Legal or Enforcement Actions

This section will summarize legal or enforcement actions taken by the GSA in relation to the GSP, along with how such actions support sustainability in the Subbasin.

10.6.8 Plan Amendments

This section will provide a description of proposed or complete amendments to the GSP.

10.7 Plan Implementation Costs

Per the GSP Emergency Regulations (23-CCR §354.6(e) and 354.44(b)(8)), this section provides estimates of the costs to implement this GSP and potential sources of funding to meet those costs.

Costs herein are estimated and discussed for each GSA. A presumed contribution from each GSA is estimated for certain activities that will be carried out via collaboration, such as preparation of annual reports, DMS hosting and maintenance, and preparing the 5-year GSP update. These costs may shift during GSP implementation depending on how the GSAs decide to undertake each specific task.

10.7.1 MCWD GSA Start-up Budget and Funding to Meet Costs

Table 10-1 summarizes the conceptual planning-level costs for the initial 5 years of GSP implementation (i.e., 2022-2027) by MCWD GSA within the Monterey Subbasin. These costs are developed for Subbasin specific activities, including

- Monitoring and data collection beyond tasks already undertaken by other agencies;
- Annual analysis and reporting of sustainability conditions;
- GSA staff overhead and legal support;

- Continued stakeholder outreach and coordination;
- Periodic evaluation and five-year update of the GSP, including updates to the MBGWFM;
- Improvements to the monitoring networks and hydrogeologic investigations to address data gaps;
- Refinement and implementation of projects and management actions, as well as implementation actions.

These planning level costs include implementation actions envisioned to occur within the first 5 years of GSP implementation. It does not include funding for development or implementation of projects and management actions; however, it does include some funding for refinement and selection of projects and management actions. When projects and management actions move forward with implementation, they will require additional funding for project feasibility and design studies, environmental permitting, and landowner outreach. These are initial estimates of costs and will likely change as more data become available.

As shown in Table 10-1, direct costs for GSP implementation are estimated to be a total of $3,745,000 over the next five years, including GSA staff time. The MCWD GSA will likely meet the estimated costs through a combination of contributions through rate payers and from grant funding, if available.

Table 10-1. MCWD GSA Monterey Subbasin Specific Estimated Planning-Level Costs for First 5 Years of Implementation

Activity	MCWD Estimated Annual Cost	Total MCWD Cost for 5 years or Lump Sum	Assumptions
Annual Monitoring and Reporting		**$400,000**	
Monitoring	$25,000	$125,000	Includes efforts supplemental to existing Fort Ord, MCWRA, and Seaside monitoring programs
Induction Logging	TBD	TBD	Anticipated to be conducted as part of the SVB-wide Deep Aquifer Study and proposed Monitoring Program
Voluntary monitoring of non-RMS wells	$5,000	$25,000	Additional specific conductivity monitoring
Reporting	$50,000	$250,000	Assumed contribution to subbasin cost shared between GSAs
Data Management System		**$35,000**	
Establish a basin-wide DMS	-	$10,000	One-time cost to import existing RMS data into a basin-wide DMS
DMS Hosting and Maintenance	$2,000	$10,000	Assumed contribution to subbasin cost shared between GSAs; includes hosting fee and updating information
Upload Marina-Ord Area data to DMS	$3,000	$15,000	Obtain data from local agencies, process, and upload
Administration and Legal		**$1,125,000**	
Administration	$200,000	$1,000,000	-
Legal	$25,000	$125,000	-
Coordination and Outreach		**$270,000**	
Stakeholder engagement	$30,000	$150,000	Ad hoc meetings and workshops, website maintenance
Intra- and Inter-basin coordination	$24,000	$120,000	Attending meetings, regular communication, etc.

Activity	MCWD Estimated Annual Cost	Total MCWD Cost for 5 years or Lump Sum	Assumptions
Required Five-year Update Incl. Model Update	-	**$500,000**	
MBGWFM refinement and recalibration for the Marina-Ord Area	-	$150,000	-
Gather and Input new data into model	-	$30,000	-
Reevaluate climate change	-	$10,000	-
Update future scenarios	-	$60,000	-
Stakeholder engagement	-	$50,000	-
Coordination with SVBGSA	-	$50,000	-
Analysis and report-writing	-	$150,000	Assumed contribution to subbasin cost shared between GSAs
Implementation Actions		**$165,000**	
Support adjacent subbasins	TBD	TBD	Not estimated at this time
Deep Aquifer Study	-	$50,000	MCWD funding contributions
Support Deep Well Moratorium / 2022/23 Actions	-	$35,000	-
Seawater Intrusion Working Group	-	$80,000	MCWD cost for participating in the SWIG and SWIG TAC for the first two years, level of effort beyond year 2 TBD
Future Modeling of Seawater Intrusion and Projects	TBD	TBD	Not estimated at this time
Improving Monitoring Networks (see Projects)			
Refine and Implement Projects and Management Actions (1)		**$1,250,000**	
Coordinate Regional Projects (R1 and R2)	-	$100,000	-
Refine Recycled Water Reuse Project (M3)	-	$150,000	Assumes completion of the Recycled Water Feasibility Study
Install Monitoring Wells and Conduct Hydraulic and Geochemical Testing for Recycled Water Injection (M4)	-	$1,000,000	-
Total (2)		**$3,745,000**	

Notes:

(1) This is initial funding for these activities but are not likely to fully cover these activities for all potential projects and management actions.

(2) Costs estimated herein do include MCWD GSA staff time.

10.7.2 SVBGSA Start-up Budget and Funding to Meet Costs

10.7.2.1 SVBGSA Operational Fee

SVBGSA established a Valley-wide Operational Fee to fund the typical annual operational costs of its regulatory program authorized by SGMA, including regulatory activities of management groundwater to sustainability (such as GSP development), day-to-day administrative operations costs, and prudent reserves. The Operational Fee funds GSA operational costs, and therefore covers any tasks undertaken by staff, such as planning, technical review, partnership development, communication, stakeholder engagement, and support for the selection, development and implementation of projects and management actions. The fee is a regulatory fee with the purpose of ensuring that groundwater use is managed sustainably so that adequate supplies remain for all users. The Operational Fee is also used as local cost share for grants.

The Operational Fee is based on the 2018 Regulatory Fee Study (Hansford Economic Consulting, 2019) commissioned by SVBGSA. The SVBGSA has the authority to charge fees, as set forth in the California Water Code §10730, 10730.1, and 10730.2. The Operational Fee is a regulatory fee authorized under California Water Code §10730 and is exempt from voter approval, as it is not a tax pursuant to California Constitution Article XIIIC (Proposition 26, Section 1(e)(3)). As the fee must be proportional and related to the benefits of the program, this study analyzed options and proposed a regulatory fee structure whereby agricultural beneficiaries are responsible for 90% of the cost and all other beneficiaries are responsible for 10% of the cost. The SVBGSA Board of Directors approved this fee in March 2019.

The Monterey Subbasin urban and agricultural groundwater users within the Corral de Tierra Area are charged the Operational Fee by domestic connection or irrigated acreage by land use code. The Operational Fee funds Valley-wide activities, including initial GSP development; however, additional funding is needed for meeting future requirements, GSP implementation, and projects and management actions.

10.7.2.2 SVBGSA Start-up Budget

Table 10-2 summarizes the conceptual planning-level costs for the initial 5 years of SVBGSA's GSP implementation for the Monterey Subbasin. This table does not include SVBGSA's Valley-wide costs for routine administrative operations and other Valley-wide costs funded through the SVBGSA operational fee outlined in 10.5.1. The Subbasin specific costs, shown in Table 10-2, include data collection and analysis focusing on the Corral de Tierra Area beyond tasks already undertaken by other agencies. These tasks could be undertaken by staff, consultants, or partner agencies. The costs comprise of annual analysis and reporting of sustainability conditions; improvements to the monitoring networks, including installation of three new monitor wells; and supplemental hydrogeologic investigations to address data gaps.

The start-up budget includes implementation actions envisioned to occur within the first 5 years of GSP implementation. It does not include funding for development or implementation of projects, management actions, and implementation actions; however, does include some funding for refinement, selection, and preliminary scoping of projects and management actions. Costs included will include listed activities, but are not anticipated to cover all feasibility studies, project design, and permitting associated will all potential projects and management actions. When projects, management actions, and implementation actions move forward with implementation, they will require additional funding for project feasibility and design studies, environmental permitting, and landowner outreach. These are initial estimates of costs and will likely change as more data become available.

These costs are independent of fees currently collected by MCWRA; no fees will be collected by SVBGSA that duplicate fees already being collected by MCWRA.

For components of this GSP being developed in coordination with other GSPs in the Salinas Valley, SVBGSA's establishment costs are split between subbasins, and initial implementation costs are estimated based on the direct costs to the Monterey Subbasin. These are initial estimates; however, the final cost and division between subbasins will be reviewed and revised as necessary prior to implementation and per approval of the SVBGSA Board.

Table 10-2. SVBGSA Monterey Subbasin Specific Estimated Planning-Level Costs for First 5 Years of Implementation

Activity	SVBGSA Estimated Annual Cost	SVBGSA Total Cost for 5 years or Lump Sum	Assumptions
Data Collection, Monitoring, and Reporting		**$160,000**	
Annual Monitoring and Reporting	$30,000	$150,000	-
Updating the Data Management System	$2,000	$10,000	Assumed contribution to subbasin cost shared between GSAs; includes hosting fee and updating information
Improving Monitoring Networks		**$367,000**	
Install up to 4 wells for groundwater elevation monitoring	-	$225,000	Assume average depth 600’ @ $125/ft = $75,000 x 3 wells total = $225,000
Development of GEMS expansion ordinance	-	$7,000	SVBGSA-wide cost split equally between subbasins; includes hosting fee and updating information
Implementation of GEMS expansion	-	$100,000	Estimate for implementation in the Corral de Tierra
Install up to 1 shallow wells for monitoring ISW	-	$15,000	-
Add Seaside wells to monitoring GWL network	-	$5,000	-
Additional groundwater level monitoring	3,000	$15,000	
Addressing Identified Data Gaps in the HCM		**$16,000**	
Aquifer properties assessment	-	$16,000	For three aquifer properties tests
Coordination and Outreach		**$130,000**	
Coordination with MCWRA	-	$10,000	Setting up a shared system; MCWRA time
Inter- and Intra-subbasin Coordination	$24,000	$120,000	-
Required Five-year Update		**$250,000**	
Coordination on model updates	-	$25,000	-
Coordination with MCWD	-	$50,000	-
Stakeholder engagement	-	$50,000	-
Analysis and report-writing	-	$125,000	Assumed contribution to subbasin cost shared between GSAs

Activity	SVBGSA Estimated Annual Cost	SVBGSA Total Cost for 5 years or Lump Sum	Assumptions
Refine and Scope Projects, Management Actions, and Implementation Actions (1)	**-**	**$500,000**	**Depends on projects and management actions pursued; Could be grant or project match**
Engineering feasibility studies and project design	-	-	-
Permitting and environmental review	-	-	-
Cost-benefit analyses	-	-	-
Total (2)	**-**	**$1,423,000**	**-**

Notes:

(1) This is initial funding for these activities but are not likely to fully cover these activities for all potential projects and management actions.

(2) Costs estimated herein do **not** include SVBGSA and member agency staff time.

10.7.3 Funding for Projects and Management Actions

The start-up budget does not include funding for specific projects and management actions. Projects and management actions implemented by other agencies and organizations that contribute to groundwater sustainability will follow the funding strategies developed by those respective agencies and organizations. For projects funded by the Subbasin GSAs or funding the GSAs raise to contribute to the implementation of projects, the GSAs will evaluate the most appropriate funding mechanisms and engage stakeholders and the respective Board of Directors in this analysis. These include:

Grant funding – The GSAs will pursue grants to the extent possible to fund projects and management actions.

Contributions from local jurisdictions, partner agencies, organizations, and companies – Where appropriate, the GSAs will work with partners to solicit contributions to jointly implement a project or management action.

Benefit assessment (218 vote) – For projects with considerable capital cost or that benefit multiple subbasins, the GSAs will consider holding a 218 vote to levy an assessment based upon the special benefits conferred from a specific project. Before doing so, the GSAs will undertake an analysis to identify the special benefit of the conferred project, the cost of the benefit, the zone of benefit, and method of calculating the assessments to be levied. This requires a public hearing and is subject to a majority protest.

Fee – Fees may be collected for a variety of purposes, such as funding a regulatory program or providing a product or service. Fees are not subject to a vote or protest proceeding, but they cannot exceed the cost of running the program or providing the product or service. Some regulatory programs need to be implemented via ordinance.

Fines and Penalties – With the establishment of an ordinance, the GSAs have the authority to impose fines and penalties, such as may be associated with a regulatory program. Imposition of a fine or penalty must provide due process, usually a hearing after notice/citation and before assessment of the fine or penalty, and funds must be put back into the program.

Special tax – The GSAs have the authority to levy a special tax for a specific purpose, such as a parcel tax or some sales tax components. This requires a two-thirds vote of the electorate.

The GSAs acknowledge that the costs associated with projects and management actions will need to be funded through mechanisms such as these. It will work with funding agencies and local partners to do so.

10.8 Plan Implementation Schedule

Implementing the Monterey Subbasin GSP will be coordinated with the implementation of the five other GSPs in the Salinas Valley. The implementation schedule reflects the significant integration and coordination needed to implement all Salinas Valley Basin GSPs in a unified manner.

In the Marina-Ord Area, the implementation schedule reflects evaluating and prioritizing projects and management actions during the first 2 to 3 years. In the Corral de Tierra Area, the initial focus of project and management action efforts will be to begin development of pumping allocations and controls immediately and to evaluate and prioritize supply-side projects.

A general schedule showing the major tasks and estimated timeline during the first 5 years of GSP implementation is provided on Figure 10-1.

MCWDGSA and SVBGSA will adaptively manage groundwater and the implementation of the GSP. The work of the GSAs and stakeholders to complete this GSP provides a solid base to guide groundwater management; however, certain conditions may provide the need to adapt and change management as envisioned in this plan. For example, if existing conditions change, such as a prolonged drought that affects groundwater conditions, or additional funding for specific projects becomes available, MCWDGSA and SVBGSA may adapt their management strategy. If that occurs, the GSAs will work through an open and transparent process with stakeholders, partner agencies, and DWR to ensure it continues to meet regulatory requirements and reaches sustainability.

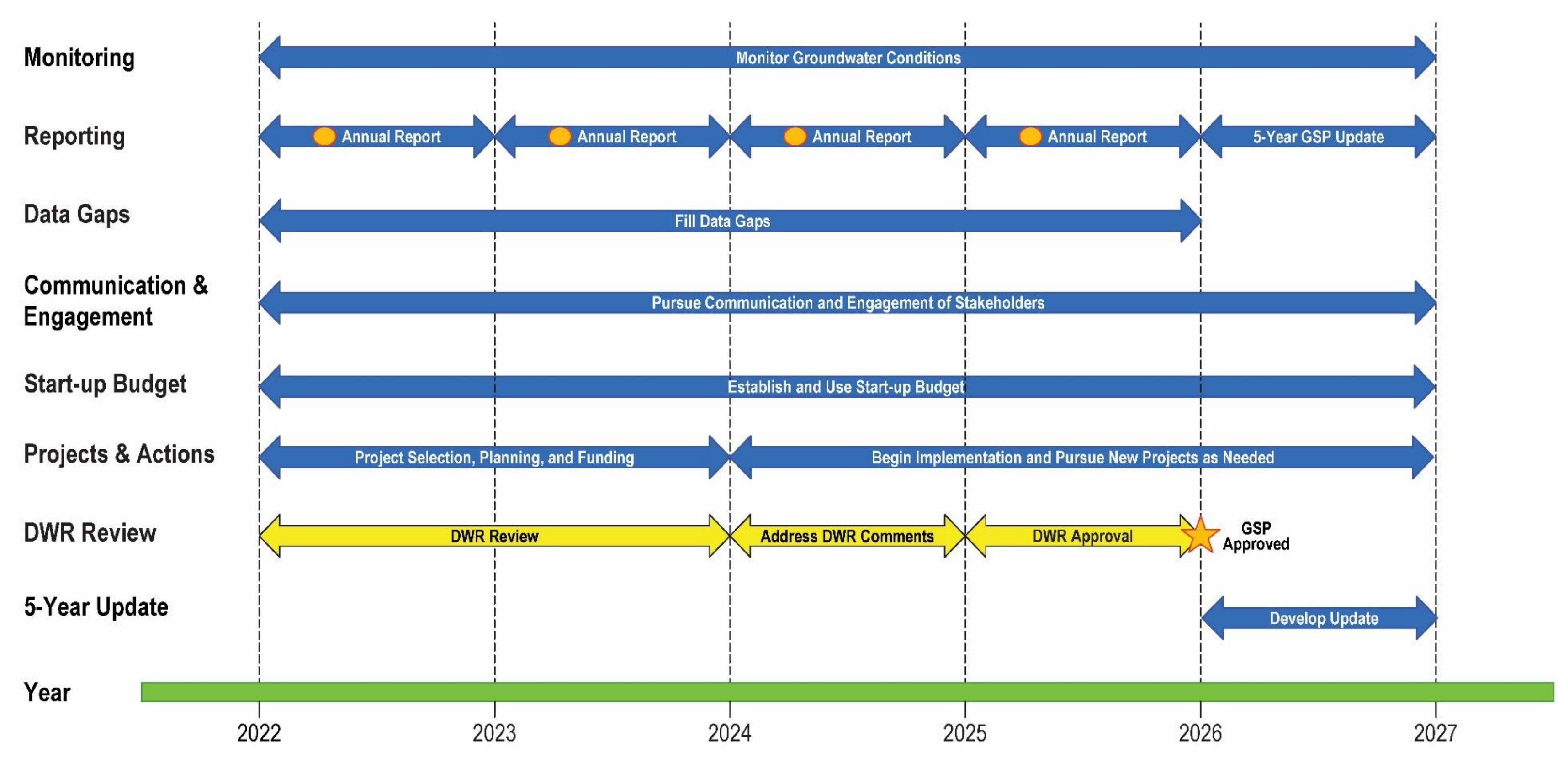


Figure 10-1. General Schedule During First Five-Years of GSP Implementation

REFERENCES

Ahtna Engineering, 2013. Final Annual Report of Quarterly Monitoring October 2011 through September 2012 Groundwater Monitoring Program Sites 2 and 12, OU2, OUCTP and OU1 Off-Site Former Fort Ord, California, dated June 2013.

Ahtna Environmental, Inc., 2019. Technical Summary Report — Perfluorooctanoic Acid and Perfluorooctane Sulfonate Basewide Review of Historical Activities and Groundwater Monitoring at Operable Unit 2 Former Fort Ord, California, prepared for U.S. Army Corps of Engineers, dated September 27, 2019.

AKEL Engineering Group, 2020. Marina Coast Water District Water Master Plan, dated May 2020.

Anderson-Nichols and Co., 1981. El Toro Groundwater Study, Final Report, dated October 1981.

Aqua Geo Frameworks, 2019. Final Report Entitled 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District, dated December 11, 2019.

Barlow, 2003. Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast, U.S. Geological Survey Circular 1262.

Brown and Caldwell, 2015. State of the Salinas River Groundwater Basin, dated January 16, 2015.

Burton and Wright, 2018. Status and Understanding of Groundwater Quality in the Monterey-Salinas Shallow Aquifer Study Unit, 2012–13: California GAMA Priority Basin Project, dated September 2018.

California Invasive Plant Council (Cal-IPC). 2011. Arundo donax: Distribution and Impact Report. Agreement No. 06-374-559-0. Submitted to State Water Resources Control Board. https://www.cal-ipc.org/wp-content/uploads/2017/11/Arundo_Distribution_Impact_Report_Cal-IPC_March-2011_small.pdf.

California Water Service, 2016. 2015 Urban Water Management Plan, Salinas District, dated June 2016.

California Regional Water Quality Control Board, 2017. Order No. R3-2017-0002, Conditional Waiver of Waste Discharge Requirements for Discharge from Irrigated Lands, dated March 8, 2017.

CCRWQCB, 2019. Water Quality Control Plan for the Central Coastal Basin, dated March 2019. https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs2017/2017_basin_plan_r3_complete.pdf.

CH2M, 2004. Hydrogeologic Assessment of the Seaside Groundwater Subbasin, dated January 2004.

City of Marina, 2010. General Plan, dated August 4, 2010.

City of Marina, 2013. Local Coastal Program Volume I Land Use Plan, dated November 2013.

City of Seaside, 2017. City of Seaside General Plan, Public Draft November 2017.

Creegan + D'Angelo, 2005. Fort Ord Reuse Authority Stormwater Master Plan, March 2005.

CCR, 2016. Title 23, Waters, Division 2, Department of Water Resources, Chapter 1.5. Groundwater Management, Subchapter 2. Groundwater Sustainability Plans. 42p. https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf.

CWC (California Water Code). 2014. https://leginfo.legislature.ca.gov/faces/codesTOCSelected.xhtml?tocCode=WAT&tocTitle=+Water+Code+-+WAT.

Denise Duffy & Associates, Inc., 2014. Proposition 84 IRWM Plan Update, dated April 18, 2014.

Department of Finance, 2020. E-1 Population Estimates for Cities, Counties, and the State — January 1, 2019 and 2020, dated May 2020.

Dupre, 1990. Maps Showing Geology and Liquefaction Susceptibility of Quaternary Deposits in the Monterey, Seaside, Spreckels, and Carmel Valley Quadrangles, Monterey County, California, dated June 4, 1990.

Durbin, 1974. Digital Simulation of the Effects of Urbanization on Runoff in the Upper Santa Ana Valley, California. U.S. Geological Survey Water Resources Investigations. no.73-41. https://pubs.usgs.gov/wri/1973/0041/report.pdf

Durbin, 1978. Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, dated November 1978.

Durbin, 2007. Groundwater Flow and Transport Model Seaside Groundwater Basin Monterey County, California, dated October 26, 2007.

DWR, 1946. Salinas Basin Investigation Summary Report (Bulletin No. 52-B), dated January 1946.

DWR, 1973. Sea Water Intrusion, Lower Salinas Valley, Monterey County, dated July 1973.

DWR, 2004. Bulletin 118 Basin Description: Salinas Valley Groundwater Basin, 180-400 Foot Aquifer Subbasin, dated February 27, 2004.

DWR, 2016a. Best Management Practices for the Sustainable Management of Groundwater - Hydrogeologic Conceptual Model, dated December 30, 2016.

DWR, 2016b. Best Management Practices for the Sustainable Management of Groundwater - Monitoring Networks and Identification of Data Gaps, dated December 2016.

DWR, 2016c. California's Groundwater. Bulletin 118 Interim Update 2016.

DWR. 2017. Best Management Practices for the Sustainable Management of Groundwater – Sustainable Management Criteria, draft dated November 2017.

DWR, 2018. Guidance Document for the Sustainable Management of Groundwater – Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development, dated July 2018.

DWR, 2020a. DWR climate change datasets, available online at https://data.cnra.ca.gov/dataset/sgma-climate-change-resources.

EKI Environment & Water, Inc., 2019. Fresh Groundwater in Dune Sand and 180-Foot Aquifer Zones South of Salinas River, 180/400 Foot Aquifer & Monterey Subbasins, dated December 20, 2019.

EKI Environment & Water, Inc., 2020. Water Supply Alternatives Study, Former Fort Ord Area, Monterey, CA, prepared for the Marina Coast Water District, June 2020.

EMC Planning Group Inc, 2012. Final Reassessment Report, Fort Ord Reuse Plan Reassessment, dated December 14, 2012.

Feeney, 2007. Seaside Groundwater Basin Watermaster Seawater Sentinel Wells Project, dated October 2007.

Feeney, 2003. Deep Aquifer Investigation—Hydrogeologic Data Inventory, Review, Interpretation and Implications, dated March 31, 2003.

Feikert, 2001. How Land-Use Affects Sediment Yields and Surface Runoff in a Small Semi-arid Watersheds, A Case Study of the El Toro Watershed, dated May 22, 2001. http://science.csumb.edu/~ccows/ccows/pubs/capstones/BFeikert_FinalThesis.pdf

FORA, 2007. FORA Board Resolution No. 07-10, dated May 2007.

Fugro, 1996. Additional Hydrogeologic Update, El Toro Area, Monterey County, California, dated February 1996.

Geosyntec Consultants, 2007. El Toro Groundwater Study, dated July 2007.

Geosyntec Consultants, 2010. Geologic Map and Cross-Sections from El Toro to Salinas Valley, dated June 2010.

Greene, 1970. Geology of Southern Monterey Basin and Its Relationship to the Ground Water Basin and Salt Water Intrusion, U.S. Geological Survey Open-File Report 70-141.

Greene, 1977. Geology of the Monterey Bay Region, California, U.S. Geological Survey Open-File Report 77-718.

Hanson et al., 2002. Geohydrology of a Deep-Aquifer Monitoring-Well Site at Marina, Monterey County, California, dated January 2002.

Harding ESE, 2001. Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California, dated April 12, 2001.

Hartwell et al., 2016. Offshore and Onshore Geology and Geomorphology, Offshore of Monterey Map Area, California, U.S. Geological Survey Open-File Report 2016-1110, p. 10.

HLA, 1994. Basewide Hydrogeologic Characterization, Fort Ord, California, U.S. Department of the Army, dated June 10, 1994.

HLA, 1999. Draft Final OU 2 Plume Delineation Investigation Report, dated February 11, 1999.

HydroMetrics, 2009. Seaside Groundwater Basin Modeling and Protective Groundwater Elevations, dated November 2009.

ICF, 2019. Fort Ord Multi-Species Habitat Conservation Plan, dated September 2019.

Jordan et al., 2005. Analysis of Aquifer Response, Groundwater Flow, and Plume Evolution at Site OU 1, Former Fort Ord, California, Lawrence Berkeley National Laboratory, dated February 21, 2005.

Johnson et al., 2016. Local (Offshore of Monterey Map Area) and Regional (Offshore from Pigeon Point to Southern Monterey Bay) Shallow-Subsurface Geology and Structure, California, U.S. Geological Survey Open-File Report 2016-1110, p. 9.

Kennedy/Jenks Consultants, 2004. Hydrostratigraphic Analysis of the Northern Salinas Valley, dated May 14, 2004.

Kulongoski and Belitz, 2005. Ground-Water Quality Data in the Monterey Bay and Salinas Valley Basins, California, 2005 - Results from the California GAMA Program.

M1W, 2018. Monterey One Water Progress Report on Pure Water Monterey Expansion, May 10, 2018

MACTEC Engineering and Consulting, Final Operable Unit Carbon Tetrachloride Plume Groundwater Remedial Investigation/Feasibility Study Former Fort Ord, California Volume 1 - Remedial Investigation, dated May 19, 2006.

MCWD, 2019. MCWD Production Well Pump Test Results, provided by MCWD Staff on September 18, 2019.MCWRA; LSCE, 2006. Monterey County Groundwater Management plan, dated May 2006.

MCWRA, 2015. CASGEM Monitoring Plan for High and Medium Priority Basins in the Salinas Valley Groundwater Basin, dated March 10, 2015.

MCWRA, 2016. Salinas River Stream Maintenance Program Permit Application Supplemental Attachment. 299 p.

MCWRA, 2017. Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin, dated October 2017.

MCWRA, 2018. Deep Aquifers Roundtable Meeting, dated March 9, 2018.

MCWRA, 2019. Salinas River Long-Term Management Plan. http://www.salinasrivermanagementprogram.org/ltmp_doc.html

MCWRA/MCWD, 1996. Annexation Agreement and Groundwater Mitigation Framework for Marina Area Land, dated March 1996.

MCWRA/U.S. Army, 1993. Agreement No. A-06404 - Agreement between the United States of America and the Monterey County Water Resources Agency Concerning Annexation of the Fort Ord Into Zones 2 and 2A of the Monterey County Water Resources Agency, dated September 1993.

Monterey County, 2010. 2010 Monterey County General Plan, Adopted October 26, 2010.

Monterey County, 2018. Greater Monterey County Integrated Regional Water Management Plan Adopted April 2013, Updated September 2018.

Montgomery & Associates, 2019. Water Year 2019 Seawater Intrusion Analysis Report Seaside Basin, Monterey County California, dated November 25, 2019.

Moran, Tara, and Alletta Belin. 2019. "A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act." Stanford Water in the West. Available at https://stacks.stanford.edu/file/druid:dw122nb4780/A%20Guide%20to%20Water%20Quality%20Requirements%20under%20SGMA.pdf.

MPMWD, 2012. Monterey Peninsula Water Management District CASGEM Monitoring Plan, dated April 18, 2012.

MPMWD, 2019. Final Draft Monterey Peninsula, Carmel Bay, and South Monterey Bay Integrated Regional Water Management Plan Update, dated September 25, 2019.

Muir, 1982. Groundwater in the Seaside Area Monterey County California, dated September 1982.

Nellor et. Al., 2017. Final Engineering Report Pure Water Monterey Groundwater Replenishment Project, revised November 2017.

RBF, 2003. Regional Urban Recycled Water Distribution Project Report.

Richard Thorup, 1976. Report on Castroville Irrigation Project, Deep Test Hole and Freshwater Bearing Strata below the 400 Foot Aquifer, Salinas Valley, California, dated April 20, 1976.

Schaaf & Wheeler, 2016. 2015 Urban Water Management Plan, Marina Coast Water District, dated June 2016.

Schaaf & Wheeler, 2021. 2020 Urban Water Management Plan, Marina Coast Water District, dated June 2021.

Stanford/Aqua Geo Frameworks, 2018. Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA, dated March 15, 2018.

Superior Court of California, 2007. Case No. M66343 - Notice of Vacated Hearing Re Biship, Mcintosh & Mcintosh Motion to Modify Exhibit C to Amended Decision, filed on February 9, 2007.

SVBGSA, 2020. Salinas Valley Groundwater Basin 180/400-Foot Aquifer Subbasin Groundwater Sustainability Plan, adopted January 9, 2020.

SVBGSA, 2021. Request for Statement of Qualifications For Completion of a Study of the Deep Aquifer Underlying the 180/400-Foot Aquifer Subbasin, in the Salinas Valley. https://svbgsa.org/wp-content/uploads/2021/09/Deep-Aquifer-RFQ-FINAL.pdf.

SWRCB, 2017. Water Quality Control Plan for the Central Coastal Basin. https://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs2017/2017_basin_plan_r3_complete.pdf.

Thorne, J., Cameron, D., & Jigour, V. 2002. A guide to wildlands conservation in the central region of California. California Wilderness Coalition, Davis. https://escholarship.org/uc/item/41m0z72f.

U.S. Army Corps of Engineers, Sacramento District, 1997. Habitat Management Plan for Former Fort Ord, California, dated April 1997.

U.S. Army Corps of Engineers, Sacramento District, 2019. Final Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California. Volume I – Groundwater. https://fortordcleanup.com/reference-documents/quality-assurance-project-plans-qapp/

USGS, 2002. User's Guide to SEAWAT: A Computer Program For Simulation of Three-Dimensional Variable-Density Ground-Water Flow. https://fl.water.usgs.gov/PDF_files/twri_6_A7_guo_langevin.pdf.

Winter et al., 1999. Ground water and surface water- A Single Resource. U.S. Geological Survey Circular 1139.

WRA Environmental Consultants, 2020. Biological Resource and Groundwater Dependency Analysis of Marina Vernal Ponds, dated 30 June 2020.

Yates et al., 2002. Laguna Seca Subarea Phase III Hydrogeologic Update, dated November 2002.

Yates, 2005. Seaside Groundwater Basin: Update on Water Resource Conditions, dated April 14, 2005.

Yates and Wiese, 1988. Hydrogeology and water resources of the Los Osos Valley ground-water basin, San Luis Obispo County, California, U.S. Geological Survey Water-Resources Investigations Report 88-4081.

Appendix 1-A

GSP Approval Documentation

Notice to Cities and Counties

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO: Hans Uslar, City Manager
City of Monterey
580 Pacific Street
Monterey, CA 93940

FROM: Remleh Scherzinger, General Manager, MCWD GSA

Special Notice to Cities and Counties within the Geographic Area covered by the Monterey Subbasin Groundwater Sustainability Plan pursuant to California Water Code Section 10728.4

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act. The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

As required by California Water Code §10728.4, the MCWD GSA is hereby providing special notice to cities and counties within the geographic area covered by the Monterey Subbasin GSP that the MCWD GSA intends to adopt the Monterey Subbasin GSP at least 90 days after your agency's receipt of this notice. The MCWD GSA will consult with your agency if consultation is requested within 30 days of receipt of this notice.

In addition, the Draft GSP is available for public comment. The deadline for comments to be reviewed and considered is November 1, 2021.

Please provide comments by either:

1. mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
2. Via a comment form submitted through the MCWD website at https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m. Please visit (on or about December 16, 2021) https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Sincerely,

Remleh Scherzinger
General Manager, MCWD GSA

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO: Charles McKee, County Administrative Officer
County of Monterey
168 West Alisal Street, Third Floor
Salinas, CA 93901

FROM: Remleh Scherzinger, General Manager, MCWD GSA

Special Notice to Cities and Counties within the Geographic Area covered by the Monterey Subbasin Groundwater Sustainability Plan pursuant to California Water Code Section 10728.4

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act. The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

As required by California Water Code §10728.4, the MCWD GSA is hereby providing special notice to cities and counties within the geographic area covered by the Monterey Subbasin GSP that the MCWD GSA intends to adopt the Monterey Subbasin GSP at least 90 days after your agency's receipt of this notice. The MCWD GSA will consult with your agency if consultation is requested within 30 days of receipt of this notice.

In addition, the Draft GSP is available for public comment. The deadline for comments to be reviewed and considered is November 1, 2021.

Please provide comments by either:

1. mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
2. Via a comment form submitted through the MCWD website at https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m. Please visit (on or about December 16, 2021) https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Sincerely,

Remleh Scherzinger
General Manager, MCWD GSA

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO: John Guertin, City Manager
City of Del Rey Oaks
650 Canyon Del Rey Boulevard
Del Rey Oaks, CA 93940

FROM: Remleh Scherzinger, General Manager, MCWD GSA

Special Notice to Cities and Counties within the Geographic Area covered by the Monterey Subbasin Groundwater Sustainability Plan pursuant to California Water Code Section 10728.4

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act. The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

As required by California Water Code §10728.4, the MCWD GSA is hereby providing special notice to cities and counties within the geographic area covered by the Monterey Subbasin GSP that the MCWD GSA intends to adopt the Monterey Subbasin GSP at least 90 days after your agency's receipt of this notice. The MCWD GSA will consult with your agency if consultation is requested within 30 days of receipt of this notice.

In addition, the Draft GSP is available for public comment. The deadline for comments to be reviewed and considered is November 1, 2021.

Please provide comments by either:

1. mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
2. Via a comment form submitted through the MCWD website at https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m. Please visit (on or about December 16, 2021) https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Sincerely,

Remleh Scherzinger
General Manager, MCWD GSA

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO:

FROM: Patrick Breen, Water Resources Manager

Notice of Public Comment Period and Public Hearing on Adoption of Monterey Subbasin Groundwater Sustainability Plan

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act.

The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

The Draft GSP is available for public comment. All comments must be submitted by November 1, 2021, to be reviewed and considered.

Please provide any comments by:

(1) mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
(2) via a comment form submitted through the MCWD website https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m.

On or about December 16, 2021, please visit https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO: Layne Long, City Manager
City of Marina
211 Hillcrest Avenue
Marina, CA 93933

FROM: Patrick Breen, Water Resources Manager

Notice of Public Comment Period and Public Hearing on Adoption of Monterey Subbasin Groundwater Sustainability Plan

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act.

The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

The Draft GSP is available for public comment. The deadline for comments to reviewed and considered is November 1, 2021.

Please provide any comments by:

(1) mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
(2) via a comment form submitted through the MCWD website https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m.

On or about December 16, 2021, please visit https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road, Marina, CA 93933

DATE: September 20, 2021

TO: Roberta Greathouse, Acting City Manager
City of Seaside
440 Harcourt Avenue
Seaside, CA 93955

FROM: Remleh Scherzinger, General Manager, MCWD GSA

Special Notice to Cities and Counties within the Geographic Area covered by the Monterey Subbasin Groundwater Sustainability Plan pursuant to California Water Code Section 10728.4

The Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA), in collaboration with the Salinas Valley Basin GSA, has prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (Monterey Subbasin GSP) as required by the Sustainable Groundwater Management Act. The Draft Monterey GSP is available for download at the MCWD website at the following link: https://mcwd.org/gsa_gsp.html.

As required by California Water Code §10728.4, the MCWD GSA is hereby providing special notice to cities and counties within the geographic area covered by the Monterey Subbasin GSP that the MCWD GSA intends to adopt the Monterey Subbasin GSP at least 90 days after your agency's receipt of this notice. The MCWD GSA will consult with your agency if consultation is requested within 30 days of receipt of this notice.

In addition, the Draft GSP is available for public comment. The deadline for comments to be reviewed and considered is November 1, 2021.

Please provide comments by either:

1. mailing them to Remleh Scherzinger, General Manager, Marina Coast Water District, 11 Reservation Road, Marina, CA 93933-2099, or
2. Via a comment form submitted through the MCWD website at https://mcwd.org/gsa_gsp.html.

When providing comments, please refer to the GSP section number or page number for each comment, if applicable.

PLEASE TAKE NOTICE that the MCWD GSA will hold a public hearing to consider adopting the Monterey Subbasin GSP as part of the MCWD GSA Board meeting on December 20, 2021, at 7:00 p.m. Please visit (on or about December 16, 2021) https://www.mcwd.org/governance_meetings.html for the Board meeting agenda and for links to the meeting.

If you have any questions about this notice, please contact Patrick Breen by email at pbreen@mcwd.org or by phone at 831.883.5951.

Sincerely,

Remleh Scherzinger
General Manager, MCWD GSA

MCWD Public Hearing Notice

Ad Number	Color	Production Color	Ad Attributes	Production Method	Production Notes
0006632544-01				AdBooker	

External Ad Number	Pick Up	Ad Type	Released for Publication
		Legal Liner	

NOTICE OF PUBLIC HEARING THE MARINA COAST WATER DISTRICT GROUNDWATER SUSTAINABILITY AGENCY (MCWD GSA) will conduct a public hearing to consider the adoption of a Groundwater Sustainability Plan (GSP) for the Salinas Valley Groundwater Basin - Monterey Subbasin (DWR Basin No. 3-004.10). The GSP was prepared pursuant to the Sustainable Groundwater Management Act of 2014, and California Water Code Section 10728.4. The GSP has been co-developed by the MCWD GSA and the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA), which provides a path to achieve sustainable groundwater management within 20 years following Plan adoption. The GSA Board of Directors will conduct the hearing at their regularly scheduled meeting at 7:00 p.m., Monday, January 17, 2022, by virtual meeting, at which time and place interested persons may participate and be heard on the matter. Visit the District's website at https://www.mcwd.org/governance_meetings.html<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mcwd.org%2Fgovernance_meetings.html&data=04%7C01%7Cpbreen%40mcwd.org%7C8c62135376024a5d3e7108d9bff05cfc%7C54b314a0dce4435b9311c747bd706a44%7C0%7C0%7C637751861370139733%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000&sdata=38iYoG5qqoK3UcfUSFRWiH7D19GJFSjz3VgopXZRpl8%3D&reserved=0> for the Board Meeting agenda and for links to the public hearing staff report which will be available one week before the public hearing. The Draft Plan is available for review on the District website at https://www.mcwd.org/gsa_sustainability_plan.html<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.mcwd.org%2Fgsa_sustainability_plan.html&data=04%7C01%7Cpbreen%40mcwd.org%7C8c62135376024a5d3e7108d9bff05cfc%7C54b314a0dce4435b9311c747bd706a44%7C0%7C0%7C637751861370149728%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000&sdata=0NDRDYRnT6sEwHLJQ5ZE88o%2Bp1Iba5XqWg22w3yOg9U%3D&reserved=0>. The public, agencies, and other interested parties are invited to attend the public hearing and provide written or verbal comments. Comments received during the public hearing will be considered by the GSA for its determination to adopt the proposed GSP.
12/18, 12/26/2021

Product	Requested Placement	Requested Position	Run Dates	# Inserts
Monterey Herald	Legals CLS	General Legal - 1076~	12/18/21, 12/26/21	2

SVBGSA Public Hearing Notice

Salinas Valley Basin
Groundwater Sustainability Agency

PUBLIC NOTICE

PUBLIC HEARING FOR ADOPTION OF GROUNDWATER SUSTAINABILITY PLANS FOR EASTSIDE, FOREBAY, LANGLEY, UPPER VALLEY, AND MONTEREY SUBBASINS

On **August 12, 2021**, the SVBGSA Board of Directors approved the release of the Groundwater Sustainability Plans (GSPs) for the Eastside, Forebay, Langley, and Upper Valley Subbasins for a public review period. On **September 9, 2021**, the SVBGSA Board of Directors approved the release of the GSP for the Monterey Subbasin for a public review period. The GSPs are being prepared according to the California Sustainable Groundwater Management Act of 2014. The GSPs are available for viewing on the SVBGSA website on the Subbasins page, which can be found at **www.svbgsa.org/subbasins/**.

The SVBGSA Board will hold a public hearing to consider adoption of the Eastside, Forebay, Langley, Upper Valley, and Monterey GSPs on **January 13th, 2022, at 3 p.m.** on Zoom. The 1/13/22 meeting agenda will be published at svbgsa.org prior to the meeting in keeping with State law. Marina Coast Water District Groundwater Sustainability Agency, the co-author and co-implementing agency of the Monterey GSP, will hold a public hearing on the GSP on **January 19th, 2022**.

MCWD Resolution

January 19, 2022

Resolution No. 2022-GSA01
Resolution of the Board of Directors
Marina Coast Water District Groundwater Sustainability Agency
Adoption of the Monterey Sub-basin Groundwater Sustainability Plan

RESOLVED by the Board of Directors ("Directors") of the Marina Coast Water District Groundwater Sustainability Agency ("District"), at a regular meeting duly called and held on January 19, 2022, via a videoconference pursuant to Governor Newsom's Executive Order N-29-20, as follows:

WHEREAS, in the fall of 2014 the California legislature adopted, and the Governor signed into law, three bills (SB 1168, AB 1739, and SB 1319) collectively referred to as the "Sustainable Groundwater Management Act" ("SGMA"), that initially became effective on January 1, 2015, and that has been amended from time-to-time thereafter; and,

WHEREAS, the stated purpose of SGMA, as set forth in California Water Code section 10720.1, is to provide for the sustainable management of groundwater basins at a local level by providing local groundwater agencies with the authority, and technical and financial assistance necessary, to sustainably manage groundwater; and,

WHEREAS, SGMA requires the designation of Groundwater Sustainability Agencies ("GSAs") for the purpose of achieving groundwater sustainability through the adoption and implementation of regulatory programs known as Groundwater Sustainability Plans ("GSPs") or an alternative plan for all medium and high priority basins as designated by the California Department of Water Resources ("DWR"); and,

WHEREAS, SGMA requires GSAs to adopt GSPs for each basin/subbasin within the GSA's jurisdiction; and,

WHEREAS, GSPs for basins designated medium priority in DWR's Bulletin 118, and for those basins designated, are due to be filed with DWR no later than January 31, 2022; and,

WHEREAS, the Monterey Sub-basin of the Salinas Valley Groundwater Basin ("Sub-basin") is designated medium priority; and,

WHEREAS, the Marina Coast Water District Groundwater Sustainability Agency (MCWDGSA) in coordination with the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) has undertaken the process to prepare a GSP for the Subbasin as required by SGMA; and,

WHEREAS, the MCWDGSA has provided the notices required by Water Code section 10727.8; and,

WHEREAS, the MCWDGSA Board of Directors and the MCWD GSA staff have held eleven public meetings where elements of the GSP for the Subbasin have been presented and discussed, and where the general public has been provided the opportunity to comment on the various elements of the GSP; and, WHEREAS, the MCWDGSA has received forty-five written public comment letters on the various elements of the GSP, which have been reviewed and commented on, where and as appropriate, as part of the GSP; and,

WHEREAS, the MCWD GSA Board of Directors has noticed a public hearing for January 19, 2022, as required by Water Code section 10728.4 for the purpose of public consideration of the adoption of the GSP for the Monterey Subbasin; and,

WHEREAS, at the public hearing, the Board of Directors received public comment regarding the GSP for the Monterey Subbasin and the comments from the public thereon; and,

WHEREAS, the GSP for the Monterey Subbasin contains all the elements required by Water Code sections 10727.2 and 10727.4; and,

WHEREAS, after its filing with DWR, the GSP for the Subbasin will be subject to a further public review period, and will undergo review by DWR for a period not exceeding two years; and,

WHEREAS, the GSP for the Subbasin will be subject to further updating during the DWR review period, and periodically thereafter; and,

WHEREAS, the MCWDGSA Board of Directors closed the public hearing on January 19, 2022, and adopted the plan at the regular Board of Directors meeting of January, 19, 2022; and,

WHEREAS, it is now necessary and appropriate for the MCWDGSA Board of Directors to adopt the GSP for the Monterey Subbasin, and authorize and concur with its filing with DWR no later than the date required by SGMA;

NOW, THEREFORE, BE IT RESOLVED, by the Board of Directors of the Marina Coast Water District Groundwater Sustainability Agency, as follows:

1. The above Recitals are true and correct.
2. The Groundwater Sustainability Plan for the Monterey Sub-basin of the Salinas Valley Groundwater Basin is adopted.
3. The General Manager and Agency Counsel are hereby authorized and directed to implement the plan and take such other and further actions as may be necessary or appropriate to implement the intent and purposes of this resolution.

PASSED AND ADOPTED on January 19, 2022, by the Board of Directors of the Marina Coast Water District Groundwater Sustainability Agency by the following roll call vote:

Ayes: Directors Moore, Morton, Zefferman, Cortez, Shriner

Noes: Directors None

Absent: Directors None

Abstained: Directors None

Jan Shriner, President

ATTEST:

Remleh Scherzinger, Secretary

CERTIFICATE OF SECRETARY

The undersigned Secretary of the Board of the Marina Coast Water District Groundwater Sustainability Agency hereby certifies that the foregoing is a full, true and correct copy of MCWD GSA Resolution No. 2022-GSA01 adopted January 19, 2022.

Remleh Scherzinger, Secretary

SVBGSA Resolution

Before the Board of Directors of the
Salinas Valley Basin Sustainable Groundwater Management Agency

Resolution No. 2022-01

Approving the Groundwater Sustainability)
Plan for the Monterey subbasin of the Salinas)
Valley Groundwater Basin, and authorizing)
and requesting its filing with the California)
Department of Water Resources.)

WHEREAS, in the fall of 2014 the California legislature adopted, and the Governor signed into law, three bills (SB 1168, AB 1739, and SB 1319) collectively referred to as the "Sustainable Groundwater Management Act" ("SGMA"), that initially became effective on January 1, 2015, and that has been amended from time-to-time thereafter; and,

WHEREAS, the stated purpose of SGMA, as set forth in California Water Code section 10720.1, is to provide for the sustainable management of groundwater basins at a local level by providing local groundwater agencies with the authority, and technical and financial assistance necessary, to sustainably manage groundwater; and,

WHEREAS, SGMA requires the designation of Groundwater Sustainability Agencies ("GSAs") for the purpose of achieving groundwater sustainability through the adoption and implementation of regulatory programs known as Groundwater Sustainability Plans ("GSPs") or an alternative plan for all medium and high priority basins as designated by the California Department of Water Resources ("DWR"); and,

WHEREAS, in December of 2016 a joint powers authority, known as the Salinas Valley Basin Groundwater Sustainability Agency ("SVBGSA") was formed for the purpose of being a GSA for the Salinas Valley Groundwater Basin ("Basin"), and the subbasins therein (with limited exceptions), within Monterey County; and,

WHEREAS, SGMA requires GSAs to adopt GSPs for each basin/subbasin within the GSA's jurisdiction; and,

WHEREAS, GSPs for basins designated medium priority in DWR's Bulletin 118 are due to be filed with DWR no later than January 31, 2022; and,

WHEREAS, the Monterey subbasin of the Salinas Valley Groundwater Basin ("Subbasin") is designated medium priority; and,

WHEREAS, the SVBGSA and the Marina Coast Water District Groundwater Sustainability Agency ("MCWDGSA") have undertaken the process to prepare a GSP for the Subbasin as required by SGMA; and, WHEREAS, the SVBGSA and MCWDGSA have agreed to create two management areas within the Subbasin, the Corral de Tierra Area to be managed by the SVBGSA, and the Marina-Ord Area to be managed by the MCWDGSA, to be managed pursuant to a single GSP for the Subbasin; and,

WHEREAS, the SVBGSA and MCWDGSA have agreed that the MCWDGSA is to be the lead GSA for the purpose of filing the GSP for the Subbasin with DWR; and,

WHEREAS, the SVBGSA and MCWDGSA have provided the notices required by Water Code section 10727.8, and previously formed Advisory Committees, consisting of a diverse group of interested parties and stakeholders, which has reviewed and provided input into the GSP for the Subbasin; and,

WHEREAS, the SVBGSA and MCWDGSA Boards of Directors and the Advisory Committees have held numerous public meetings where elements of the GSP for the Subbasin have been presented and discussed, and where the general public has been provided the opportunity to comment on the various elements of the GSP; and,

WHEREAS, the SVBGSA formed a Subbasin Committee for the Subbasin, which has also held numerous public meetings to discuss the elements of the GSP, and where the general public has been provided the opportunity to comment on the various elements of the GSP; and,

WHEREAS, the SVBGSA has received a significant amount of written public comments on the various elements of the GSP, which have been reviewed and commented on as part of the GSP; and,

WHEREAS, the SVBGSA has noticed a public hearing for January 13, 2022, as required by Water Code section 10728.4 for the purpose of considering adoption of a GSP for the Subbasin; and,

WHEREAS, at the public hearing, the Board of Directors considered the GSP for the Subbasin and the comments from the public thereon; and,

WHEREAS, the Board of Directors of the MCWDGSA will consider approving the GSP after the SVBGSA Board of Directors considered its approval; and,

WHEREAS, the GSP for the Subbasin contains all the elements required by Water Code sections 10727.2 and 10727.4; and,

WHEREAS, after its filing with DWR, the GSP for the Subbasin will be subject to a further public review period, and will undergo review by DWR for a period not exceeding two years; and

WHEREAS, the GSP for the Subbasin will be subject to further updating during the DWR review period, and periodically thereafter; and

WHEREAS, it is now necessary and appropriate for the Board of Directors to consider the approval of the GSP for the Subbasin, and authorize and request its filing with DWR by the MCWDGSA no later than the date required by SGMA; NOW, THEREFORE, BE IT RESOLVED, by the Board of Directors of the Salinas Valley Basin Groundwater Sustainability Agency, as follows:

1. The above Recitals are true and correct.

2. The Groundwater Sustainability Plan for the Monterey subbasin of the Salinas Valley Groundwater Basin is approved.

3. The MCWDGSA is hereby requested to approve the GSP, and authorized and requested, upon its approval of the GSP, to cause the GSP to be filed with the California Department of Water Resources no later than January 31, 2022, as required by the Sustainable Groundwater Management Act.

4. The General Manager and Agency Counsel are hereby authorized and directed to take such other and further actions as may be necessary or appropriate to implement the intent and purposes of this resolution.

PASSED AND ADOPTED on this 13th day of January, 2022, by the following vote, to-wit:

AYES: Directors Adams, Alejo, Bramers, Chapin, Granillo, Lipe, McIntyre, Stefani, and Chair Pereira
NOES: Directors Brennan and Rocha
ABSENT: None
ABSTAIN: None

I, Harrison Tregenza, Clerk of the Board of Directors of the Salinas Valley Basin Groundwater Sustainability Agency, State of California, hereby certify that the foregoing is a true copy of an original order of said Board of Directors duly made and entered in the minutes thereof for the meeting on January 13, 2022.

Dated: 1/21/2022

Harrison Tregenza, Clerk of the Board of Directors of the Salinas Valley Basin Groundwater Sustainability Agency,
County of Monterey, State of California

DocuSigned by:
Harrison Tregenza
41088B0ED25E46D...

Appendix 1-B

Framework Agreement Between MCWD GSA and SVBGSA

JOINT EXERCISE OF POWERS AGREEMENT

establishing the

SALINAS VALLEY BASIN GROUNDWATER SUSTAINABILITY AGENCY

JOINT EXERCISE OF POWERS AGREEMENT

establishing the

SALINAS VALLEY BASIN GROUNDWATER SUSTAINABILITY AGENCY

THIS JOINT EXERCISE OF POWERS AGREEMENT ("Agreement') establishing the Salinas Valley Basin Groundwater Sustainability Agency ("Agency") is made and entered into as of 12/22/16 ("Effective Date"), by and among the public agencies listed on the attached Exhibit "A" (collectively "Members" and individually "Member") for the purpose of forming a Groundwater Sustainable Agency ("GSA") and achieving groundwater sustainability in the Salinas Valley Groundwater Basin.

RECITALS

WHEREAS, in the fall of 2014 the California legislature adopted, and the Governor signed into law, three bills (SB 1168, AB 1739, and SB 1319) collectively referred to as the "Sustainable Groundwater Management Act" ("SGMA"), that initially became effective on January 1, 2015, and that has been amended from time-to-time thereafter; and

WHEREAS, the stated purpose of SGMA, as set forth in California Water Code section 10720.1, is to provide for the sustainable management of groundwater basins at a local level by providing local groundwater agencies with the authority, and technical and financial assistance necessary, to sustainably manage groundwater; and

WHEREAS, SGMA requires the designation of Groundwater Sustainability Agencies ("GSAs") for the purpose of achieving groundwater sustainability through the adoption and implementation of Groundwater Sustainability Plans ("GSPs") or an alternative plan for all medium and high priority basins as designated by the California Department of Water Resources; and

WHEREAS, SGMA requires that the Basin have a designated GSA by no later than June 30, 2017, and an adopted GSP by no later than January 31, 2020, if a high or medium priority basin in critical overdraft, and no later than January 31, 2022, if a high or medium priority basin; and

WHEREAS, SGMA authorizes a combination of local agencies to form a GSA by entering into a joint powers agreement as authorized by the Joint Exercise of Powers Act (Chapter 5 of Division 7 of Title 1 of the California Government Code) ("Act"); and

WHEREAS, each Member is a local agency, as defined by SGMA, within that portion of the Salinas Valley Groundwater Basin ("Basin" and as more fully described below) within Monterey County, which is designated basin number 3-004 in Department of Water Resources Bulletin No. 118 (update 2016), and consisting of seven sub-basins plus that portion of the Paso Robles sub-basin within Monterey County (but not including the adjudicated portion of the

Seaside sub-basin), each of which is designated as either a high or medium priority basin, and one of which (the 180/400 ft. aquifer) is designated in critical overdraft; and

WHEREAS, the Members are therefore authorized to create the Agency for the purpose of jointly exercising those powers granted by the Act, SGMA, and any additional powers which are common among them; and

WHEREAS, the Members, individually and collectively, have the goal of cost effective sustainable groundwater management that considers the interests and concerns of all beneficial uses and users of groundwater within and adjacent to the Basin; and

WHEREAS, the Members hereby enter into this Agreement to establish the Agency to serve as a GSA for the Basin and undertake the management of groundwater resources pursuant to SGMA; and

WHEREAS, the Members intend to cooperate with adjacent GSAs such as any GSA formed over a portion of the Paso Robles sub-basin (3-04.06) within San Luis Obispo County, and the Pajaro Valley Water Management Agency; and

WHEREAS, the Members intend to study the potential for state legislation to, among other amendments, amend the WRA Act to modify the governance structure of the WRA in a form similar to the governance of the Agency established herein and to establish that agency as the statutorily designated GSA for the Basin, or establish a new entity to be so designated;

NOW THEREFORE,

In consideration of the matters recited and the mutual promises, covenants, and conditions set forth in this Agreement, the Members hereby agree as follows:

Article I: Definitions

Section 1.1 – Definitions.

As used in this Agreement, unless the context requires otherwise, the meaning of the terms hereinafter set forth shall be as follows:

(a) "Act" means the Joint Exercise of Powers Act, set forth in Chapter 5 of Division 7 of Title 1 of the California Government Code, sections 6500, *et seq.*, as may be amended from time-to-time.

(b) "Agreement" means this Joint Exercise of Powers Agreement establishing the Salinas Valley Basin Groundwater Sustainability Agency.

(c) "Agency" means the Salinas Valley Basin Groundwater Sustainability Agency, which is a separate entity created by this Agreement pursuant to the provisions of the Act and SGMA.

(d) "Agricultural Directors" means the four Directors representing agricultural interests, as more fully set forth in rows (f) – (i) of Exhibit B of this Agreement.

(e) "Agricultural Association" means the Salinas Basin Agricultural Water Association.

(f) "Alternate Director" means an Alternate Director appointed pursuant to Section 6.6 of this Agreement.

(g) "Appointing Authority" means the entity authorized to appoint Primary and Alternate Directors pursuant to Sections 6.2, 6.3 and 6.6 of this Agreement and as identified in Exhibit B to this Agreement.

(h) "Basin" means that portion of the Salinas Valley Groundwater Basin, newly designated no. 3-004 in the Department of Water Resources' Bulletin No. 118 (update 2016), within the County of Monterey and that includes the following sub-basins: 1) 180/400 Foot Aquifer (No. 3-004.01); 2) East Side Aquifer (3-004.02); 3) Forebay Aquifer (3-004.04); 4) Upper Valley Aquifer (3-004.05); 5) Langley Area (3-004.09); 7) the newly designated Monterey sub-basin (3-004.10); and, 8) the portion of the Paso Robles Area (3-004.06) in Monterey County; but not including that portion of the Seaside Area that has been adjudicated, all as their boundaries may be modified from time to time through the procedures described in California Water Code section 10722.2 or by the Department of Water Resources under its separate authority, and not including any other area for which a GSA has been established pursuant to SGMA.

(i) "Board of Directors" or "Board" means the governing body of the Agency as established by Section 6.1 of this Agreement.

(j) "Brown Act" means the California Open Meeting Law, Government Code section 54950 *et seq.*

(k) "Bylaws" means the bylaws adopted by the Board of Directors pursuant to Section 6.8 of this Agreement to govern the day-to-day operations of the Agency.

(l) "Cause" means a conviction of a crime i) of moral turpitude, or ii) involving fraud, misrepresentation, or financial mismanagement, or iii) a finding by an administrative body or agency, or a court of law, that the person has violated any conflict of interest provision of federal, state or local law.

(m) "City Selection sub-Committee" means a subcommittee of the Monterey County City Selection Committee, established by Government Code section 50270 et seq, and consisting of the mayors of the following cities: Gonzales, Soledad, Greenfield, and King City.

(n) "County" means the County of Monterey.

(o) "CPUC" means the California Public Utilities Commission.

(p) "CPUC Regulated Water Company" means an investor owned water company operating in the Basin that has been granted a certificate of public convenience and necessity by the CPUC and is regulated by the CPUC.

(q) "Determination Date" means the date on which the Agency votes to notify the State of its intent to become a GSA as provided in Water Code sections 10723 (a) and (b).

(r) "Director" or "Directors" means Primary and Alternate Directors as set forth in Section 6.6 of this Agreement.

(s) "Director Position(s)" means those eleven Board positions, singularly or plural, established pursuant to Section 6.1 of this Agreement.

(t) "Disadvantaged Community" means a disadvantaged community or economically distressed area as those terms are defined in Water Code section 79702 (as may be amended from time-to-time) within the Basin.

(u) "Effective Date" means the date by which two Members have executed this Agreement which date shall be set forth in the introductory paragraph of this Agreement.

(v) "Fiscal Year" means that period of 12 months beginning July 1 and ending June 30 of each calendar year.

(w) "Groundwater Sustainability Agency" or "GSA" has the meaning set forth in California Water Code section 10721(j).

(x) "Groundwater Sustainability Plan" or "GSP" has the meaning set forth in California Water Code section 10721(k).

(y) "GSA Eligible Entity or Entities" means those entities eligible to become a GSA pursuant to SGMA.

(z) "Initial Board" means the initial Board of Directors established pursuant to Section 6.2, below.

(aa) "Initial Contribution" means the required contribution of Members as set forth in Section 10.4 of this Agreement.

(bb) "Local Agency" or "Local Agencies" has the meaning set forth in California Water Code Section 10721(n).

(cc) "Local small water system" means a system for the provision of piped water for human consumption that serves at least two, but not more than four, service connections, including any collection, treatment, storage, and distribution facilities under control of the operator of such system which are used primarily in connection with such system, and any collection or pretreatment storage facilities not under the control of the operator which are used primarily in connection with such system; it does not include two or more service connections, which supply dwelling units occupied by members of the same family, on one parcel, all as set forth in Monterey County Code section 15.04.020 (g).

(dd) "Majority Vote" means the affirmative vote of six Directors then present and voting at a meeting of the Board.

(ee) "Member" or "Members" means the GSA Eligible Entities listed in the attached Exhibit "A" that have executed this Agreement, including any new Members that may subsequently join this Agency with the authorization of the Board, pursuant to Section 5.2 of this Agreement.

(ff) "Mutual Water Company" has the meaning set forth in Corporations Code section 14300.

(gg) "Permanent Board" means the permanent Board of Directors established pursuant to Section 6.3 of this Agreement.

(hh) "Permanent Director" means a Director appointed to the Permanent Board.

(ii) "Permanent Director Position" means a Director Position on the Permanent Board.

(jj) "Primary Director" means a Primary Director appointed pursuant to Sections 6.4 of this Agreement.

(kk) "Public Water System" means a system for the provision of water for human consumption through pipes or other constructed conveyances that has 15 or more service connections or regularly serves at least 25 individuals daily at least 60 days out of the year. A public water system includes the following: (1) Any collection, treatment, storage, and distribution facilities under control of the operator of the system that are used primarily in connection with the system, (2) Any collection or pretreatment storage facilities not under the control of the operator that are used primarily in connection with the system, or (3) Any water system that treats water on behalf of one or more public water systems for the purpose of rendering it safe for human consumption, all as set forth in Health and Safety Code section 116275 (h).

(ll) "South County Cities" means the cities of Gonzales, Soledad, Greenfield and King City.

(mm) "State" means the State of California.

(nn) "State Small Water System" means a system for the provision of piped water to the public for human consumption that serves at least five, but not more than 14, service connections and does not regularly serve drinking water to more than an average of 25 individuals daily for more than 60 days out of the year, as set forth in California Health and Safety Code section 116275 (n).

(oo) "Super Majority Vote" means the affirmative vote of eight Directors then present and voting at a meeting of the Board.

(pp) "Super Majority Plus Vote" means the affirmative vote of eight Directors then present and voting at a meeting of the Board but including the affirmative vote of three of the Agricultural Directors.

(qq) "Sustainable Groundwater Management Act" or "SGMA" means the comprehensive groundwater legislation collectively enacted and referred to as the "Sustainable Groundwater Management Act" as codified in California Water Code Sections 10720 *et seq.* and as may be amended from time-to-time.

(rr) "WRA" means the Water Resources Agency of the County of Monterey.

Unless otherwise indicated, all statutory references are to the statutory codes of the State.

Article II: The Agency

Section 2.1 – Agency Established.

There is hereby established a joint powers agency known as the Salinas Valley Basin Groundwater Sustainability Agency. The Agency shall be, to the extent provided by law, a public entity separate from the Members of this Agreement.

Section 2.2 – Purpose Of The Agency.

The purpose of Agency is to cooperatively carry out the requirements of SGMA including, but not limited to, serving as the GSA for the Basin and developing, adopting and implementing a GSP that achieves groundwater sustainability in the Basin, all through the exercise of powers granted to a GSA by SGMA and those powers common to the members as provided in the Act.

Article III: Term

Section 3.1 – Term.

This Agreement shall become operative on the Effective Date. Subject to the terms of Sections 11.6, 11.7 and 11.8, below, this Agreement shall remain in effect unless terminated pursuant to Section 11.10, below.

Article IV: Powers

Section 4.1 – Powers.

The Agency shall possess the ability to exercise those powers specifically granted by the Act, SGMA, and the common powers of its Members related to the purposes of the Agency, including, but not limited to, the following:

a) To designate itself the GSA for the Basin pursuant to SGMA.

b) To adopt rules, regulations, policies, bylaws and procedures governing the operation of the Agency and the adoption and implementation of the GSP.

c) To develop, adopt and implement a GSP for the Basin pursuant to SGMA.

d) To retain or employ consultants, advisors, independent contractors, agents and employees.

e) To obtain legal, financial, accounting, technical, engineering, and other services needed to carry out the purposes of this Agreement.

f) To conduct studies, collect and monitor all data related and beneficial to the development, adoption and implementation of the GSP for the Basin.

g) To perform periodic reviews of the GSP including submittal of annual reports.

h) To register and monitor wells.

i) To issue revenue bonds or other appropriate public or private debt and incur debts, liabilities or obligations.

j) To levy taxes, assessments, charges and fees as provided in SGMA or as otherwise provided by law.

k) To regulate and monitor groundwater extractions as permitted by SGMA, provided that this provision does not extend to a Member's operation of its system to distribute water once extracted or otherwise obtained, unless and to the extent required by other laws now in existence or as may otherwise be adopted.

l) To establish and administer projects and programs for the benefit of the Basin.

m) To cooperate, act in conjunction, and contract with the United States, the State, or any agency thereof, counties, municipalities, special districts, groundwater sustainability agencies, public and private corporations of any kind (including without limitation, investor-owned utilities), and individuals, or any of them, for any and all purposes necessary or convenient for the full exercise of the powers of the Agency.

n) To accumulate operating and reserve funds and invest the same as allowed by law for the purposes of the Agency.

o) To apply for and accept grants, contributions, donations and loans under any federal, state or local programs for assistance in developing or implementing any of its projects or programs in connection with any project untaken in the Agency's name for the purposes of the Agency.

p) To acquire by negotiation, lease, purchase, construct, hold, manage, maintain, operate and dispose of any buildings, property, water rights, works or improvements within and without the respective jurisdictional boundaries of the Members necessary to accomplish the purposes describe herein.

q) To sue or be sued in its own name.

r) To invest funds as allowed by law.

s) Any additional powers conferred under SGMA or the Act, or under applicable law, insofar as such powers are needed to accomplish the purposes of SGMA, including all powers granted to the Agency under Article 4 of the Act which are in addition to the common powers of the Members, including the power to issue bonds or otherwise incur debts, liabilities or obligations to the extent authorized by the Act or any other applicable provision of law and to pledge any property or revenues of the rights thereto as security for such bonds and other indebtedness.

t) Any power necessary or incidental to the foregoing powers in the manner and according to the procedures provided for under the law applicable to the Members to this Agreement and to perform all other acts necessary or proper to fully carry out the purposes of this Agreement.

Section 4.2 – Exercise Of Powers.

In accordance with Section 6509 of the Act, the foregoing powers shall be subject to the restrictions upon the manner of exercising such powers pertaining to the County.

Section 4.3 – Water Rights And Consideration Of All Beneficial Uses And Users Of Groundwater In The Basin.

As set forth in Water Code section 10723.2 the GSA shall consider the interests of all beneficial uses and users of groundwater in the Basin, as well as those responsible for implementing the GSP. Additionally, as set forth in Water Code section 10720.5(a) any GSP adopted pursuant to this Agreement shall be consistent with Section 2 of Article X of the California Constitution and nothing in this Agreement modifies the rights or priorities to use or store groundwater consistent with Section 2 of Article X of the California Constitution, with the exception that no extraction of groundwater between January 1, 2015 and the date the GSP is adopted may be used as evidence of, or to establish or defend against, any claim of prescription. Likewise, as set forth in Water Code section 10720.5(b) nothing in this Agreement or any GSP adopted pursuant to this Agreement determines or alters surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights.

Section 4.4 – Preservation Of Police Powers.

Nothing set forth in this Agreement shall be deemed to modify or otherwise limit a Member's police powers in any way, or any authority to regulate groundwater under existing law or any amendment thereto.

Article V: Membership

Section 5.1 – Members.

The Members of the Agency shall be the entities listed on the attached Exhibit A so long as their membership has not been withdrawn or terminated pursuant to the provisions of Article XI of this Agreement. GSA Eligible Entities shall have until the Determination Date to execute this Agreement and pay their Initial Contribution, and become Members. Any GSA Eligible Entity that has not executed this Agreement and paid their Initial Contribution by the Determination Date shall be subject to the process described in Section 5.2, below, to become a Member.

Section 5.2 – New Members.

New Members may be added to the Agency by the unanimous vote of all other Members so long as: 1) the new Member is a GSA Eligible Entity; and, 2) the new Member agrees to or has met any other conditions that the existing Members may establish from time-to-time.

Once an application is approved unanimously by the existing Members the attached Exhibit A shall be amended to reflect the new Member.

Article VI: Directors And Officers

Section 6.1 – Board Of Directors.

The Agency shall be governed and administered by an eleven (11) member Board of Directors which is hereby established. All voting power of the Agency shall reside in the Board.

Section 6.2 – Initial Board of Directors.

An Initial Board shall be composed of the Director Positions with the qualifications and Appointing Authority as described in Exhibit B. The nominating groups identified in Section 6.5, below, may, but are not required to, provide nominations to the relevant Appointing Authority for the Initial Board; however, any such nomination must be received by the respective Appointing Authority no later than January 31, 2017. If such nominations are received no later than the time specified the Appointing Authorities shall follow the respective procedures for appointment to the Permanent Board set forth in Section 6.5, below. If such nominations are not received by the time specified, the Appointing Authority may make appointments to the Initial Board as it determines in its sole discretion.

The Initial Board shall serve only until September 30, 2017, at which time a Permanent Board shall be appointed as described below.

Section 6.3 – Permanent Board.

Subject to the Appointment and Nominating procedures set forth in Section 6.5, below, beginning on October 1, 2017, a Permanent Board shall be established consisting of the Director Positions with the qualifications and Appointing Authority as described in Exhibit B. With the exception of the CPUC Regulated Water Company Director Position, each Permanent Director Position shall have a term consisting of three (3) years and shall hold office until their successor is appointed by their Appointing Authority and the Agency has been notified of the succession. The terms of Permanent Director Positions shall be staggered, with Director Positions identified in rows (a), (c), (f), (h) and (j) of exhibit C serving three (3) year terms from initial appointment, and those identified in rows (b), (d), (g), (i), and (k) serving two (2) year terms from initial appointment, and thereafter serving three (3) year terms. The CPUC Regulated Water Company Director Position shall serve a term of two (2) years, and a Director shall hold office until their successor is appointed and the Agency has been notified of the succession. Notwithstanding the actual date of their initial appointment, for purposes of establishing the terms of Permanent Directors such initial appointment shall be deemed to have commenced on the July 1 preceding such initial appointment, and the terms of Directors shall thereafter commence on July 1 of the respective appointing year. Each Director Position shall require an affirmative appointment by the Appointing Authority for every term.

Section 6.4 – General Qualifications.

a) Each Director, whether on the Initial Board or Permanent Board, must have the following general qualifications:

i. General education and/or knowledge, interest in and experience relating to the control, storage, and beneficial use of groundwater.

ii. General understanding and knowledge of the Basin and all its beneficial users.

iii. Working knowledge and understanding of how to develop strategic plans, policies, programs, and financing/funding mechanisms.

iv. Genuine commitment to collaboratively work together to (i) achieve groundwater sustainability through the adoption and implementation of a GSP for the Basin, and all its beneficial uses; and (ii) provide for the ongoing sustainable management of the Basin.

v. General knowledge and understanding of one or more of the different facets (administration, financial, legal, organizational, personnel, etc.) needed for a successful and productive organization.

vi. Ability to commit the time necessary, estimated at a minimum 15-20 hours per month, to responsibly fulfill their commitment to the organization. This includes, but is not limited to: (i) Board meetings, (ii) Board training, (iii) analyzing financial statements and technical reports, (iv) reviewing Board documents before Board meetings, (v) attending Board meetings, and (vi) serving on committees to which they are assigned.

vii. A permanent resident within the Basin, or a representative of an agency with jurisdiction, or a business or organization with a presence, within the Basin.

b) Nominating groups and Appointing Authorities, as described in Section 6.5, should endeavor to avoid nominating or appointing a person to a Director Position that, because of his or her employment or other financial interest, is likely to be disqualified from a substantial number of decisions to be made by the Board on the basis of conflict-of-interest requirements.

Section 6.5 – Appointments and Nominations for Director Positions on the Permanent Board.

The appointment and nominating process for each Primary and Alternate Director Positions on the Permanent Board shall be as follows:

a) City of Salinas Director Position.

The City of Salinas shall appoint the Director Position listed in Row (a) of Exhibit B, the specific qualifications of such Director Position to be at the discretion of the City of Salinas.

b) South County Cities Director Position.

The Director Position listed in Row (b) of Exhibit B shall be filled by a representative from one of the four cities listed therein. The City Selection sub-Committee shall determine which city shall be the Appointing Authority for each term of the Director Position. The specific qualifications of such Director Position shall be at the discretion of that city designated the Appointing Authority. If the City Selection sub-Committee cannot reach agreement on a city to be the Appointing Authority for this Director Position, the County Board of Supervisors shall decide which city shall be the Appointing Authority.

c) Other GSA Eligible Entity Director Position.

i. Representative of the entities listed on Exhibit C shall be eligible to participate in the nominating process for the Other GSA Eligible Entity Director Position listed in Row (c) of Exhibit B.

ii. The representatives collectively by agreement among themselves shall make nominations to the Appointing Authority for the persons to fill both the Primary and Alternate Director Positions when the term of such position are expiring or are vacant.

iii. The representatives shall nominate one or more persons to fill both the Primary and Alternate Director Positions. If more than one person is nominated the representatives shall indicate the preferred nominee.

iv The Appointing Authority shall appoint the nominee (if only one) or appoint from among the nominees; the Appointing Authority may reject a nominee only for Cause. If the representatives cannot or do not forward any nominations the Appointing Authority shall make the appointment based upon its own determination.

v. The representatives may also advise the Appointing Authority regarding the removal of their nominee from the Director Positions for Cause. If the Appointing Authority determines that Cause exists such Director shall be removed and a new Director appointed to fill out the remaining term of the removed Director. The representatives may also request that their nominee in the Director Position be removed for any reason or no reason. If such request is made the Appointing Authority shall remove the Director and a new Director appointed to fill out the remaining term of the removed Director.

vi. From time-to-time entities may ask to be removed from Exhibit C. If such request is made the Appointing Authority shall notify the other Members and the Board, and Exhibit C shall be modified accordingly.

vii. From time-to-time other entities may request to be included on Exhibit C. The then-existing representatives shall inform the Appointing Authority if such requests are acceptable. If accepted by the representatives the Appointing Authority shall notify the other Members and the Board, and Exhibit C shall be modified accordingly.

d) Disadvantaged Community, or Public Water System Systems, including Mutual Water Companies serving residential customers, Director Position.

i. Representative of the entities listed on Exhibit D shall be eligible to participate in the nominating process for the Disadvantaged Community, or Public Water System Systems, including Mutual Water Companies serving residential customers, Director Position listed in Row (d) of Exhibit B.

ii. The representatives by agreement among themselves shall collectively make nominations to the Appointing Authority for the persons to fill both the Primary and Alternate Director Positions when the term of such positions are expiring or are vacant.

iii. The representatives shall nominate one or more persons to fill both the Primary and Alternate Director Positions. If more than one person is nominated the representatives shall indicate the preferred nominee.

iv. The Appointing Authority shall appoint the nominee (if only one) or appoint from among the nominees; the Appointing Authority may reject a nominee only for Cause. If the representatives cannot or do not forward any nominations the Appointing Authority shall make the appointment based upon its own determination.

v. The representatives may also advise the Appointing Authority regarding the removal of their nominee from the Director Positions for Cause. If the Appointing Authority determines that Cause exists such Director shall be removed and a new Director appointed to fill out the remaining term of the removed Director. The representatives may also request that their nominee in the Director Position may be removed for any reason or no reason. If such request is made the Appointing Authority shall remove the Director and a new Director appointed to fill out the remaining term of the removed Director.

vi. From time-to-time entities may ask to be removed from Exhibit D. If such request is made the Appointing Authority shall notify the other Members and the Board, and Exhibit D shall be modified accordingly.

vii. From time-to-time other entities may request to be included on Exhibit D. The then-existing representatives shall inform the Appointing Authority if such requests are acceptable. If accepted by the representatives the Appointing Authority shall notify the other Members and the Board, and Exhibit D shall be modified accordingly.

e) CPUC Regulated Water Company Director Position.

i. Representative of the entities listed on Exhibit E must meet the requirements of Section 1.1 (o) and shall be eligible to participate in the nominating process for the CPUC Regulated Water Company Director Position listed in Row (e) of Exhibit B.

ii. The representatives by agreement among themselves shall collectively make nominations to the Appointing Authority for the persons to fill both the Primary and Alternate Director Positions when the term of such position are expiring or are vacant.

iii. The representatives shall nominate one or more persons to fill both the Primary and Alternate Director Positions. If more than one person is nominated the representatives shall indicate the preferred nominee.

iv The Appointing Authority shall appoint the nominee (if only one) or appoint from among the nominees; the Appointing Authority may reject a nominee only for Cause. If the representatives cannot or do not forward any nominations the Appointing Authority shall make the appointment of an employee or agent of a CPUC Regulated Water Company listed on Exhibit E based upon its own determination.

v. The representatives may also advise the Appointing Authority regarding the removal of their nominee from the Director Position for Cause, although such authority to remove shall rest solely with the Appointing Authority.

vi. From time-to-time entities may ask to be removed from Exhibit E. If such request is made the Appointing Authority shall notify the other Members and the Board, and Exhibit E shall be modified accordingly.

vii. From time-to-time other entities may request to be included on Exhibit E. The then-existing representatives shall inform the Appointing Authority if such requests are acceptable. If accepted by the representatives the Appointing Authority shall notify the other Members and the Board, and Exhibit E shall be modified accordingly.

f) Agriculture Director Positions.

i. The Agricultural Association shall be eligible to participate in the nominating process for the Agriculture Director Positions listed in Rows (f) – (i) of Exhibit B. The Agricultural Association shall be solely responsible for its membership.

ii. The Agricultural Association shall make nominations to the Appointing Authority for the persons to fill each Primary and Alternate Director Position when the terms of such positions are expiring or are vacant.

iii. The Agricultural Association shall nominate at least two persons to fill each Director Position; the Agricultural Association shall indicate the preferred nominee for each Director Position.

iv The Appointing Authority shall appoint from among the nominees for each Director Position; the Appointing Authority may reject a nominee only for Cause. If the Agricultural Association cannot or does not forward any nominations the Appointing Authority shall make the appointment based upon its own determination.

v. The Agricultural Association may also advise the Appointing Authority regarding the removal of a nominee from a Director Position for Cause. If the Appointing Authority determines that Cause exists such Director shall be removed and a new Director appointed to fill out the remaining term of the removed Director. The Agricultural Association may also request that their nominee in a Director Position may be removed for any reason or no reason. If such request is made the Appointing Authority shall remove the Director and a new Director appointed to fill out the remaining term of the removed Director.

g) Environment Director Position.

i. Representative of the entities listed on Exhibit F shall be eligible to participate in the nominating process for the Environment Director Position listed in Row (j) of Exhibit B.

ii. The representatives by agreement among themselves shall collectively make nominations to the Appointing Authority for the persons to fill both the Primary and Alternate Director Positions when the term of such positions are expiring or are vacant.

iii. The representatives shall nominate at least two persons to fill both the Primary and Alternate Director Positions and the representatives shall indicate the preferred nominee.

iv The Appointing Authority shall appoint from among the nominees; the Appointing Authority may reject a nominee only for Cause. If the representatives cannot or do not forward any nominations the Board shall solicit applications from interested persons. At an open public meeting, the Board shall select qualified applicants whose names shall be forwarded to the Appointing Authority. The Board may indicate a preferred nominee. The Appointing Authority shall make the appointment from the list of candidates in its sole discretion. If the Board cannot, or does not, forward a list of candidates, the Appointing Authority shall make the appointment based upon its own determination.

v. The representatives may also advise the Appointing Authority regarding the removal of their nominee from the Director Position for Cause. If the Appointing Authority determines that Cause exists such Director shall be removed and a new Director appointed to fill out the remaining term of the removed Director. The representatives may also request that their nominee in the Director Position may be removed for any reason or no reason. If such request is made the Appointing Authority shall remove the Director and a new Director appointed to fill out the remaining term of the removed Director.

vi. From time-to-time entities may ask to be removed from Exhibit F. If such request is made the Appointing Authority shall notify the other Members and the Board, and Exhibit F shall be modified accordingly.

vii. From time-to-time other entities may request to be included on Exhibit F. The then-existing representatives shall inform the Appointing Authority if such requests are acceptable. If accepted by the representatives the

Appointing Authority shall notify the other Members and the Board, and Exhibit F shall be modified accordingly.

h) Public Member Director Position.

i. The Public Member Primary and Alternate Director Positions listed in Row (k) of Exhibit B shall be filled by application to the Board when the term of such position is expiring or is vacant.

ii. Board staff shall process the applications to an open and public meeting of the Board.

iii. At the public hearing, the Board shall select the qualified applicants whose names shall be forwarded to the Appointing Authority. The Board may indicate a preferred nominee.

iv The Appointing Authority shall appoint from among the nominees in its sole discretion. If the Board cannot or does not forward any nominations the Appointing Authority shall make the appointment based upon its own determination.

v. The Board may also advise the Appointing Authority regarding the removal of the Public Member Director for Cause, although such authority to remove shall rest solely with the Appointing Authority.

Section 6.6 – Primary Directors And Alternates.

Subject to the Appointing and Nominating procedures set forth in Section 6.5, above, each Appointing Authority shall appoint one Primary Director and one Alternate Director for each Director Position. With the exception of the Chairperson and Vice-Chairperson duties as more fully described in Section 6.7, below, the Alternate Director shall serve and assume the rights and duties of the Primary Director when the Primary Director is unable to attend or participate in a Board meeting. Unless appearing as a substitute for a Primary Director, Alternate Directors shall have no vote, and shall not participate in any discussions or deliberations of the Board, but may appear at Board meetings as members of the public. The Primary and Alternate Directors may be removed by their Appointing Authority only for Cause only upon the recommendation of or consultation with the nominating body for that Director Position, or upon the request of the nominating body for that Director Position. In the event that a Primary or Alternate Director is removed from their position, that Director Position shall become vacant and the Appointing Authority for that Director Position shall appoint a new Primary or Alternate Director pursuant to the provisions of Section 6.5 who shall fill the remaining term of that Director Position. In the event that a Director resigns from a Director Position, the Board shall notify the nominating body for that Director Position and the Appointing Authority for that Director Position shall appoint a new Primary or Alternate Director pursuant to the provisions of Section 6.5 who shall fill the remaining term of that Director Position.

Section 6.7 – Officers Of The Board.

a) Designation.

Officers of the Board shall consist of a Chairperson and Vice-Chairperson who shall be selected from the Primary Directors. The Chairperson shall preside at all meetings of the Board. Notwithstanding the appointment of an Alternate Director for the Chairperson, the Vice-Chairperson shall perform the duties of the Chairperson in the absence or disability of the Chairperson; however, the Alternate Director may otherwise attend and participate in the meeting as a substitute for the absent Primary Director. The Chairperson and Vice-Chairperson shall exercise and perform such other powers and duties as may be assigned by the Board. In the absence of both the Chairperson and Vice-Chairperson, and notwithstanding the appointment of an Alternate Director for the Director Position serving as Vice-Chairperson, the Board shall elect a Chairperson Pro-Tem from the Primary Directors to preside at a meeting; however, the Alternate Director for the Vice-Chairperson may otherwise attend and participate in the meeting as a substitute for the absent Primary Director.

b) Election.

The Board shall elect officers at the initial meeting of the Board, described in Section 7.1, below. The Primary Director appointed by the City of Salinas shall be designated as the Chairperson Pro Tem to convene and preside at the initial meeting of the Board, described in Section 7.1, until a Chairperson is elected by the Board. The Chairperson so elected shall serve in such capacity until June 30 of the succeeding calendar year. Thereafter, the Board shall annually elect the officers of the Board from the Primary Directors. Officers of the Board shall hold office for a term of one year commencing on July 1 of each calendar year and they may serve for multiple consecutive terms. Officers of the Board may be removed and replaced at any time, with or without cause, by a Majority Vote. In the event that an officer loses their position as a Primary Director, that officer position shall become vacant and the Board shall elect a new officer from existing Primary Directors to serve the remaining officer term.

Section 6.8 – Bylaws.

The Board shall adopt Bylaws governing the conduct of meetings and the day-to-day operations of the Agency on or before the first anniversary of the Effective Date.

Section 6.9 – Official Seal And Letterhead.

The Board may adopt, and/or amend, an official seal and letterhead for the Agency.

Section 6.10 – Conflict of Interest.

Directors shall be subject to the provisions of the California Political Reform Act, California Government Code section 81000 et seq, and all other laws governing conflicts of interests. Directors shall file the statements required by Government Code section 87200, et seq.

Article VII: Board Meetings And Actions

Section 7.1 – Initial Meeting.

The initial meeting of the Board shall be held at either the County Board of Supervisors chambers, located at 168 W. Alisal Street in Salinas, or at the Salinas City Council chambers, located at 200 Lincoln Avenue in Salinas within thirty days (30) days of the Effective Date of this Agreement. The date and time of the meeting shall be prominently publicized and noticed in addition to any requirements of the Brown Act in an effort to maximize public participation.

Section 7.2 – Regular Meeting Schedule.

At its initial meeting, and annually before July 1 of each calendar year thereafter, the Board shall establish a schedule of regular meetings, including time and place, at a location overlying the Basin. The Board may vote to change the regular meeting location, time and place, and may call special or emergency meetings, provided that the new, special or emergency meeting location remains at a place overlying the Basin, unless otherwise authorized by the Brown Act.

Section 7.3 – Principal Office.

At its initial meeting the Board shall establish a principal office for the Agency, which shall be located at a place overlying the Basin. The Board may change the principal office from time to time as the Board sees fit so long as that principal office remains at a location overlying the Basin.

Section 7.4 – Conduct Of Board Meetings.

Meetings of the Board of Directors shall be noticed, held, and conducted in accordance with the provisions of the Brown Act and such By-laws as the Board may adopt that are consistent with the Brown Act.

Section 7.5 – Quorum.

A quorum of the Board shall consist of a majority of the Director Positions.

Section 7.6 – Voting.

Each Director Position shall have one vote. In all cases, when a quorum is present, a Majority Vote shall be required to conduct business, unless a Super Majority Vote or a Super Majority Plus Vote is required.

Section 7.7 – Super Majority Vote Requirement.

Items that require a Super Majority Vote include the following unless otherwise required by law:

a) Approval of a GSP;

b) Amendment of budget and transfer of appropriations;

c) Withdrawal of Members pursuant to Section 11.6 (d); and,

d) Termination of Members pursuant to Section 11.7 (c).

Section 7.8 – Super Majority Plus Vote Requirement.

Items that require a Super Majority Plus Vote include the following unless otherwise required by law:

a) Decisions to impose fees not requiring a vote of the electorate or property owners;

b) Proposals to submit to the electorate or property owners (as required by law) decisions to impose fees or taxes; and

c) Limitations on well extractions (pumping limits).

Section 7.9 – Conflict Of Interest Code.

At the initial meeting of Board, the Board shall begin the process for adoption and filing of a Conflict of Interest Code pursuant to the provisions of the Political Reform Act of 1974 (Government Code section 81000 et seq.).

Article VIII: Board Committees

Section 8.1 – Committees Of The Board.

a) Board Committees.

The Board may from time-to-time establish one or more standing or ad hoc committees consisting of Directors to assist in carrying out the purposes and objects of the Agency, including but not limited to a Budget and Finance Committee, Planning Committee, and an Executive Committee. The Board shall determine the purpose and need for such committees. Meetings of standing committees shall be subject to the requirements of the Brown Act.

b) Advisory Committee.

The Board shall establish an advisory committee consisting of Directors and non-Directors. The advisory committee shall be designed to ensure participation by and input to the Board of those constituencies set forth in Water Code section 10723.2 whose interests are not directly represented on the Board. The Board shall determine the number and qualifications of committee members.

Article IX: Operations And Management

Section 9.1 – Initial Administrative And Legal Services.

One or more of the Members shall provide initial administrative, legal and other support services to the Agency at no charge until the appointment of the Permanent Board as provided in Section 6.3, above. The Members shall collectively determine which of the Members shall provide such services.

Section 9.2 – Contracting Administrative And Legal Services.

The Agency may engage one or more Members to provide administrative or legal services following the conclusion of the initial administrative and legal services described in Section 9.1 of this Agreement, on terms and conditions acceptable to the Board. Any Member so engaged shall have such responsibilities as are set forth in the contract for such Member's services.

Section 9.3 – Executive Director.

The Agency may appoint an Executive Director from time-to-time under terms and conditions to be determined by the Board. The Executive Director shall report to and serve at the pleasure of the Board. The Executive Director shall be responsible for the general administration of the Agency, the preparation and implementation of a GSP, and such other duties as may be determined by the Board. If the Board has contracted for administrative services as described in Section 9.2, above, and appoints an Executive Director, the Executive Director shall be responsible for the oversight and control of such contracted administrative services pursuant to the policies and directives established by the Board.

Section 9.4 – Legal Counsel And Other Officers.

a) General Counsel

The Agency may appoint a General Counsel from time-to-time under terms and conditions to be determined by the Board. The General Counsel shall report to and serve at the pleasure of the Board. The General Counsel shall be responsible for the general oversight of the Agency's legal affairs, including litigation. The Board may contract with other counsel for specialized legal services under the supervision of the General Counsel.

b) Treasurer and Auditor

The City of Salinas shall serve as the initial Treasurer and Auditor for the Agency upon its formation, and shall discharge the duties set forth in Sections 6505 and 6505.5 of the Act. Subsequent to formation of the Agency, the Board may appoint a separate Treasurer or separate Auditor pursuant to Section 6505.6 of the Act, and those officers shall discharge the duties set forth in Sections 6505 and 6505.5 of the Act, respectively. The Board may change such Auditor or Treasurer from time-to-time provided such chance is consistent with the Act.

c) Custodian of Property

The Public Works Director of the City of Salinas ("PW Director") shall serve as the initial Custodian of the Agency's Property as set forth in Section 6505.1 of the Act upon the Agency's formation. The PW Director shall file an official bond as described in Government Code section 1450 et seq. in the amount of $50,000, the premium of which shall be paid by the Agency. Subsequent to the formation of the Agency, the Board may designate a different Custodian provided such Custodian files an official bond in an amount required by the Board.

b) Other Officers

Subject to the limits of the Agency's approved budget, the Board may establish other officer positions and appoint and contract for the services of such other officers as it may deem necessary or convenient for the business of the Agency, all of whom shall serve at the pleasure of the Board.

Section 9.5 – Employees.

Subject to the limits of the Agency's approved budget, the Agency may hire employees to discharge the duties and responsibilities of the Agency, subject to the general oversight and control of the Executive Director.

Section 9.6 – Independent Contractors.

Subject to the limits of the Agency's approved budget, the Board may contract for the services of such consultants, advisers and independent contractors as it may deem necessary or convenient for the business of the Agency.

Article X: Financial Provisions

Section 10.1 – Fiscal Year.

The Fiscal Year of the Agency shall be July 1 – June 30.

Section 10.2 – Establishment Of Funds.

The Board shall establish and maintain such funds and accounts as may be required by generally accepted government accounting practices. The Agency shall maintain strict accountability of all funds and report all receipts and disbursements of the Agency on no less than a quarterly basis.

Section 10.3 – Budgets.

a) Initial Budgets

The initial budget of the Agency for the Fiscal Year ending June 30, 2017, shall not exceed $50,000. The budgets of the Agency for Fiscal Years 2017 – 2018 and 2018 – 2019 shall not exceed $1,100,000 each unless otherwise agreed to by the unanimous vote of the Members as described in Section 10.4, below.

b) Regular Budgets

Beginning for Fiscal Year 2019 – 2020, no later than sixty (60) days prior to the end of each Fiscal Year, the Board shall adopt a budget for the Agency for the ensuing Fiscal Year. The Board may authorize mid-year budget adjustments, as needed by Super Majority Vote.

Section 10.4 – Initial Contributions.

a) Fiscal Years 2017 – 2018 and 2018 - 2019

In order to provide the necessary capital to initially fund the Agency during Fiscal Year 2017 - 2018, the Members identified below shall each provide the listed Initial Contribution to the Agency's Treasurer/Auditor no later than July 7, 2017:

1) County:	$670,000
2) WRA:	$ 20,000
3) City of Salinas:	$330,000
4) City of Gonzales:	$ 20,000
5) City of Soledad:	$ 35,000
6) City of Greenfield:	$ 35,000
7) City of King:	$ 30,000
8) Castroville CSD	$ 20,000

In order to provide the necessary capital to fund the Agency during Fiscal Year 2018 – 2019, the Members identified below shall each provide the listed Initial Contribution to the Agency's Treasurer/Auditor no later than July 6, 2018:

1) County:	$670,000
2) WRA:	$ 20,000
3) City of Salinas:	$330,000
4) City of Gonzales:	$ 20,000
5) City of Soledad:	$ 35,000
6) City of Greenfield:	$ 35,000
7) City of King:	$ 30,000
8) Castroville CSD	$ 20,000

b) Additional Initial Contributions

New Members not listed above executing this Agreement no later than the Determination Date shall pay a minimum Initial Contribution of twenty thousand dollars ($20,000) per year for the two fiscal years. New Members not listed above executing this Agreement after the

Determination Date shall pay a minimum Initial Contribution of fifty thousand dollars ($50,000) per year for the two fiscal years.

Should the Board determine that additional funding for each of Fiscal Years 2017 – 2018 and 2018 – 2019 is necessary for Agency operations the Board shall adopt a resolution requesting each of the Members to consider additional funding and demonstrating in detail 1) the need for the funding, and 2) the purposes for which the additional funding will be utilized. Such requested funding shall be in the same proportion as the Initial Contributions set forth in Section 10.4 (a) unless the Members unanimously agree otherwise.

Upon receipt of the resolution requesting additional funding representatives of the Members may meet and confer regarding the request; however, each Member shall consider and act upon the request no later than 30 (thirty) days following the adoption of the resolution by the Board.

c) Reimbursement of Initial Contributions

To the extent the Agency is able to secure other funding sources, and to the extent permitted by law, the Agency shall reimburse these Initial Contributions to the Members on a proportionate basis in relation to their cumulative Initial Contributions to the Agency.

Section 10.5 – Payments To The Agency.

All costs and expenses of the Agency may be funded from: (i) voluntary contributions from third parties; (ii) grants; (iii) contributions from Members from time to time to supplement financing of the activities of the Agency; (iv) advances or loans from the Members or other sources; (v) bond revenue; and, (vi) taxes, assessments, fees and/or charges levied by the Agency under the provisions of SGMA or as otherwise authorized by law.

Section 10.6 – Directors' Stipends and Expenses.

Directors shall be eligible to receive a stipend in the amount of $ 100 for each Board meeting actually attended plus mileage to and from Board meetings. In addition, Directors shall be reimbursed for the actual and necessary expenses incurred in the discharge of their duties pursuant to an adopted Board policy. Directors are not required to accept the stipend or mileage, or expenses, and may decline the same by written notice to the Board.

Article XI: Relationship Of Agency And Its Members

Section 11.1 – Separate Entity.

In accordance with Sections 6506 and 6507 of the Act, the Agency shall be a public entity separate and apart from the Members.

Section 11.2 – Liabilities.

In accordance with Section 6507 of the Act, the debt, liabilities and obligations of the Agency shall be the debts, liabilities and obligations of the Agency alone and not of its Members. The Members do not intend hereby to be obligated either jointly or severally for the debts, liabilities or obligations of the Agency, except as may be specifically provided for in California Government Code Section 895.2 as amended or supplemented.

Section 11.3 – Insurance.

The Agency shall procure appropriate policies of insurance providing coverage to the Agency and its Directors, officers and employees for general liability, errors and omissions, property, workers compensation, and any other coverage the Board deems appropriate. Such policies shall name the Members, their officers and employees as additional insureds.

Section 11.4 – Indemnity.

Funds of the Agency may be used to defend, indemnify, and hold harmless the Agency, each Member, each Director, and any officers, agents and employees of the Agency for their actions taken within the course and scope of their duties while acting on behalf of the Agency. To the fullest extent permitted by law, the Agency agrees to save, indemnify, defend and hold harmless each Member from any liability, claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses or costs of any kind, whether actual, alleged or threatened, including attorney's fees and costs, court costs, interest, defense costs, and expert witness fees, where the same arise out of, or are attributable in whole or in part, to negligent acts or omissions of the Agency or its employees, officers or agents or the employees, officers or agents of any Member, while acting within the course and scope of an Member relationship with the Agency. Notwithstanding the foregoing, the sole negligence, gross negligence, or intentional acts of any Member is exempted from this Section 11.3 - Indemnity.

Section 11.5 – Agreements With Members

The Agency intends to carry out activities in furtherance of its purposes consistent with the powers established by this Agreement and with the participation of all Members. Notwithstanding the foregoing, the Board shall have the authority to approve any agreements with one or more Members in order to further the purposes of the Agency, including, but not limited to, the commencement of a condemnation action within the jurisdictional boundary of the agreeing Member or Members.

Section 11.6 – Withdrawal Of Members.

a) Any Member shall the have the ability to withdraw by providing ninety (90) days written notice of its intention to withdraw. Said notice shall be given to the Board and to each of the other Members. If such Member is an Appointing Authority, the Member's withdrawal shall not be effective unless and until the non-withdrawing Members agree to an amendment to this

Agreement providing for the composition of and appointment to the Board.

b) A Member shall not be fiscally liable for any contribution to an adopted budget provided that the Member provides written notice ninety (90) days prior to the adoption of the budget of its intention to withdraw.

c) In the event of a withdrawal, this Agreement shall continue in full force and effect among the remaining members as set forth in Section 11.8, below.

d) Notwithstanding the foregoing, Members shall not have the ability to withdraw if there is outstanding bonded debt or other long term liability of the Agency unless and until it is determined by the Board by Super Majority Vote that the withdrawal of the Member shall not adversely affect the ability of the Agency to perform its financial obligations pursuant to the bonded debt or other liability. The Board shall communicate its finding to the non-withdrawing Members who may approve the withdrawal by unanimous vote.

Section 11.7 – Termination Of Members.

a) As an alternative to pursuing litigation against a Member for failure to meet its funding obligations set forth in this Agreement or as may be adopted by the Board from time to time, the Board may vote to terminate such Member. The Board shall transmit its determination to the Members who may approve the termination by unanimous vote of the Members not proposed to be terminated. If such Member is an Appointing Authority, the Member's termination shall not be effective unless and until the non-terminated Members agree to an amendment to this Agreement providing for the composition of and appointment to the Board.

b) In the event of a termination, this Agreement shall continue in full force and effect among the remaining members as set forth in Section 11.8, below.

c) Notwithstanding the foregoing, Members may not be terminated if there is outstanding bonded debt or other long term liability of the Agency unless and until it is determined by the Board by Super Majority Vote that the termination of the Member shall not adversely affect the ability of the Agency to perform its financial obligations pursuant to the bonded debt or other liability. The Board shall communicate its finding to the Members who may approve the termination by unanimous vote of the Members not proposed to be terminated.

Section 11.8 – Continuing Obligations: Withdrawal Or Termination.

a) Provided that at least two Members remain, the withdrawal or termination of one or more Members shall not terminate this Agreement or result in the dissolution of the Agency; this Agreement shall remain in full force and effect among the remaining Members; and the Agency shall remain in operation.

b) Except as provided in Section 11.6 (b), any withdrawal or termination of a Member shall not relieve the Member of its financial obligations under this Agreement in effect prior to the effective date of the withdrawal or termination.

Section 11.9 – Disposition Of Money Or Property Upon Board Determination Of Surplus.

Upon determination by the Board that any surplus money is on hand, such surplus money shall be returned to the then existing Members in proportion to their cumulative contributions to the Agency, or such surplus money may be deposited in a Board designated reserve account. Upon determination by the Board that any surplus properties, works, rights and interests of the Agency are on hand, the Board shall first offer any such surplus for sale to the Members and such sale shall be based on highest bid received. If no such sale is consummated, the Board shall offer the surplus properties, works, rights and interests of the Agency for sale in accordance with applicable law to any governmental agency, private entity or persons for good and adequate consideration.

Section 11.10 – Termination And Dissolution.

a) Mutual Consent

i) Except as otherwise provided in this Section 11.10 (a), this Agreement may be terminated and the Agency dissolved at any time upon the unanimous approval of the Members provided that provision has been made by the Members for the payment, refunding, retirement, or other disposition of any bonded debt or other long term liability in the name of the Agency.

ii) Upon Dissolution of the Agency, each then existing Member shall receive a proportionate share, based upon the cumulative contributions of all then remaining Members, of any remaining assets after all Agency liabilities and obligations have been paid in full. The distribution of remaining assets may be made "in kind" or assets may be sold and the proceeds thereof distributed to the Members. The Agency shall remain in existence for such time as is required to determine such distribution, and the Board, or other person or entity appointed by the Members, shall be responsible for its determination. Such distribution shall occur within a reasonable time after a decision to terminate this Agreement and dissolve the Agency has been approved by the Members. No former Member that previously withdrew or was terminated as of the effective date of the decision to terminate this Agreement and dissolve the Agency shall be entitled to a distribution upon dissolution.

b) Insufficient Members

Subject to the provisions of Sections 11.6 and 11.7, should Members either be terminated or withdraw such that only one Member remains, this Agreement shall terminate and the Agency dissolved. In such event the last remaining Member shall be entitled to all assets of the Agency.

c) Failure to be Financially Sustainable

In the event that the Agency does not take the necessary actions to create a sustainable revenue stream necessary to fully finance its operating budget by the end of Fiscal Year 2018 – 2019 this Agreement shall terminate and the Agency shall be dissolved, unless otherwise agreed to by amendment to this Agreement approved unanimously by all then-existing Members. In the event of such termination and dissolution, the process of dissolution shall begin on July 1, 2019, and proceed as set forth in Section 11.10 (a) (ii), above.

d) Legislative Determination

Should the State adopt legislation specifying that the Basin should be managed by a statutorily designated entity this Agreement shall terminate and the Agency shall be dissolved upon such terms and conditions as the legislation may designate. Upon such dissolution, the assets and liabilities of the Agency shall be disposed of in the manner specified by the legislation. If the legislation does not so specify, the assets and liabilities of the Agency shall be disposed of in the manner provided in Section 11.10 (a), above.

Article XII: Miscellaneous Provisions

Section 12.1 – Complete Agreement.

The foregoing constitutes the full and complete Agreement of the Members. This Agreement supersedes all prior agreements and understandings, whether in writing or oral, related to the subject matter of this Agreement that are not set forth in writing herein.

Section 12.2 – Amendment.

This Agreement may be amended from time-to-time by the unanimous consent of the Members, acting through their governing bodies. Such amendments shall be in the form of a writing signed by each Member.

Section 12.3 – Successors And Assigns.

The rights and duties of the Members may not be assigned or delegated without the written consent of all other Members. Any attempt to assign or delegate such rights or duties in contravention of this Agreement shall be null and void. Any assignment or delegation permitted under the terms of this Agreement shall be consistent with the terms of any contracts, resolutions or indentures of the Agency then in effect.

This Agreement shall inure to the benefit of and be binding upon the successors and assigns of the Members hereto. This section does not prohibit a Member from entering into an independent agreement with another person, entity, or agency regarding the financing of that Member's contributions to the Agency or the disposition of proceeds, which that Member receives under this Agreement so long as such independent agreement does not affect, or purport to affect, the rights and duties of the Agency or the Members under this Agreement.

Section 12.4 – Dispute Resolution.

In the event there are disputes and/or controversies relating to the interpretation, construction, performance, termination, breach of, or withdrawal from this Agreement, the Members involved shall in good faith meet and confer within twenty-one (21) calendar days after written notice has been sent to all the Members. In the event that the Members involved in the dispute ("Disputing Members") are not able to resolve the dispute through informal negotiation, the Disputing Members agree to submit such dispute to formal mediation before litigation. If Disputing Members cannot agree upon the identity of a mediator within ten (10) business days after a Disputing Member requests mediation, then the non-Disputing Members shall select a mediator to mediate the dispute. The Disputing Members shall share equally in the cost of the mediator who ultimately mediates the dispute, but neither of the Disputing Members shall be entitled to collect or be reimbursed for other related costs, including but not limited to attorneys' fees. If mediation proves unsuccessful and litigation of any dispute occurs, the prevailing Member shall be entitled to reasonable attorneys' fees, costs and expenses in addition to any other relief to which the Member may be entitled. If a Disputing Members refuses to participate in mediation prior to commencing litigation, that Member shall have waived its right to attorneys' fees and costs as the prevailing party.

Section 12.5 – Execution In Parts Or Counterparts.

This Agreement may be executed in parts or counterparts, each part or counterpart being an exact duplicate of all other parts or counterparts, and all parts or counterparts shall be considered as constituting one complete original and may be attached together when executed by the Members hereto. Facsimile or electronic signatures shall be binding.

Section 12.6 – Member Authorization.

The governing bodies of the Members have each authorized execution of this Agreement, as evidenced by their respective signatures below.

Section 12.7 – No Predetermination Or Irrevocable Commitment of Resources.

Nothing herein shall constitute a determination by the Agency or any Members that any action shall be undertaken or that any unconditional or irrevocable commitment of resources shall be made, until such time as the required compliance with all local, state, or federal laws, including without limitation the California Environmental Quality Act, National Environmental Policy Act, or permit requirements, as applicable, have been completed.

Section 12.8 – Notices.

Notices authorized or required to be given pursuant to this Agreement shall be in writing and shall be deemed to have been given when mailed, postage prepaid, or delivered during working hours to the addresses set forth for each of the Members hereto on Exhibit "A" of this Agreement, or to such other changed addresses communicated to the Agency and the Members in writing.

Section 12.9 – Severability And Validity Of Agreement.

Should the participation of any Member, or any part, term or provision of this Agreement, be decided by the courts or the legislature to be illegal, in excess of that Member's authority, in conflict with any law of the State, or otherwise rendered unenforceable or ineffectual, the validity of the remaining portions, terms or provisions of this Agreement shall not be affected thereby and each Member hereby agrees it would have entered into this Agreement upon the same remaining terms as provided herein.

Section 12.10 – Singular Includes Plural.

Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

IN WITNESS WHEREOF, the Members hereto, pursuant to resolutions duly and regularly adopted by their respective governing boards, have caused their names to be affixed by their proper and respective officers as of the day and year so indicated.

COUNTY OF MONTEREY

By Janet B Parker

Chair of the Board of Supervisors

Dated: 12-22-16

APPROVED AS TO FORM

CHARLES J. MCKEE, County Counsel

By [signature]

LESLIE J. GIRARD

WATER RESOURCES AGENCY OF THE COUNTY OF MONTEREY

By [signature]

Chair of the Board of Supervisors of the Water Resources Agency

Dated: 1-31-2017

APPROVED AS TO FORM

CHARLES J. MCKEE, County Counsel

By [signature]

CITY OF SALINAS

By____________________

Mayor

Dated: ____________________

Section 12.10 – Singular Includes Plural.

Whenever used in this Agreement, the singular form of any term includes the plural form and the plural form includes the singular form.

IN WITNESS WHEREOF, the Members hereto, pursuant to resolutions duly and regularly adopted by their respective governing boards, have caused their names to be affixed by their proper and respective officers as of the day and year so indicated.

COUNTY OF MONTEREY

By______________________________
Chair of the Board of Supervisors

Dated: ________________________

APPROVED AS TO FORM

CHARLES J. MCKEE, County Counsel

By______________________________

WATER RESOURCES AGENCY OF THE COUNTY OF MONTEREY

By______________________________
Chair of the Board of Supervisors of the Water Resources Agency

Dated: ________________________

APPROVED AS TO FORM

CHARLES J. MCKEE, County Counsel

By______________________________

CITY OF SALINAS

By______________________________
Mayor

Dated: 12-20-16

APPROVED AS TO FORM

CHRISTOPHER CALLIHAN, City Attorney

By_______________________________

CITY OF SOLEDAD

By_______________________________
Mayor

Dated: ____________________

APPROVED AS TO FORM

____________________, City Attorney

By_______________________________

CITY OF GONZALES

By_______________________________
Mayor

Dated: ____________________

APPROVED AS TO FORM

____________________, City Attorney

By_______________________________

CITY OF GREENFIELD

By_______________________________
Mayor

Dated: ____________________

APPROVED AS TO FORM

CHRISTOPHER CALLIHAN, City Attorney

By________________________________

CITY OF SOLEDAD

By________________________________
Mayor

Dated: 03/03/17

APPROVED AS TO FORM

Michael Rodriquez, City Attorney

By________________________________

CITY OF GONZALES

By________________________________
Mayor

Dated: ____________________

APPROVED AS TO FORM

____________________, City Attorney

By________________________________

CITY OF GREENFIELD

By________________________________
Mayor

Dated: ____________________

CITY OF GONZALES

By Maria Orozco

Maria Orozco, Mayor

Dated: 2/21/17

APPROVED AS TO FORM

By

Michael F. Rodriquez, City Attorney

Dated: 2-21-2017

APPROVED AS TO FORM

__________________, City Attorney

By____________________________________

CITY OF KING

By____________________________________

Mayor

Dated: 3-24-2017

APPROVED AS TO FORM

__________________, City Attorney

By 3-24-2017

CASTROVILLE COMMUNITY SERVICES

By____________________________________

Chair of the Board of Directors

APPROVED AS TO FORM

__________________, District Counsel

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

By____________________________________

Chair of the Board of Directors

APPROVED AS TO FORM

__________________, Agency Counsel

APPROVED AS TO FORM

_______________, City Attorney

By_______________________________

CITY OF KING

By_______________________________
Mayor

Dated: _______________________

APPROVED AS TO FORM

_______________, City Attorney

By_______________________________

CASTROVILLE COMMUNITY SERVICES

By_______________________________
Chair of the Board of Directors

APPROVED AS TO FORM

_______________ District Counsel

APPROVED AS TO FORM

____________________, City Attorney

By______________________________________

CITY OF KING

By______________________________________
Mayor

Dated: ______________________________

APPROVED AS TO FORM

____________________, City Attorney

By______________________________________

CASTROVILLE COMMUNITY SERVICES

By______________________________________
Chair of the Board of Directors

APPROVED AS TO FORM

____________________, District Counsel

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

By Gloria De La Rosa
Chair of the Board of Directors

APPROVED AS TO FORM

Robert R. Wellington, Agency Counsel

EXHIBIT A

MEMBERS

COUNTY OF MONTEREY
County Administrative Officer
168 W. Alisal St., Salinas, CA 93901

WATER RESOURCES AGENCY OF MONTEREY COUNTY
General Manager

CITY OF SALINAS
City Manager

CITY OF SOLEDAD
City Manager

CITY OF GONZALES
City Manager

CITY OF GREENFIELD
City Manager

CITY OF KING (KING CITY)
City Manager

CASTROVILLE COMMUNITY SERVICES DISTRICT
General Manager

EXHIBIT B

BOARD OF DIRECTORS

	Director	Representing	Specific Qualifications	Appointing Authority
a)	City of Salinas.	City of Salinas.	To be determined by the Appointing Authority.	Salinas City Council.
b)	South County Cities.	Cities of Gonzales, Soledad, Greenfield, and King City.	To be determined by the Appointing Authority.	Appropriate City Council as recommended by the City Selection sub-Committee.
c)	Other GSA Eligible Entity.	GSA Eligible Entities but not including the cities of Salinas, Gonzales, Soledad, Greenfield or King City.	Must be a representative of a GSA Eligible Entity but not including the cities of Salinas, Gonzales, Soledad, Greenfield or King City.	Monterey County Board of Supervisors.
d)	Disadvantaged Community, or Public Water System, including Mutual Water Companies serving residential customers.	Unincorporated Disadvantaged Communities, or Public Water Systems, including Mutual Water Companies serving residential customers only.	Must be a resident of a Disadvantaged Community in the unincorporated area, or a representative Public Water System, including Mutual Water Companies serving residential customers only.	Castroville Community Services District.
e)	CPUC Regulated Water Company.	CPUC Regulated Water Companies in the Basin.	Must be a representative of a CPUC Regulated Water	Salinas City Council.

			Company.	
f)	Agriculture.	Agricultural interests.	Must be an individual that is: 1) engaged in, and derives the majority of his or her gross income or revenue from, commercial agricultural production or operations; or 2) designated by an entity this is engaged in commercial agricultural production or operations, and the individual derives the majority of his or her gross income or revenue from agricultural production or operations, including as an owner, lessor, lessee, manager, officer, or substantial shareholder of a corporate entity.	Monterey County Board of Supervisors.
g)	Agriculture.	Agricultural interests.	Same as (f).	Monterey County Board of Supervisors.
h)	Agriculture.	Agricultural interests.	Same as (f).	Monterey County Board of Supervisors.
i)	Agriculture.	Agricultural interests.	Same as (f).	Monterey County Board of Supervisors.
j)	Environment.	Environmental users and interests.	Must be a representative of an	Monterey County

			established environmental organization that has a presence or is otherwise active in the Basin.	Board of Supervisors.
k)	Public Member.	Interests not otherwise represented on the Board.	A rural residential well owner; an industrial processor; a Local Small or State Small Water System; or other mutual water company.	Monterey County Board of Supervisors.

EXHIBIT C

OTHER GSA ELIGIBLE ENTITY DIRECTOR POSITION NOMINATING GROUP

COUNTY OF MONTEREY

WATER RESOURCES AGENCY OF MONTEREY COUNTY

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY

EXHIBIT D

DISADVANTAGED COMMUNITY, OR PUBLIC WATER SYSTEM, INCLUDING MUTUAL WATER COMPANIES SERVING RESIDENTIAL CUSTOMERS DIRECTOR POSITION NOMINATING GROUP

CASTROVILLE COMMUNITY SERVICES DISTRICT (Group Contact)
Eric Tynan, General Manager
11499 Geil St.
Castroville, CA 95012
(831) 633-2560 phone
(831) 633-3102 fax
info@castrovillecsd.org

ENVIRONMENTAL JUSTICE COALITION FOR WATER

SAN JERARDO COOPERATIVE

SAN ARDO WATER DISTRICT

SAN VICENTE MUTUAL WATER COMPANY

EXHIBIT E

CPUC REGULATED WATER COMPANY DIRECTOR POSITION NOMINATING GROUP

ALISAL WATER CORPORATION DBA ALCO WATER SERVICE (Group Contact)
Thomas R. Adcock, President
249 Williams Road
Salinas, CA 93905
831-424-0441 phone
831-424-0611 fax
tom@alcowater.com

CALIFORNIA WATER SERVICE COMPANY

EXHIBIT F

ENVIRONMENT DIRECTOR POSITION NOMINATING GROUP

SUSTAINABLE MONTEREY COUNTY

LEAGUE OF WOMEN VOTERS OF MONTEREY COUNTY

LANDWATCH MONTEREY COUNTY

FRIENDS AND NEIGHBORS OF ELKHORN SLOUGH

CALIFORNIA NATIVE PLANT SOCIETY, MONTEREY CHAPTER

TROUT UNLIMITED

SURFRIDERS

THE NATURE CONSERVANCY

CARMEL RIVER STEELHEAD ASSOCIATION

Appendix 2-A

SVBGSA Key Messages

Appendix 2B. Key Messages

Initially, our message points focus on: (1) **getting to know your GSA**; (2) **an overview of groundwater sustainability planning for our community**; and (3) **how we got here**. The key messages will be expanded as the work evolves.

Key Messages: Get to Know Your GSA

- The SVBGSA is on a mission to develop a Salinas Valley Integrated Groundwater Sustainability Plan by 2023 and achieve groundwater sustainability in the Salinas Valley by 2040.
- Our groundwater basin is comprised of 6 subbasins one of which is identified as “Critically Over-Drafted” – the 180/400-Foot Aquifer.
- The rate of the community’s current water use is unsustainable. To meet our community’s ongoing water supply needs now and into the future we must balance the basin.
- The State has put us on a tight timeline to fix the problem. We ambitiously accept the challenge.
- As of 2020, we have GSP for the 180/400-Foot Aquifer Subbasin and have scoped projects and programs to bring the subbasin back into balance.
- From 2020 through 2022 we will work on GSPs for the other five basins.
- We will start implementing our plans immediately and efficiently use our GSA sustainability fee to work towards sustainability.
- Developing a sustainability plan for groundwater impacts everyone. That’s why the SVBGSA Board and our Advisory Committee are diverse and include stakeholders from every walk of life in the Salinas Valley.
- We have an unprecedented opportunity, and responsibility, to work together collaboratively and develop a science-based Groundwater Sustainability Plan.
- Join us! Visit our website, sign up for updates, attend the next meeting and follow us on Facebook.

Key Messages: Groundwater Sustainability Plan

The Eastside Subbasin Groundwater Sustainability Plan and Salinas Valley Integrated Sustainability Plan are our 20-year plans to ensure that the Salinas Valley Groundwater Basin (SVGB) will be managed sustainably for our current and future generations.

- Aquifer subbasin planning is not only critical to our future - it's mandatory. SGMA mandates that science-based GSPs be developed for the Basin by 2020 and 2022, and that the plan be implemented by 2040.
- The stakes are high. Should we choose not to act, or fail to meet the 2020, 2022, or 2040 milestones, the State can intervene with required (and hefty) pumping restrictions and extraction fees.
- To meet these milestones, we have been granted the authority to develop GSPs, monitor and measure the basin and individual wells within the basin, implement capital projects, and assess necessary fees for planning and implementation.
- Six "Sustainability Indicators" will be evaluated in the GSPs and used to gauge what we need to do to bring our groundwater supply and demand back into balance.
- Given the hydrologic and geographic diversity of the SVGB, the ISP will identify overlapping projects and programs which benefit the basins. Our planning process includes initiating planning committees for the subbasins and maintains our governance structure of the Board, advisory committee, and planning committee.
- Stakeholder engagement is a key component to the development and implementation of the GSP. We encourage and invite the community to get involved. Attend our monthly Board meetings, attend a Subbasin Planning Committee meeting, sign up for our newsletter.

Key Messages: Our History

- The Salinas Valley Basin GSA is firmly rooted in stakeholder engagement.
- From 2015-2017, local agencies and stakeholders worked with the Consensus Building Institute (CBI) to facilitate the formation of the GSA.
- In 2015, CBI began by conducting a Salinas Valley Groundwater Stakeholder Issue Assessment, which included interviews and surveys. This process resulted in recommendations for a transparent, inclusive process for the local implementation of SGMA and the formation of the GSA.
- Following the Issue Assessment, The Collaborative Work Group of stakeholders representing a broad range of interests met from March 2016 through April 2017 and developed recommendations on the governance structure, voting, and legal structure of the GSA.
- The Stakeholder Forum was simultaneously held throughout 2016 and served as a critical element for interested stakeholders and the public to learn about and provide input on the GSA.

- After nearly two years of community engagement led by the top consensus-building professionals in the nation, the Salinas Valley Basin Groundwater Sustainability Agency was formed in April 2017 with a broad and diverse foundation of support.

Appendix 2-B

SVBGSA Media Policy

Appendix 2C. Media Policy

The press is an important partner for getting our message out to the community. To maximize our effectiveness in working with the media, a consistent protocol will be followed by staff, consultants, board members, and committee members.

Agency Spokesperson(s)

- The primary spokesperson for all media inquiries is the General Manager (GM). Media inquiries should first be directed to the GM to coordinate a response.
- Reporters may want to also interview board and community members. Some board members may enjoy media conversations, while others do not. The SVBGSA will maintain a standby list of a few board and community members, who will be prepared and can be called on for media inquiries.
- In preparation for the interview, the GM and Public Information Officer (PIO) will work closely with the spokespeople in preparation for media interviews. Factual and coordinated talking points will be provided in advance of the interview.

Responding Quickly

- Reporters work on tight deadlines. To ensure an opportunity is not missed, all media inquiries should receive an immediate response and referred to the GM at the earliest possible opportunity.

The Back-Up Plan

- If the GM is unavailable and cannot be reached for comment, media inquiries should be directed to the Board's back-up media representative. The Board's representative will contact the PIO to determine whether a response is necessary. If the response is not urgent, offer the media an appointment time for when the GM is available. If it is a time sensitive and urgent matter, a statement will be released from the Board representative in close coordination with the PIO.

News Monitoring and Tracking

- Following the interview or statement, if published, the GM or PIO will circulate the coverage to the Board and committee members.

Appendix 2-C

Summary of Written Comments and Responses

Number	Chapter	Date Received	Commenter	Comment	Format	Action
1	3	7/10/2020	Heather Lukacs, Community Water Center	See Appendix 2-D	Email	Table 3-1 focuses on municipal water systems, and Figures 3-4. 3-6 through 3-8 show well type densities. Water budgets are discussed in more detail in chapter 6. Water budget assumptions are described in chapter 6.
2	NA	7/16/2020	Heather Lukacs	See Appendix 2-D	Email	This table is not included in the Monterey Subbasin.
3	1-4	11/17/2020	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
4	1 to 5	1/8/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
5	9	3/8/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Letter	1. All projects described in both the agenda packet memorandum as well as Chapter 9 are conceptual projects at this point. If projects are considered for implementation, they will undergo more rigorous analysis, which will include modeling to determine impacts. 2. More data will be obtained during implementation, including additional pumping data, and recycled water use data. These data will be included in annual reports and GSP updates as they become available during implementation. 3. The SVBGSA will partner with MCWRA to develop a plan to address de minimis extraction.
6	6	3/10/2021	George Fontes, Salinas Basin Water Alliance	See Appendix 2-D	Email	Water budgets based on modeling took more time than anticipated, and subsequently the allocations policies were presented as conceptual approaches that could be later applied to budgets once they were available. Several subbasins have opted to not include allocations as a management action in their GSP. Additionally, there are multiple ways to estimate extraction throughout the basin, and each of these methods comes with uncertainty and an acknowledgment of data gaps. The water budgets being developed from the model are using the best available data and information, as well as with strong partnership with the USGS. Additional data will be collected during implementation, and the water budgets will be updated. SVBGSA looks forward to continued collaboration with stakeholders such as the Salinas Basin Water Alliance.
7	Whole GSP	3/22/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Letter	SVBGSA hosted an Allocations Workshop on November 18, 2020, and the Corral de Tierra management area committee discussed and voted on an allocations-demand management strategy for allocations. They approved an approach based on a per connection allocation for small parcels and a per acreage for large parcels. The hybrid per connection/per acreage allocation structure estimates de minimis extraction and subtracts it from the overall sustainable yield. This is discussed in greater detail in Chapter 9, Section 9.4.8 as the first project for the Corral de Tierra area. This GSP acknowledges the hydrogeologic connection between the Corral de Tierra and Laguna Seca areas, and the need for continued collaboration with the Seaside Watermaster during Implementation. The modeling teams for the MBGWFM and Seaside models will continue to improve their models to better align active layers and hydrogeologic conceptualization based on additional data gathered during implementation. Further, the MBGWFM and this GSP acknowledge that under a 'no pumping' project scenario, water levels in the Corral de Tierra area will continue to decline. This will be addressed more completely during Implementation with stakeholders as SVBGSA considers projects and continued collaboration with regulatory partners such as MCWRA and Monterey County.
8	4 and 5	4/5/2021	Hydrogeologic Working Group	See Appendix 2-D	Letter	See response document in Appendix 2-E.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
9	9	4/21/2021	George Fontes, Salinas Basin Water Alliance	See Appendix 2-D	Email	We use the best available data and science to develop these GSPs, per SGMA. Data acquisition will also come during implementation to better understand groundwater relationships between subbasins, project impacts, and changes over time for improved management. Projects and management actions must be in the GSP to meet current conditions using the best available information as they are. Projects can be updated with updated data during implementation, and with more detailed scoping.
10	NA	4/22/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Letter	Text in the GSP has been updated per the email.
11	1 to 8	4/23/2021	Community Water Center	See Appendix 2-D	Edits	-Chapter 2: A map of all DACs and a DAC appendix are added to Chapter 2. A map with all state and local small water systems for which the GSA has boundaries for is included in Chapter 3, Figure 3-4. -Chapter 4: Text about the effect of groundwater pumping on groundwater quality was added to Chapter 5, Section 5.4.3: the "Distribution and Concentrations of Diffuse or Natural Groundwater Constituents" section. A discussion on the effect of lowering groundwater elevation on groundwater quality is included in Chapter 8 in the "Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators" section for groundwater elevations. -Chapter 5: - Nitrate is not identified as a constituent of concern for this subbasin at this time. Water quality data for DDW wells and ILRP on-farm domestic and irrigation supply wells were used to make maps showing the spatial distribution of water quality exceedances of Title 22 or Basin Plan standards from 2013 to 2019 are now included in a new Chapter 5 Appendix. - The relationship between declining water levels and arsenic levels was evaluated for the Corral de Tierra area as presented in the August 2021 Subbasin Planning Committee Meeting. There is no established relationship at this time, and SVBGSA has included an arsenic-specific implementation action in Chapter 9 to understand if a relationship exists. Table 8-6 lists all the constituents for which data is available for the 3 types of wells in the monitoring network (DDW wells, ILRP on-farm domestic, and ILRP irrigation supply wells). Table 5-3 lists all the constituents that have had an exceedance in these 3 sets of wells, while Table 8-6 includes all the constituents that were included in the analysis that have been sampled for historically in each set of wells. -Chapter 6: The sustainable yield derived from the model will be evaluated during Implementation with additional data. This GSP uses the central tendency climate scenario recommended by DWR. Although DWR encourages evaluation of the other extreme climate scenarios, they are not required and would not likely change the management approach at this time, so they are not currently included. Climate change assumptions will be reevaluated as part of the 5-year update. -Chapter 7: - Groundwater Elevations: RMS wells were chosen based on geospatial distribution and well depth. Additionally, the network is dependent on the wells that are already monitored by MCWRA. This was done to avoid any overlap in monitoring of groundwater elevations. Thus, the types of wells that SVBGSA has access to is dependent on the wells that MCWRA has permission to monitor. - Water Quality: Small public water systems wells, regulated by Monterey County Health Department, include both state small water systems that serve 5 to 14 connections and local water systems that serve 2 to 4 service connections. SVBGSA had originally planned to work with the County to add data from small and local water systems into the monitoring network. These wells are not in the current proposed monitoring system because well location coordinates, construction information and quality data are not easily accessible. The Monterey County Health Department monitors water quality in the state small and local water systems and their data is not readily transferable. In addition, there is sufficient other available data to characterize the basin. There were no water quality data gaps identified per SGMA requirements for GSPs as there is adequate spatial coverage to assess impacts to beneficial uses and users. -Chapter 8: - Groundwater Elevations: Domestic well analyses were conducted for the minimum thresholds and measurable objectives. Wells that did not have accurate locations were not included, because water levels vary greatly throughout the Subbasin, thus, it is unlikely that the water level for the centroid of a PLSS section can accurately represent all wells that have the centroid of the section as their location. - Water Quality: Subbasin planning committees determined the approach to setting SMC.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
12	1 to 4	4/26/2021	Tamara Voss, Monterey County Water Resources Agency	Internal Comments, Not Provided	Edits	Edits have been added to Chapter 1-4 as appropriate. Please note that the existing hydraulic conductivity data do not distinguish between the 180-Foot and the 400-Foot aquifers, thus, they are not distinguished on Figure 4-21.
13	5	4/26/2021	Tamara Voss, Monterey County Water Resources Agency	Internal Comments, Not Provided	Email	Edits have been added to Chapter 5 as appropriate. Please note that due to the connectivity of the lower 180-ft and the 400-ft aquifers, the existing information is insufficient to distinguish the exact screening aquifer of most of those wells such that the wells could be visualized differently in Figures 5-13, 23, and 28. Future updates to the GSP will consider revising these figures when more information is available. Although there are no additional wells to the southeast of MW-7 on Cross Section A-A', it is not a data gap as that area is outside of the Monterey Subbasin.
14	3	4/27/2021	Margaret-Anne Coppernoll	See Appendix 2-D	Letter	Different crops have different irrigation requirements, and many agricultural operations use a myriad of irrigation technologies. Monterey County Farm Bureau will have more information about this. MCWRA has the authority to pursue this and SVBGSA will actively collaborate with MCWRA to find pathways forward to account for and manage all groundwater extraction.Water quality is described in Chapter 5. Agencies that test and report water quality are aware of changing water testing recommendations from the EPA and other entities.
15	9	4/28/2021	Community Water Center	See Appendix 2-D	Email	Several of the recommendations from this letter were implemented and tailored in subsequent GSPs.
16	7	5/10/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Letter	See response document in Appendix 2-E.
17	9	5/11/2021	Fred Nolan, Public Commentary (Date based on post mark)	See Appendix 2-D	Letter	Recycled water is an important component in reaching and maintaining sustainability. Recycled water projects are detailed in Chapter 9, and will be explored further during implementation.
18	8	5/12/2021	Norman Groot, Salinas Basin Agricultural Water Association	See Appendix 2-D	Edits	The SVBGSA does not set water quality objectives for farming operations, and fully acknowledges and supports Ag Order 4.0. Additionally, the water quality SMC primarily focuses on a 'do no harm' approach, whereby groundwater management implemented by SVBGSA will be evaluated for negative impacts to water quality, but no groundwater management implementation will not be evaluated for negative impacts. In this way, existing water quality programs and standards are included in the GSPs, and the SVBGSA can direct its resources to GSP implementation with stakeholders in the Basin.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
19	7	5/27/2021	Tamara Voss, Monterey County Water Resources Agency	Internal Comments, Not Provided	Letter	Edits have been added to Chapter 7 as appropriate. Please note that wells behind the SWI front will be included in the monitoring network but not as RMS, since no SMC is appropriate for these wells. However, should the situation in the Monterey Subbasin change or worsen, additional RMS will be added in the future annual assessment. MCWD Deep Aquifers production wells are not added to the RMS network since production wells are not recommended as RMWs per GSP guidelines. The data gaps figures reviews the seawater intrusion and GWE monitoring network together as these two issues are closely correlated. Similar with reviewing the lower 180-ft/400-ft wells together.
20	8	7/12/2021	John Farrow, M. R. WOLFE & ASSOCIATES, P.C. (Landwatch)	See Appendix 2-D	Email	See response document in Appendix 2-E.
21	8	7/13/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
22	8	7/20/2021	James Sang, Public Commentary	See Appendix 2-D	Email	This letter was addressed in a longer form response. In summary: Infiltration and recharge to get water from the surface to the aquifer are complex mechanisms and not easily managed for a whole basin. Rainwater has the opportunity to infiltrate the soil at many places at the land surface, however this infiltrated water does not always readily translate into direct recharge to the aquifer. The recommendations provided here may be easily incorporated/reflected into the Eastside GSP projects of (A1) Managed Aquifer Recharge of Overland Flow, (A2) Floodplain Enhancement and Recharge, the Eastside Management Action of (E1) Conservation and Agricultural BMPs, and the Eastside Implementation Action of (G5) Support Protection of Areas of High Recharge. Iterations of these projects are found in several other GSPs.
23	8	7/30/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
24	NA	8/12/2021	Salinas Valley Water Coalition	See Appendix 2-D	Email	SVBGSA is currently working on reconvening the 180/400-Foot GSP Subbasin committee to discuss implementation. The content of the Integrated Implementation Plan is still under development, but is not currently anticipated to include management actions and projects. The SVIHM is the best available tool to determine water budgets at this time, and future results will be used to update the GSPs when available. The paragraph regarding the development of projects and management actions for the 180/400-Foot Aquifer Subbasin GSP has been deleted. The support for the 11043 permit and seawater intrusion barrier projects is noted.
25	6	8/12/2021	Stephanie Hastings, Salinas Basin Water Alliance	See Appendix 2-D	Email	For now, all additional simulations and analysis of intersubbasin flow (beyond what's in the water budgets) will be considered by the integrated implementation committee after GSP submittal.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
26	NA	8/12/2021	Stephanie Hastings, Salinas Basin Water Alliance	See Appendix 2-D	Letter	Intersubbasin subsurface flow is included in the current water budgets. While the underestimated pumping in the SVIHM may affect the intersubbasin flow, the SVIHM is still the best available tool for the development of water budgets. Additional simulations and analysis of intersubbasin flow (beyond what's in the water budgets) will be considered by the integrated implementation committee after GSP submittal.
27	9	8/23/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
Comments above were received prior to the full public release of the GSP. Several comments led to revisions in the chapters.						
Comments below are on the publicly released review version of the GSP.						
28	6	9/6/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
29	10	9/6/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	Email	See response document in Appendix 2-E.
30	Whole GSP	10/8/2021	Norman Groot, Farm Bureau Monterey	See Appendix 2-D	Email	Thank you for your support and input. The Integrated Implementation Plan will be written to with the goal of achieving sustainability in the entire Salinas Valley Basin and the Integrated Implementation Committee will focus on achieving sustainability in an integrated manner across the Valley.
31	Whole GSP	10/14/2021	John Farrow, LandWatch	See Appendix 2-D	Email	A1. While the 180/400 looked at projects and management actions that involved the whole Valley, the focus was on the 180/400. During subbasin committee meetings, members agreed that while any projects and management actions will be evaluated in a valley-wide light, only the plans that would primarily help that subbasin reach or maintain sustainability should be included in the plan. To ensure projects and management actions are selected and implemented in an integrated manner, SVBGSA established the Integrated Implementation Committee. While the subbasin GSPs were developed through subbasin planning committees, GSA staff and consultants ensured the projects and management actions, as well as the plans, are not in conflict with each other. Additional steps needs to be completed before projects, management actions, or the water charges framework move forward, and the text of this GSP has clarified that the use of the word "will" is reflective of what will occur if/when a project or management action moves forward. The 180/400 GSP nor DWR's review of it commit SVBGSA to anything in other subbasins. A2. Not all the subbasins need all the projects or management actions that are planned in other subbasins. The projects included in the Eastside, Langley, Forebay, Upper Valley, and Monterey GSPs are not dependent on the water charges framework for funding. They took a different approach and described all potential funding mechanisms due to the recognition that the appropriate funding mechanism varies according to the specific project. A3. The Upper Valley and Forebay Subbasins are already sustainable and therefore the GSPs fewer projects and management actions than some other subbasins. Each GSP focuses on the specific projects or management actions that contribute to maintaining/achieving sustainability in that respective subbasin; however, the GSPs acknowledge that the impacts of any project or management action, regardless which subbasin it originated for, will be evaluated for the whole valley. Benefits assessments will

Number	Chapter	Date Received	Commenter	Comment	Format	Action
						determine who funds projects and management actions, if funded through a 218 vote, regardless of subbasin. A4. The projects for the Eastside, Langley, and Monterey Subbasins were determined by the Subbasin Planning Committees. Each subbasin is unique and while there are some projects that are currently conceptualized as being multi-subbasin, the details are to be determined during GSP implementation. Project costs are still being refined but the GSP provides initially estimates. The Subbasin Implementation Committees and Integrated Implementation Committee will determine if any of these projects will be used to achieve or maintain sustainability and will subsequently refine the scoping, costs, and funding approach. B. See response to M. R. WOLFE & ASSOCIATES, P.C. letter dated July 19, 2021 (comment letter No. 19). D. SVBGSA in coordination with legal counsel has developed improved water quality SMC language to be included in the final draft of the GSP, which notably includes regulation of groundwater extraction. This language is in response to DWR's comments about the water quality SMC language in the 180/400-Foot Aquifer Subbasin GSP. This GSP also includes the Water Quality Coordination Group (formerly Water Quality Partnership) to elaborate on how SVBGSA will work with other agencies responsible for aspects of water quality.
32	Whole GSP	10/15/2021	Tyler Sullivan, California Coastkeeper Alliance	See Appendix 2-D	JotForm	1. Comment noted. 2 and 3. While the 180/400 looked at projects and management actions that involved the whole Valley, the focus was on the 180/400. During subbasin committee meetings, members agreed that while any projects and management actions will be evaluated in a valley-wide light, only the projects that would primarily help that subbasin reach or maintain sustainability should be included in the plan. To ensure projects and management actions are selected and implemented in an integrated manner, SVBGSA established the Integrated Implementation Committee. While the subbasin GSPs were developed through subbasin planning committees, GSA staff and consultants ensured the projects and management actions, as well as the plans, are not in conflict with each other. SVBGSA will look at climate change assumptions as part of 5-year update. The GSP includes both projects and management actions. Subbasin committees preferred to pursue projects prior to pumping reductions; however, the Plan does include the potential for demand management if needed. SVBGSA is aware of its legal responsibilities and has developed plans that include sufficient options to meet sustainability goals. 4. Under SGMA, what constitutes 'significant and unreasonable' conditions are locally defined and balance uses and users. The subbasin committee established the SMC. According to the Belin article, the Salinas Valley constitutes an 'yellow light' - there are no ESA-related in-stream flow requirements, but impacts from groundwater extraction on both ESA-protected steelhead and other GDEs should be evaluated to see if there are adverse impacts. This GSP no longer relies on the biological opinion, including for water budgets. SVBGSA is only responsible for depletion of interconnected surface water due to groundwater extraction, not for reservoir releases or surface water flows. In addition to working with NMFS to determine what constitutes an adverse impact to steelhead in relation to groundwater extraction, this GSP includes both supply-side and demand-side management options to maintain sustainability. In particular, following each annual report, the SMC TAC will evaluate sustainability and recommend actions if necessary. 5. After careful consideration and consultation with attorneys, the final GSP includes revised water quality undesirable results text that addresses DWR's comments on the 180/400-Foot Aquifer Subbasin GSP. The Partnership (now called the Coordination Group), includes space to coordinate with the CCRQCB, as suggested. SVBGSA intends to establish that Coordination Group during the first two years of GSP implementation. 6. SVBGSA has made a concerted effort to address DAC issues and involve DACs in decision making. SVBGSA has met with CWC several times, and has also incorporated several of their suggestions into the GSPs. In a discussion regarding groundwater levels, at a workshop one DAC community member highlighted that the farmworkers depend on agriculture for their livelihoods in this basin, and

Number	Chapter	Date Received	Commenter	Comment	Format	Action
						they don't want to set groundwater level goals at a level that will significantly harm agriculture, so there must be a balance. SVBGSA has sought that balance, involving DACs all the way up to their permanent seat on the Board of Directors. Additionally, SVBGSA worked to assess the needs and barriers to DAC involvement and developed the DAC Engagement Strategy to guide outreach and involvement going forward. The GSP addresses the Human Right to Water and highlights how in Ch 3, 8, and 10.
33	Whole GSP	10/15/2021	Heather Lukacs, Community Water Center	See Appendix 2-D	Email	See responses to letters by CWC and San Jerardo dated 7/10/20, 4/23/21, 4/28/21, and 6/17/21. SVBGSA in coordination with legal counsel has developed improved water quality SMC language to be included in the final draft of the GSP. This language is in response to DWR's comments about the water quality SMC language in the 180/400-Foot Aquifer Subbasin GSP. In addition, during the public comment period, an analysis on the Central Valley on groundwater extraction during droughts and nitrates was released. During GSP implementation, SVBGSA can consider this new analysis and whether it has potential applicability in the Salinas Valley. SVBGSA will look at climate change assumptions as part of 5-year update.
34	Whole GSP	10/15/2021	Douglas Deitch, Monterey Bay Conservancy	See Appendix 2-D	Email	1. SVBGSA has funded the Deep Aquifers Study and is co-funding the development of a Seawater Intrusion Model with MCWRA. The SVOM climate change simulation include sea level rise. DWR Climate Change guidance recommends using values of +15 cm for 2030 projected conditions and +45 cm for 2070 projected conditions. 2. SVBGSA is undertaking a study of the Deep Aquifers to better understand the Aquifers, their current condition, and management options. This is distinct from the Monterey One Water ASR wells, which are located in the Seaside Basin.
35	Whole GSP	10/15/2021	Elizabeth Kraft, MCWRA	See Appendix 2-D	Email	SVBGSA appreciates the support for the conceptual projects and management actions within the GSP, and during GSP implement will work with the MCWRA on the refinement and implementation of any that involve MCWRA infrastructure or water management. GSP text was revised as suggested.
36	Whole GSP	10/15/2021	Stephanie Hastings, Salinas Basin Water Alliance	See Appendix 2-D	Email	I. SVBGSA replaced the Integrated Sustainability Plan for the Integrated Implementation Plan. The Integrated Implementation Committee will outline the implementation of the 6 GSPs in the Salinas Valley Basin and address questions of groundwater relationship between the subbasins. This Committee will help ensure all subbasins get to sustainability. II. A. The SVIHM is the best available tool to compute water budgets for the subbasins in the Salinas Valley. The 180/400-Foot Aquifer Subbasin GSP will be updated using the SVIHM to be consistent with the rest of the subbasins in the 2-Year Update currently underway. The SVIHM was used to develop water budgets for the Langley, Eastside, 180/400, Forebay, and Upper Valley using the same model simulations so that they would be consistent. The Monterey Subbasin used a different model due in part to poor calibration of the SVIHM in the Monterey Subbasin; however, it adopted boundary conditions from the SVIHM to increase compatibility and the Monterey Subbasin GSP includes an implementation action to integrate the Monterey Subbasin Model into the SVIHM when it is released. SVBGSA ran a no pumping scenario with the SVIHM to determine locations of surface water depletion due to pumping; however, it is a static model that does not shed light on how intersubbasin flow would have changed. It is a static dataset that reflects how reservoirs were actually operated, not how they would have been operated with no pumping. The Integrated Implementation Committee will consider the flow and relationship between subbasins early in 2022. II. B. 1. a & b. Sustainable yields were defined according to SGMA regulations. The water budgets measure inflows and outflows of the groundwater system, and both interbasin flow and groundwater extraction are accounted for. Minimum thresholds are meant to be prevented to avoid undesirable results. If each subbasin avoids their minimum thresholds, then neighboring subbasins will likely not be prevented from reaching or maintaining sustainability. The GSP does not dispute that its conditions affect adjacent subbasins; however, it does not prevent them from reaching sustainability. The sediment relationships between the 180/400-Foot Aquifer Subbasin, and the adjacent Langley/Eastside Subbasin demonstrate a dynamic environment where different sediments were deposited over time and subsequently, impact groundwater flow. The boundary with the Eastside Subbasin generally represents the furthest extents of the alluvial fans, which are characterized by clays and other fine sediments. These sediments frequently act as an impediment to flow, if not fully a barrier in certain locations. Subsequently, the gradient relationship is not the only influence to groundwater flow between the 180/400-Foot and Eastside Subbasins, and needs to be considered along with all subsurface

Number	Chapter	Date Received	Commenter	Comment	Format	Action
						characteristics. While there is a relationship between the groundwater contours developed for the 180/400 and Eastside Subbasins, the contours themselves are not fully representative of flow between the subbasins. As the model is further refined with additional and expanded data during Implementation, the SVBGSA and stakeholders will have a clearer view of the groundwater flow relationships, particularly as they relate to the recorded sediments in this area. The boundary with the Langley Subbasin was selected based on topographical changes, and the GSP fully acknowledges there is no hydrogeologic boundary that coincides with the administrative boundary. The key characteristic of the Langley Subbasin is the Aromas Sands, which are very permeable. Despite this connection and high permeability along with lowered groundwater elevations, the seawater intrusion front is not advancing in the direction of the Langley Subbasin. Subsequently, it would be premature to conclude that groundwater elevations in the Langley Subbasin are inducing or facilitating seawater intrusion in the 180/400-Foot Aquifer Subbasin. The groundwater flow relationship between the Langley and the Eastside Subbasins is largely uncharacterized as a result of a lack of data both about the sediment changes and the groundwater elevations in the area. This is a data gap that will be addressed during implementation. It is important to note that the 180/400-Foot Aquifer Subbasin GSP includes a plan in place to halt and reverse seawater intrusion and increase groundwater elevations, which will also serve to prevent adverse seawater intrusion impacts to the Eastside Subbasin. Both the Eastside Subbasin and the Langley Subbasin have developed projects and management actions to raise groundwater levels in their subbasins. The SMC were largely developed to be both achievable, as well as provide for operational flexibility during future droughts. Furthermore, these subbasins will be a part of the Integrated Implementation Plan, which will work to address seawater intrusion through a variety of strategies, which include increasing groundwater elevations. Additionally, the SWIG has been meeting regularly to learn and strategize projects to address seawater intrusion. The subbasins under the SVBGSA will be integrated during implementation, data acquisition, further data development, and coordinated stakeholder engagement. II. B. 1. c. Subbasin Planning Committees for each subbasin chose how they wanted to measure reduction in groundwater storage. The definition of storage for groundwater is expressly based on a change in pressure heads, or groundwater elevations, within an aquifer. Freeze and Cherry, in their seminal 1979 textbook Groundwater state, "The specific storage Ss of a saturated aquifer is defined as the volume of water that a unit volume of aquifer releases from storage under a unit decline in hydraulic head." Hydraulic head is the sum of all pressures acting on water in the subsurface, which in unconfined aquifers, is generally summarized as elevation. Therefore, given the direct relationship between groundwater elevations and specific storage, groundwater elevations are appropriate as a proxy for storage. This is also explained in chapter 4.4.2 of the GSP, and a reference to that section has been added into Ch 8. Using the groundwater elevations as a proxy for storage is a reasonable alternative in Subbasins with less GEMS data available for estimating groundwater production. Additionally, the Langley, Eastside, Forebay, and Upper Valley Subbasins are characterized as having one principal aquifer, instead of multiple. This allows for the estimation of storage based on groundwater levels, since it is assumed that the groundwater is generally all connected in those Subbasins, and groundwater elevations are subsequently representative of groundwater conditions. II. B. 2. A description of how minimum thresholds will affect adjacent subbasins were provided per GSP Regulations. The Forebay and Upper Valley Subbasin Planning Committees defined how the SMC for all sustainability indicators in their subbasins will be measured. The SMC in the Forebay and Upper Valley are set at similar levels to the other subbasins and will not prevent adjacent subbasins from reaching sustainability. Text was added to clarify how the minimum thresholds were developed based on the significant and unreasonable statement and why they are not in conflict. II. B. 3. SVBGSA has considered the interest of all beneficial users in the Salinas Valley. The GSA does not "allocate the burden of sustainability" nor undertake any actions that threaten or impinge on water rights. III. Projects and management actions were chosen by Subbasin Planning Committees, and are sufficient to maintain or achieve sustainability. The project mentioned was not brought up in any of the Subbasin Committee discussions on projects and management actions; however, the GSP does not preclude additional projects to be considered in the future. The Integrated Implementation Committee will determine which projects will be used to maintain or achieve sustainability in the Salinas Valley. Aquilogic Memo: The SVBGSA agrees that impacts on adjoining basins or subbasins must be addressed before implementing any

Number	Chapter	Date Received	Commenter	Comment	Format	Action
						management actions or projects. SVBGSA plans to conduct these analyses, which will include, among other things, updating the water budgets and sustainable management criteria in the 5-year updates if necessary, to account for inter-basin flows and impacts on adjoining basins or subbasins, when an appropriate tool becomes available. SVBGSA additionally agrees that the superposition approach included in the comment is a reasonable approach for addressing any action's or project's impact on inter-basin flows. This type of approach lessens the influence of model errors by addressing changes between simulations, and not absolute values in any simulation. SVBGSA will use this approach to address both intra and inter-basin impacts from any action or project. SVBGSA further agrees that the additional simulations proposed in the comment letter will facilitate a deeper understanding of the Salinas Valley Groundwater Basin, even though the additional simulations are not associated with specific actions or projects. To that end, SVBGSA staff will propose to the SVBGSA Board of Directors that the requested simulations would be informative, that these simulations be conducted before the next GSP assessment, and that the additional simulations will provide essential background understanding that will allow a thorough vetting of any potential management actions or projects. If and when approved by the SVBGSA Board of Directors, SVBGSA staff will work with all interested parties and stakeholders through the Integrated Implementation Committee to develop the assumptions and approaches for these simulations.
37	Whole GSP	10/15/2021	Audubon California, Clean Water Action, Clean Water Fund, Local Government Commission, The Nature Conservancy, Union of Concerned Scientists, and Community Water Center	See Appendix 2-D	JotForm	1. A. DACS and Drinking Water Users: Average domestic well depths were added to Section 3.3 and the populations of identified DACs were added to Figure 2-3 in Chapter 2. Interconnected Surface Water: Depth-to-groundwater data and areas with shallow groundwater shown on Figures 5-35 and 5-36 were derived by subtracting groundwater contours from land surface DEM data, in accordance with best practices. Groundwater contours and location of wells used to prepare these contours are shown on figures under Section 5.1.2. The depth-to-water data was reviewed with the surface water features shown on Figure 4-23 to identify potential ISW locations. The GSP has made an assumption that groundwater within 20 feet of land surface may be connected to surface water based on streambed incision in the Salinas River Valley. More data is needed to improve the ISW analysis as discussed in 5.6.2. This data could be amplified by the ISW monitoring network once it is fully developed including the proposed new wells. The monitoring network is set to measure shallow groundwater elevations near areas of interconnection that will be used to measure SMC. GDEs: Depth-to-groundwater data was compared with the NC dataset shown on 5-37 to identify potential GDE locations within the subbasin and discussed under Section 5.7. However, due to the uncertainty in shallow groundwater data, the GSAs may field verify these potential GDEs during GSP implementation. A higher depth-to-groundwater threshold may be considered if/when the GSAs verify that valley oaks are present. Text was added to re-emphasize that rooting depth data are limited. GSP Regulations do not require a complete list of fauna and flora in the Subbasin. However, discussion of threatened and endangered species within the Monterey County and potentially within the subbasin has been added. As discussed in Section 5.7.2., Fort Ord communities are located within the Fort Ord Munition Response Area where munition investigation activities that may disturb these wetlands have been carried out by FORA and the Army. These communities as well as other natural resources within the former Fort Ord are being managed and monitored by the USACE, FORA, and ESCA Remediation Response (RP) Team. 1. B. The Communication and Public Engagement Plan can be updated with more detail on the extensive outreach that has been carried out. When appropriate, DAC and environmental stakeholder feedback has been incorporated into the GSP - see responses to those comments. 1. C. DACS and Drinking Water Users: There is one recognized DAC within the Subbasin shown on Figure 2-1, located within the Marina-Ord Area and served by MCWD's municipal system. The impact of chronic lowering of groundwater level minimum thresholds on domestic well analysis uses PLSS section location data, as well as historical groundwater elevation data. The reasons for the exclusion of wells are outlined in the GSP in Section 8.7.3.2. The wells used for the domestic well analysis were first derived from the OSWCR database which includes wells that are abandoned or destroyed. Wells were first filtered by identifying the wells that had construction data. Then wells that were drilled prior to 1995 were filtered as more water systems started coming online replacing domestic wells. This left 19 wells with requisite data and constructed within a reasonable time frame to be considered subject to GWL impacts.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
						Chapter 9 outlines an implementation action, Water Quality Partnership, that specifically addresses the unique role of the GSAs to play a convening role in addressing water quality concerns while engaging key partners and local stakeholders. Regarding degraded water quality, Chapter 8 contains sufficient description of the minimum thresholds, measurable objectives, and undesirable results on “beneficial uses and users of groundwater or land uses and property interests” (354.28(b)(4), 354.26(b)(3)). Minimum thresholds and measurable objectives were developed by the GSAs’ Subbasin Planning Committees to meet the needs and concerns of local stakeholders, which included specific additional text regarding arsenic in the Corral de Tierra Area. Minimum thresholds and measurable objectives are based on Title 22 drinking water standards and Basin Plan irrigation water quality objectives. The Subbasin Planning Committees agreed to the minimum thresholds and measurable objectives. GDEs and ISW: The impacts on all beneficial uses and users were considered in establishing this SMC. What is significant and unreasonable is locally defined, balancing all uses and users. The effect of undesirable results on beneficial users are discussed in Section 8.12.3.4 of the GSP. As discussed in Section 8.12.1, the Subbasin does not have large areas where ISW occurs, and areas of identified ISW are located within areas of potential GDEs. Therefore, the SMCs for ISW also focus on managing groundwater impacts for GDEs. Shallow groundwater elevation as proxy has been used to establish the MT and MO for ISW. SMCs for chronic lowering of groundwater levels are set to be consistent with SMCs for ISW. 2. This GSP meets SGMA regulations with its use of DWR-recommended 2030 and 2070 climate scenarios for the future water budgets, including the base for the sustainable yield. Use of extremely wet and dry scenarios is not required. SVBGSA will reevaluate appropriate climate scenarios to use prior to the 5-year Update. Incorporation of climate change scenarios into project and management action benefits will be done as part of project feasibility and scoping for those selected to move forward. 3. The monitoring networks are to monitor groundwater conditions across the subbasin for all beneficial uses and users, not be prioritized for certain users. Additionally, monitoring networks were developed following DWR BMPs. Monitoring of shallow groundwater elevations near areas of interconnected surface water is sufficient to assess significant and unreasonable impacts to beneficial users. SGMA requires monitoring groundwater conditions that may impact beneficial uses and users, not monitoring the users themselves. The groundwater elevation and water quality monitoring networks are adequate and sufficient to monitor changing conditions in the principal aquifer. Monitoring networks do not need to cover every part of the Subbasin, the areas highlighted in Attachment E are represented by the current monitoring network, which uses existing sites and data collection programs. The current monitoring network will also be expanded during implementation as described throughout the GSP. 4. The projects and management actions chosen by the GSAs and Subbasin Planning Committees are the ones that are included in the GSP. The GSAs may consider this program in the future if it so chooses. Degradation of water quality due to GSA impact will be monitored as outlined in the GSP. As the GSP states, avoiding water quality impacts will be considered as part of project selection and design. Project-specific monitoring will be established as needed to ensure projects don't cause minimum thresholds to be exceeded. Recharge project locations and site specifications have not been completely developed yet but this will be considered. The climate resilience of specific management actions will be considered during project selection and design.
38	6	10/20/2021	Robert Jaques, Seaside Basin Watermaster	See Appendix 2-D	JotForm	Edits are incorporated with modifications.
39	9	10/21/2021	Erika Marx, US Army Garrison Presidio of Monterey	See Appendix 2-D	Email	Comment noted. The basin GSAs will continue to coordinate with the Army on stormwater and groundwater management. Information on decommission of the stormwater outfall has been added to Chapter 9.
40	Whole GSP	10/29/2021	Mike Lerch, California State University Monterey Bay	See Appendix 2-D	Letter	Thank you for your support and input. Demand allocations within the MCWD jurisdiction areas are not within the scope of this GSP and will be further resolved by MCWD and local jurisdictions. MCWD will collaborate with CSUMB during GSP implementation regarding monitoring programs and project implementation.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
41	9	10/30/2021	James Sang	See Appendix 2-D	Letter	There are multiple proposed solutions to help bring the Monterey Subbasin, and specifically the Corral de Tierra. The proposed projects and management actions have been evaluated to provide an initial understanding of the level of investment needed to begin working towards sustainability in this area. The Subbasin committee has worked with GSAs' staff and GSAs' consultants to develop these options over the course of developing the GSP. The GSAs' have looked for more cost-effective options, however options for this area are limited and costly. This area is unique in its geography and historical groundwater conditions, which adds to the level of complexity and investment required to bring it to sustainability. Multiple projects and management actions will be required, and these all come with associated costs. Several of the listed projects specifically address enhancing recharge. Recharge is dependent on soils, subsurface conditions, and groundwater conditions; it can occur in both short and long-term timeframes. The GSAs are looking at as many feasible recharge-focused actions as possible, and will enlist the assistance of all groundwater users in the area from the domestic well-owners to the municipal water providers and agricultural users. The sustainable yield calculations are based on best available data, and will be refined as more data are collected during implementation. Furthermore, implementing projects and management actions will begin immediately upon submitting the GSP to DWR. The GSAs understand there is no time to waste for getting the Monterey Subbasin to sustainability. The GSP is written to comply with SGMA, and be accepted by DWR. The groundwater quality concerns from former Fort Ord and in the Corral de Tierra area are well documented in the GSP in Chapter 5. There are existing programs to remediate these concerns as detailed in Chapters 3 and 7, and implementation activities will be designed with water quality impacts in mind, as detailed in Chapters 8, 9 and 10. Cal-Am's extractions from the Carmel River Basin is a separate issue as it provides water for the Monterey Peninsula. This is a separate system from the Cal-Am systems in the Corral de Tierra area that depend on groundwater.
42	Whole GSP	11/1/2021	Ngodoo Atume, Audubon California, Clean Water Action, Clean Water Fund, Local Government Commission, The Nature Conservancy, and Union of Concerned Scientists	See Appendix 2-D	JotForm	See response document in Appendix 2-E.
43	6	11/1/2021	Pete Leffler, Luhdorff & Scalmanini, California American Water,	See Appendix 2-D	Letter	See response document in Appendix 2-E.
44	9	11/1/2021	Nisha Patel, City of Seaside	See Appendix 2-D	Email	See response document in Appendix 2-E.
45	9	11/4/2021	Mike McCullough, Monterey One Water	See Appendix 2-D	JotForm	MCWD is in conservation with M1W regarding availability of recycled water. Section 9.4.6 (Project M3) has been revised to reflect most recent information available to MCWD.

Number	Chapter	Date Received	Commenter	Comment	Format	Action
46	6B	11/19/2021	Pete Leffler, Luhdorff & Scalmanini, California American Water,	See Appendix 2-D	Email	See response document in Appendix 2-E.

Appendix 2-D

Comment Letters

Monterey Subbasin Groundwater Sustainability Plan Development Comment Letters Received

(1) Heather Lukacs, Community Water Center. 7-10-2020

(2) Heather Lukacs, 7-16-2020

(3) Robert Jaques, Seaside Basin Watermaster. 11-17-2020

(4) Robert Jaques, Seaside Basin Watermaster. 1-8-2021

(5) Robert Jaques, Seaside Basin Watermaster. 3-8-2021

(6) George Fontes, Salinas Basin Water Alliance. 3-10-2021

(7) Robert Jaques, Seaside Basin Watermaster. 3-22-2021

(8) Hydrogeologic Working Group. 4-5-2021

(9) George Fontes, Salinas Basin Water Alliance. 4-21-2021

(10) Robert Jaques, Seaside Basin Watermaster. 4-22-2021

(11) Heather Lukacs, Community Water Center & H. Amezquita, San Jerardo Cooperative. 4-23-2021

(14) Margaret-Anne Coppernoll. 4-27-2021

(15) Community Water Center. 4-28-2021

(16) Robert Jaques, Seaside Basin Watermaster. 5-10-2021

(17) Fred Nolan. 5-11-2021

(18) Norman Groot, Salinas Basin Agricultural Water Association. 5-12-2021

(20) John Farrow, M. R. Wolfe & Associates, P.C. on behalf of LandWatch. 7-12-2021

(21) Robert Jaques, Seaside Basin Watermaster. 7-13-2021

(22) James Sang. 7-20-2021

(23) Robert Jaques, Seaside Basin Watermaster. 7-30-2021

(24) Salinas Valley Water Coalition. 8-12-2021

(25, 26) Stephanie Hastings, Salinas Basin Water Alliance. 8-12-2021

(27) Robert Jaques, Seaside Basin Watermaster. 8-23-2021

(27) Robert Jaques, Seaside Basin Watermaster (Chapter 6). 9-6-2021

(28, 29) Robert Jaques, Seaside Basin Watermaster (Chapter 10). 9-6-2021

(30) Norman Groot, Monterey County Farm Bereau. 10-08-2021

(31) John Farrow, M. R. WOLFE & ASSOCIATES, P.C. (Landwatch). 10-14-2021

(32) California Coastkeeper Alliance. 10-15-2021

(33) Community Water Center. 10-15-2021

(34) Douglas Deitch, Monterey Bay Conservancy. 10-15-2021

(35) Elizabeth Krafft, Monterey County Water Resources Agency. 10-15-2021

(36) Stephanie Hastings, Salinas Basin Water Alliance. 10-15-2021

(37) The Nature Conservancy and Others. 10-15-2021

(38) Robert Jaques, Seaside Basin Watermaster. 10-20-2021

(39) Erika Marx, US Army Garrison Presidio of Monterey. 10-21-2021

(40) Mike Lerch, California State University Monterey Bay. 10-29-2021

(41) James Sang. 10-30-2021

(42) Pete Leffler, Luhdorff & Scalmanini, California American Water. 11-1-2021

(43) Nisha Patel, City of Seaside. 11-1-2021

(44) Ngodoo Atume, Audubon California, Clean Water Action, Clean Water Fund, Local Government Commission, the Nature Conservancy, and Union of Concerned Scientists. 11-1-2021

(45) Mike McCullough, Monterey One Water. 11-4-2021

(46) Pete Leffler, Luhdorff & Scalmanini, California American Water. 11-19-2021

Gmail

Emily Gardner <gardnere@svbgsa.org>

Recommendations for Langley and other subbasin GSPs related to drinking water users

6 messages

Heather Lukacs Fri, Jul 10, 2020 at 2:06 PM
To: gardnere@svbgsa.org
Cc: Donna Meyers <meyersd@svbgsa.org>, Gary Petersen <peterseng@svbgsa.org>, Horacio Amezqutia
Thomas R Adcock Justine Massey

Hi Emily, Gary, and Donna,

I appreciate the process allowing for comment on the early drafts of the subbasin GSPs.

Tom, I have included you so that you can see Figure 3-5 that I referenced during my comments at today's meeting - in order to help make sure Alco and Pajaro Sunny Mesa CSD boundaries are accurately represented (see attached), and also because you indicated interest in helping support outreach to water systems.

We at CWC are happy to support in identifying, ground-truthing, and outreach to drinking water users in the Langley Subbasin and other subbasins in the Salinas Valley.

The first step we recommend is to generate a list of the following to support outreach and also to include in Chapter 3 of the draft subbasin GSPs:

- Public water systems - which serve over 15 connections
- State and local small water systems - which serve between 2-14 connections

We at CWC currently have lists for both types of systems from Monterey County Environmental Health (along with contact information for each water system). This information was also used by the GSP consultants in the 180/400 GSP so they should also have these lists with location and water quality information for all water systems in the subbasins.

Next, we recommend creating maps of the location, water quality, and other information of all drinking water supply wells - which came up during today's meeting. For the 180/400 Foot Aquifer GSP, Figure 7-9 Public Water Supply Wells was included together with Appendix 7E (see attached) which has water system names, well construction information, coordinates, and monitoring data range. (see more on this below).

Lastly, these maps and lists can then be shared with local drinking water users who can provide feedback and help groundtruth the information. This could be part of a drinking water workshop - is the information we have accurate? Given this information, is the monitoring network accurate? Are drinking water users collecting other information that could be added to this plan?

I look forward to discussing this and also more specific recommendations (see below) for Chapter 3 of the Subbasin GSPs.

Thank-you,
Heather

Recommendations for Chapter 3 of Subbasin GSPs

- **Revise the description of the plan area to include the type and location of all water systems and private domestic wells that serve drinking water users, their current groundwater quality conditions, and the number of people served.** All public water system service areas and state and local small service areas should be included in this chapter as well as a list of all these system names, water system ID numbers, and number of service connections (or population served). Private wells should also be identified as being groundwater-dependent drinking water supplies. All public water systems and state/local small water systems are important to identify and include in this chapter because all are reliant on groundwater, many are highly vulnerable to water level and water quality changes, and all will be impacted by the way groundwater is managed in the basin. Adequately characterizing the public water systems, state and local small water systems, and domestic wells in the GSP is important to set the stage to: (1) better identify areas that are vulnerable to groundwater level, groundwater quality, or seawater intrusion challenges, (2) quantify drinking water demand in the subbasin for both the current and projected water budget, (3) provide a basis for the monitoring network of drinking water supplies, and (4) ensure inclusive and representative engagement of drinking water users in the planning process.

- **Revise Chapter 3 to include a map of the service areas of all of the state and local small water systems in the 180/400 foot aquifer subbasin.** The 180/400 Foot Aquifer GSP mentions 136 small water systems in Chapter 7, page 7-20 of the 180/400-Foot Aquifer GSP (January 3, 2020) which indicates that the consultants have this data. We recommend that this data for all Salinas Valley subbasins be included in a map in Chapter 3 of each GSP, be clearly labelled, and have an associated table with key information. The Monterey County Environmental Health Bureau (EHB) maintains publically available data which includes shape files of state and local small water system service areas (e.g. polygons of all parcels served by each state or local small water system) to water system IDs. Lists of state and local small service areas and out-of-compliance water systems are available online on their state and local small water system webpage. Monterey County EHB also maintains individual files for each SSWS and LSWS in the County, which often contain well completion reports for each system. All water quality data, location data, and well completion reports are publically available upon request from the Monterey County EHB.
- **Update water system boundaries in Figure 3-5** (Langley, 6/28/2020 GSP) to reflect that Alco no longer operates wells in this area, and update Pajaro Sunny Mesa CSD water system boundaries.
- **List domestic water use and/or rural residential water use under the Water Use Section (Section 3.2.2).** This section indicates that, "Domestic use outside of census-designated places is not considered urban use." Even if the Monterey County Water Resource Agency (MCWRA) does not report rural residential use, it is an important beneficial use and should be listed as a "water use sector." Water use estimates for state and local small water systems could be based on the number of connections served by each water system (which Monterey County has on file).
- **Revise Chapter 3 to include a specific discussion, supported by maps and charts, of the spatial or temporal water quality trends for all constituents that have exceeded drinking water standards and may affect drinking water beneficial users, as required under 23 CCR § 354.16(d).** In the 180/400 Foot Aquifer GSP, Tables 8-6 through 8-9 for all public drinking water wells (including those listed in Appendix 7E), state and local small water system wells, and private domestic wells were included which indicate that the consultant has this data available. It is important to include all water quality data (both in map and tabular form) for all constituents that will have minimum thresholds later. Water quality is an important part of the basin setting. See map viewer from Greater Monterey County RWMG of all available water quality data for state and local small water systems in Monterey County: http://www.greatermontereyirwmp.org/documents/disadvantaged-community-plan-for-drinking-water-and-wastewater/.

--
Heather Lukacs, PhD
Pronouns: She/Her/Hers
Director of Community Solutions
Community Water Center

[redacted] CA 95076
[redacted] CA 95814
[redacted]

All CWC staff are currently working remotely. Please reach all staff via email and cell phone.

---

2 attachments

Thursday, July 16, 2020

Salinas Valley Basin
Groundwater Sustainability Agency

SVBGSA Public Comments Form

Name	Heather Lukacs
Organization	Community Water Center
Email Address	heather.lukacs@communitywatercenter.org
Subbasin	Langley, Eastside, Forebay, Upper Valley, Monterey, Whole Basin, 180/400
Chapter	3
Section	Table 3-2 Existing Well Types
Comments	We request that this table include all Monterey County regulated drinking water systems and clearly distinguish between type of drinking water system. Local small water systems serve 2-4 connections, state small water systems serve 5-14 connections, private domestic wells serve 1 connection. In addition this table should list agricultural and industrial users as separate well types. This distinction is made in Figure 3-6 but not in this Table. It is important to distinguish between well type here in order to set the stage for good water budget estimates, for the monitoring network, and throughout the plan. This data is all readily available to the public and GSA.

From:	bobj83@comcast.net
To:	Patrick Breen
Cc:	Bob Jaques; Georgina King; Tina Wang
Subject:	FW: Wells within MCWD northeast of the Seaside Basin
Date:	Tuesday, November 17, 2020 1:21:40 PM
Attachments:	Salinas_GWL_SWI_2017.pdf Data north of Seaside Basin.docx

Patrick,

Below is an email from Georgina King of Montgomery & Associates, the Watermaster's hydrogeologic consultant. In it she provides her comments after reviewing the water quality and water level data that Tina Wang sent her last year.

There are a couple of recommendations in her email that I would like to have discussed and addressed at an appropriate point in time as you develop the GSP for the MCWD portion of the Monterey Basin. I have highlighted them in yellow.

Thanks,

Robert S. Jaques, PE
Technical Program Manager
Seaside Basin Watermaster
83 Via Encanto
Monterey, CA 93940
Office: (831) 375-0517
Cell: (831) 402-7673

From: Georgina King <gking@elmontgomery.com>
Sent: Tuesday, December 17, 2019 11:47 AM
To: bobj83@comcast.net
Cc: Luis Mendez <lmendez@elmontgomery.com>
Subject: RE: Wells within MCWD northeast of the Seaside Basin

Bob,

I have reviewed and plotted up the water quality data and parts of reports EKI provided. I also looked at MCWRA's recent maps of seawater intrusion (2017).
I have pasted some maps and charts into a Word document Essentially, what we see is that:

1. There is Salinas Valley seawater intrusion quite far south and into the Seaside Basin in the 180 ft aquifer equivalent to formations shallower than the Shallow Aquifer (Paso Robles) in the Seaside Basin. But we know this from the induction logs in the northern Sentinel Wells. The data available and included on our map is from Fort Ord monitoring – all of which is very shallow (180-ft aquifer) and not in our Shallow (Paso Robles) aquifer. As reference for depth,

the FO-9 shallow aquifer in the Paso Robles is screened from 610-650 ft below ground.

2. The 400 ft aquifer which is equivalent to the Shallow Aquifer (Paso Robles) in the Seaside Basin has a similar southern extent to what we have included in the SIAR mostly because there is no data/wells available to update the extent. There has been considerable inland advancement. There are no 400-foot Fort Ord monitoring wells that have data more recent than 2008. Perhaps we should find out if some of these wells can start being sampled by the GSA in that area?

3. FO-10 shallow and deep have had almost 15 feet of groundwater level drop over the past 11 years, most of which has been since the start of the drought in 2012. There must be some pumping in this area that is causing this. I do not have the data to help me figure this out. The GSA is going to have to address this.

4. To conclude, the lack of data available for the 400-ft aquifer (equivalent to Paso Robles aquifer) means we still have a large data gap between the 400-ft aquifer seawater intrusion and the Seaside Basin.

Please call me if you want to discuss this further.

I am also attaching the MCWRA presentation on Groundwater Level and Seawater Intrusion maps as there is some interesting info in there.

Georgina

Georgina King, P.G., C.Hg.

MONTGOMERY & ASSOCIATES
www.elmontgomery.com

MONTEREY COUNTY WATER RESOURCES AGENCY

1947

2017 Salinas Valley

Groundwater Level Contours
&
Seawater Intrusion Maps

TODAY'S ACTION

Consider Receiving the
2017 Groundwater Level Contours and
Coastal Salinas Valley
Seawater Intrusion Maps

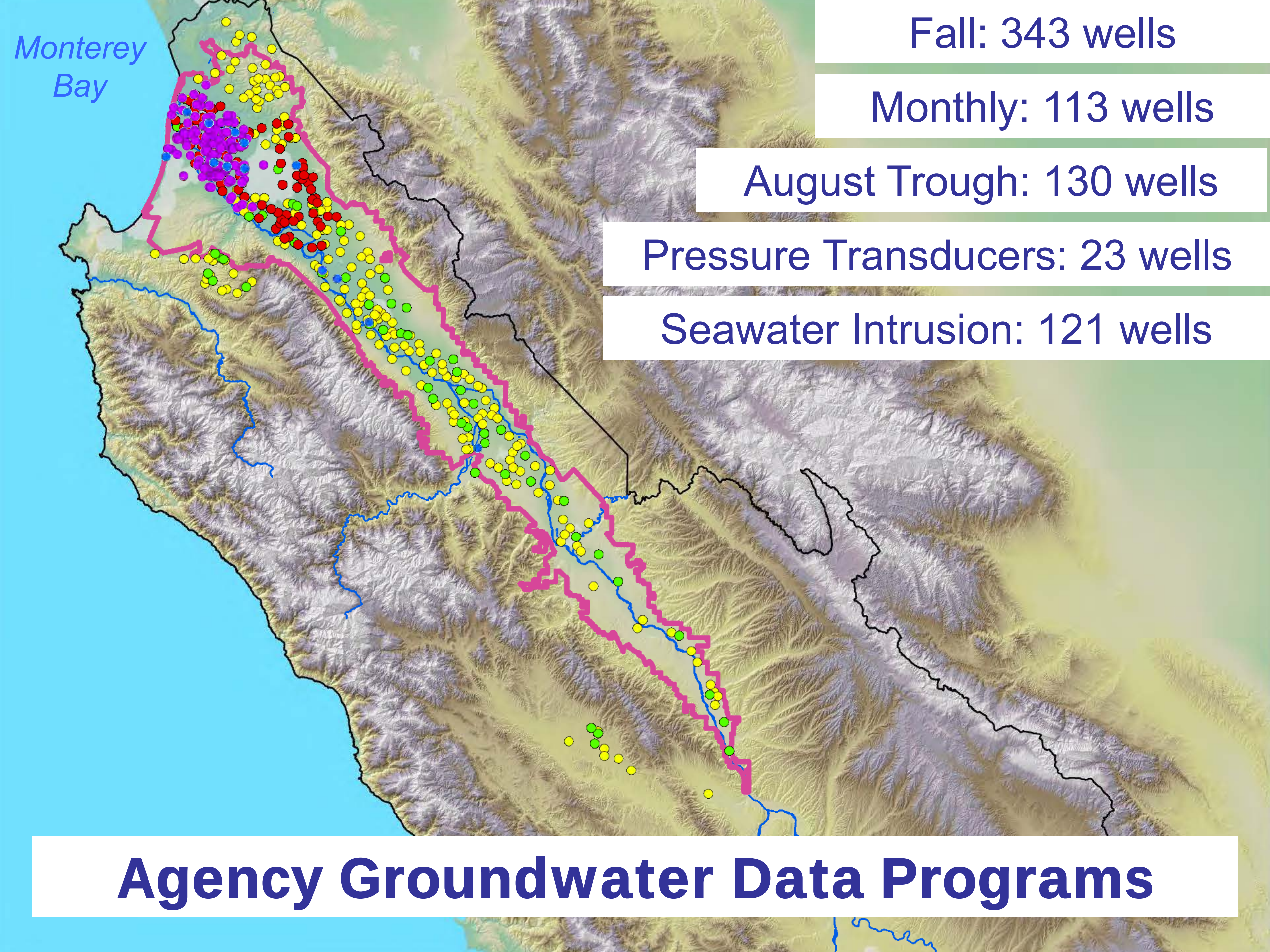
Committee Action/Financial Impact

- No previous committee action
- No financial impact from receiving this report

Agency Groundwater Monitoring Programs

- GWL & WQ data collected & analyzed since 1947

- Purposes:
  - Monitor health of basin
  - Evaluate Agency projects
  - Develop basin management strategies



Fall: 343 wells

Monthly: 113 wells

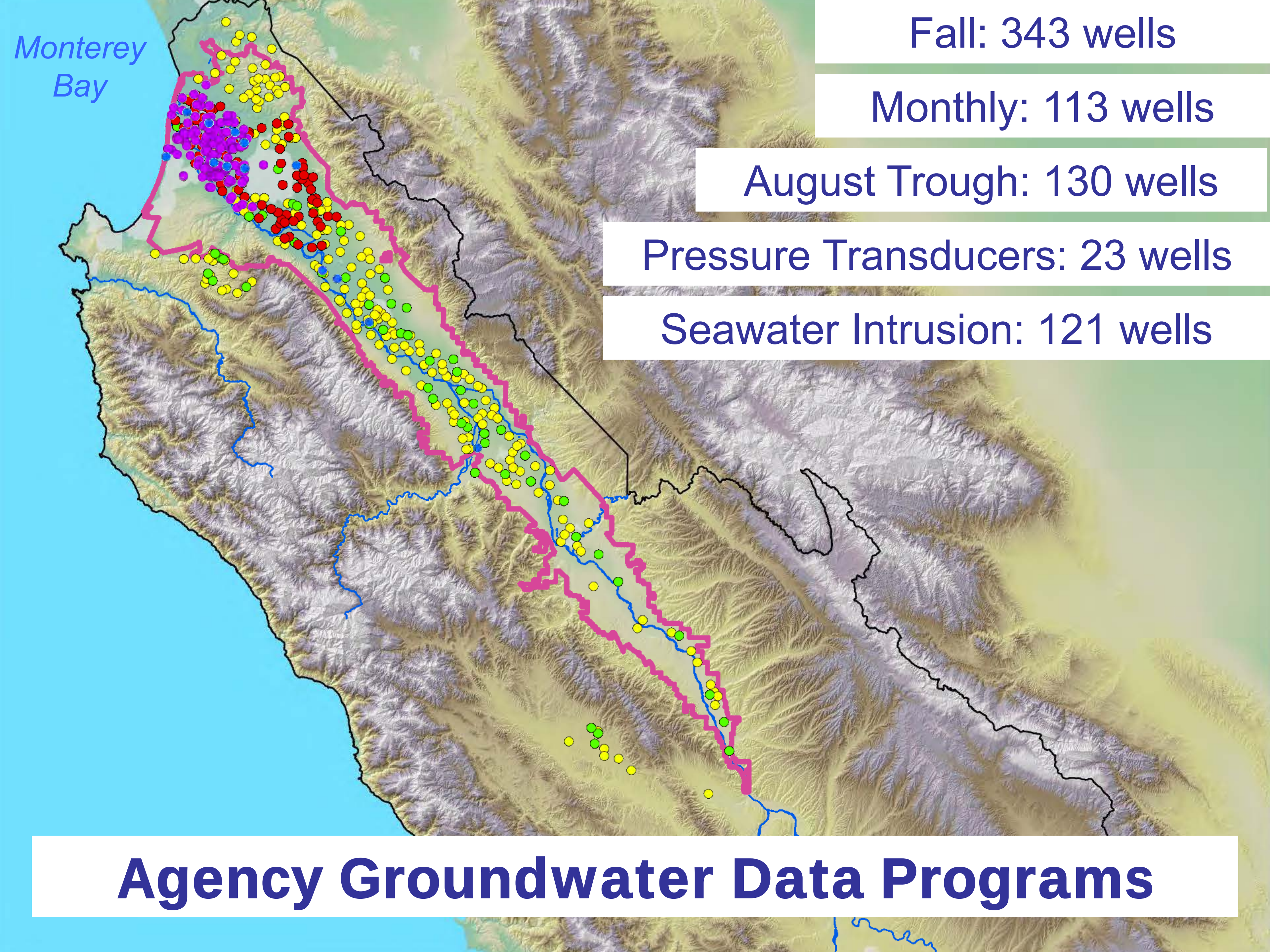
August Trough: 130 wells

Pressure Transducers: 23 wells

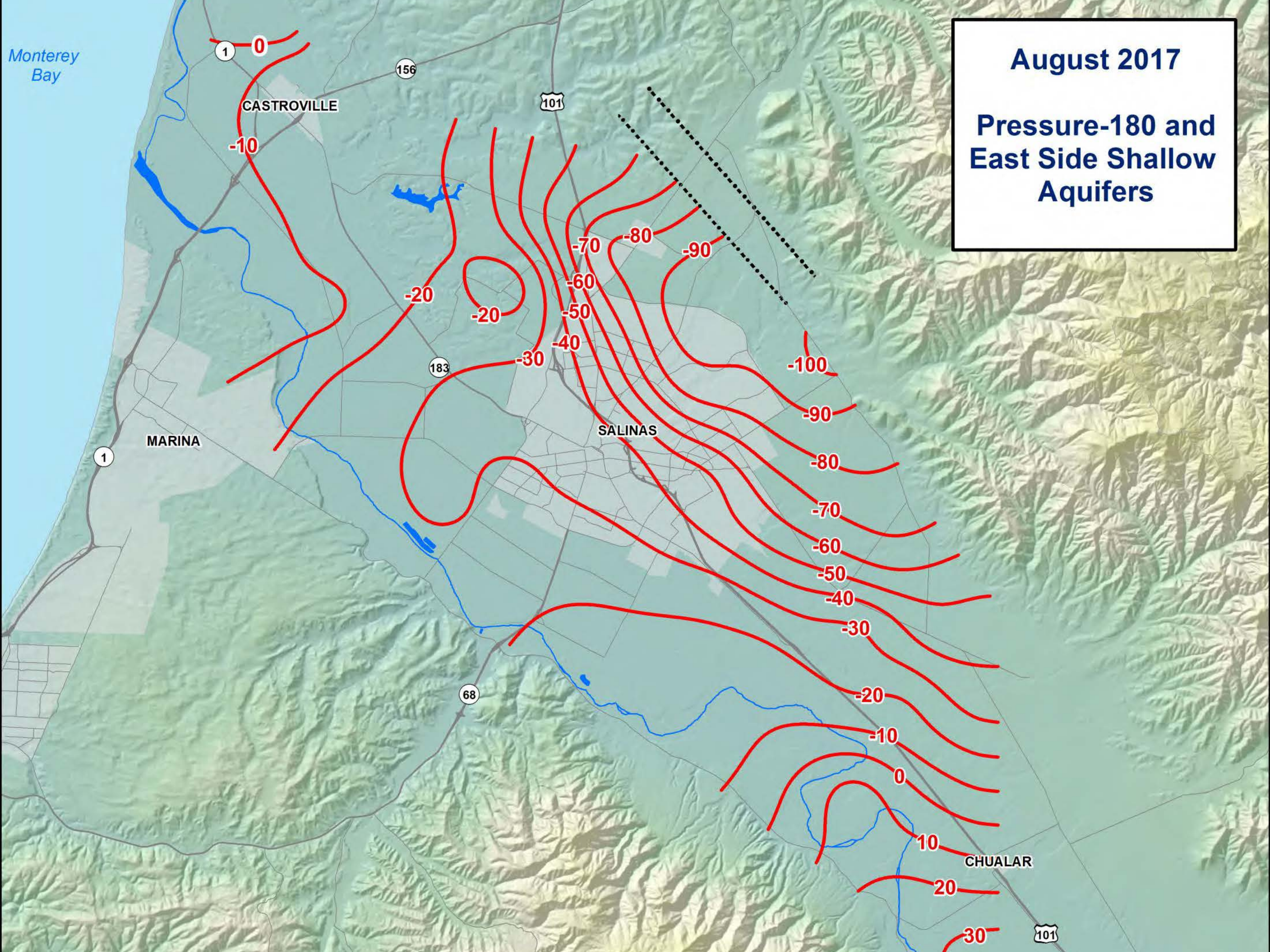
Seawater Intrusion: 121 wells

Agency Groundwater Data Programs

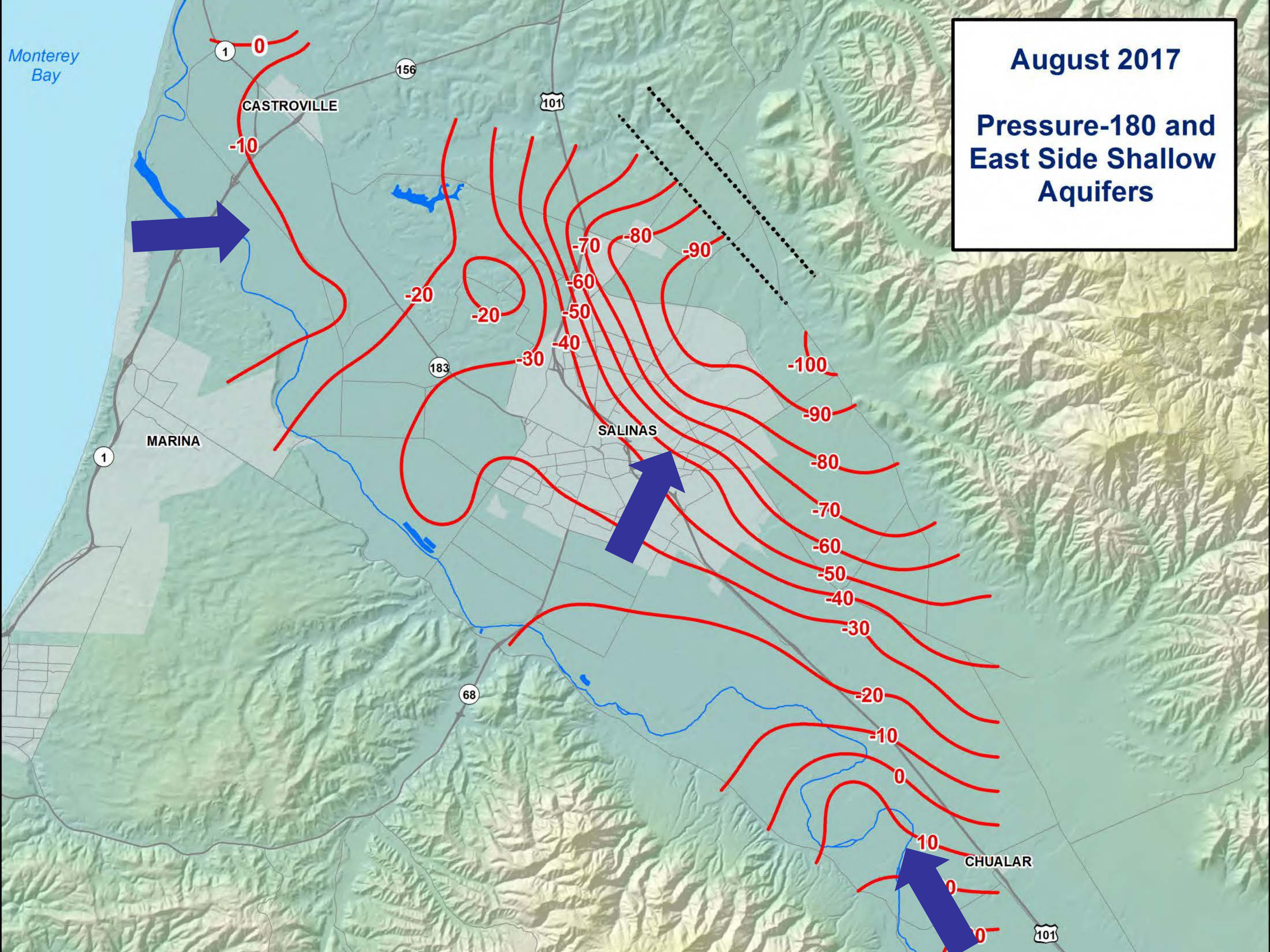
Agency Groundwater Data Programs



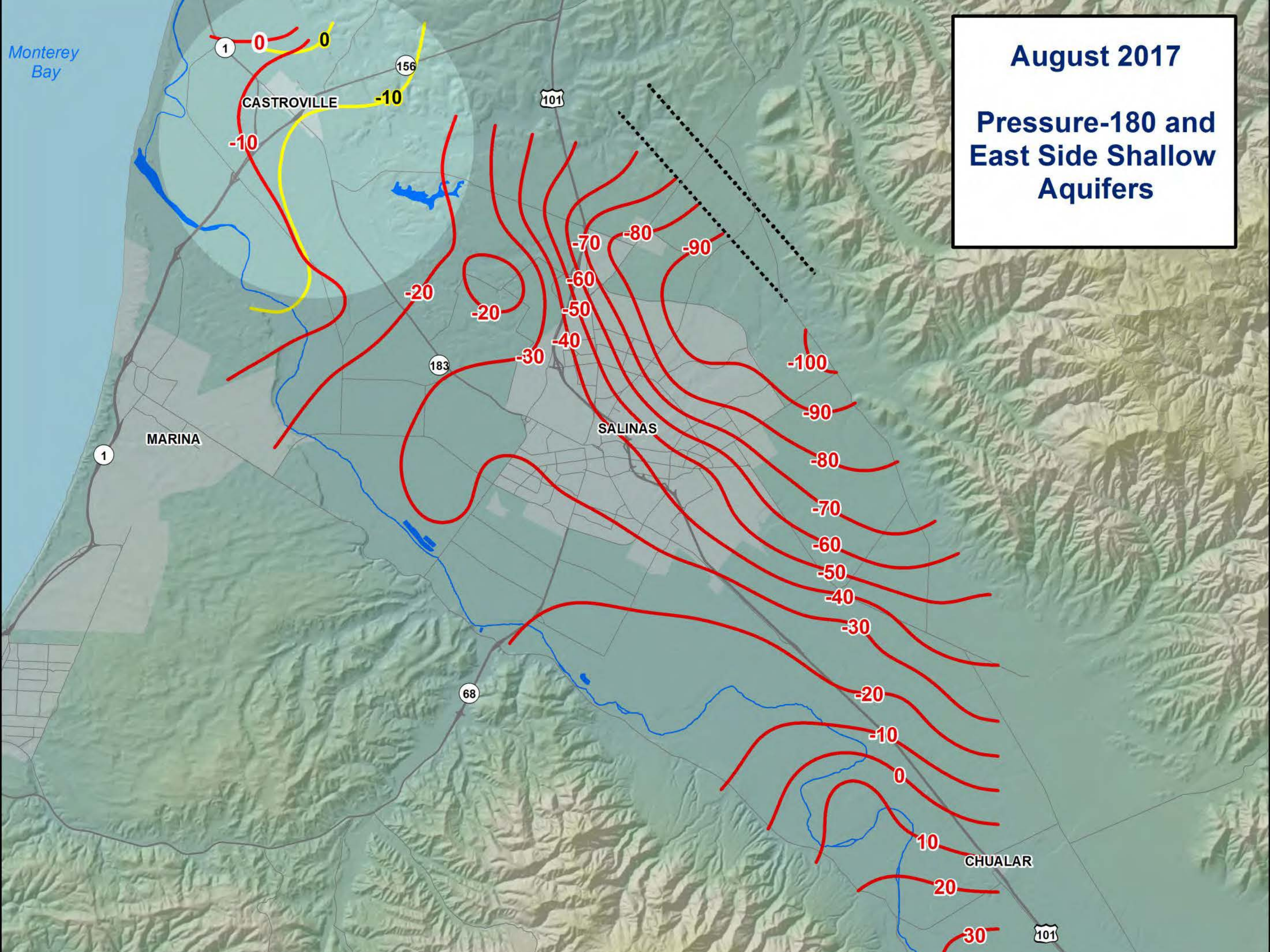
2017 Groundwater Level Contours



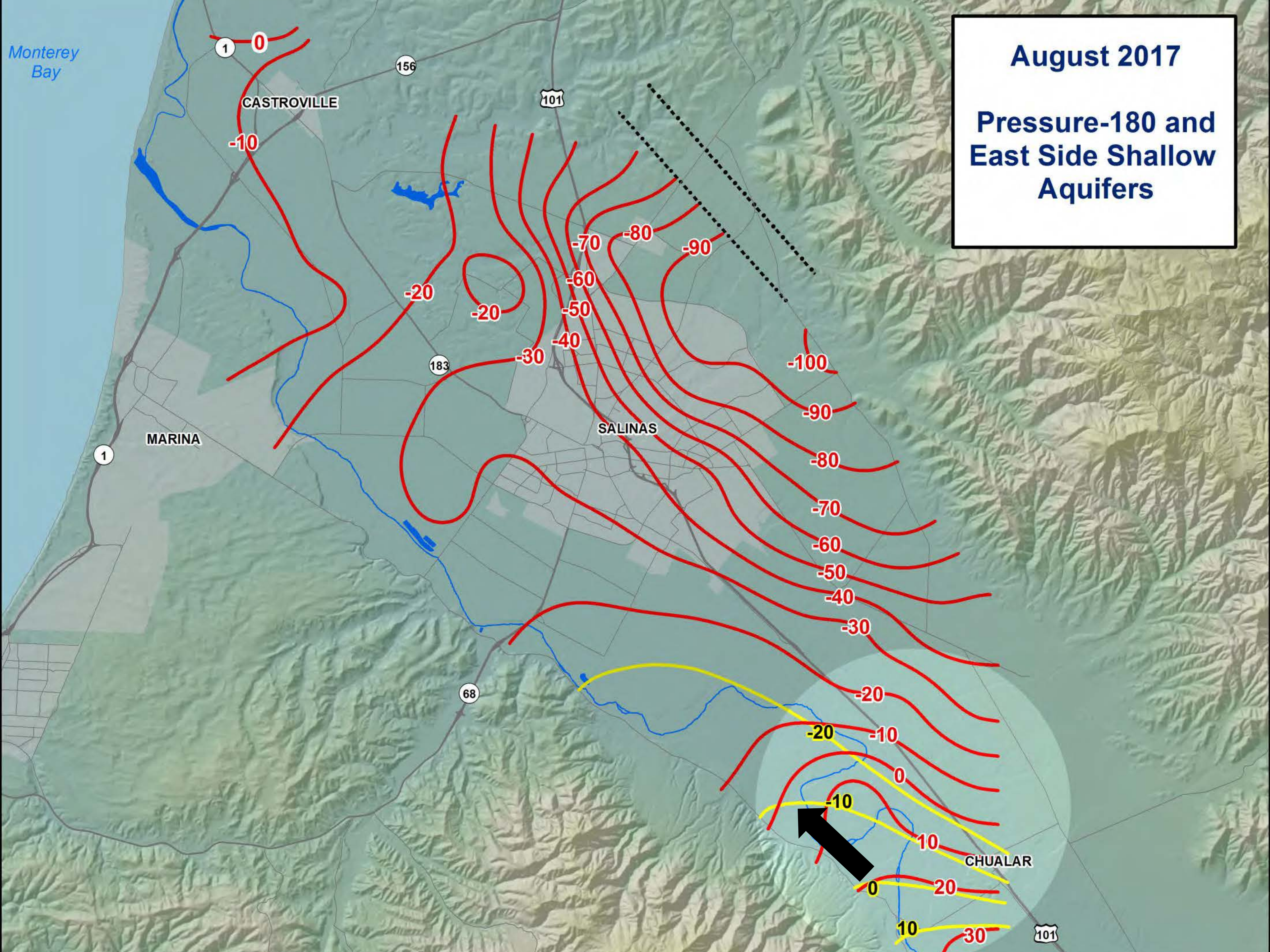
August 2017
Pressure-180 and East Side Shallow Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
0
-10
-20
-20
-30
-40
-50
-60
-70
-80
-90
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30



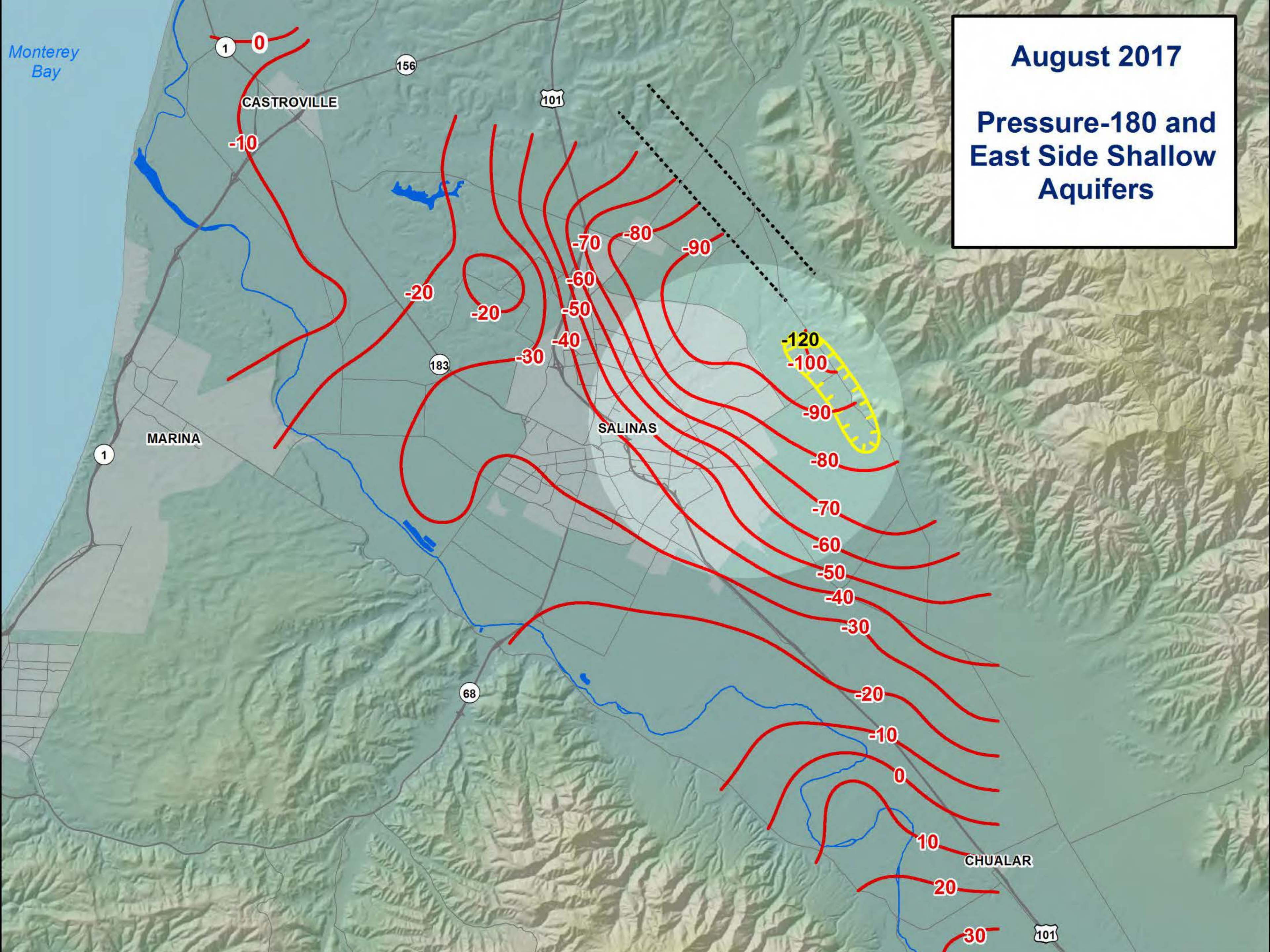
August 2017
Pressure-180 and East Side Shallow Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
0
-10
-20
-20
-30
-40
-50
-60
-70
-80
-90
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10

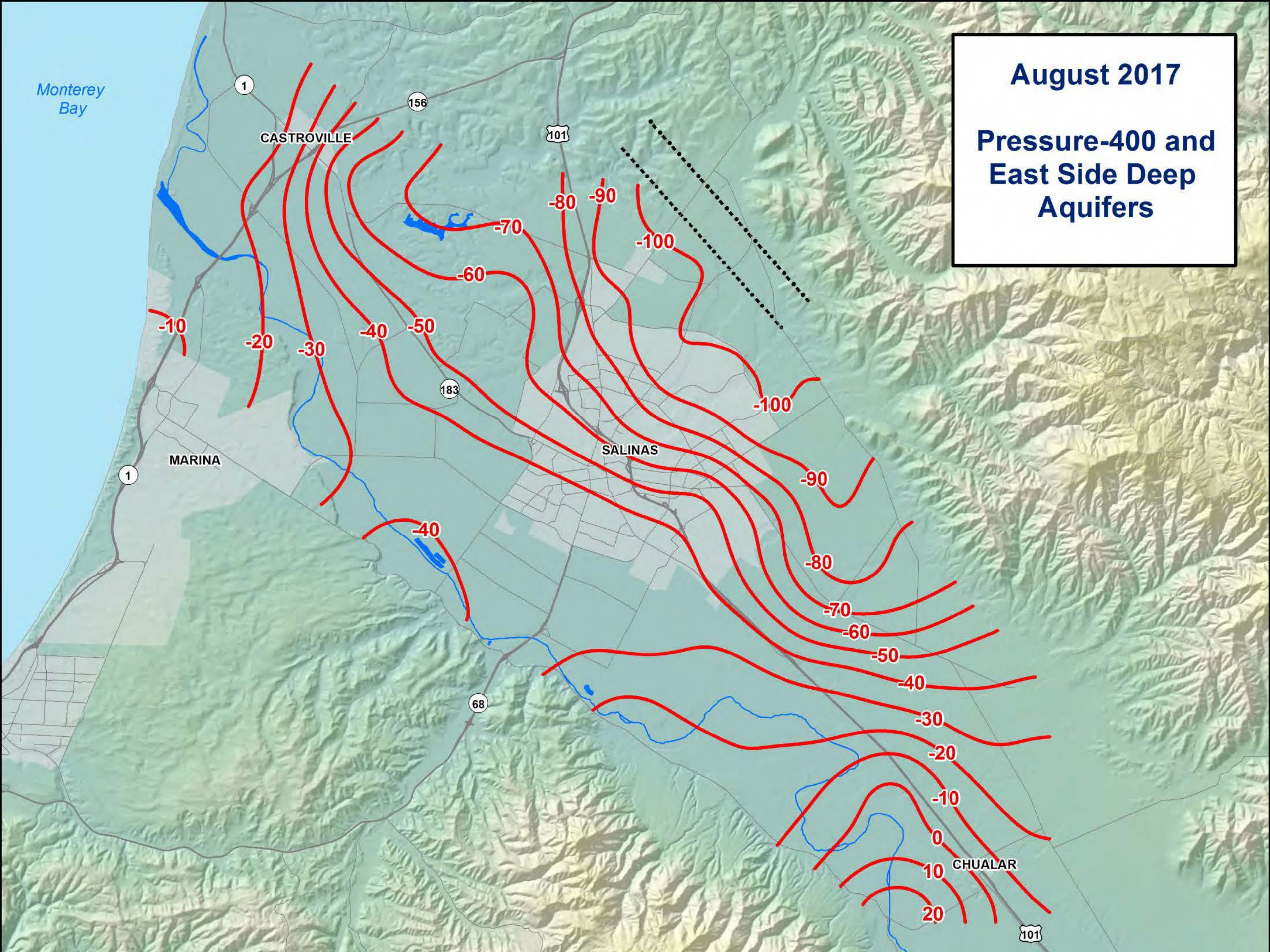


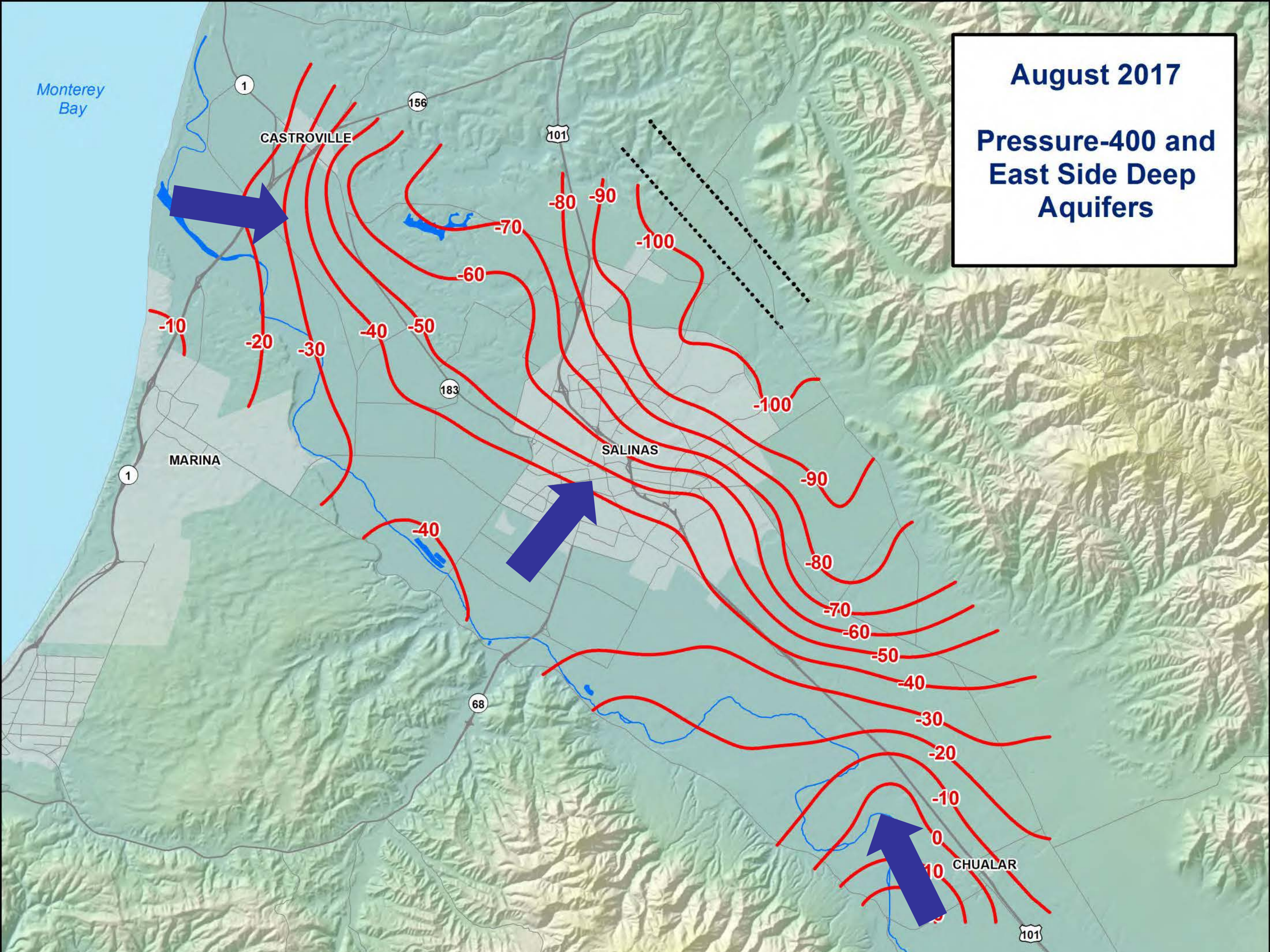
August 2017
Pressure-180 and East Side Shallow Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
0
0
-10
-10
-20
-20
-30
-40
-50
-60
-70
-80
-90
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30



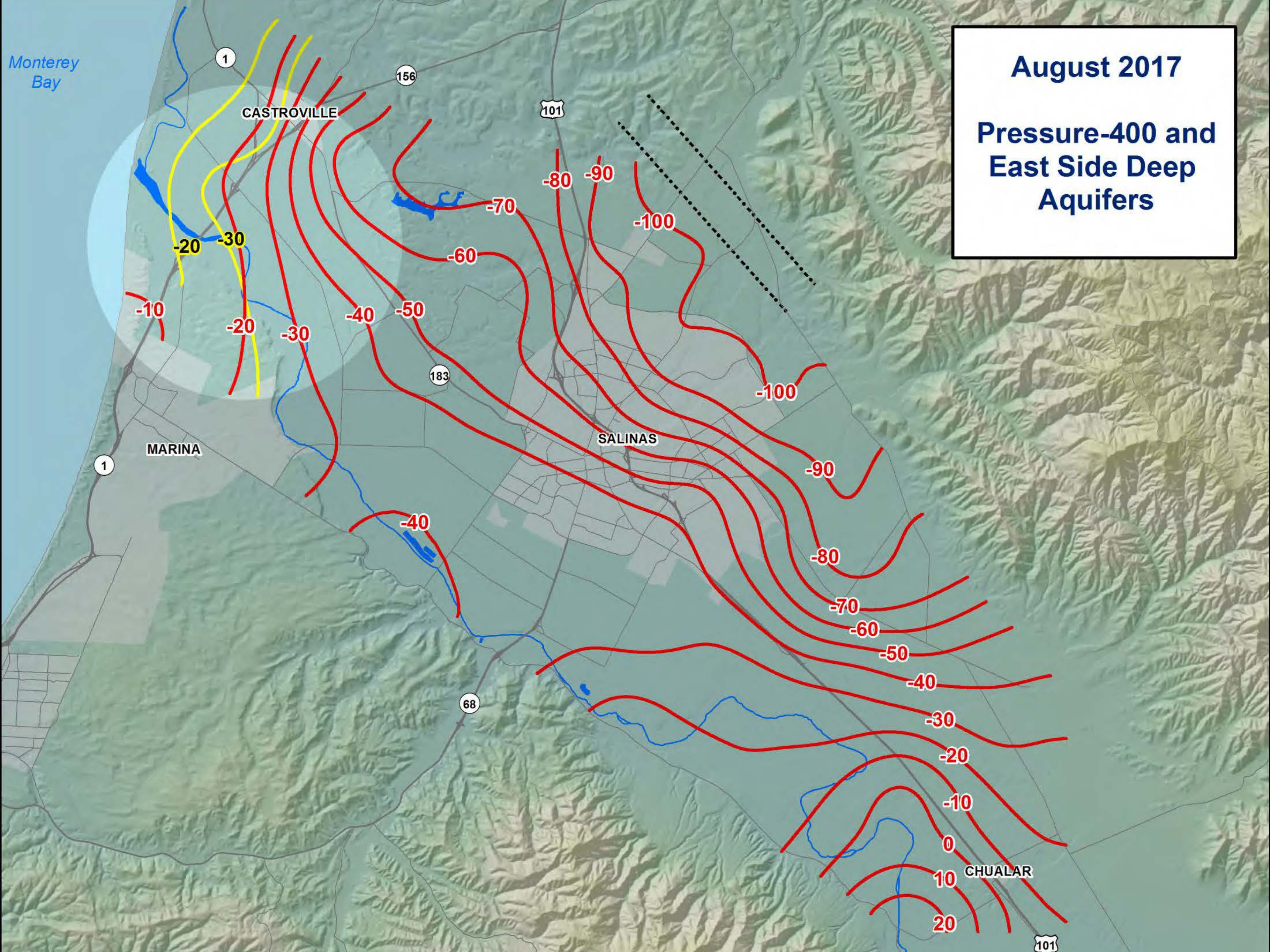
August 2017
Pressure-180 and East Side Shallow Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
0
-10
-20
-20
-30
-40
-50
-60
-70
-80
-90
-100
-90
-80
-70
-60
-50
-40
-30
-20
-20
-10
0
-10
10
0
20
10
30


August 2017
Pressure-180 and East Side Shallow Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
0
-10
-20
-20
-30
-40
-50
-60
-70
-80
-90
-120
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20
30

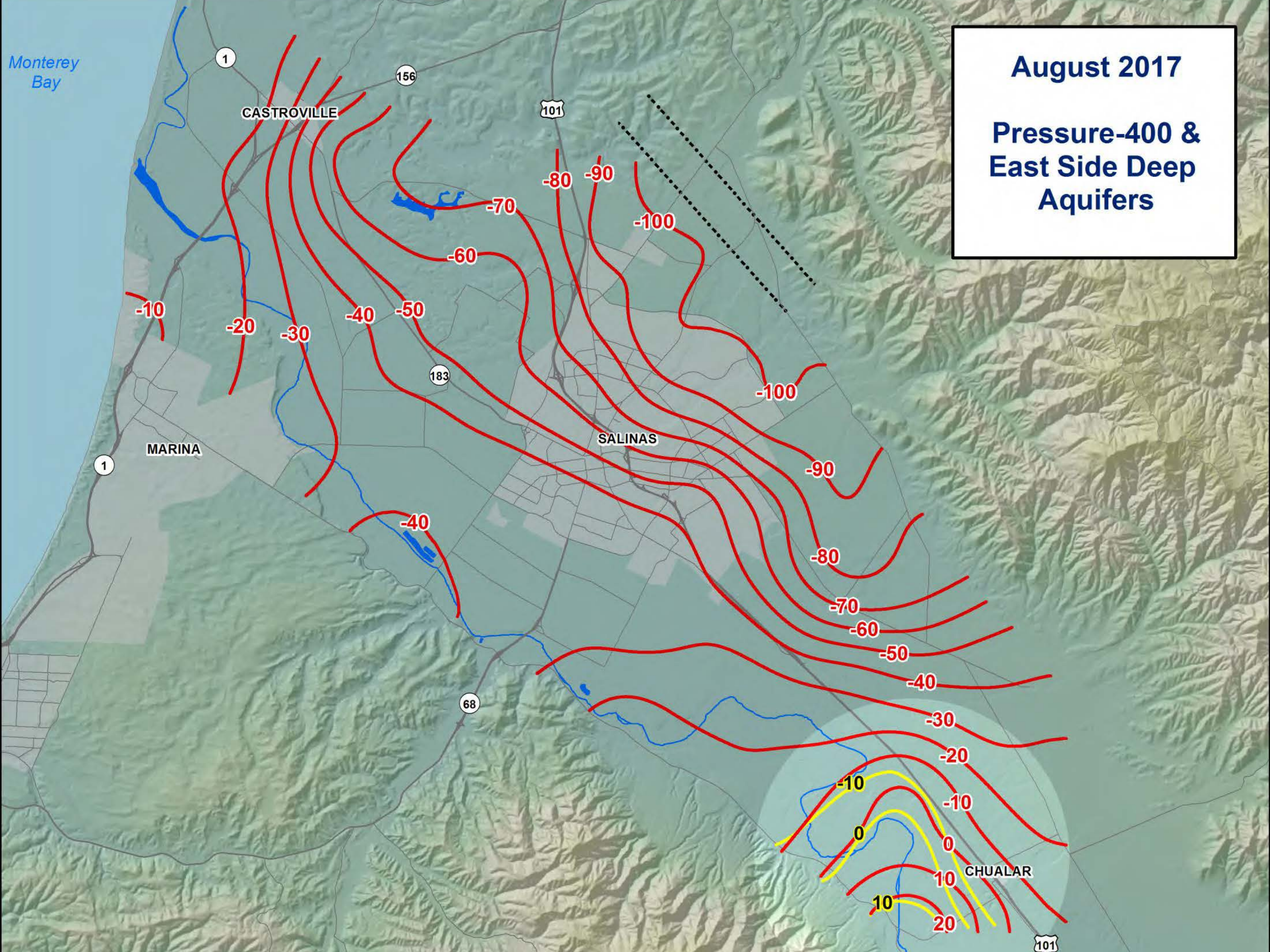

August 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
10
20



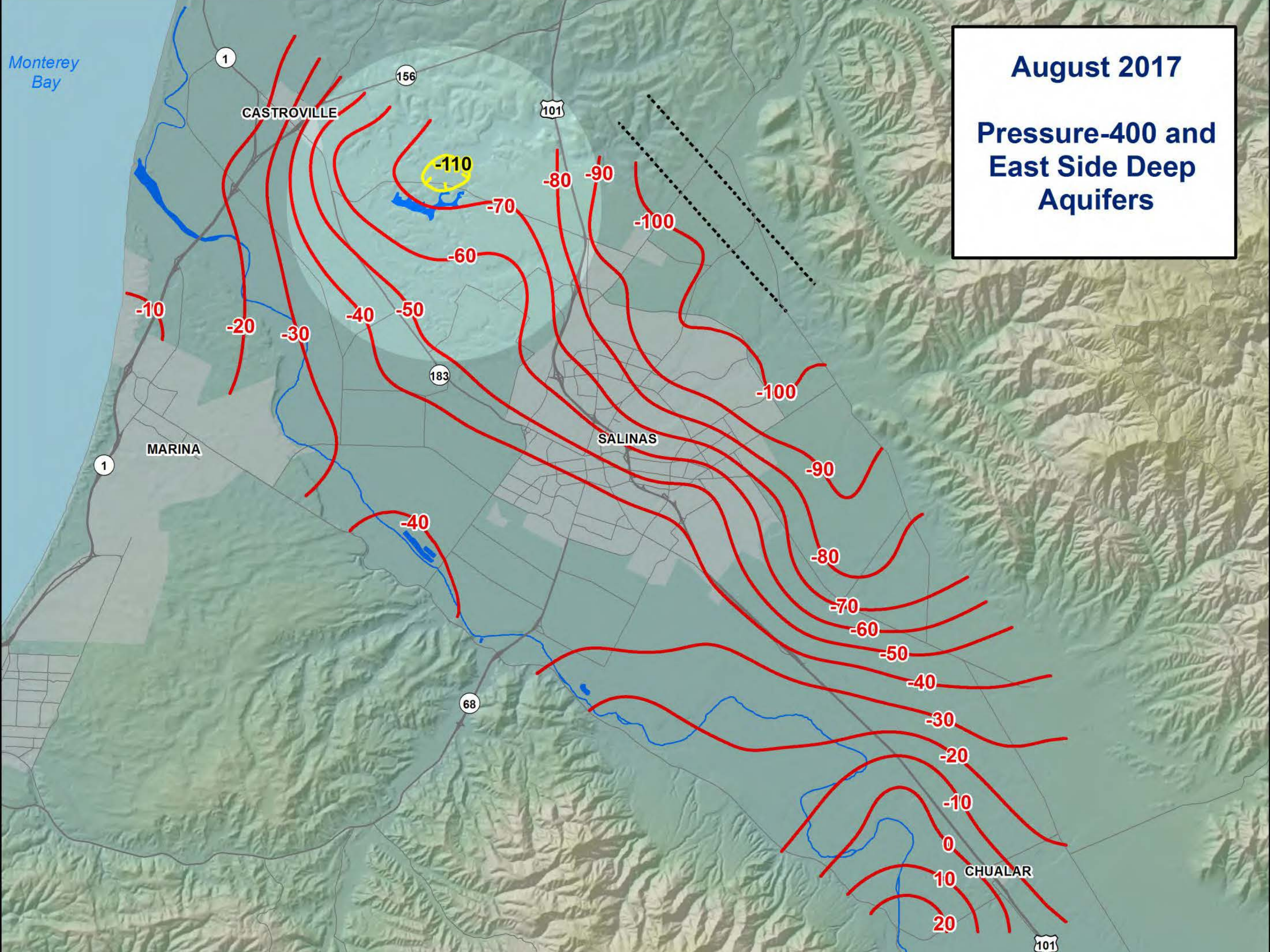
August 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
1
101
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
-40



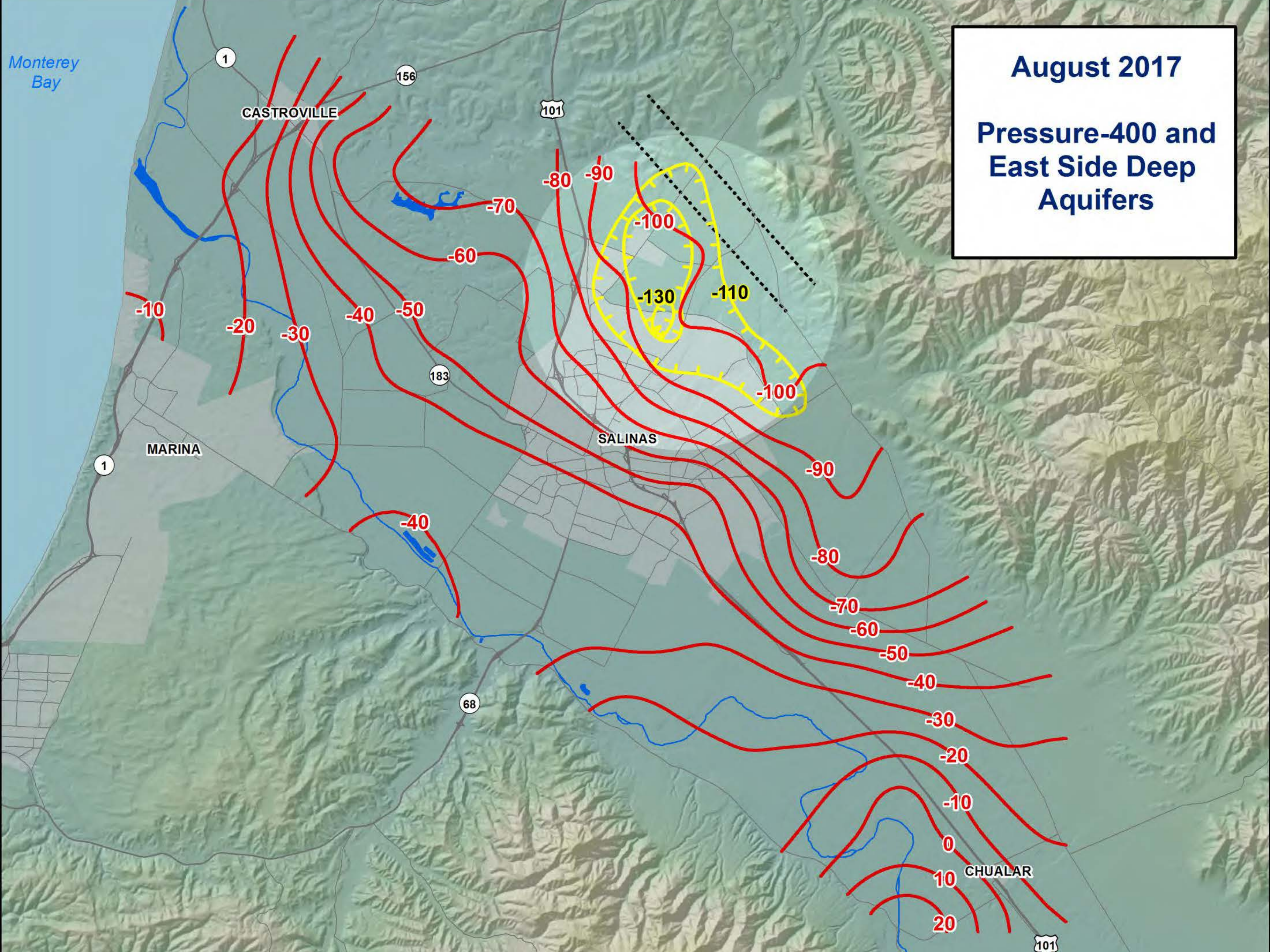
August 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
10
20



August 2017
Pressure-400 & East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-40
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
-10
0
0
10
10
20



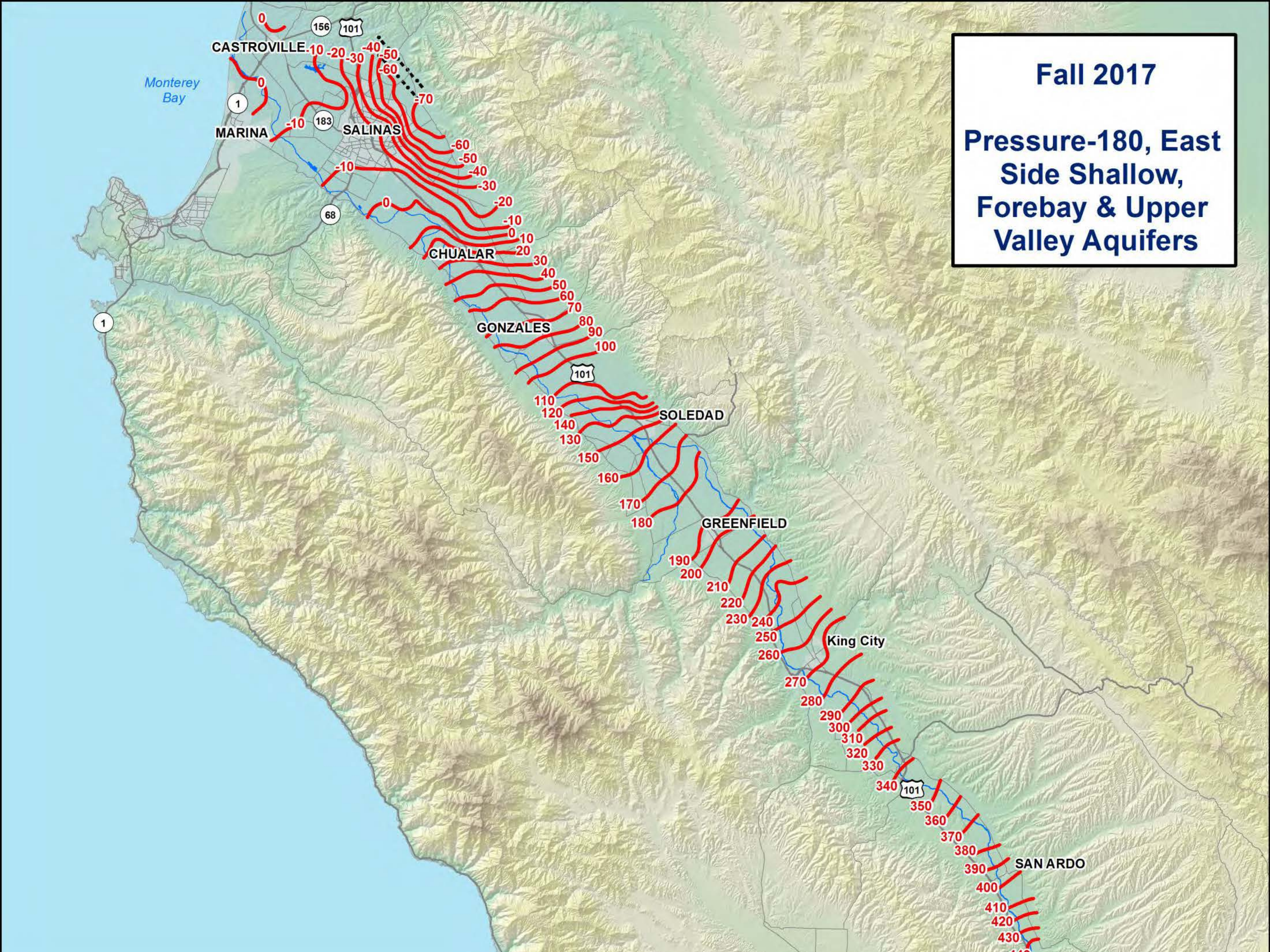
August 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
-110
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
0
10
20



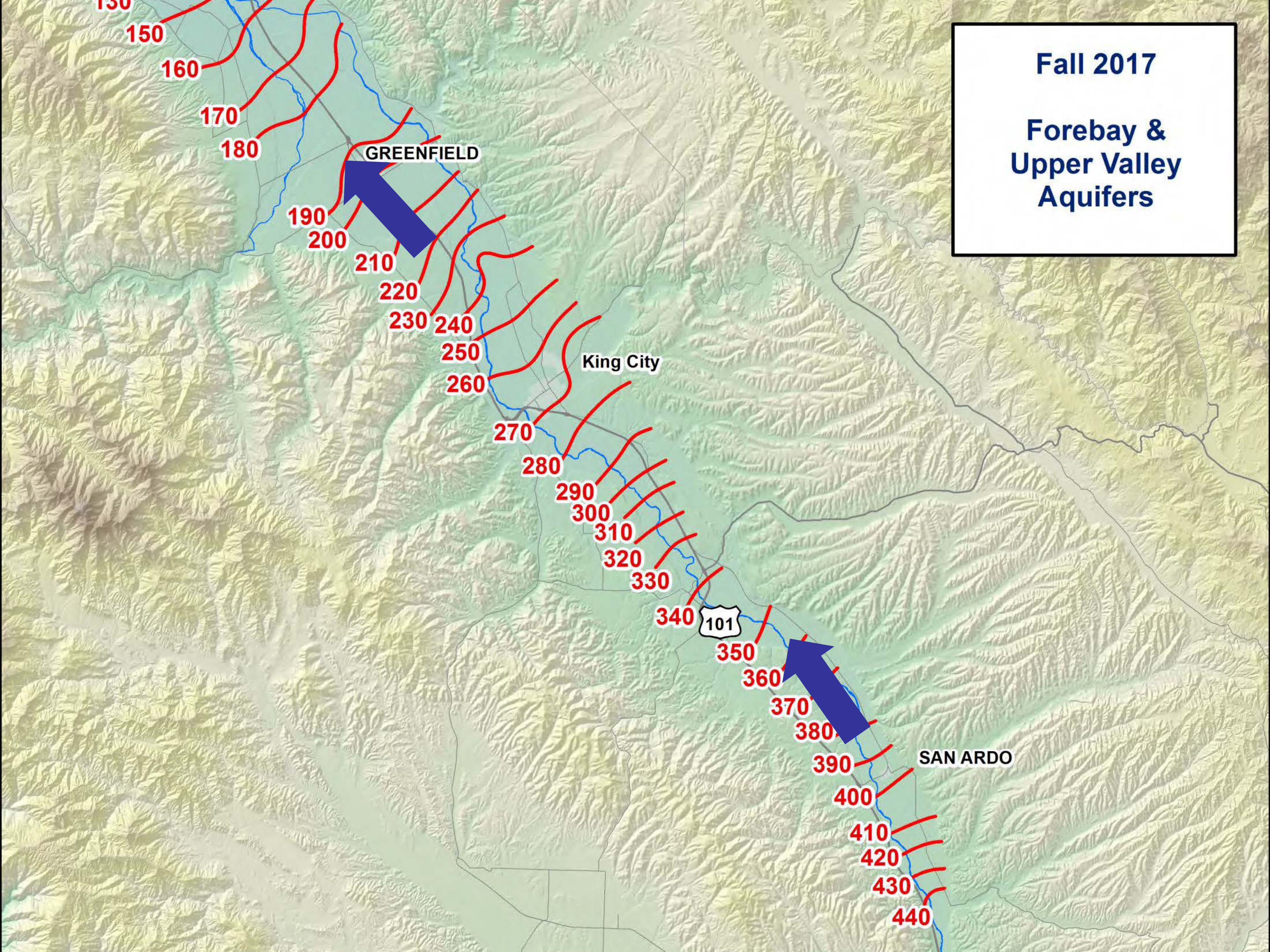
August 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-130
0
10
20

Summary: 2017 August GWL Changes Since 2015

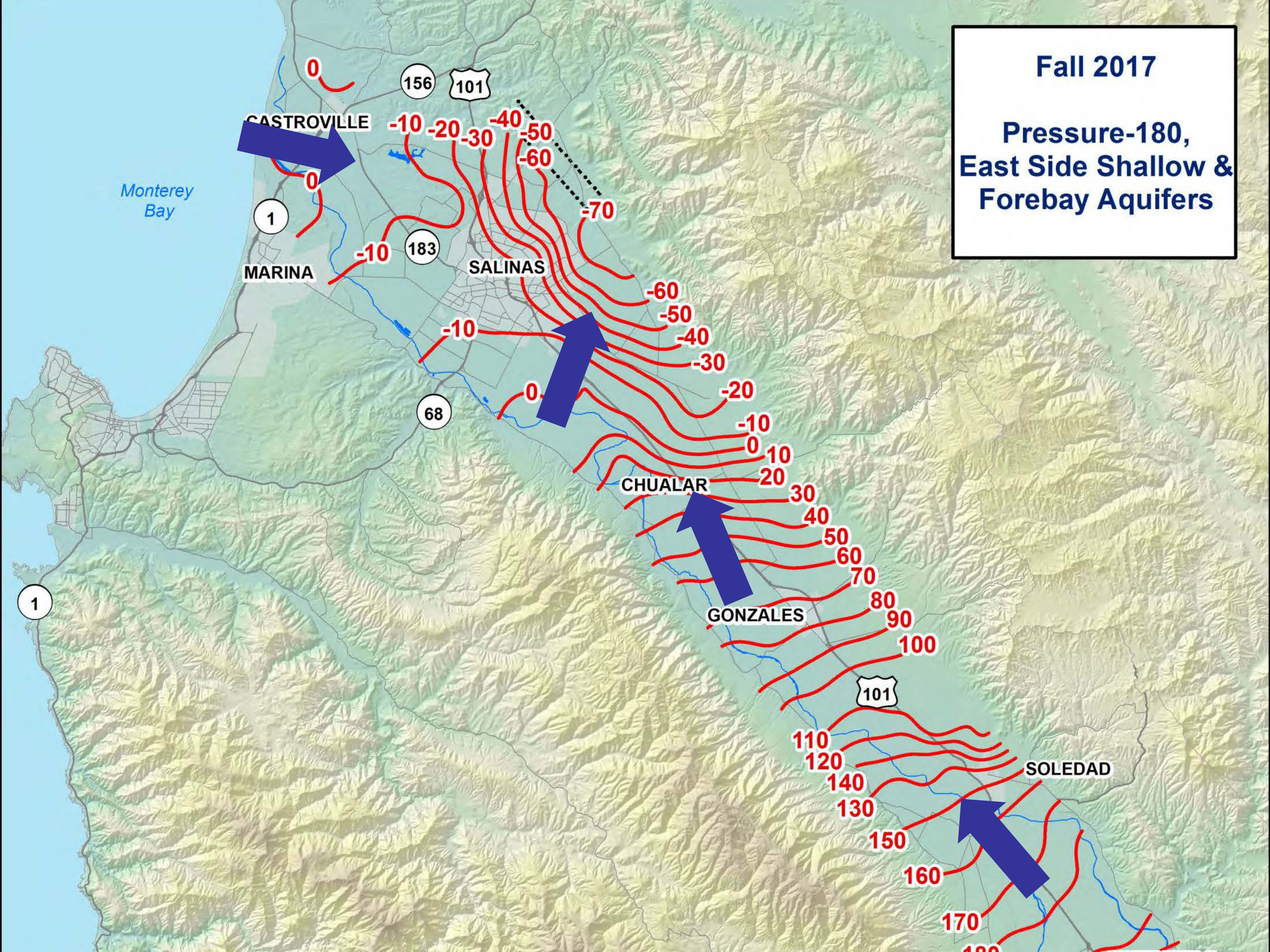
- P180
  - Coastal GWLs remain below sea level
  - East Side GWLs have risen 20 feet
  - Zero line moved two miles down valley
- P400
  - GWLs are recovering nearly everywhere
  - Coastal GWLs remain below sea level
  - “Espinosa Trough” has disappeared
  - East Side Trough has shrunken; GWLs up 10-30ft
  - Zero line has not moved



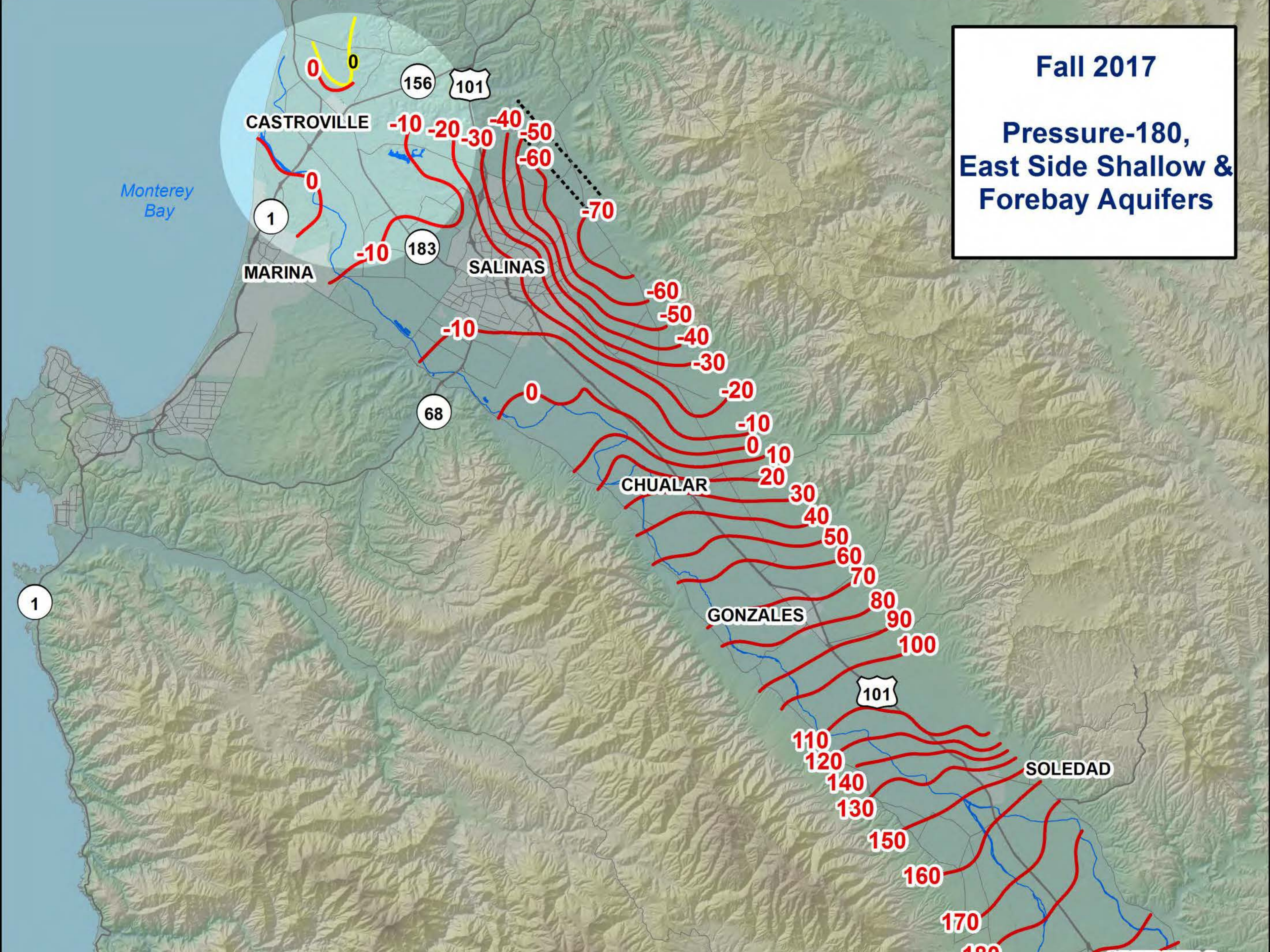
Fall 2017
Pressure-180, East Side Shallow, Forebay & Upper Valley Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
GREENFIELD
King City
SAN ARDO

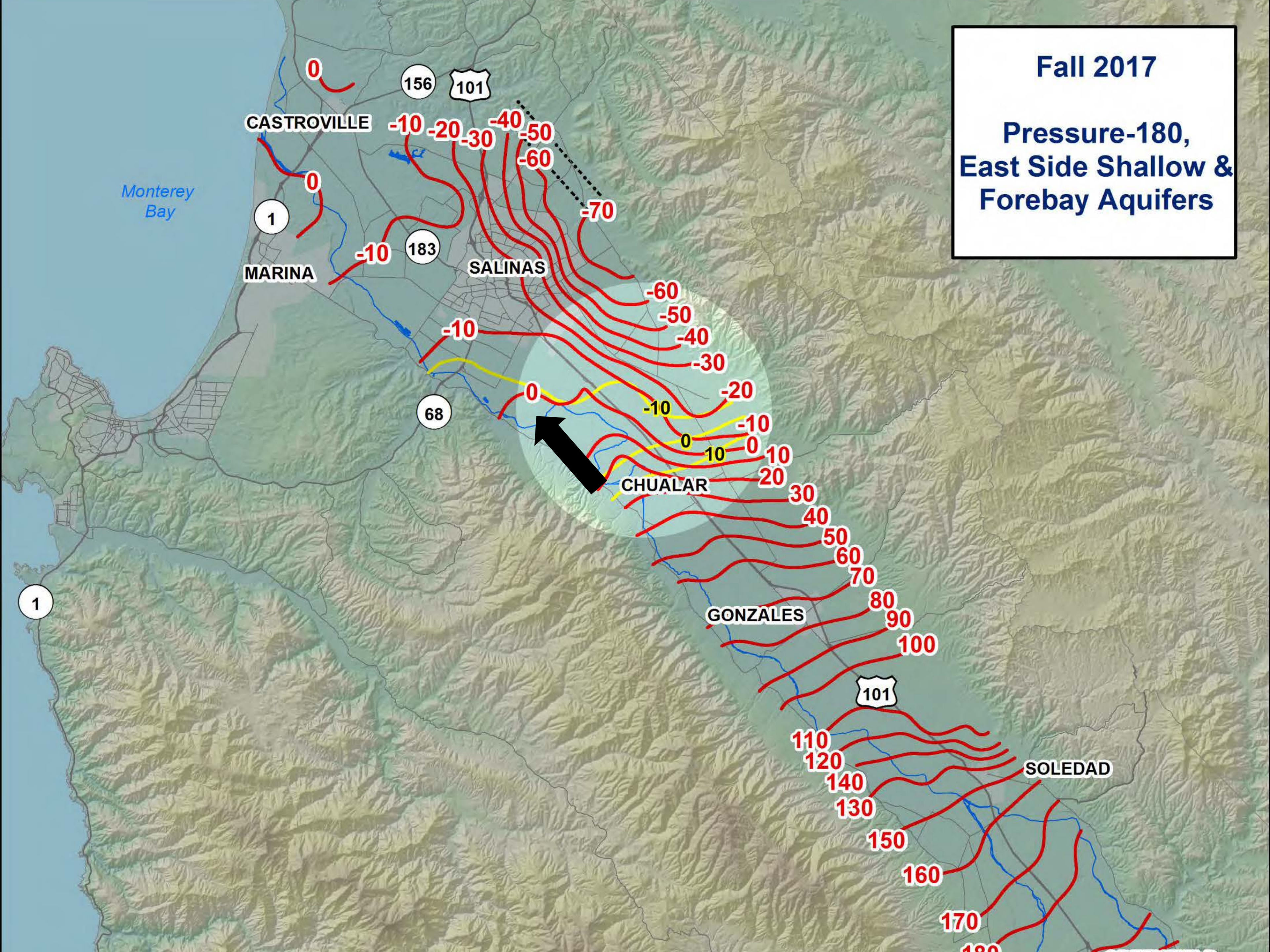


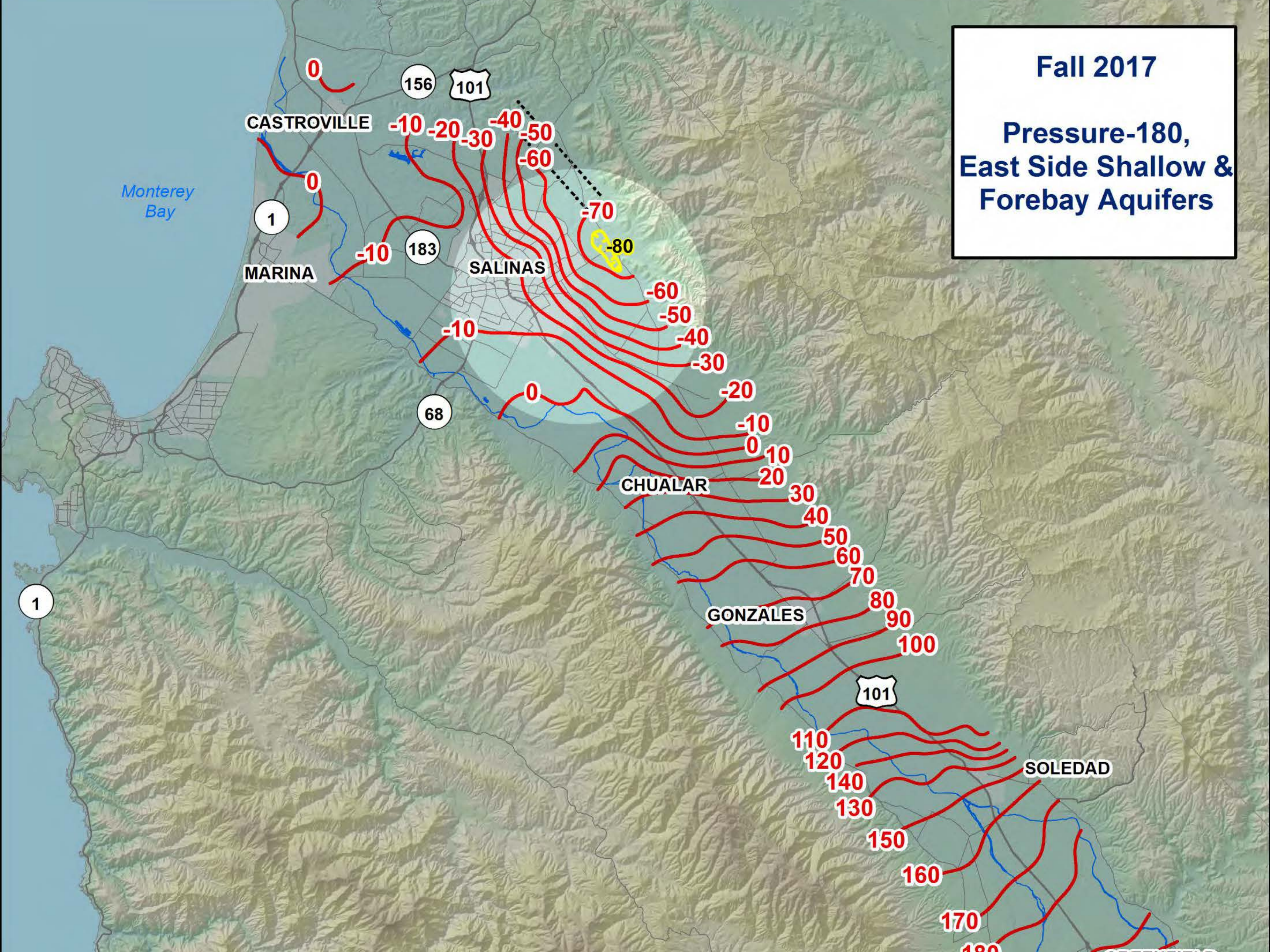
Fall 2017
Forebay & Upper Valley Aquifers
GREENFIELD
King City
SAN ARDO
101
130
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440



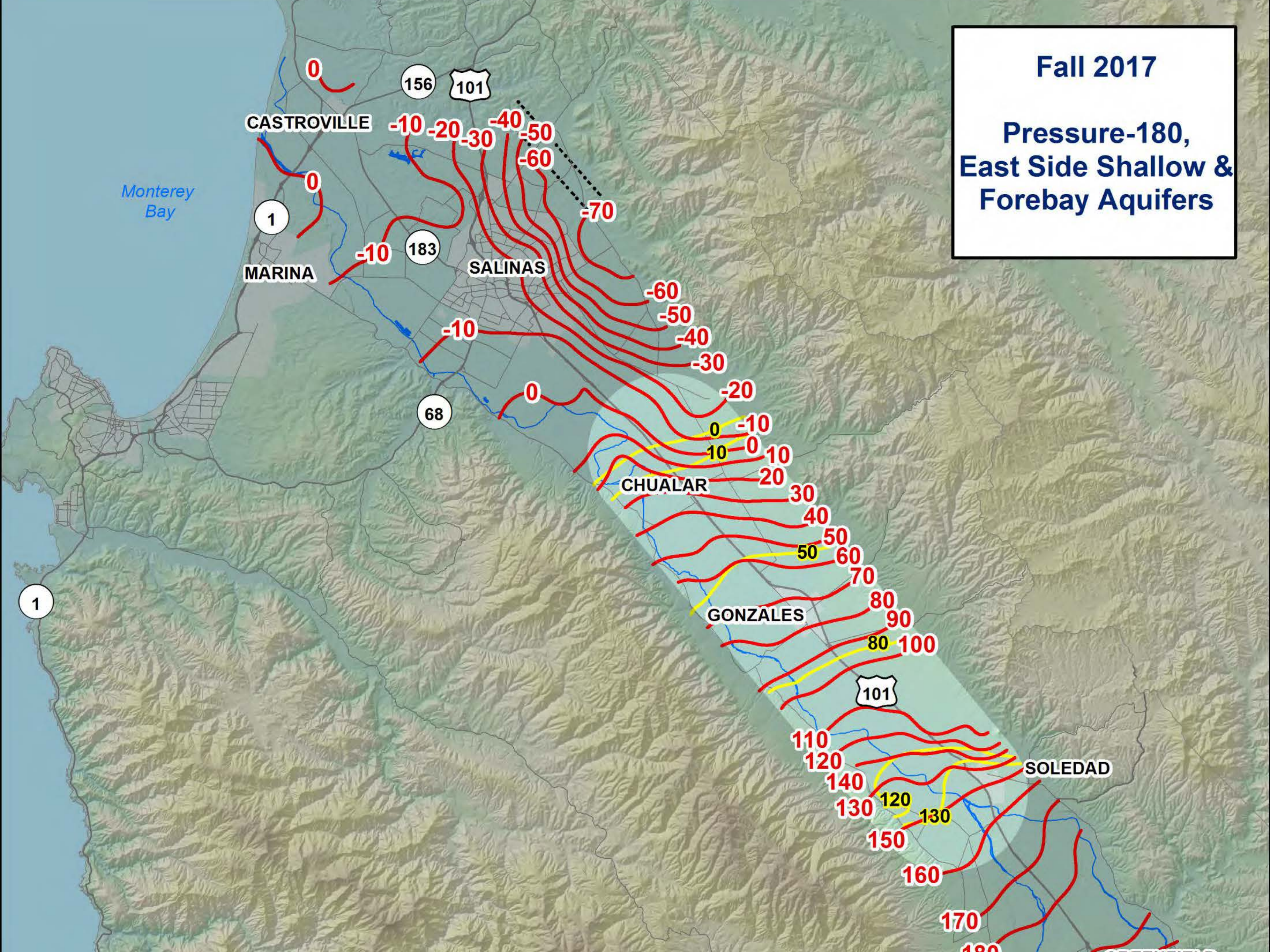
Fall 2017
Pressure-180,
East Side Shallow &
Forebay Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
156
101
1
183
68
0
-10
-20
-30
-40
-50
-60
-70
10
20
30
40
50
60
70
80
90
100
110
120
140
130
150
160
170

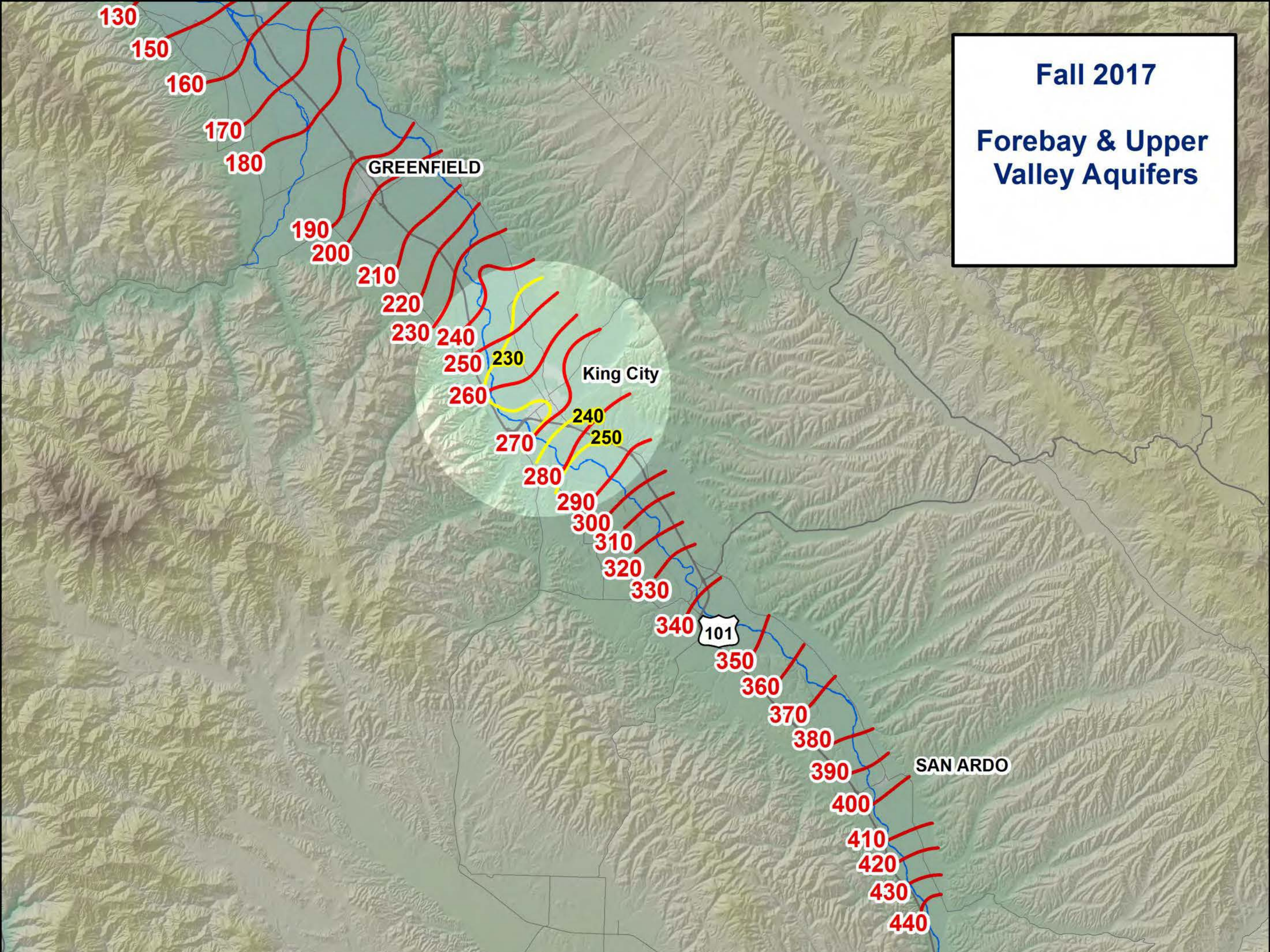

Fall 2017
Pressure-180,
East Side Shallow &
Forebay Aquifers
Monterey
Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
156
101
1
183
68
101
1
0
0
-10
-20
-30
-40
-50
-60
-70
0
-10
-60
-50
-40
-30
-20
-10
-10
0
0
10
20
30
40
50
60
70
80
90
100
110
120
140
130
150
160
170

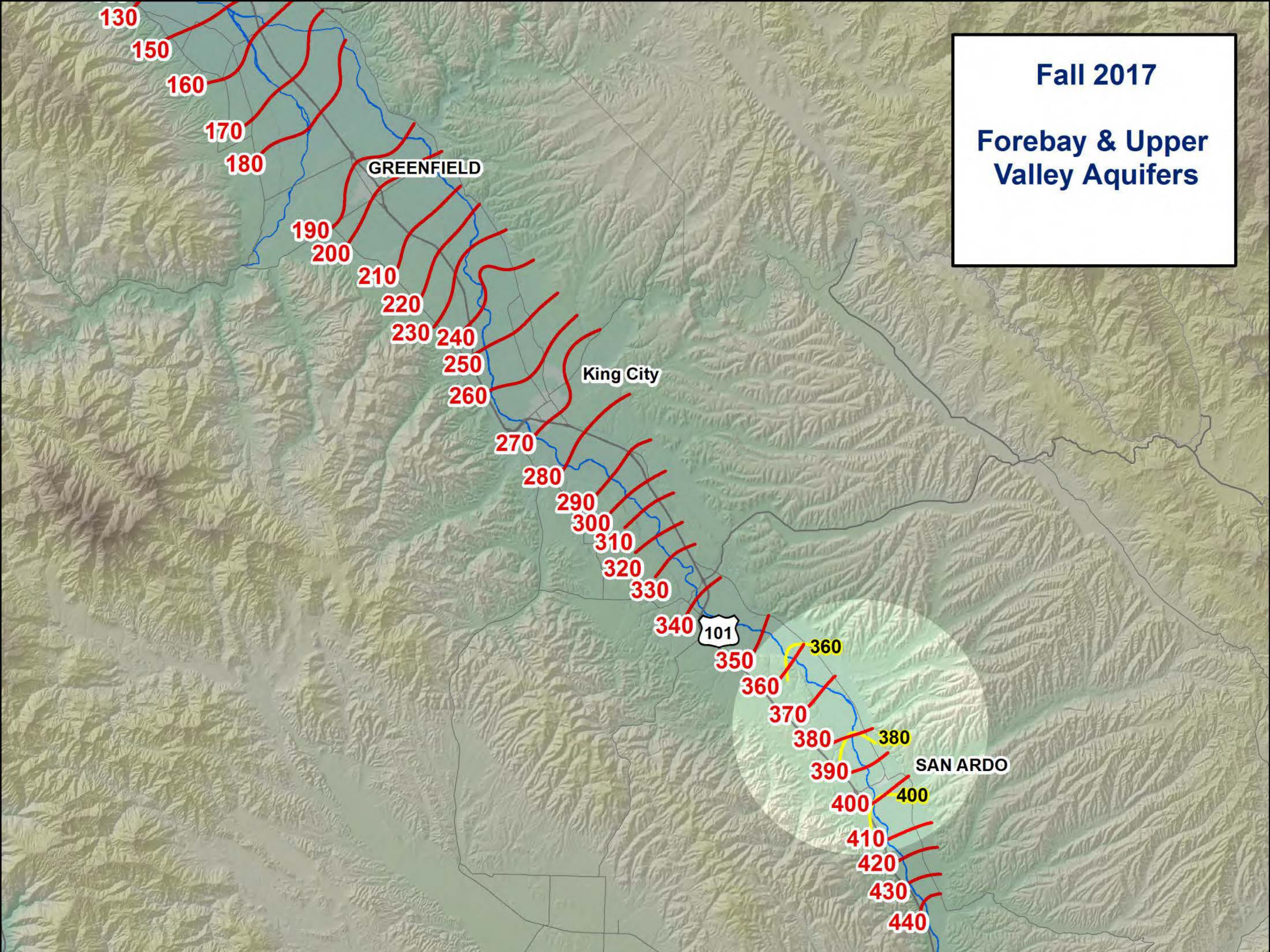

Fall 2017
Pressure-180, East Side Shallow & Forebay Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
1
156
101
183
68
0
-10
-20
-30
-40
-50
-60
-70
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

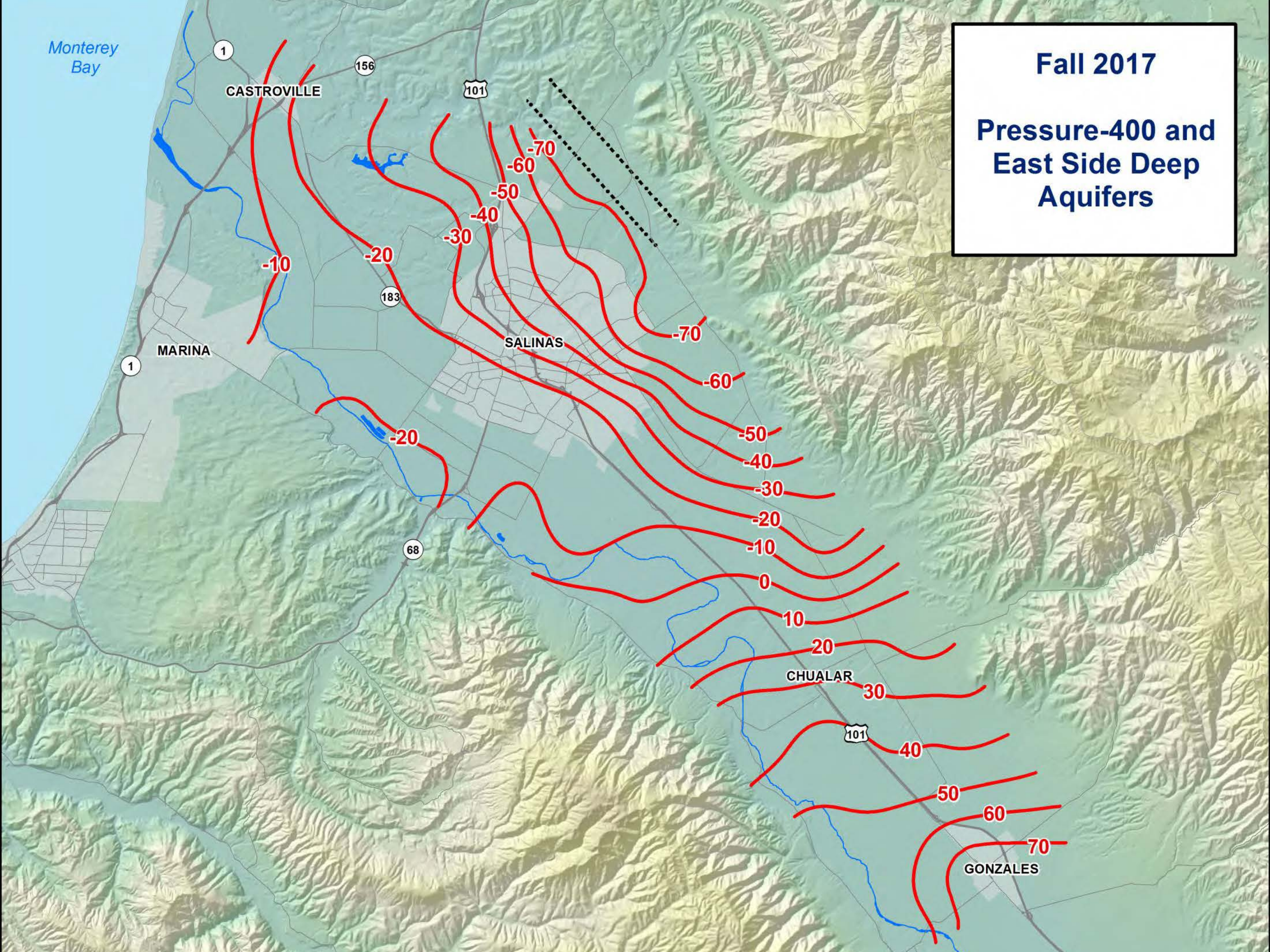


Fall 2017
Pressure-180, East Side Shallow & Forebay Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
156
101
1
183
68
0
-10
-20
-30
-40
-50
-60
-70
-80
10
20
30
40
50
60
70
80
90
100
110
120
140
130
150
160
170

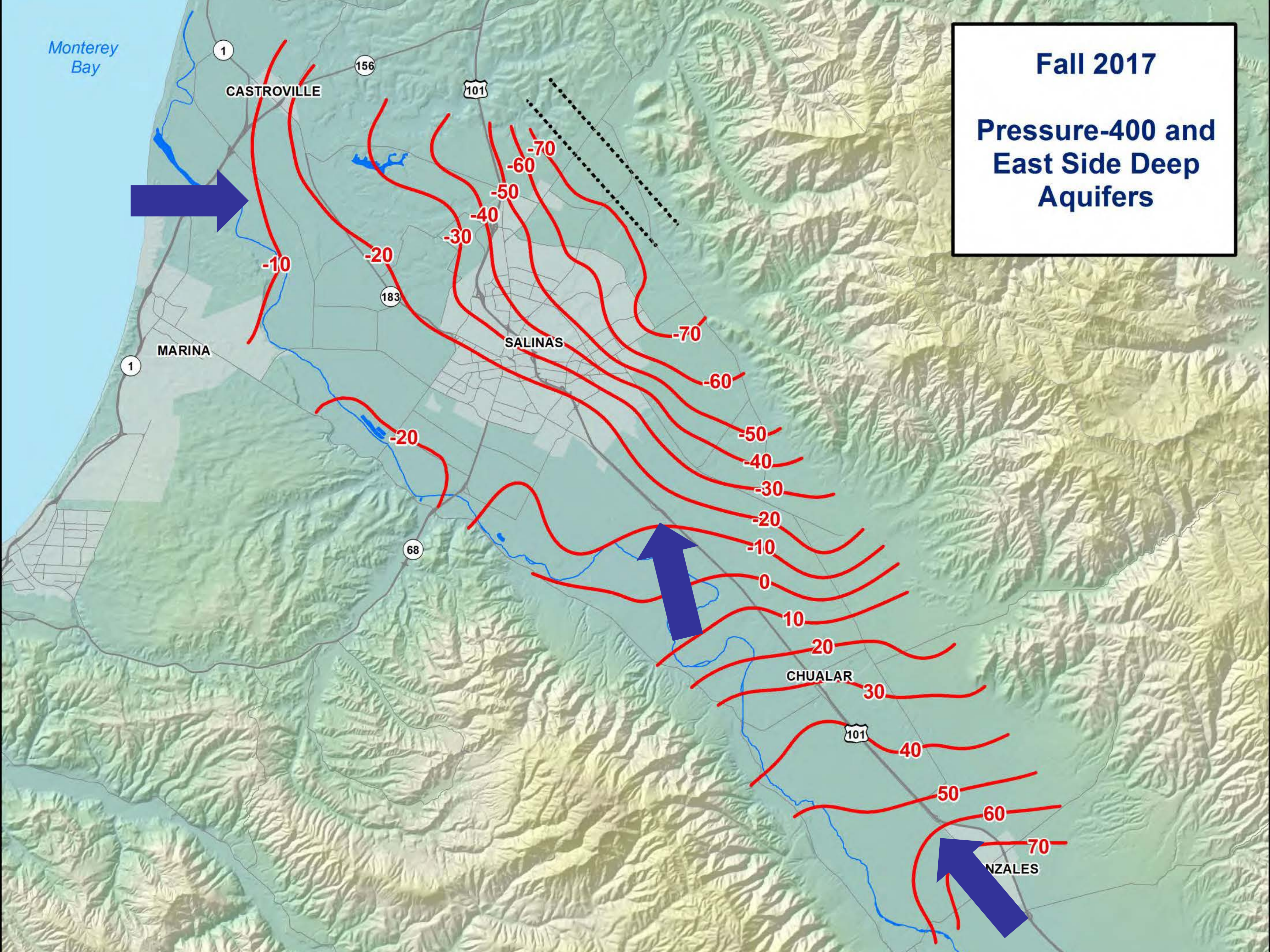

Fall 2017
Pressure-180, East Side Shallow & Forebay Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
SOLEDAD
156
101
1
183
68
0
-10
-20
-30
-40
-50
-60
-70
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


Fall 2017
Forebay & Upper Valley Aquifers
GREENFIELD
King City
SAN ARDO
101
130
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440
230
240
250

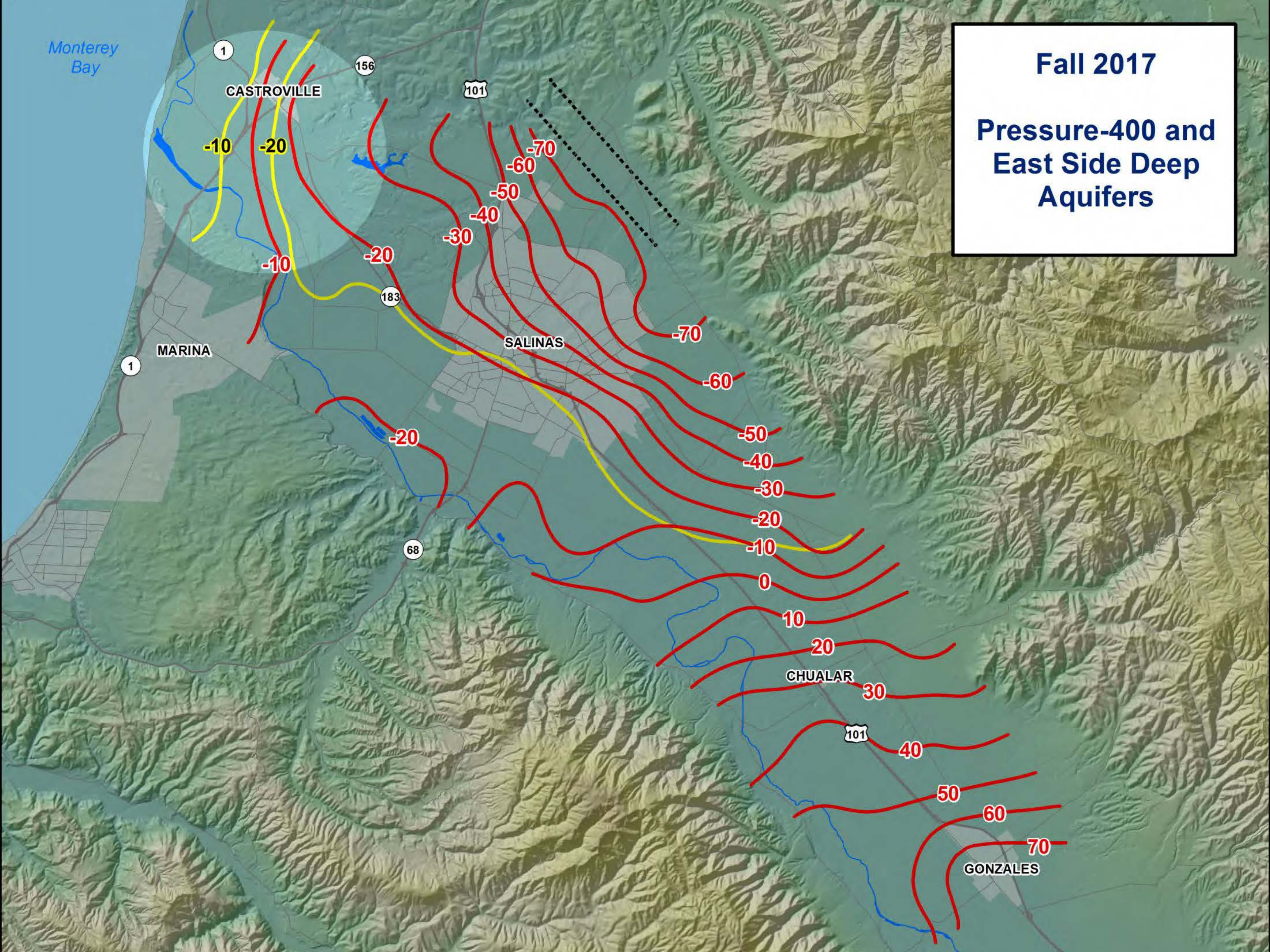

Fall 2017
Forebay & Upper Valley Aquifers
GREENFIELD
King City
SAN ARDO
101
130
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
360
370
380
380
390
400
400
410
420
430
440

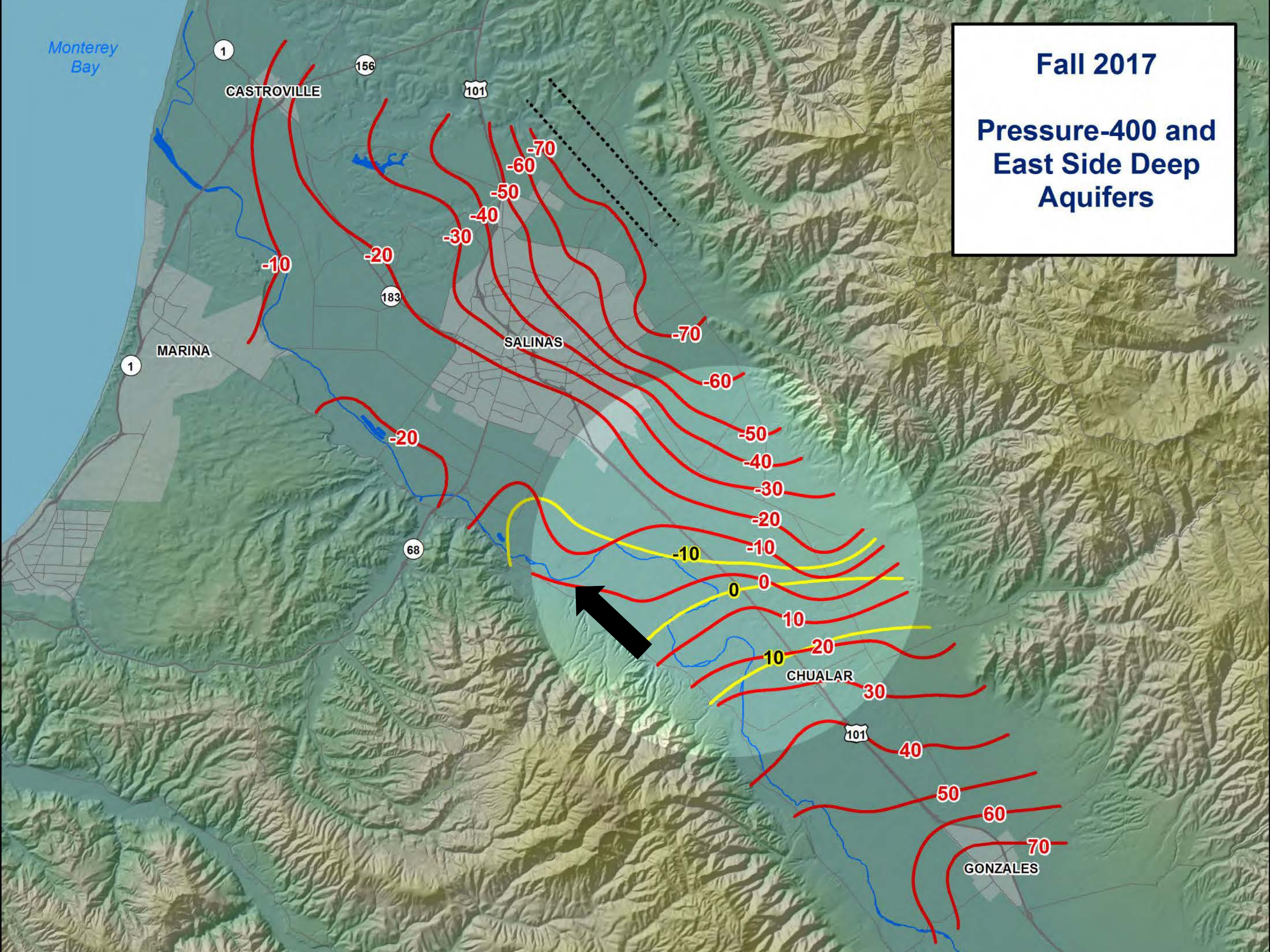


Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70

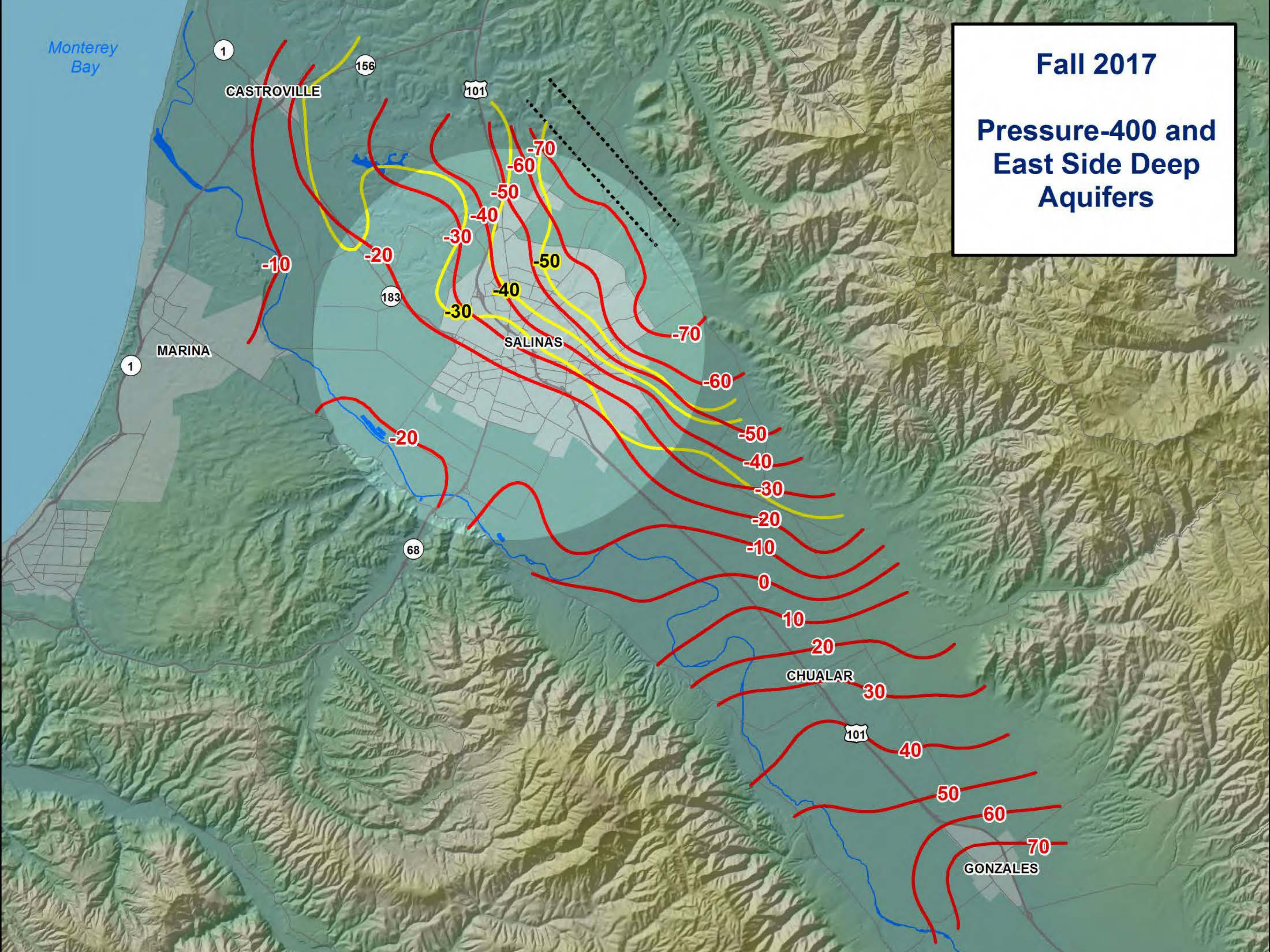


Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
NZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70

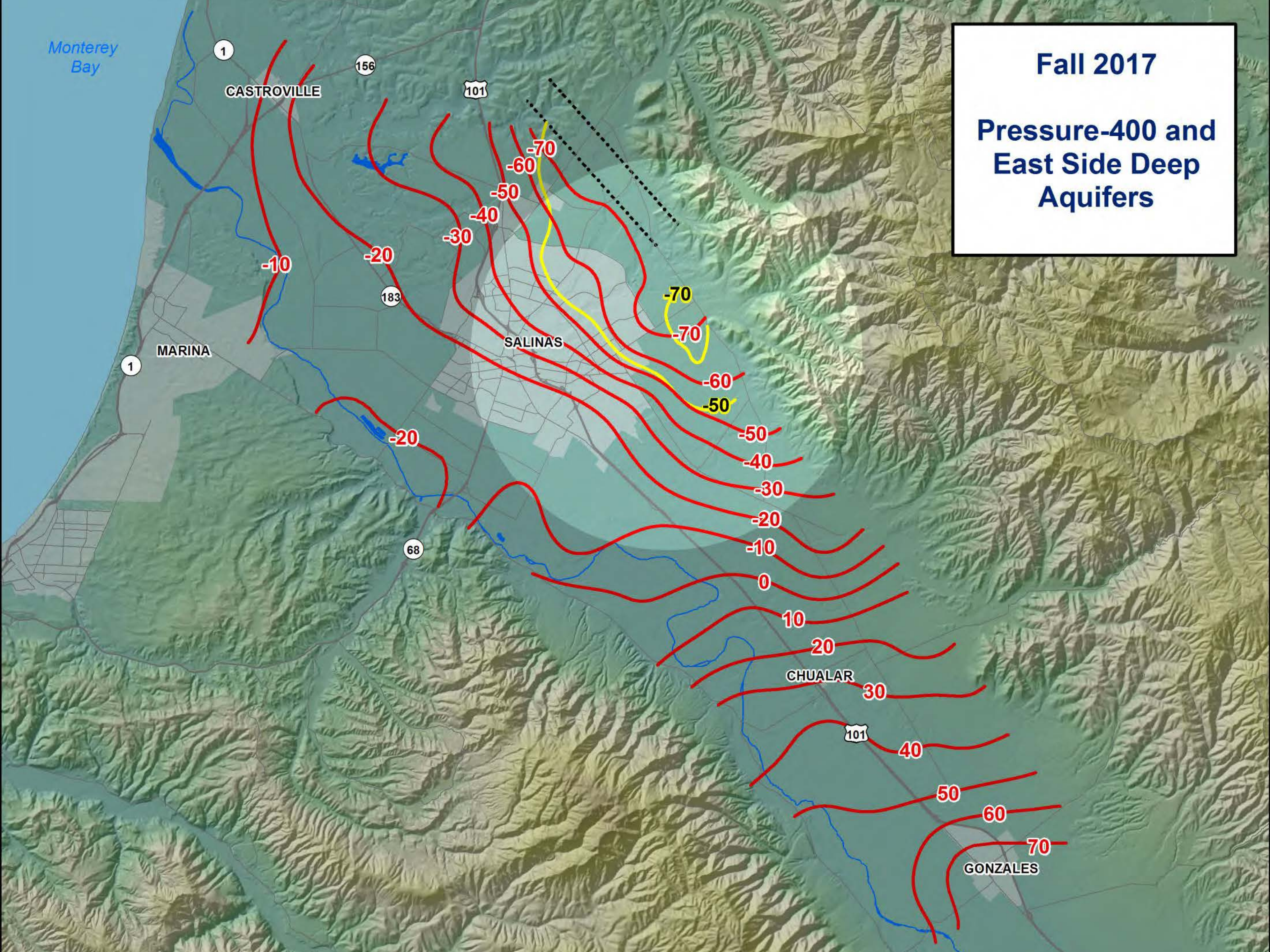

Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70



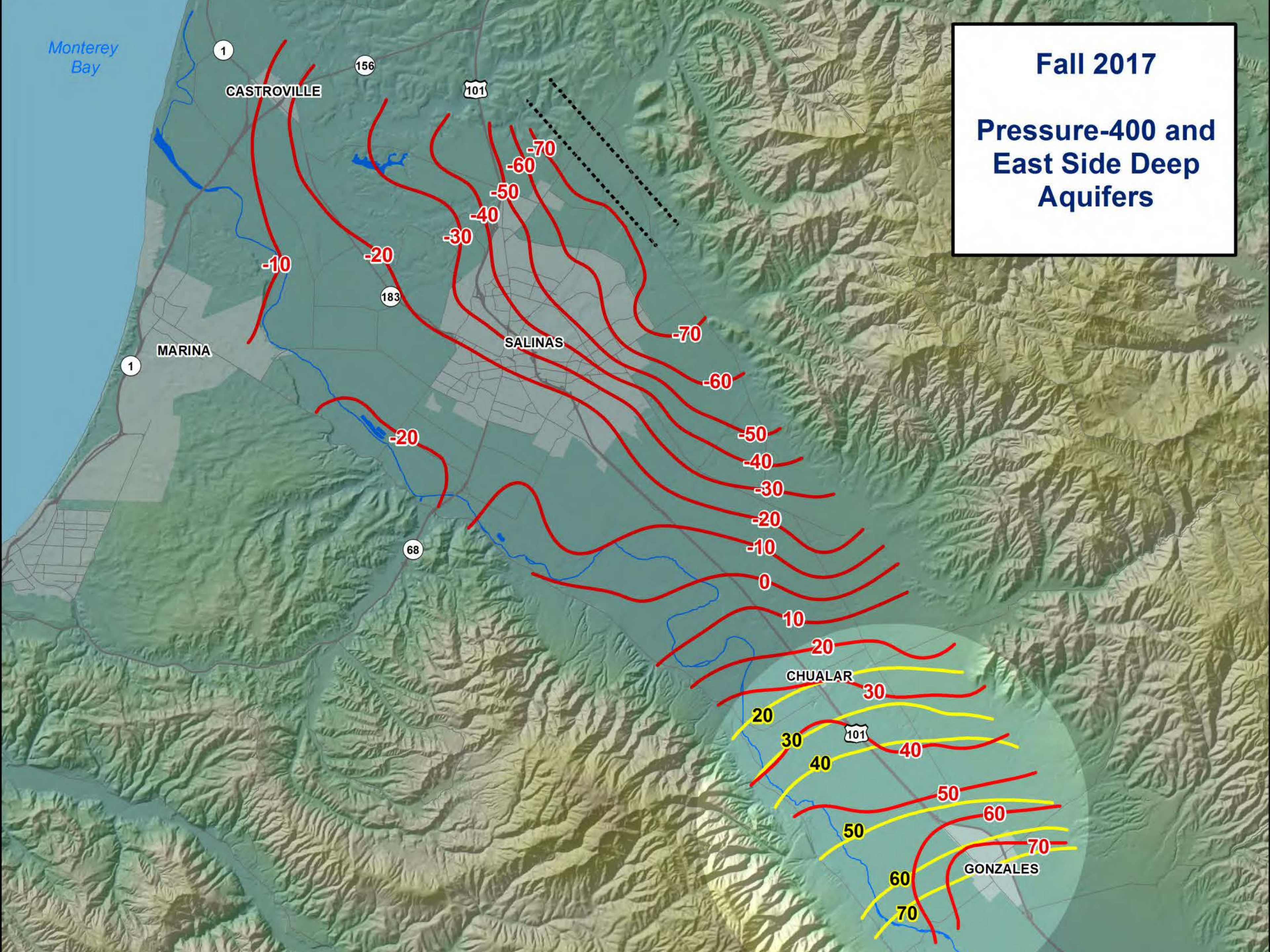
Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70



Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70



Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70


Fall 2017
Pressure-400 and East Side Deep Aquifers
Monterey Bay
CASTROVILLE
MARINA
SALINAS
CHUALAR
GONZALES
1
156
101
183
68
-10
-20
-30
-40
-50
-60
-70
0
10
20
30
40
50
60
70

Summary: 2017 Fall GWL Changes Since 2015

- P180, East Side Shallow, Forebay, Upper Valley Aquifers
    - Coastal GWLs: little to no change
    - East Side: trough 10 feet recovery
    - Zero line moved three miles down valley
    - Largest recoveries near King City (30ft)
    - San Lucas to San Ardo area: little change

Summary: 2017 Fall GWL Changes Since 2015

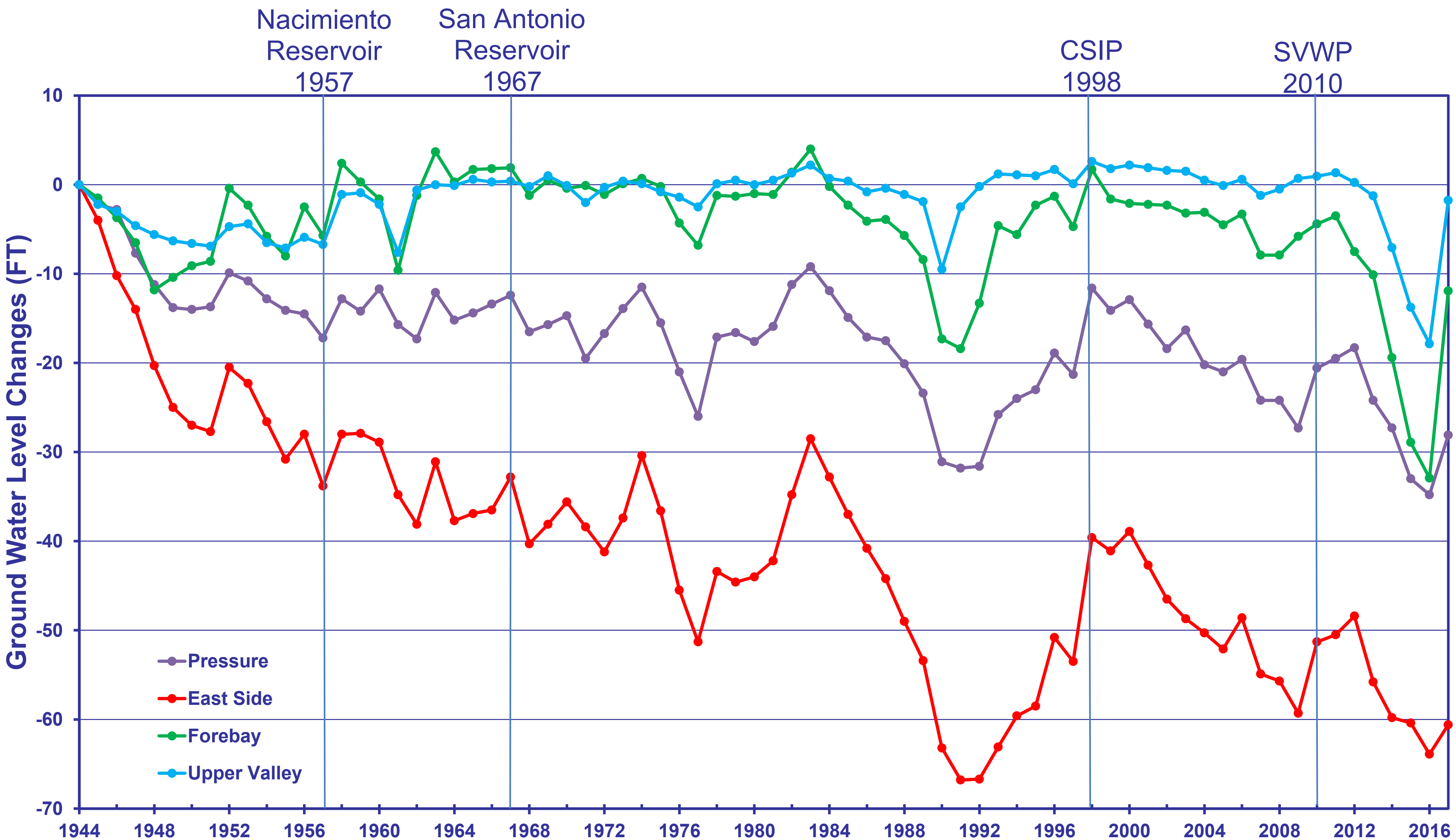
- P400, East Side Deep
  - Coastal GWLs: No change to 5ft higher
  - Salinas area: Little change
  - East Side: little to no change north, up to 10 ft recovery between Chualar & Gonzales
  - Zero line two miles down valley
  - 10 ft recovery near Chualar; little change near Gonzales

GWL Changes Since 1944

Fall data (1944-2017)

- Indicator of change in aquifer storage
- Approximately 400 GWL measurements
- 200-300 used for comparison
- Each Subarea represented by one value

Fall Groundwater Level Changes by Subarea



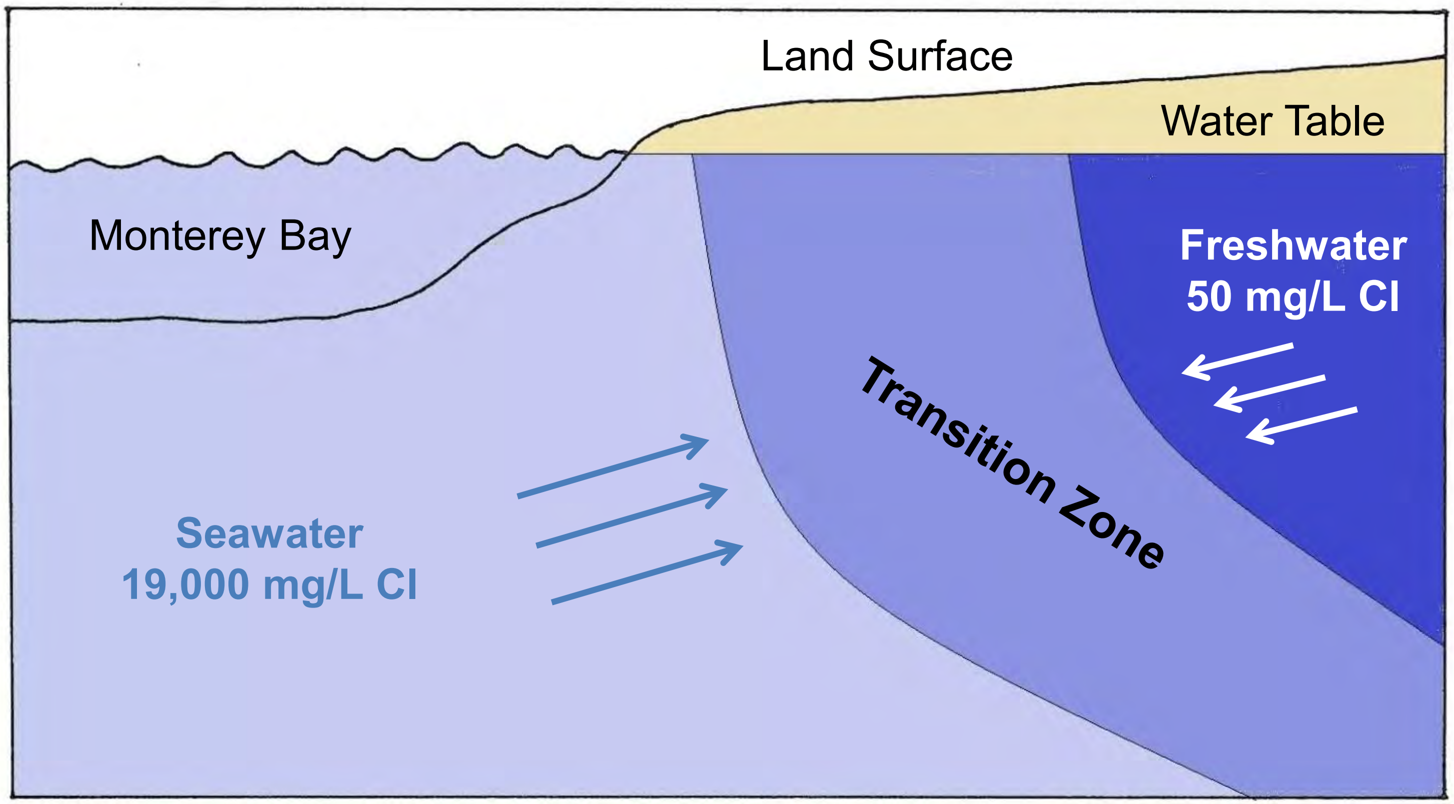
MONTEREY COUNTY WATER RESOURCES AGENCY

1947

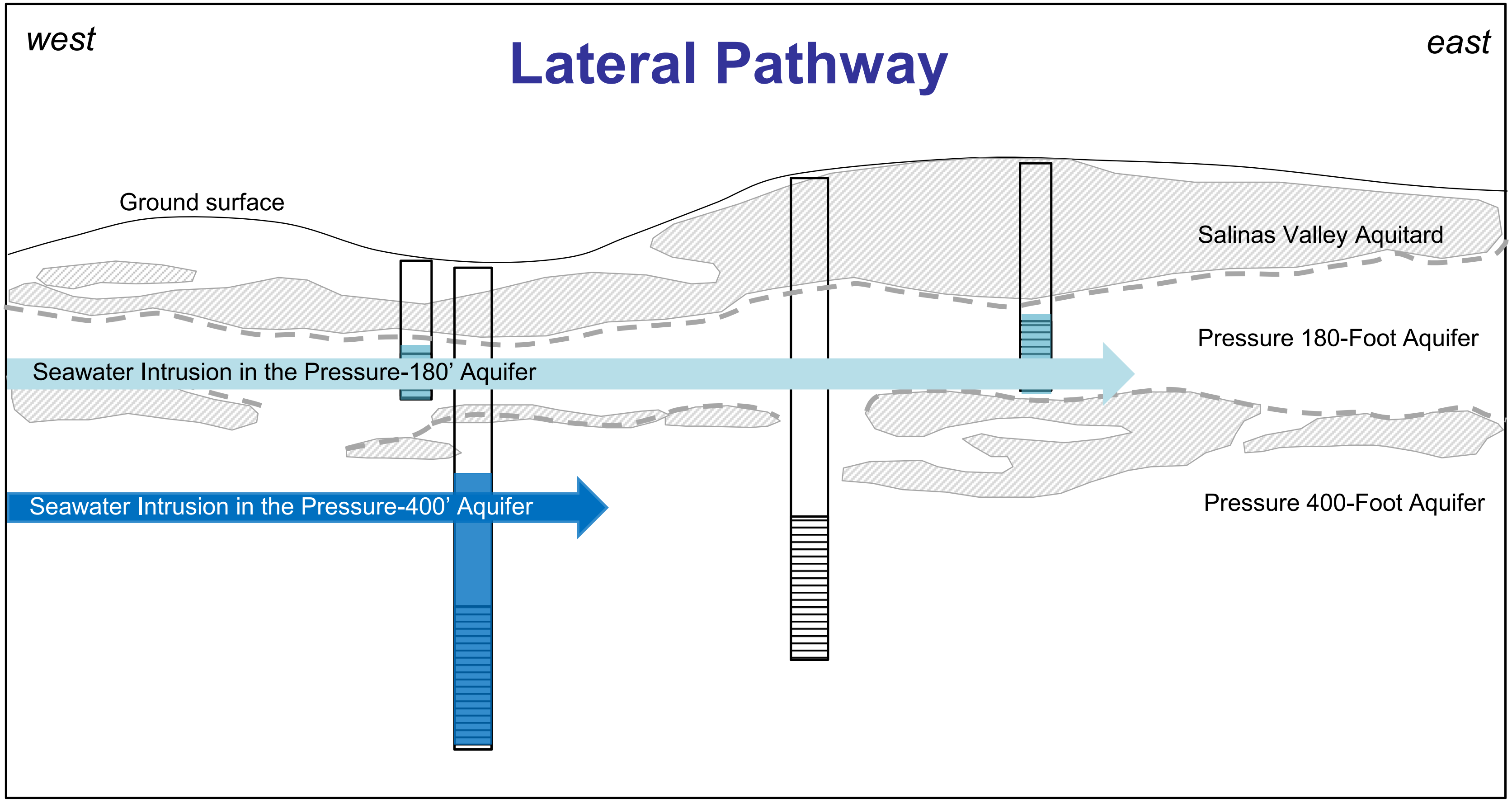
Coastal Salinas Valley Seawater Intrusion Maps

500 mg/L Chloride Contours 2017

Seawater Intrusion – Transition Zone



Seawater Intrusion – Pathways

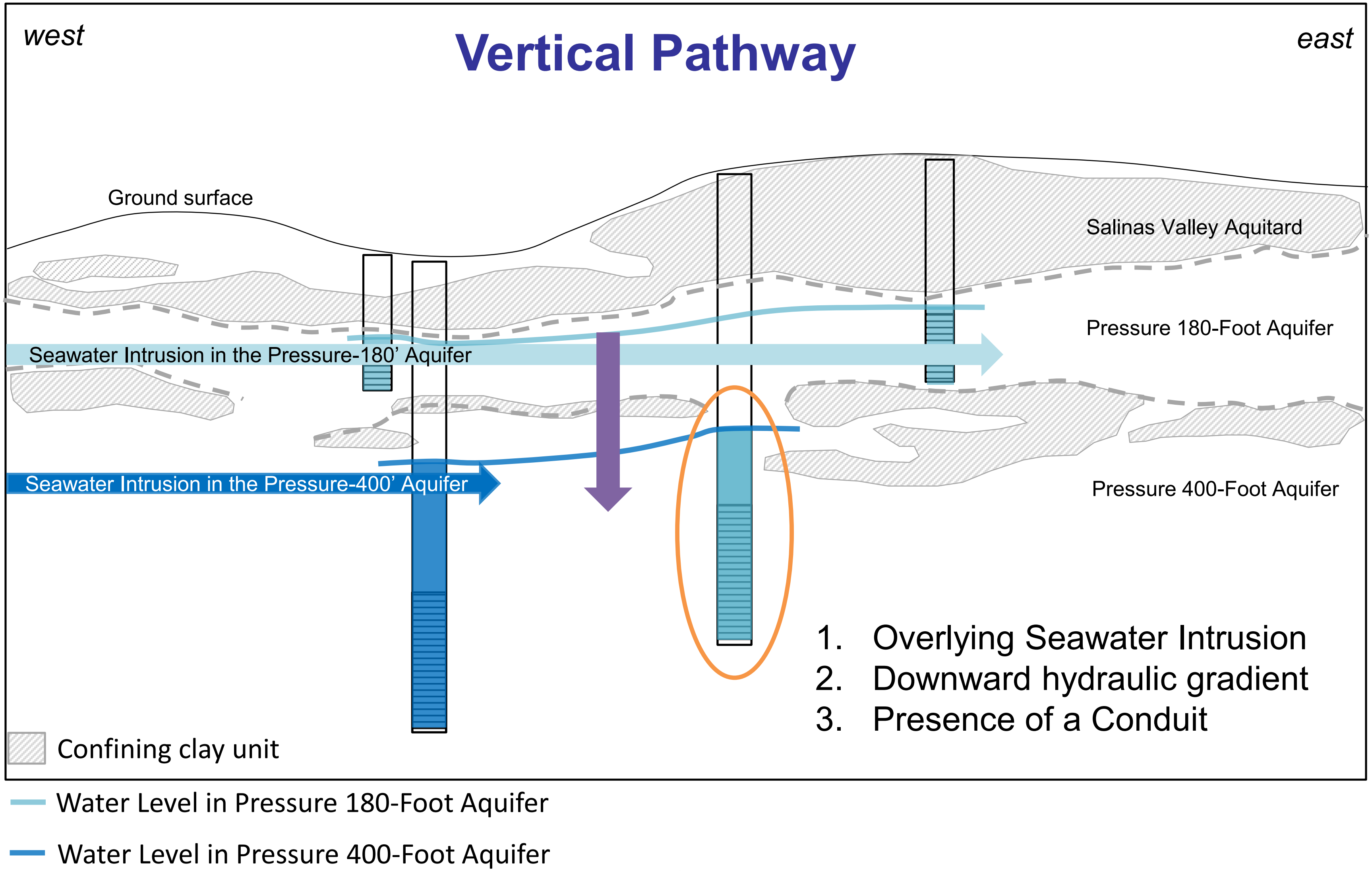


Confining clay unit

Water Level in Pressure 180-Foot Aquifer

Water Level in Pressure 400-Foot Aquifer

Seawater Intrusion – Pathways



Seawater Intrusion – Monitoring Program

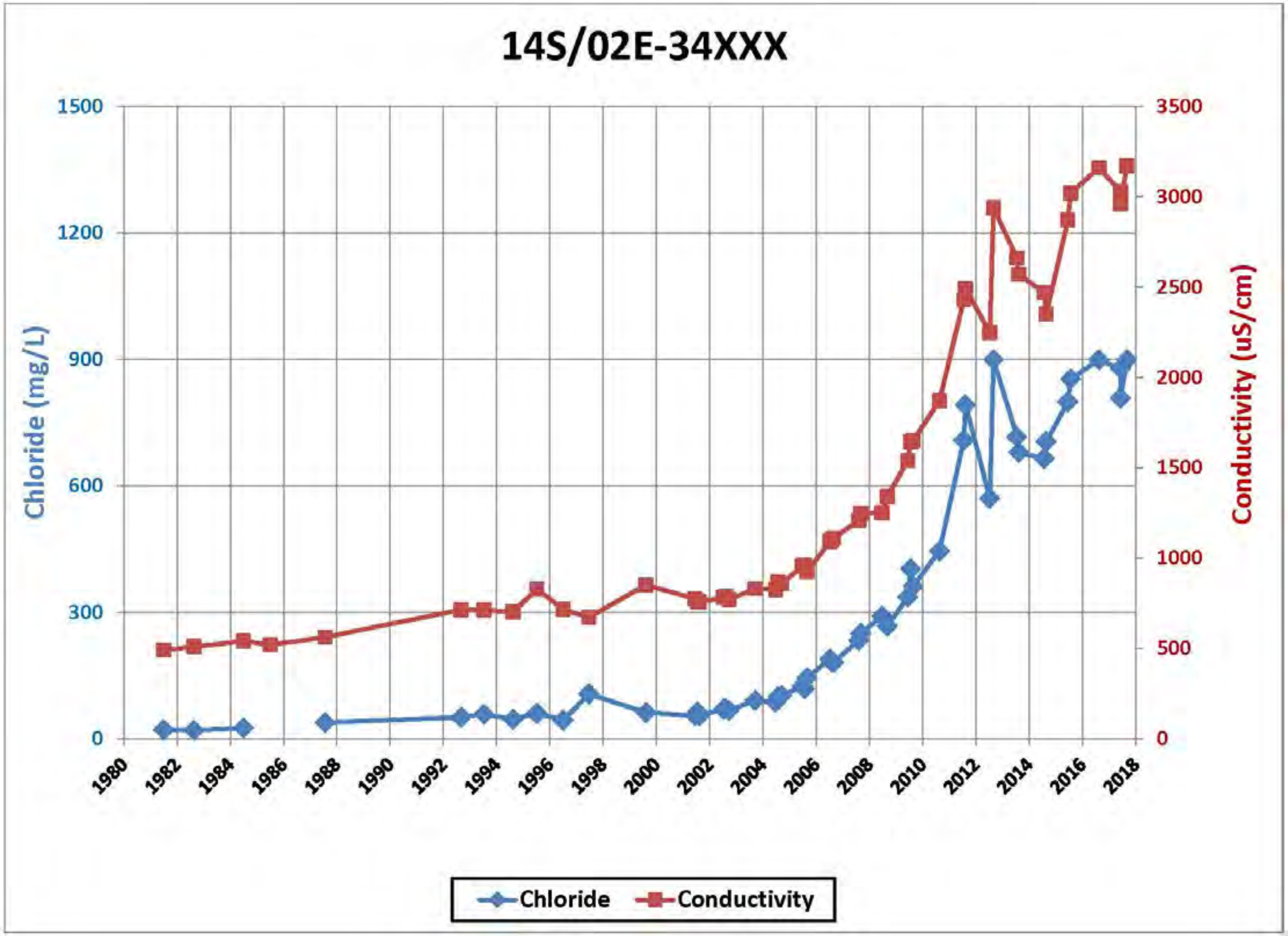
- Groundwater Wells
  - Sampled annually during peak pumping
  - 96 Agricultural wells sampled twice (Jun & Aug)
  - 25 Dedicated monitoring wells sampled
    - Agency's wells and MPWSP wells
  - Analyzed for General Minerals

Seawater Intrusion – Analysis

- Data Evaluation
  - Historical Chloride & Conductivity Trends
  - Stiff and Piper Diagrams
  - Chloride Concentration vs. Na/Cl Molar Ratio Trends

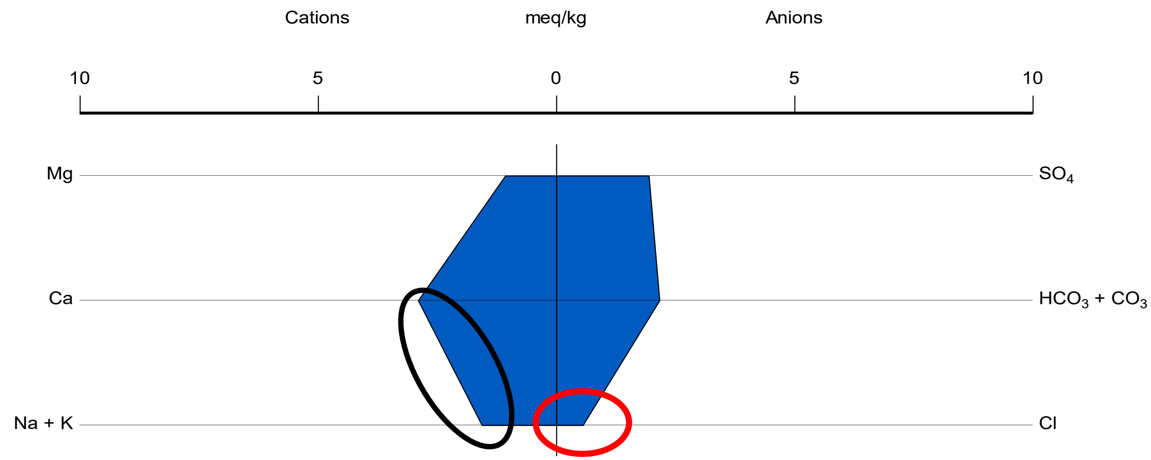
- Data Development Process
  - Water Quality
  - Well Construction
  - Well Pumping Data
  - Ground Water Level Contours

Chloride & Conductivity Time Series Indicating Intrusion

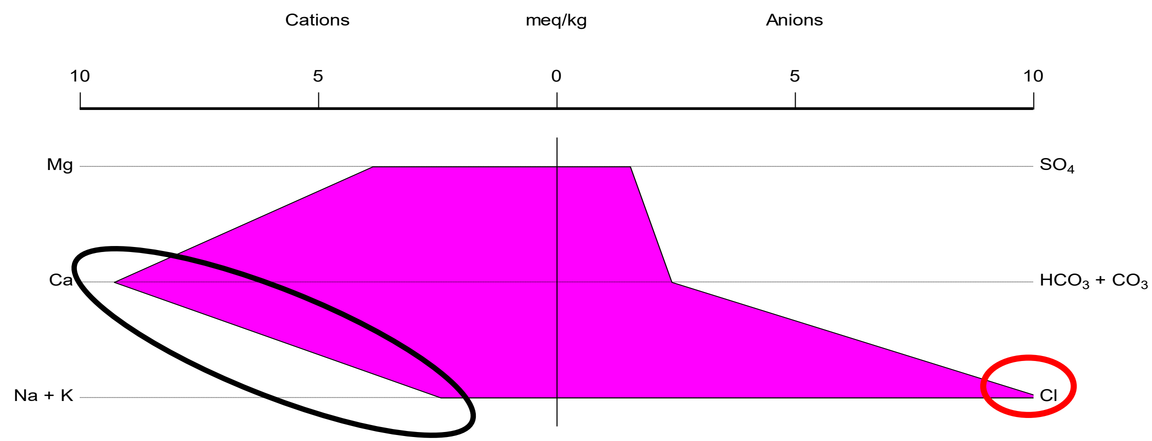


Stiff Diagrams

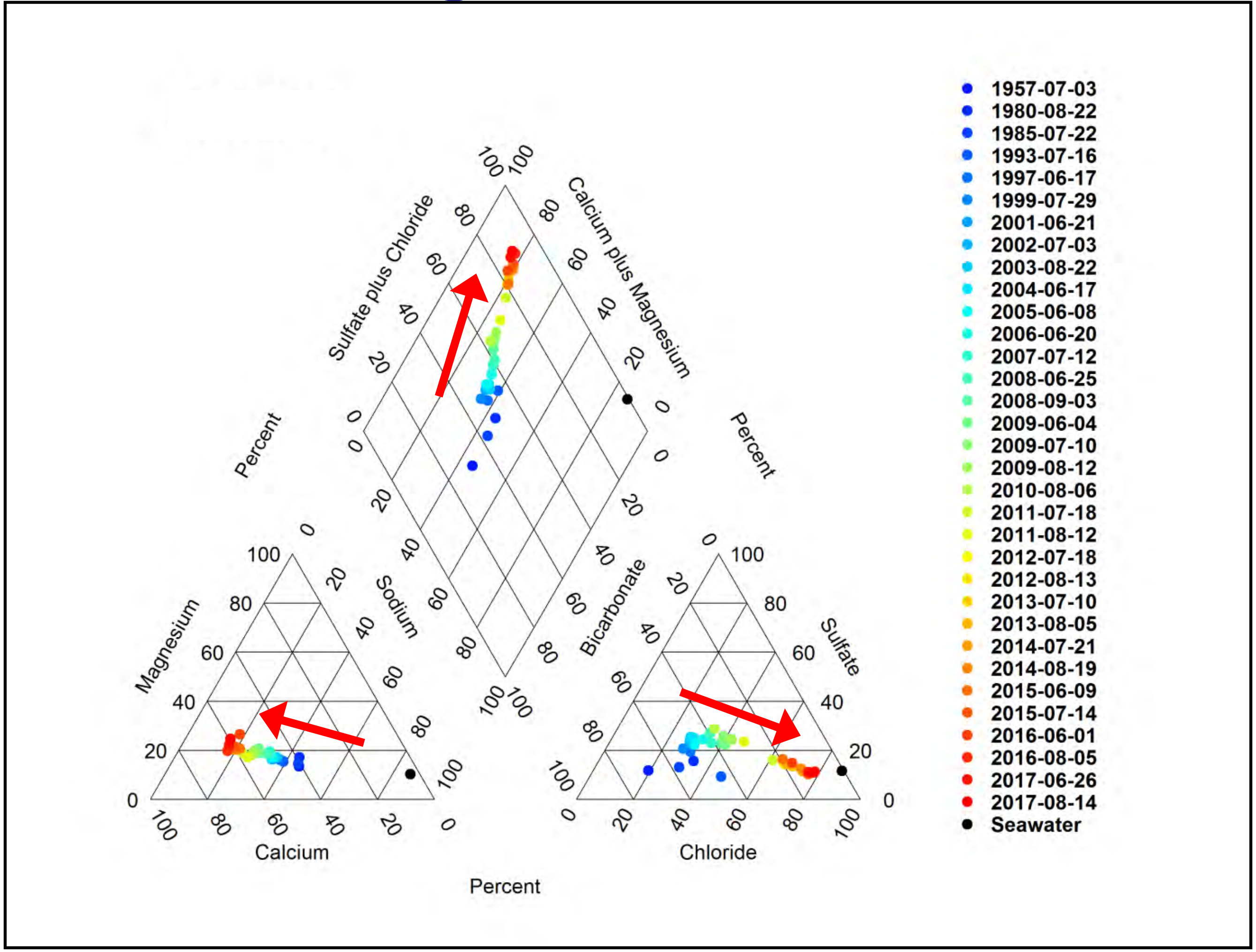
No Intrusion - 1982



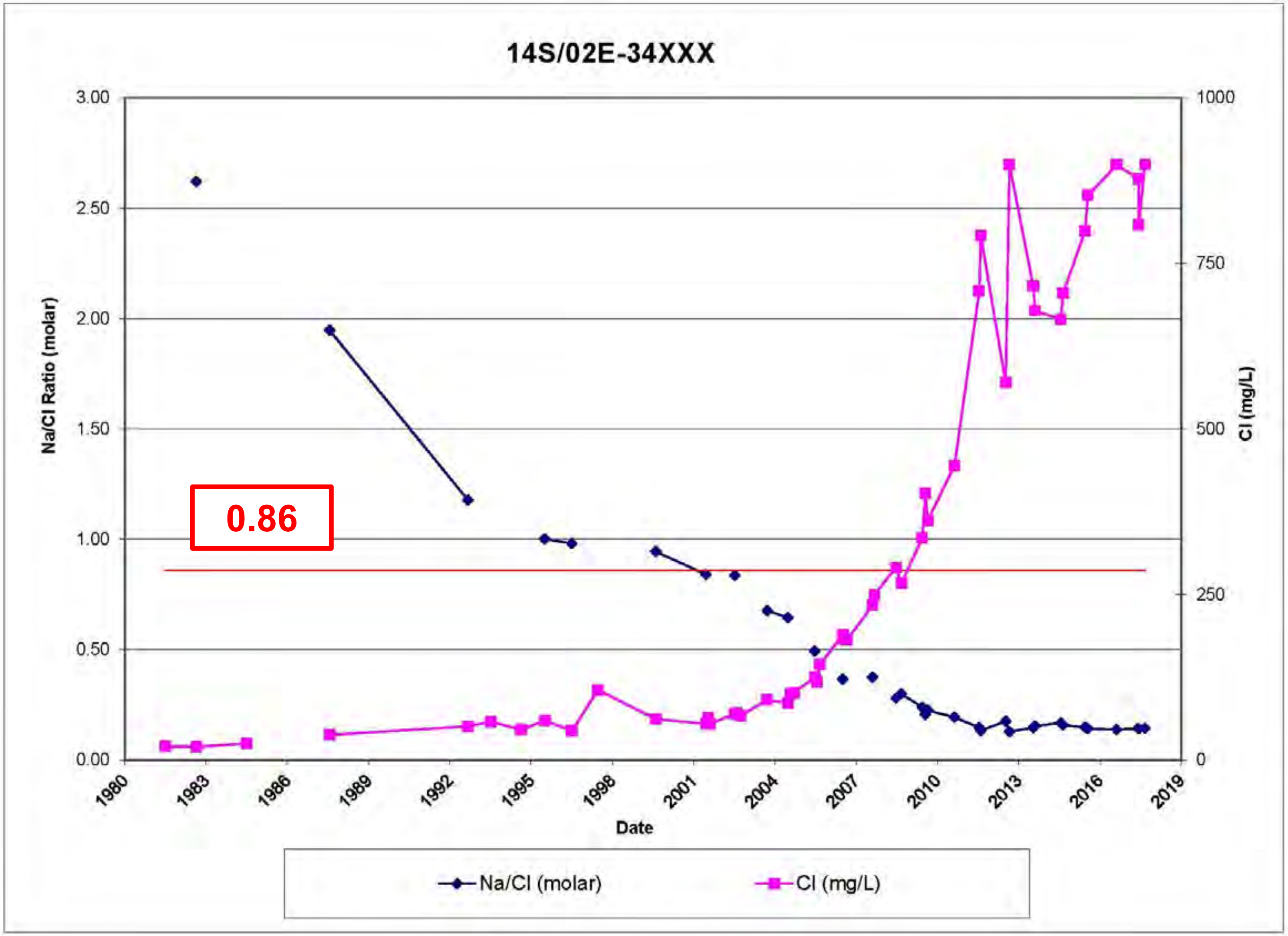
Early Intrusion - 2009



Piper Diagram
Indicating Phase-I Intrusion



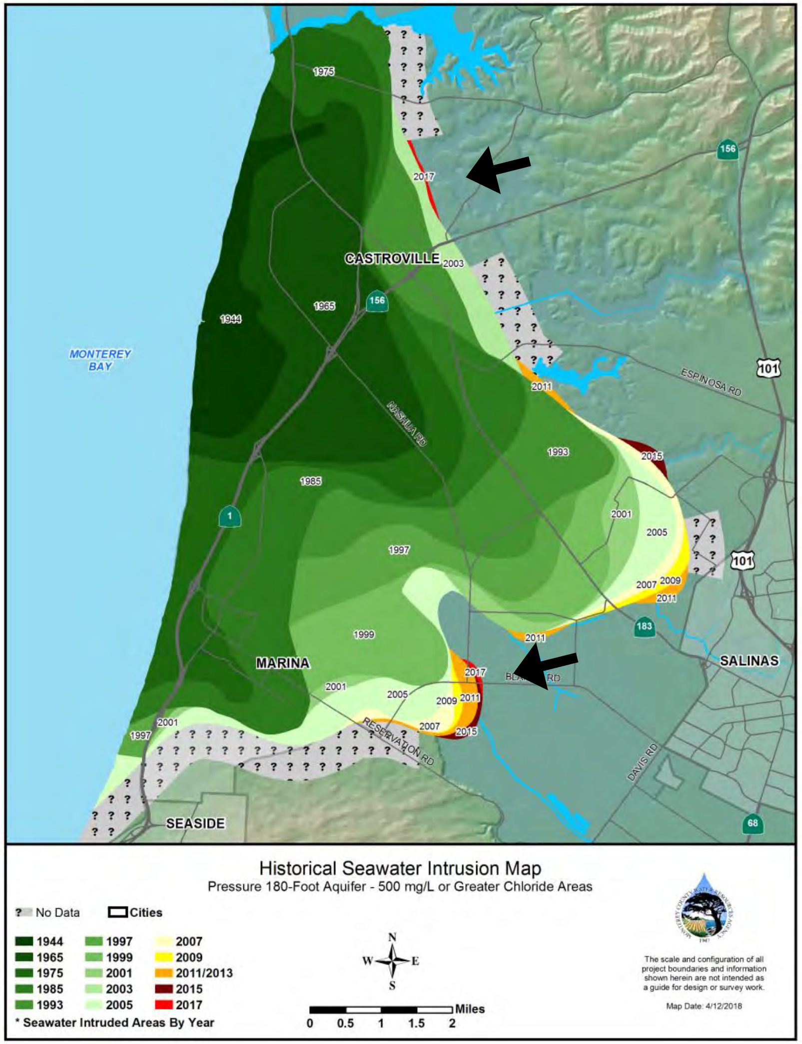
Chloride vs. Na/Cl Molar Ratio



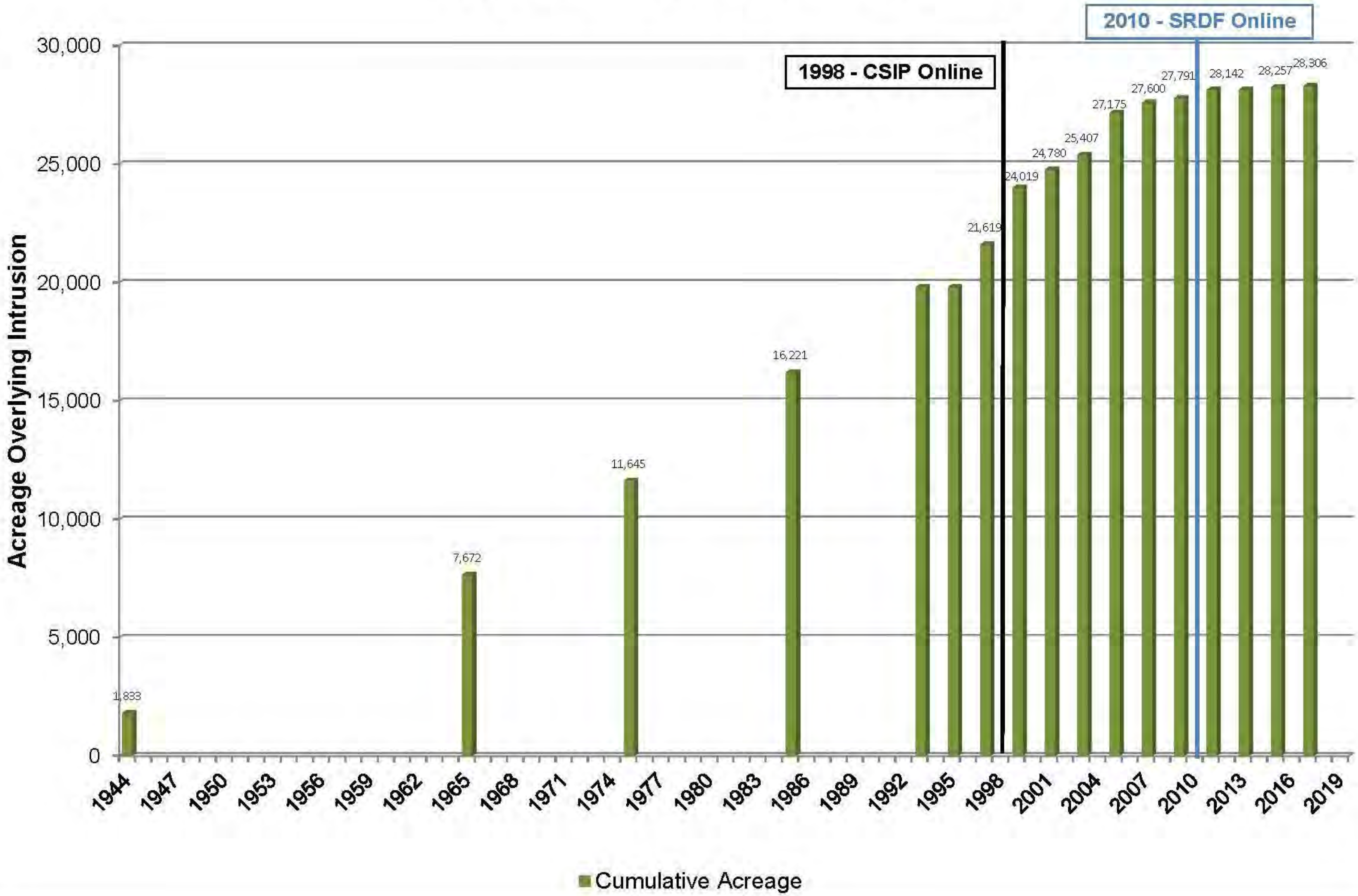
Seawater Intrusion – Data Processing

- Lab Results are Evaluated & Uploaded into WRAIMS Database Annually
- 500 mg/L Contours are Developed from the Odd Year Data & Added to the Historical SWI Maps

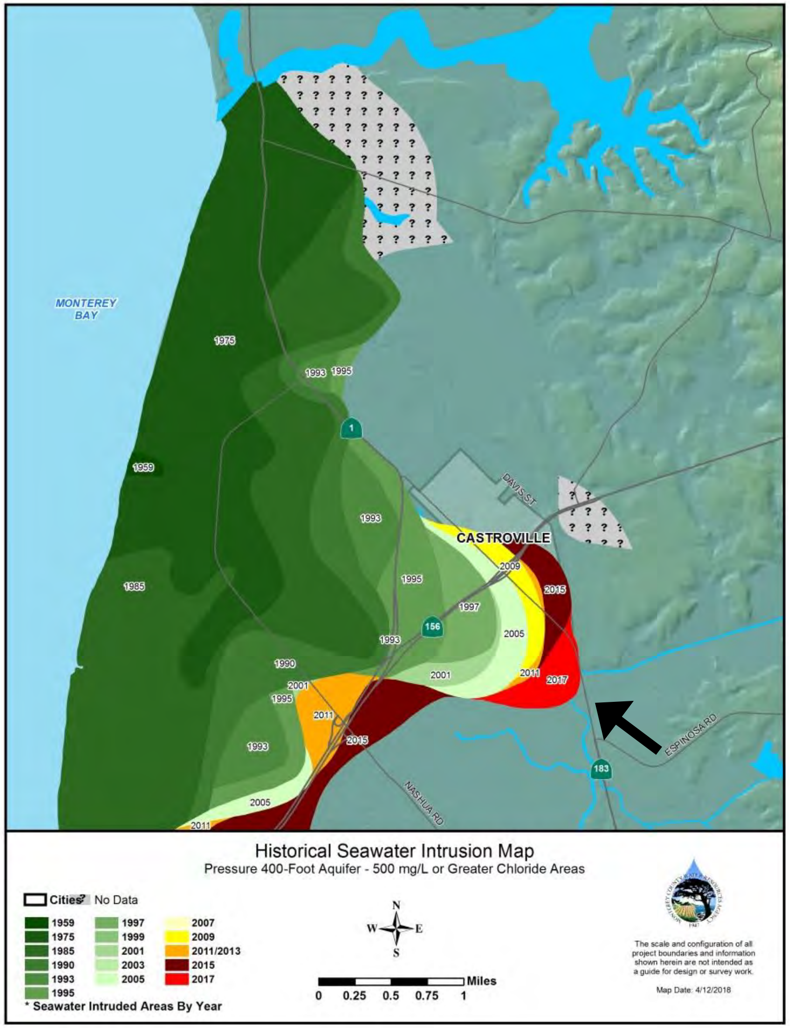
2017 Pressure 180-Foot Aquifer 500 mg/L Chloride Areas



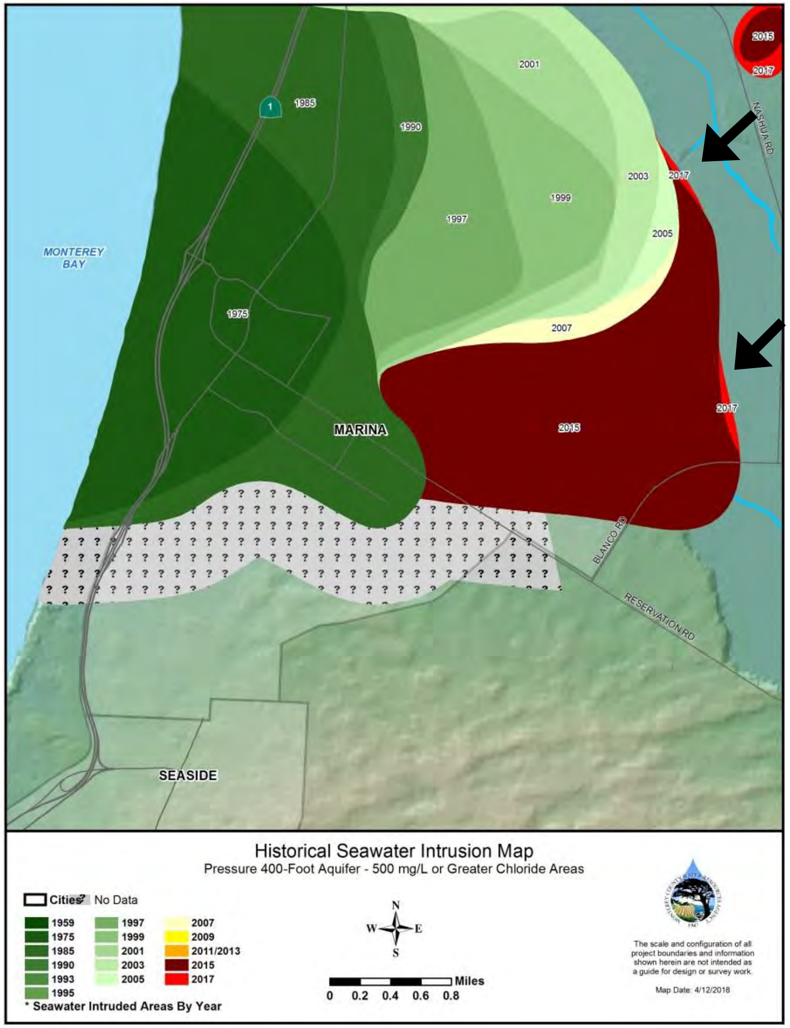
Acreage Overlying the 500 mg/L Chloride Contour
Pressure 180-Foot Aquifer



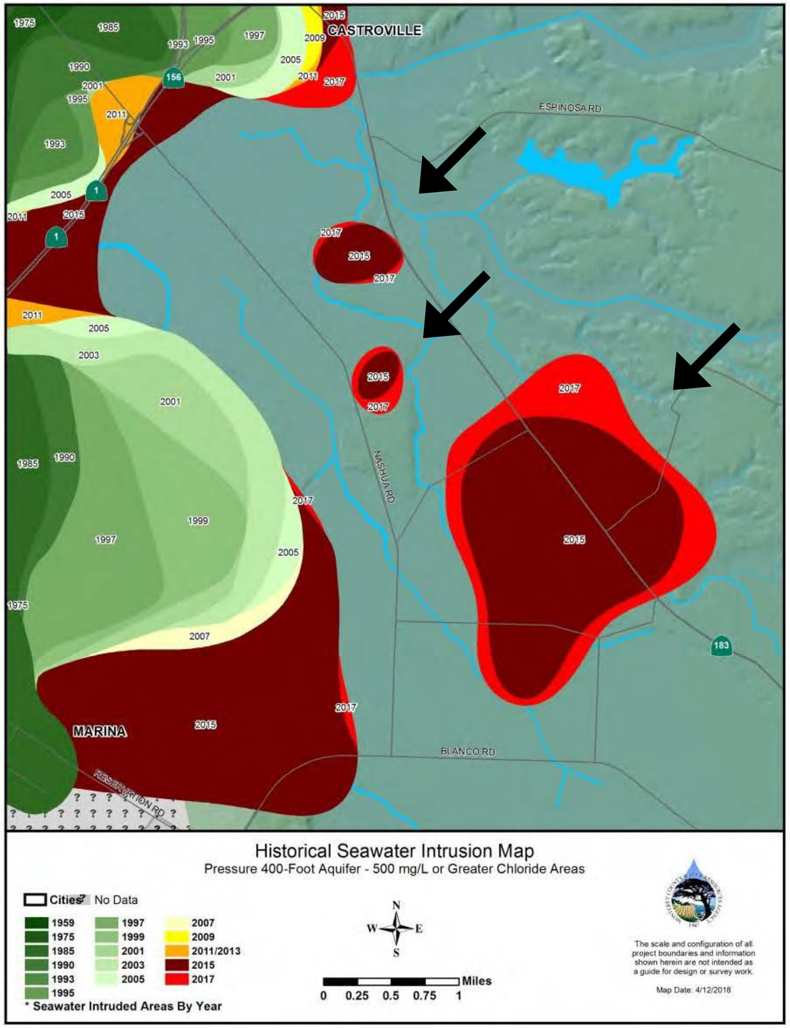
2017 Pressure 400-Foot Aquifer 500 mg/L Chloride Areas



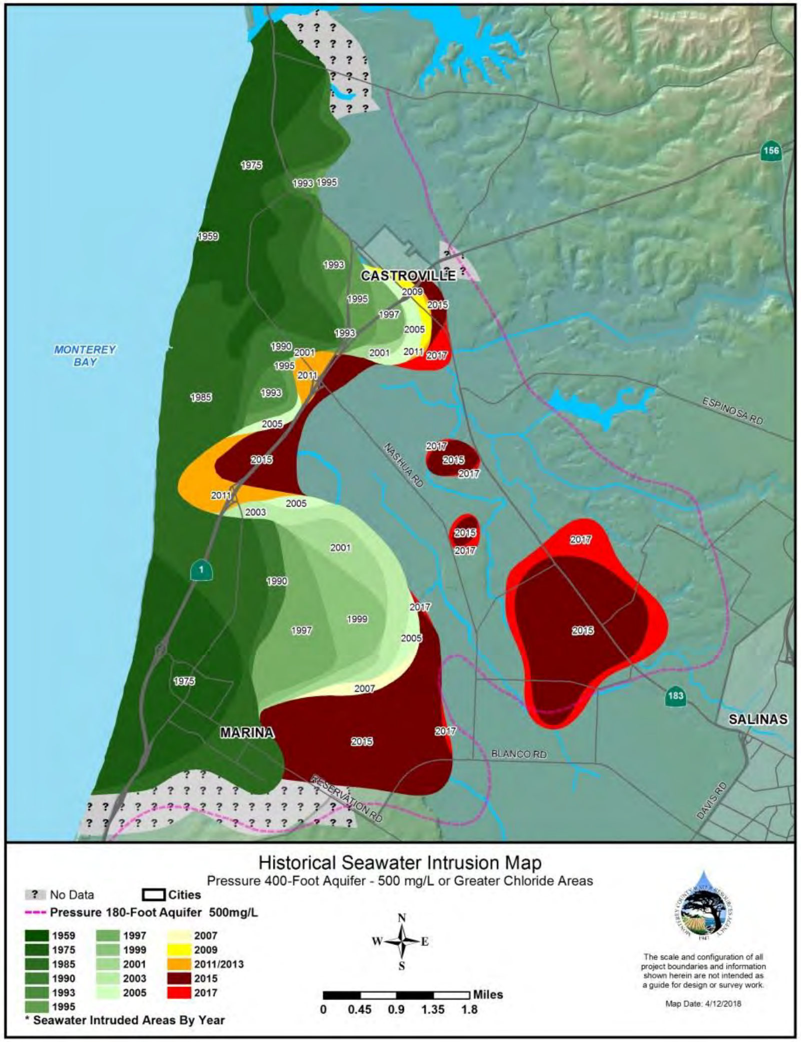
2017 Pressure 400-Foot Aquifer 500 mg/L Chloride Areas

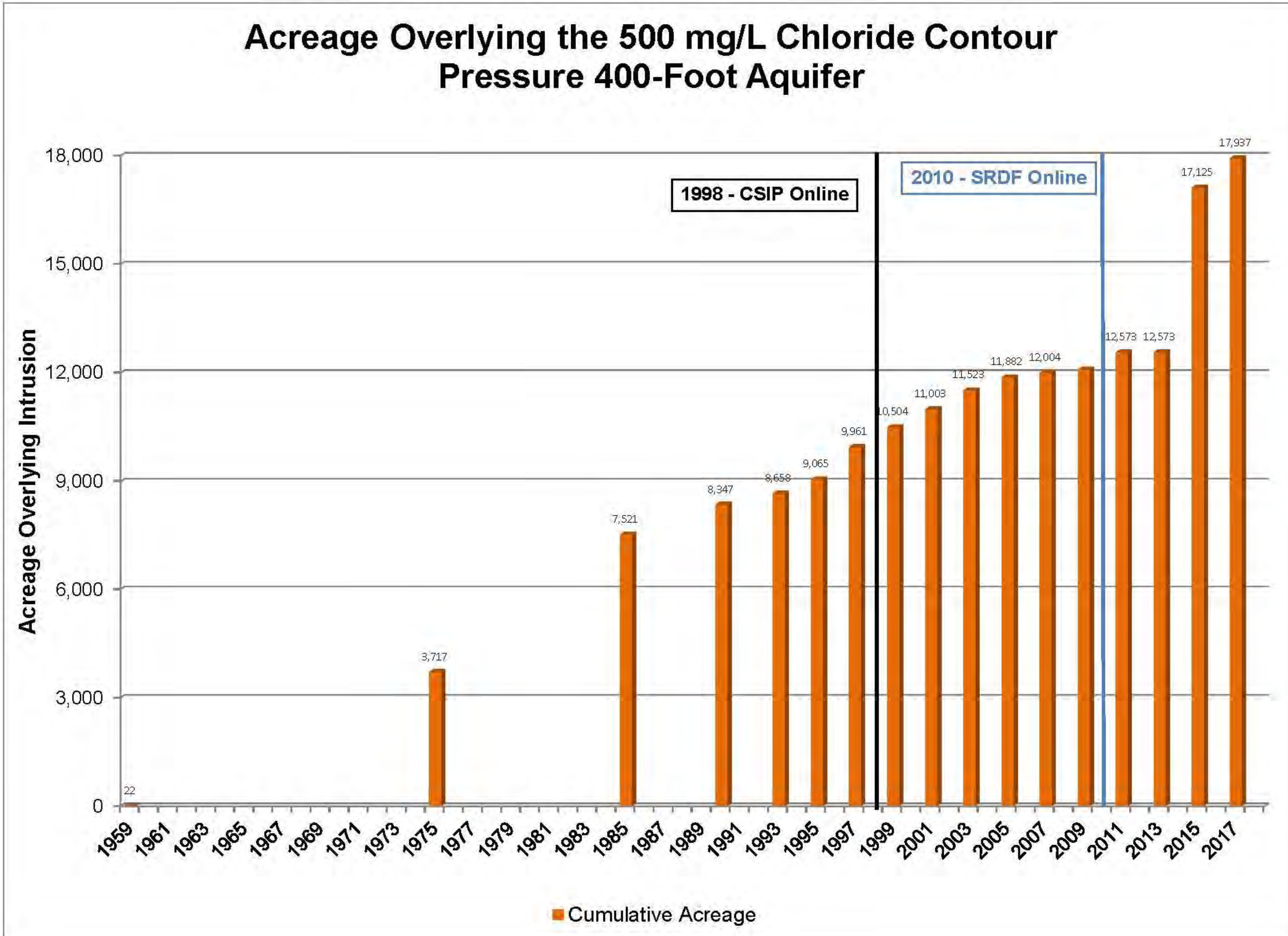


2017 Pressure 400-Foot Aquifer 500 mg/L Chloride Areas



2017 Pressure 400-Foot Aquifer 500 mg/L Chloride Areas





Acreage Overlying the 500 mg/L Chloride Contour
Pressure 400-Foot Aquifer
Acreage Overlying Intrusion
18,000
15,000
12,000
9,000
6,000
3,000
0
1998 - CSIP Online
2010 - SRDF Online
22
3,717
7,521
8,347
8,658
9,065
9,961
10,504
11,003
11,523
11,882
12,004
12,573
12,573
17,125
17,937
1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Cumulative Acreage

Conclusion

Pressure 180-Ft Contours

- Rate of SWI Continues to Decrease
- Minimal Advancement
- Minimal Lobe Broadening

Pressure 400-Ft Contours

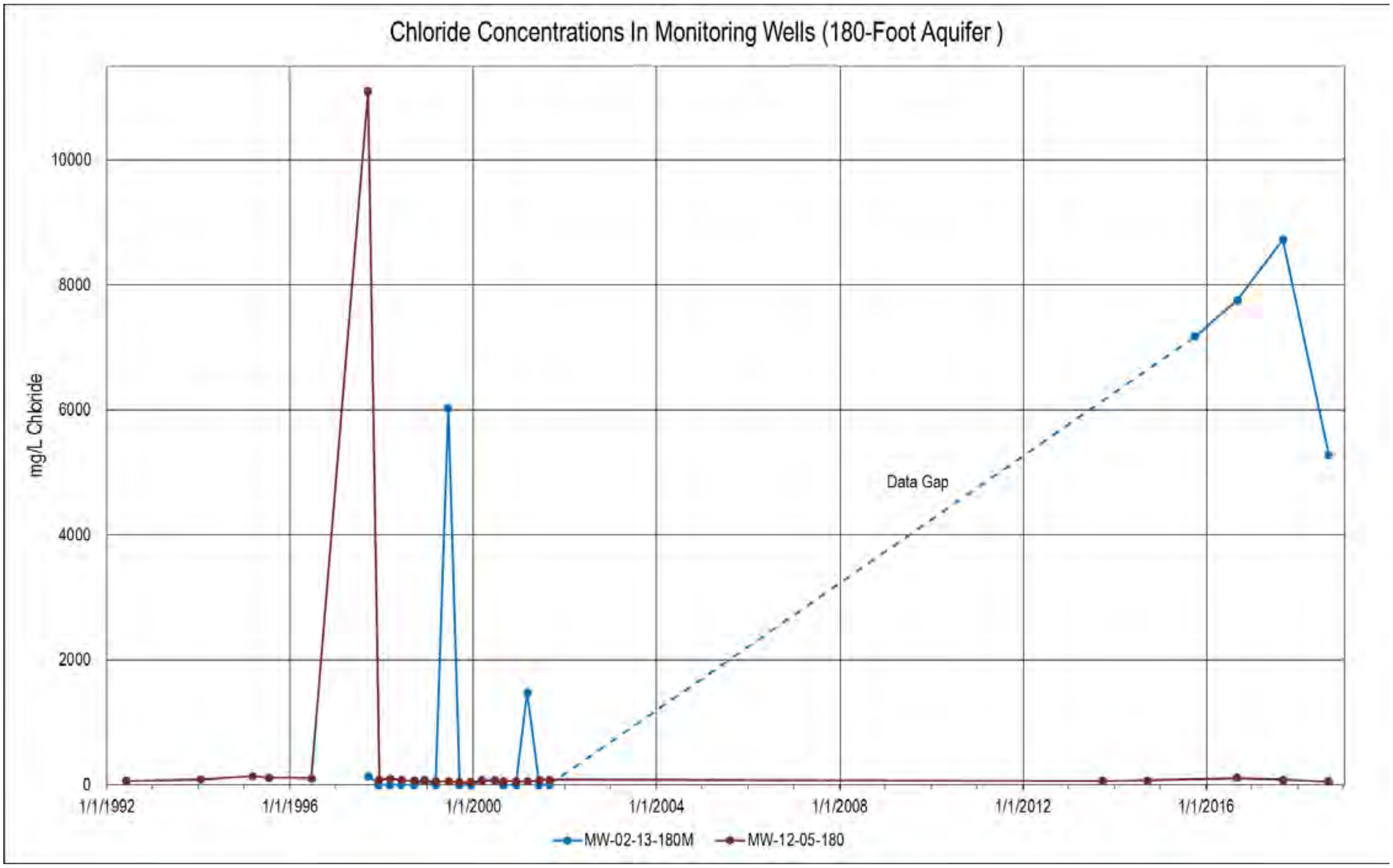
- Continued Lobe Broadening
- Expansion of the Intruded WQ in Front of the 500 mg/L Contour (“Islands)
- Minimal Advancement

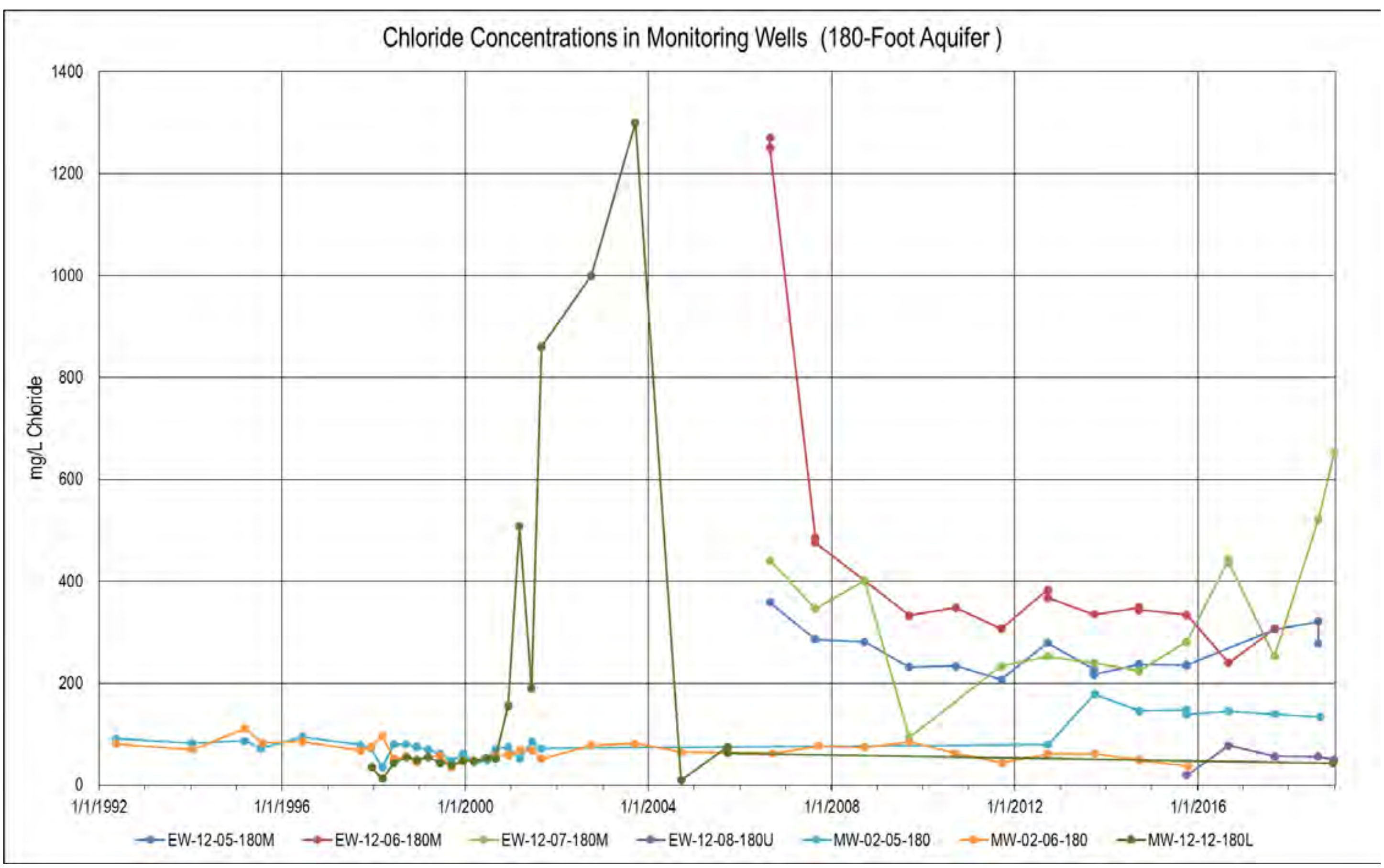
TODAY'S ACTION

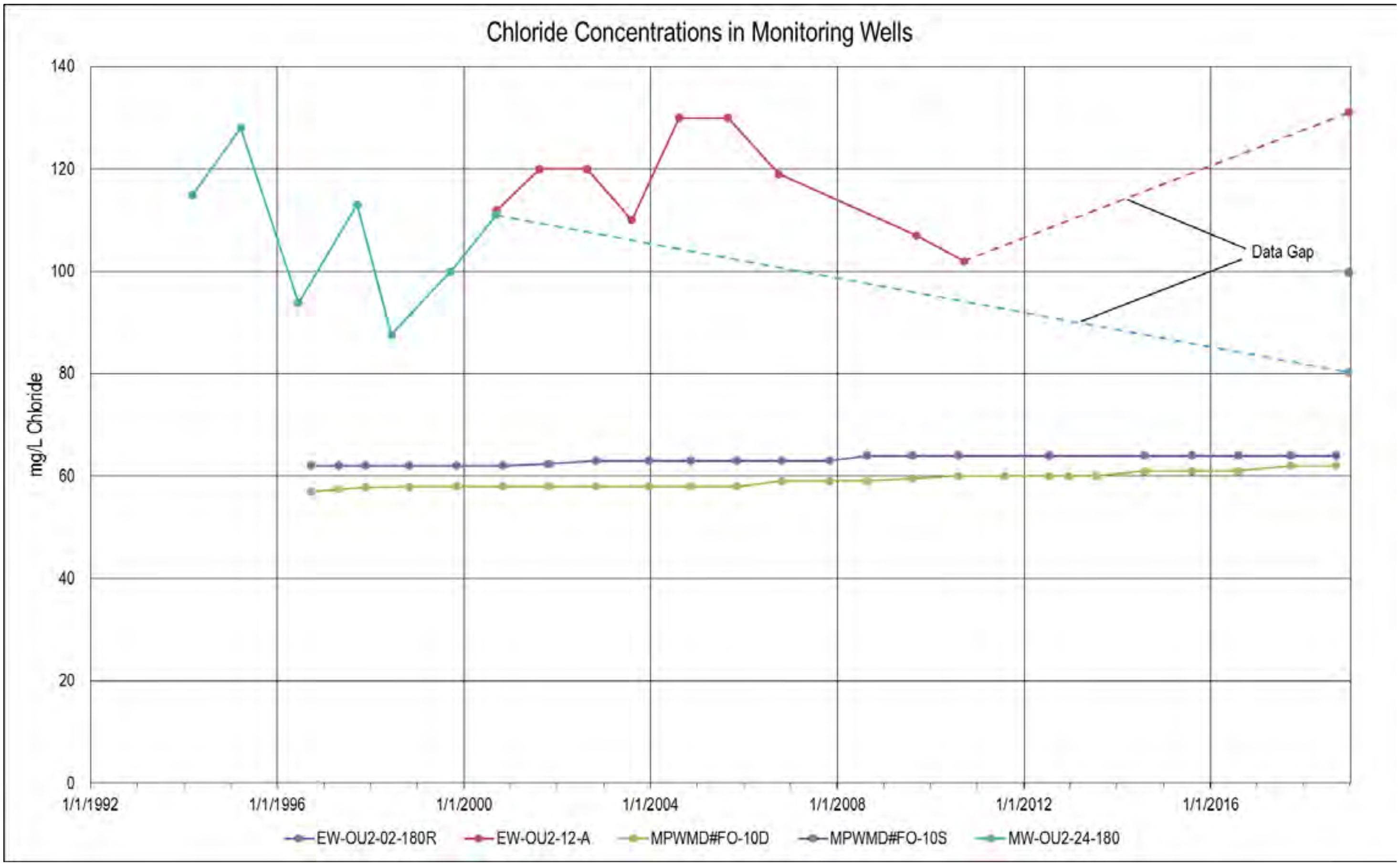
Consider Receiving the
2017 Groundwater Level Contours and
Coastal Salinas Valley
Seawater Intrusion Maps

MONTEREY COUNTY WATER RESOURCES AGENCY

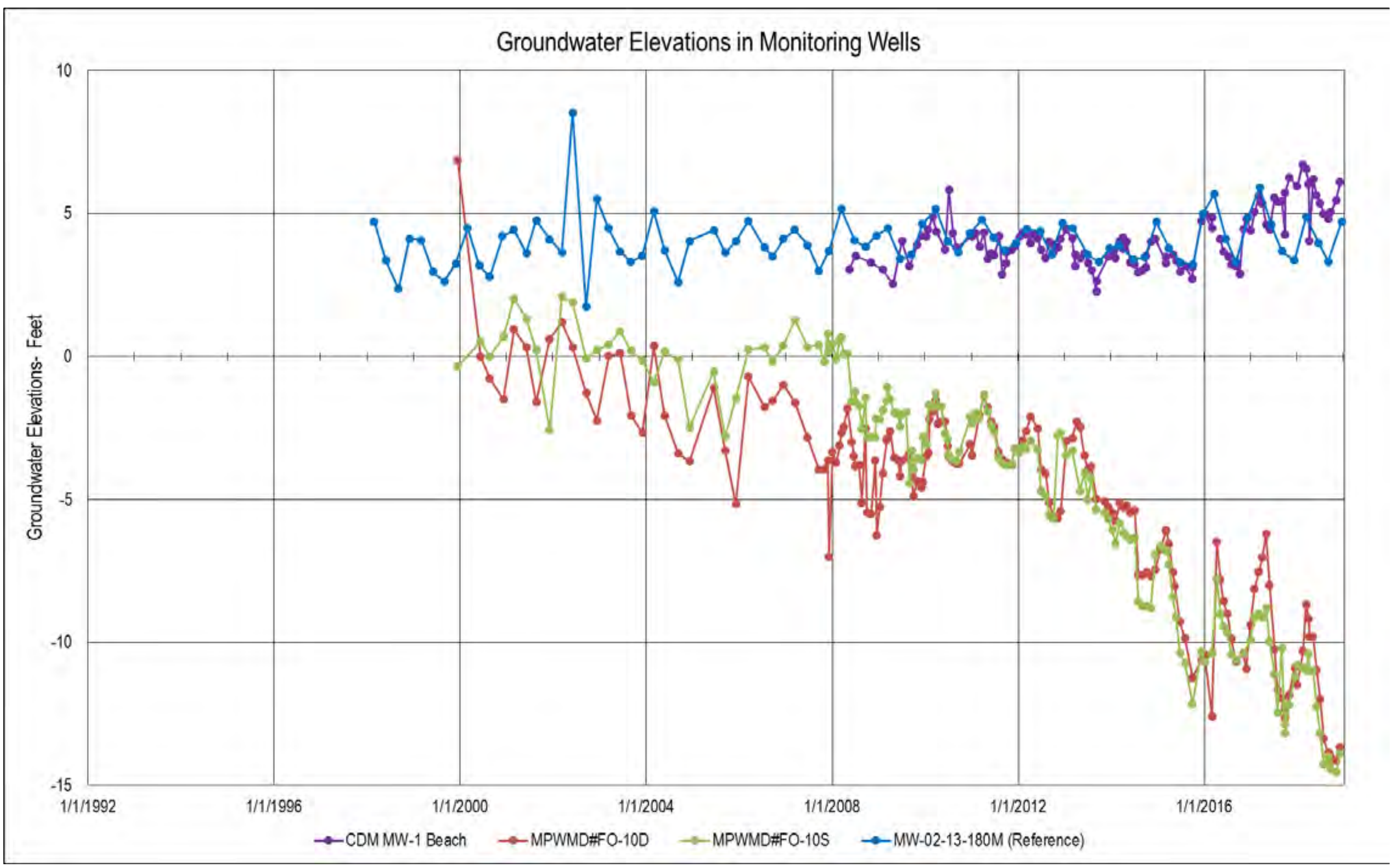
1947


Chloride Concentrations In Monitoring Wells (180-Foot Aquifer)
mg/L Chloride
0
2000
4000
6000
8000
10000
1/1/1992
1/1/1996
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
Data Gap
MW-02-13-180M
MW-12-05-180

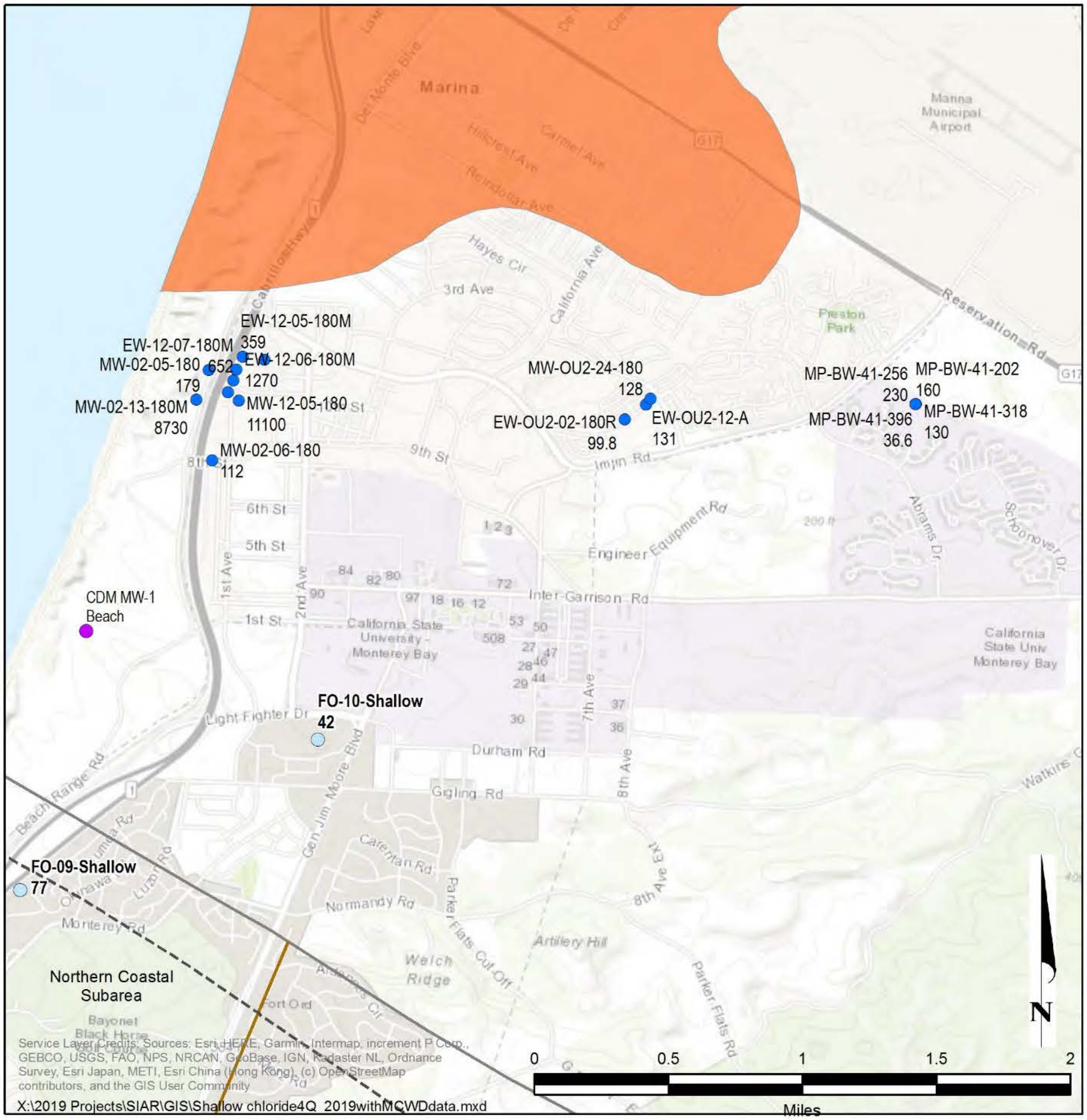

Chloride Concentrations in Monitoring Wells (180-Foot Aquifer)
mg/L Chloride
0
200
400
600
800
1000
1200
1400
1/1/1992
1/1/1996
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
EW-12-05-180M
EW-12-06-180M
EW-12-07-180M
EW-12-08-180U
MW-02-05-180
MW-02-06-180
MW-12-12-180L



Chloride Concentrations in Monitoring Wells
mg/L Chloride
140
120
100
80
60
40
20
0
1/1/1992
1/1/1996
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
Data Gap
EW-OU2-02-180R
EW-OU2-12-A
MPWMD#FO-10D
MPWMD#FO-10S
MW-OU2-24-180



Groundwater Elevations in Monitoring Wells
Groundwater Elevations- Feet
10
5
0
-5
-10
-15
1/1/1992
1/1/1996
1/1/2000
1/1/2004
1/1/2008
1/1/2012
1/1/2016
CDM MW-1 Beach
MPWMD#FO-10D
MPWMD#FO-10S
MW-02-13-180M (Reference)

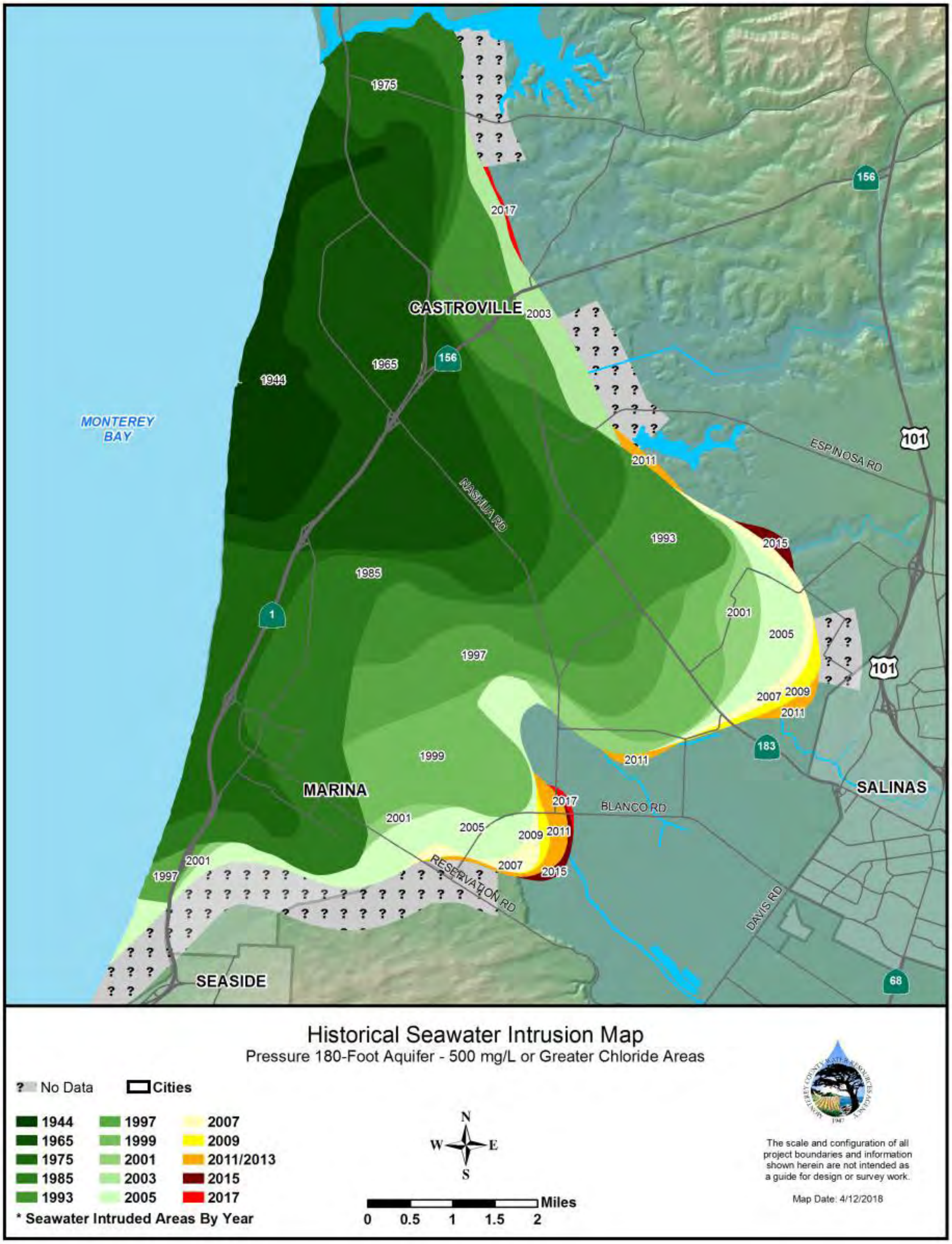


EXPLANATION

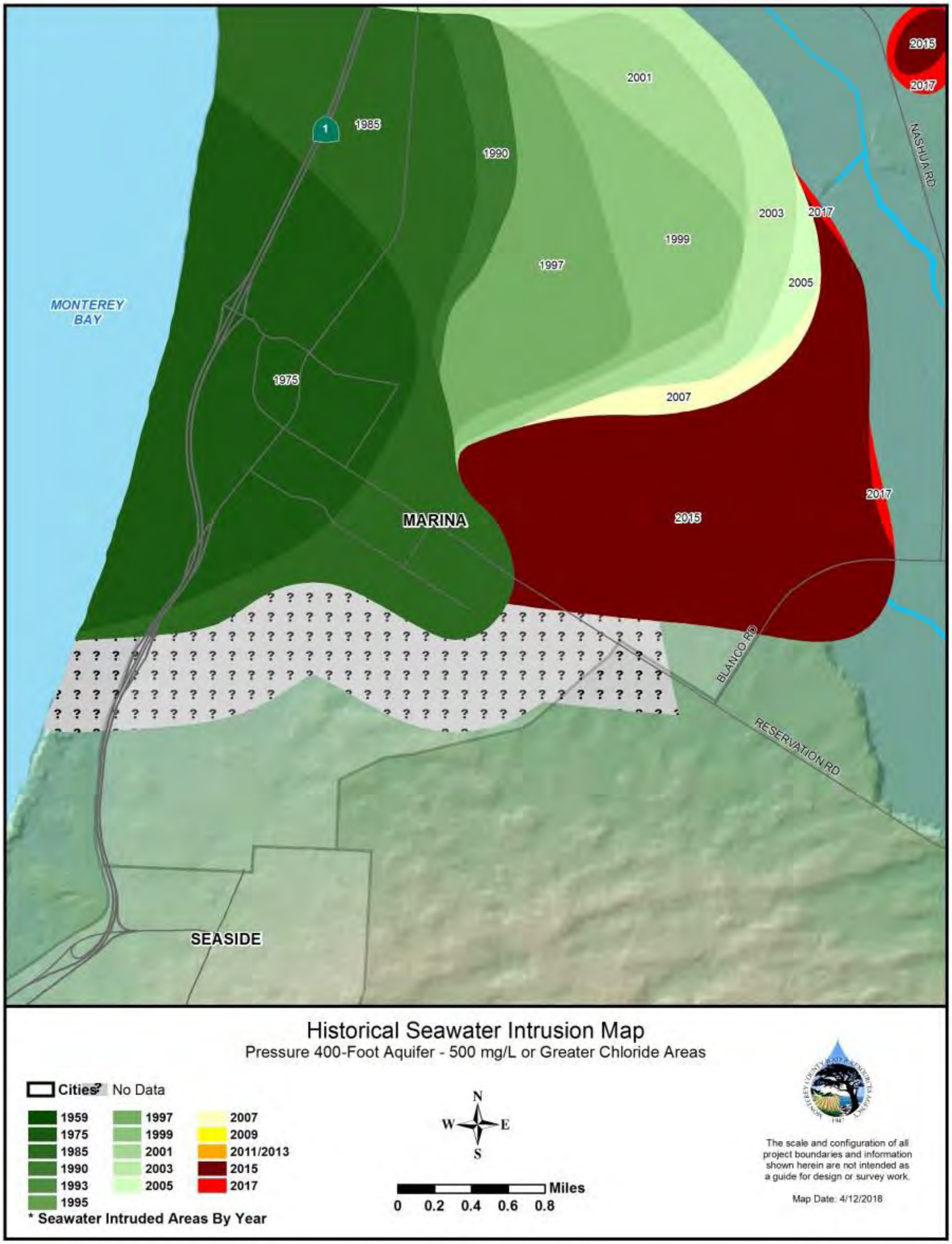
- Fort Ord Monitoring Wells with Maximum Chloride concentration (mg/L)
- Groundwater Elevation Data Reference Well
- 4th Quarter WY 2019 Chloride Concentration in mg/L
- Approximate Shallow Aquifer Northern Boundary

Adjudicated Seaside Groundwater Basin Boundary

- Basin Boundary
- Subarea Boundary
- >500 mg/L Chloride Areas - 400 ft Aquifer in Salinas Valley



2017 Seawater Intrusion Map – 180-foot Aquifer



2017 Seawater Intrusion Map – 400-foot Aquifer

PAGE NO.	PARAGRAPH	COMMENT
General Overall Comment	N/A	1. There are a huge number of acronyms in this Chapter. Please include near the front of the Chapter a list of acronyms and their meanings. 2. I am confused by the many names given to the various aquifers. For example in the Seaside Basin we have 3 aquifers: Aromas Sands, Paso Robles, and Santa Margarita. In the adjacent Monterey Subbasin Marina Management Area there are the upper and lower 180' and 400', the Dunes Sands, and the Deep Aquifers. In the Monterey Subbasin Corral de Tierra Management Area there are the El Toro Principle aquifers. I'm sure many of these are hydrogeologically interconnected and thus, in essence, the same aquifer. Near the front of this Chapter please include a table that gives the corresponding name of the aquifers in each of the Management Areas and the adjacent Seaside Subbasin and the 180/400-foot Subbasin, and a cross-section figure that graphically depicts the aquifers across each of these Management Areas and Subbasins.
7	First bulleted para	This para includes language indicating that there is a data gap in the southern portion of the Marina-Ord area Dune Sand Aquifer. Language should be added to say that this data gap needs to be filled as part of the GSP.
8	First bullet at top of page	This para states that the Dune Sand Aquifer protects the upper 180' aquifer from SWI. Please elaborate on how this protection is provided.
	2nd bullet under "400 Foot Aquifer"	Please explain what is causing the local groundwater depression just north of the boundary between the Seaside Subbasin and the Marina-Ord area. The Watermaster is very concerned that we are starting to see increasing chloride levels in our monitoring well FO-10 which is in that area and also in our monitoring well FO-9 which is inside the Seaside Subbasin not too far south and west of FO-10. For more detail on this please refer to page 33 of the Watermaster's 2020 Seawater Intrusion Analysis Report (SIAR) which is posted at this link: http://www.seasidebasinwatermaster.org/Other/2020%20Seawater%20Intrusion%20Analysis%20Report%20Final%2012-3-20.pdf
Figure 5-3	N/A	The depression referred to on page 8 is clearly shown in this Figure so the response to the comment above about this should also refer to this Figure.
Figure 5-7	N/A	The groundwater contours for the 400-foot aquifer shown in this Figure extend into the Seaside Subbasin. We do not have a 400-foot aquifer in the Seaside Subbasin. Presumably this is either the Paso Robles or the Santa Margarita aquifer, so the legend of this Figure should make that clarification.
Figure 5-8	N/A	The groundwater contours for the Deep Aquifers shown in this Figure extend into the Seaside Subbasin. We do not have a Deep Aquifer in the Seaside Subbasin, and the aquifers we do have, with the exception of the Aromas Sands, are all much deeper than the contours that are shown.

Figures 5-9 and 5-10	N/A	There are groundwater level contours in the Laguna Seca Subarea of the Seaside Subbasin that should also be plotted on this Figure, since they correspond to the same aquifers that are part of the El Toro Primary Aquifer. Those contours are contained in the Watermaster's 2017 Seawater Intrusion Analysis Report on pages 54 and 55. For 2017 the link to the SIAR is: http://www.seasidebasinwatermaster.org/Other/2017%20Seawater%20Intrusion%20Analysis%20Report_Final.pdf
21	Dune Sand Aquifer	The word "the" is missing in the first sentence of this bulleted para, right before the word "large".
23	First para under Corral de Tierra Area	When the term "El Toro Primary Aquifer System" is first introduced please describe the aquifers that comprise it, and if they are not the Paso Robles and Santa Margarita aquifers, explain how they correspond to those aquifers, which are the ones we monitor in the Laguna Seca Subarea of the Seaside Subbasin.
Figure 5-13	N/A	The plots in this Figure of MPWMD#FO-10 and MPWMD#FO-11S show falling groundwater levels, whereas the other plots in this Figure should stable levels. The reason for the falling levels in these wells, which are in the southwestern portion of the Marina-Ord area, should be explained in the text.
Figure 5-14	N/A	This Figure shows groundwater levels in the Deep Aquifers. The plot for MPWMD#FO-10D shows groundwater levels in the Santa Margarita aquifer, not the Deep Aquifer. I am not sure, but the same may be true of MPWMD#FO-11D.
31	Figure 5-18	The text should discuss the dramatic decline in groundwater elevations occurring since 1998, and a trend line for that portion of the data would be helpful to highlight the rate of decline.
Figure 5-20	N/A	There is considerably more groundwater level measurement data in the Seaside Subbasin than is depicted in this Figure. That data is available in the Watermaster's annual SIARs and should be added to this Figure, just as the data in the 180/400-foot Aquifer Subbasin is shown.
37	N/A	A paragraph should be added within the discussion of the AEM data describing the comments and concerns about the reliability of the AEM data which were raised by the Blue Ribbon Panel that reviewed the Cal Am Slant Well reports.
41	Next to last para	A sentence should be added at the end of this para stating that there is also a data gap in the southwestern portion of the Marina-Ord area, which prevents knowing the location of the SWI front in that area as well.
Figure 5-24	Legend	In the legend the "Note" pertaining to the Groundwater with TDS <1,000 mg/L is missing.
Figure 5-28	N/A	The text where it discusses this Figure should note that the Watermaster's Sentinel Well SBWM-1, which is located next to the coast just north of the Seaside-Marina-Ord boundary has not shown any indication of SWI in any of the aquifers that it penetrates, which include the Paso Robles and Santa Margarita aquifers. Therefore, it is not clear why the extent of the "Area of Known Seawater Intrusion" is shown going into that area. Due to the lack of monitoring well data in that area (as mentioned in some of the comments above) it is not clear how the extent of the SWI front can be accurately depicted in that part of the Marina-Ord area. This is supported by the MCWRA SWI mapping in Appendix 5B which has

		"???" shown in that area due to lack of data. This comment also applies to Figure 5-29 which also shows the "Area of Known Seawater Intrusion".
48	Next to last para	A sentence should be added at the end of this para stating that Wells MPWMD#FO-9 and FO-10 have also been showing increasing TDS levels in recent years.
	Last para	Provide a para here that discusses the apparent migration of SWI from the Marina-Ord area, south toward the Seaside Subbasin, as discussed in the Watermaster's 2020 SIAR.
Figure 5-29	N/A	Add an inset plot of TDS levels from well MPWMD#FO-9 to this Figure
50	Bullet list under the heading of Data Sources	Add MPWMD and the Watermaster as entities from which data was collected.

Re: Comments on Agenda Packet Items from Most Recent Monterey Subbasin GSP Committee Meeting

Emily,

I didn't have time to thoroughly read thru the last meetings agenda packet until this past weekend. I'd like to offer the comments below, all of which are referenced to the page numbers of the Agenda packet. I would have cc'd Sara Hardgrave with this email, as she is the Chair, but I found I only have her old email address, not her new one with Supervisor Adams' office, so your forwarding this to her would be appreciated.

Thanks,

Robert S. Jaques, PE
Technical Program Manager
Seaside Basin Watermaster

<u>Page 13:</u> As I mentioned in my comment during the meeting, I believe it is important with any diversion project, such as the one being proposed for the Toro Creek, that the impact of such diversions on adjacent basins (in this case the Seaside Adjudicated Basin) be fully examined. My understanding from our hydrogeologist consultants is that the primary recharge area for the Santa Margarita aquifer in the Seaside Basin is from rainfall percolating through Toro Creek and other areas in that vicinity. It would be harmful to the Seaside Basin if some of that recharge water was diverted for use in the Corral de Tierra Subarea.

On this page there is also reference to "State diversion regulations." It would be good to elaborate on what those regulations say with regard to the proposed Toro Creek diversion.

<u>Page 57:</u> If it is of any help we have production data from the Seaside Golf Courses (there are two 18 hole courses there) which have an allocation of 540 AFY under the Adjudication Decision and in Water Year 2020 actually pumped 537 AF. So for one course the annual pumping amount might be approximately ½ this amount of 270 AFY. This is quite a bit higher than the 168 AFY amount estimated for the Corral de Tierra Golf Course. Golf course superintendents are pretty savvy about their irrigation amounts as it affects turf management. I would think that pumping data from that golf course could be obtained, so the pumping amount won't have to be estimated.

<u>Page 59:</u> I worked on a performance evaluation of the Las Palmas Wastewater Treatment Plant some years ago. As noted in the Wallace report, they use reclaimed water for landscape and open space irrigation within the Las Palmas housing development. However, they rely on a spray field for disposal of the remainder of their effluent that cannot be used for such irrigation. In the winter months the plant has experienced problems with effluent disposal to its spray field, when rainfall causes the sprayed effluent to run off rather than percolate and evaporate. So I believe there is definitely some excess reclaimed water that could be available from this plant. The plant's Annual Report of Waste Discharge, filed with the RWQCB, should have that information.

<u>Page 66:</u> I fully concur with expanding the Groundwater Extraction Management System (GEMS) maintained by the Monterey County Water Resources Agency to cover the full area of the Corral de

Tierra portion of the Monterey Subbasin, as mentioned on pages 21-22, and of requiring Well Registration as mentioned on page 22. If done, I expect this would greatly increase the amount of pumping data that would become available. As noted on page 55, "No extraction information has been found for these private on-site wells in the Subarea" which indicates the need to get more pumping data.

In Figures 2 and 3, and the Land Use Table on this page, what Category is the Corral de Tierra Golf Course? As a major water user it would be helpful for it to be easy to find in the reported data.

Page 69: There is considerable discussion about De Minimis users and that data from them cannot be required. I think there should be some way that the County or MCWRA could require them to submit pumping data, outside of the SGMA regulations, i.e. perhaps under the GEMS as noted above. As Abby mentioned during her presentation, the De Minimis users' collective pumping amounts are estimates only and she commented that the estimate could be low. In either case, I think getting a better handle on how much is really being pumped by the De Minimis users is important to the overall Water Balance and decision that will be made regarding the projects to be implemented to achieve Sustainability.

SBWA
SALINAS BASIN WATER ALLIANCE

Salinas Basin Water Alliance

P.O. Box 247, Salinas, CA 93902

March 10, 2021

Chair Tom Adcock
SVBGSA Advisory Committee
P.O. Box 1350
Carmel Valley, CA 93924

Dear Chair Adcock and SVBGSA Board Members,

On behalf of our directors and members, we are writing to voice several concerns about the GSA's process for approving and promoting projects and management actions for subbasins throughout the Salinas Valley.

First, we are concerned about the agency's timelines for subbasin committees to approve water allocation policies *before* disclosing or approving water budgets. We are acutely aware that the agency's mission is to ensure the sustainability of groundwater throughout the valley. How can we accomplish this if staff-recommended policies to committees are disconnected from the actual amounts of water being used annually in each subbasin? We have seen this order of operations in every one of the subbasin meetings so far and are concerned it flies in the face of the agency's extraordinary efforts to be transparent and effective.

Secondly, we are concerned about how the agency is formulating water budgets. We represent more than 37,000 acres owned and farmed throughout the valley. From our experience, the data being used from 2013 and earlier is not accurate to water usage today, self-reporting data is not a sufficient safeguard for sustainability, and thirdly, any valley-wide formula based on crops is insufficient as temperatures, soil composition, and other conditions vary. If we are to accurately measure and equitably discuss water use throughout the Salinas Valley, we must draw on water metering data to create water budgets.

We appreciate the opportunity to bring our valley-wide experience to the table and look forward to working with all the subcommittees to find sustainable solutions for everyone in the Salinas Valley.

Sincerely,

DocuSigned by:
George Fontes
273F0A0313E424...

George Fontes, President, Board of Directors
Salinas Basin Water Alliance

From:	Emily Gardner
To:	Tina Wang
Subject:	Fwd: Monterey Subbasin GSP Committee Special Meeting on March 23
Date:	Thursday, July 22, 2021 3:56:15 PM

---------- Forwarded message ---------
From: <bobj83@comcast.net>
Date: Mon, Mar 22, 2021 at 11:04 AM
Subject: Monterey Subbasin GSP Committee Special Meeting on March 23
To: Hardgrave, Sarah <HardgraveS@co.monterey.ca.us>, Emily Garnder <gardnere@svbgsa.org>, Abby Ostovar <aostovar@elmontgomery.com>, Derrik Williams <dwilliams@elmontgomery.com>
CC: Bob Jaques <bobj83@comcast.net>, Jonathan Lear <jlear@mpwmd.net>, Tamara Voss <vosstl@co.monterey.ca.us>, Laura Paxton <watermasterseaside@sbcglobal.net>

Everyone,

As I commented on at the last GSP Committee meeting, I believe that Pumping Allocations will be an essential (not just a "Contingency") Action in order for the Corral de Tierra subarea to achieve the Subbasin's Sustainable Yield (SY). The other actions that are Projects only are projected to reduce pumping by a little less than 400 AFY, and the amount of reduction needed to reach SY is estimated to be 1,000 AFY. Thus, a substantial additional amount of reduction will be needed, and this appears only capable of being accomplished by implementing pumping allocations to further reduce pumping.

The term "Sustainable Yield" in the context of the documents being prepared for the GSP is actually the "Natural Safe Yield" as confirmed by Derrik at a recent meeting. The Sustainable Yield concept should be explained to the Committee members, because it is different than the Natural Safe Yield. The Sustainable Yield is nearly always less than the Natural Safe Yield. Specifically, if pumping within a subarea is concentrated in one location, localized lowering of ground water levels can occur there, even if the Natural Safe Yield of the subarea is not being exceeded. It appears that the majority of the pumping in the Corral de Tierra subarea is concentrated in the westernmost portion of the subarea, adjacent to the Laguna Seca Subarea of the Seaside Subbasin. This appears to be a major cause in the lowering of groundwater levels in the Laguna Seca Subarea, as well as in that part of the Corral de Tierra subarea, and hence need to be addressed in the GSP to stop this lowering of groundwater levels.

From the perspective of the Seaside Basin Watermaster, we are looking for the GSP for the Corral de Tierra subarea to address the depletion of groundwater in the Laguna Seca Subarea that is being caused by overpumping in the Corral de Tierra subarea. This is because if pumping in the Laguna Subarea were reduced or even stopped altogether, our modeling shows that even more water from the Laguna Seca subarea would be drawn into the Corral de Tierra subarea because of the lowered groundwater levels in the Corral de Tierra subarea. This tells us that the Watermaster has no capability of stopping the chronic lowering of groundwater levels in the Laguna Seca Subarea, and that this can only be corrected by reducing pumping in the Corral de Tierra subarea.

In summary, I believe this issue needs to be clearly discussed and highlighted in the GSP, so it is clear to all reader of the GSP that pumping allocations to reduce pumping will be necessary, and that they will need to be implemented early-on in the implementation of the GSP in order to avoid causing further detrimental impacts on the Laguna Seca subarea.

Thanks,

Robert S. Jaques, PE

Technical Program Manager

Seaside Basin Watermaster

83 Via Encanto

Monterey, CA 93940

Office: (831) 375-0517

Cell: (831) 402-7673

--

April 5, 2021

Marina Coast Water District
11 Reservation Road
Marina, CA 93933
Attn: Patrick Breen, Water Resources Manager
Email: pbreen@mcwd.org

Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Attn: Emily Gardner, Deputy General Manager and Derrik Williams, GSP Project Manager
Email: gardnere@svbgsa.org; dwilliams@elmontgomery.com

SUBJECT: HWG COMMENTS ON DRAFT MONTEREY SUBBASIN GROUNDWATER SUSTAINABILITY PLAN, CHAPTERS 4 AND 5

Dear Mr. Breen, Ms. Gardner, and Mr. Williams:

This letter provides the comments of the Hydrogeologic Working Group (HWG) on the Draft Monterey Subbasin Groundwater Sustainability Plan (GSP) Chapters 4 and 5. This letter provides both an Executive Summary highlighting some of our main comments, and a Detailed Comments section. It should be noted that the Executive Summary and Detailed Comments provided in this letter are not necessarily intended to be comprehensive, and additional comments may be provided at a later time.

EXECUTIVE SUMMARY

Our comments on the Draft Monterey Subbasin GSP Chapters 4 and 5 generally relate to the following items: description of geologic conditions, conclusions regarding groundwater conditions, preferential use of airborne electromagnetics (AEM) data over field data, and hydrogeologic interpretation of AEM data. Our high-level summary comments on Draft GSP chapters 4 and 5 are provided below, with a detailed comments section following this Executive Summary.

HWG summary comments on Chapters 4 and 5 are:

- The GSP presents a hydrogeologic conceptual model (HCM) with some inaccuracies based on invalid hydrogeologic interpretations of the AEM surface geophysics and other data that is not in agreement with available field data including boring logs, aquifer test, groundwater level, and groundwater quality data;
- The GSP does not utilize the most up-to-date hydrogeologic conceptual model for the northern Monterey Subbasin and southern 180/400 Aquifer Subbasin area in understanding the

hydrogeology of the area even the though the HWG conducted the most recent and extensive investigation of the hydrogeology specific to this area (e.g., HWG Technical Report, November 2017);

- Groundwater levels/quality and aquifer/aquitard continuity are mischaracterized in the northern Monterey Subbasin and southern 180/400 Aquifer Subbasin due to: inappropriate application of the Fort Ord Site Conceptual Model to this area; use of inaccurate hydrogeologic interpretations from AEM data; and lack of using all available field data and the most recent comprehensive hydrogeologic conceptual model of the area;
- The Dune Sand Aquifer (DSA) is not a Principal Aquifer and has been misclassified in the Monterey Subbasin GSP, and is in conflict with the 180/400 Foot Aquifer Subbasin GSP where the Dune Sand Aquifer is not classified as a Principal Aquifer;
- The inaccurate HCM analyses create conflicts with the 180/400-Foot Aquifer Subbasin GSP;
- While the HWG concur that achieving sustainability within the 180/400-Foot Aquifer Subbasin is important for achieving sustainability within Monterey Subbasin, the cause of depressed groundwater elevations and seawater intrusion in the Monterey Subbasin is mischaracterized as essentially being entirely due to pumping within the 180-/400-Foot Aquifer Subbasin and Seaside Subbasin; however, pumping from wells within Monterey Subbasin have played a major role in historical/current undesirable groundwater conditions and the Monterey Subbasin needs to do its part in achieving local and regional sustainability;
- The Monterey Subbasin GSP relies primarily on a study conducted by WRA Environmental (and by reference a study by Formation Environmental) in its discussion of groundwater dependent ecosystems (GDEs); however, there are many concerns about the methods/conclusions used in these studies to establish groundwater dependency of ecosystems that have been documented previously by HWG and supplemented by a recent study conducted by Geoscience/AECOM.

More specific and detailed comments on Monterey Subbasin Draft GSP chapters 4 and 5 are provided below.

DETAILED COMMENTS

Chapter 4 – Hydrogeologic Conceptual Model

1. The GSP states, “The geology described here is based on previously published scientific reports from investigations conducted by the USGS, State of California, other consulting firms, and academic institutions.”(Section 4.1.1, Geological and Structural Setting, p. 64).

HWG Comment: *We note that extensive field work conducted by the HWG between 2013 and 2018, including test slant well installation/testing, drilling of several borings and installation of an extensive monitoring well network, extensive data analyses covering the coastal southern 180/400-Foot Aquifer Subbasin and coastal northern Monterey Subbasin are documented in publicly available reports prepared by the HWG and posted on the Monterey Peninsula Water Supply Project (MPWSP) website (e.g., HWG,* *November 2017). These HWG documents incorporated data from previous studies by others (many of which are cited in the Monterey Subbasin GSP), and allowed for improved hydrogeologic interpretations by incorporating both existing and new field data collected by HWG. The Monterey Subbasin GSP ignores these HWG documents and makes geologic interpretations that are inconsistent with the most recent data that has been collected. Some of the specific inconsistencies are noted in other comments in this letter.*

2. The GSP mischaracterizes the Dune Sand Aquifer in multiple instances in Chapter 4. One example is the attempt to label the Dune Sand Aquifer as a "Principal Aquifer" (Section 4.2.1, Hydrogeology in the Marina-Ord Area, Table 4-1, page 79).

HWG Comment: *The Dune Sand Aquifer is not a Principal Aquifer in the subbasin. The Draft GSP prepared by City of Marina (2019) stated the Dune Sand Aquifer, "…is not commonly used for drinking water or agricultural irrigation". The Monterey County Water Resources Agency (MCWRA), which has studied and characterized the groundwater basin for many decades, does not consider the Dune Sand Aquifer as a principal aquifer (e.g., no seawater intrusion maps are prepared for the Dune Sand Aquifer by MCWRA). The 180/400-Foot Aquifer Subbasin GSP, which the MCWD GSA adopted and submitted to DWR, also does not classify the Dune Sand Aquifer as a Principal Aquifer. The Dune Sand Aquifer is not a Principal Aquifer due in part to its lack of capability for use in groundwater production (e.g., thin saturation, groundwater quality issues related to sea water intrusion and nitrates, etc.). In addition, the Hydrogeology section for the Corral de Tierra Area in Monterey Subbasin GSP Chapter 4 states that following about the upper 120 feet of sediments, "Several small domestic wells draw groundwater from these local alluvial aquifers, but these volumes of groundwater are minimal…Since this volume of groundwater is neither economic or significant, these shallow sediments are not considered a principal aquifer…Groundwater in these sediments is hydraulically connected to the small streams found in the area…" (page 111 of Chapter 4). This conclusion for the Corral de Tierra Area is inconsistent with designating the Dune Sand Aquifer, which cannot even claim to be tapped by "several small domestic wells", as a Principal Aquifer. As noted above, designation of the Dune Sand Aquifer as a Principal Aquifer is inconsistent with the 180/400-Foot Aquifer Subbasin GSP (where the Dune Sand Aquifer also is present), which specifically did not designate the Dune Sand Aquifer as a Principal Aquifer. It is also important to point out that the Dune Sand Aquifer, as defined in the Monterey Subbasin GSP, consists of two distinct aquifers – the coastal Dune Sand Aquifer that directly overlies the 180-Foot Aquifer and the perched/mounded Dune Sand Aquifer (known as the A-Aquifer in Fort Ord studies) that overlies the Fort-Ord Salinas Valley Aquitard (FO-SVA) clay layer (incorrectly referred to as Salinas Valley Aquitard in the Monterey Subbasin GSP). The coastal Dune Sand Aquifer is intruded with sea water, while the perched/mounded Dune Sand Aquifer is perched in areas, has thin saturation, is impacted by nitrates, and is not developed with production wells for any significant water supply uses.*

3. The GSP relies on old geologic cross-sections from 2001 (Section 4.2.1.1, Cross-Sections, pages 80-85).

HWG Comment: *The cited geologic cross-section references and Figures 4-9 through 4-12 do not utilize best available science and most recent borehole and geophysical logs for wells drilled in the area, nor do* *they utilize the most recent geologic cross-sections developed based on these data (see HWG, November 2017). This results in mischaracterization of hydrogeologic conditions for the GSP Plan Area. Geologic cross-sections that use the latest available data and include areas within the Monterey Subbasin are provided in previously published HWG documents (HWG, November 2017; HWG et al., February 2020).*

4. With regard to the Dune Sand Aquifer, the GSP states, "The aquifer is perched further away from the coast in areas where the SVA exists… " (Section 4.2.12, Principal Aquifers, page 86).

HWG Comment: *The HWG agrees with this GSP statement about the Dune Sand Aquifer being perched in areas where it is underlain by the SVA (more correctly referred to as the FO-SVA). However, perched aquifers should not be designated as Principal Aquifers as is being done in the Monterey Subbasin GSP.*

5. The GSP refers to an average saturated thickness of the Dune Sand Aquifer being approximately 50 feet (Section 4.2.12, Principal Aquifers, page 86).

HWG Comment: *As described above, there are two distinct aquifers being referred to collectively in the GSP as the Dune Sand Aquifer. While the coastal DSA may have a saturated thickness of 50 feet or more in some areas, the perched/mounded DSA has a saturated thickness considerably less than 50 feet.*

6. The GSP does not distinguish and describe the differences between the Salinas Valley Aquitard (SVA) and Fort-Ord Salinas Valley Aquitard (FO-SVA) and its significance to the perched/mounded aquifer (underlain by FO-SVA) versus the Dune Sand Aquifer and its equivalents (not underlain by FO-SVA) in many places in the document (Chapter 4).

HWG Comment: *It should be noted that the SVA and FO-SVA are not the same aquitard and FO-SVA occurs at a higher elevation; therefore, they should not be referred to as the same aquitard.*

7. The GSP shows a Conceptual Site Model diagram that was developed from Fort Ord studies, and implies that the Fort Ord Conceptual Site Model diagram applies throughout the Monterey Subbasin (Section 4.2.1.2, Principal Aquifers, Figure 4-13, p.87).

HWG Comment: *Recent studies completed by the HWG demonstrate that the Fort Ord Conceptual Site Model does not apply in the southern portion of the 180/400 Foot Aquifer Subbasin or the northern portion of the Monterey Subbasin. In particular, the concepts of an Intermediate 180-Foot Aquitard and lack of a 180/400 Foot Aquitard do not apply outside of Fort Ord. Work completed by HWG demonstrates that the 180-Foot Aquifer is one vertically continuous aquifer and that the 180/400 Foot Aquitard is present (HWG, November 2017).*

8. The GSP states that horizontal hydraulic conductivity in the DSA ranges from 0.14 to 120 feet/day (Section 4.2.1.2, Principal Aquifers, p.87).

HWG Comment: *It is important to distinguish the two major portions of what is referred to in the GSP as the DSA – coastal and perched/mounded. While the coastal DSA does have K values on the higher end of the cited range, perched/mounded portion of the DSA only has K values at the lower end of the cited range.*

9. The GSP makes general statements on hydrogeologic interpretations of AEM data, including outside of the GSP Plan area (Section 4.2.1.2, Principal Aquifers, p. 88).

HWG Comment: *It is not clear why the GSP is speculating on aquifer conditions outside of the Monterey GSP Plan Area based solely on AEM data, and without consideration of geologic and well data. The GSP also provides no demonstration/evidence of how these conclusions were reached. The HWG has previously provided extensive documentation of erroneous hydrogeologic interpretations of the AEM data (HWG, November 2017, January 2018, August 2018, January 2019, March 2019, and April 2019). The HWG April 2019 document clearly demonstrates with field data that the hydrogeologic interpretations of aquitard gaps from the AEM study are invalid. Furthermore, as described above, MPWSP monitoring well borehole logs demonstrate that areas of uncertain aquitard continuity identified by MCWRA (who did not have MPWSP monitoring well borehole data available to them at the time of their study) near the northern Monterey Subbasin boundary are no longer uncertain and clearly have significant aquitard material present. Furthermore, review of water level and water quality data for the MPWSP clearly demonstrate the presence and continuity of the 180/400-Foot Aquitard in this area.*

The Monterey Subbasin GSP does not describe the applicability of the concept of a sea water wedge (i.e., where sea water intrusion occurs, less saline water often overlies more saline water in a given aquifer) to explain the expected presence of less saline water overlying more saline water in some areas of the vertically continuous 180-Foot Aquifer. The presence of less saline water in the upper portion of an aquifer does not demonstrate the aquifer is not sea water intruded. Furthermore, given the standard of 500 mg/L chloride applied by MCWRA for defining the area of seawater intrusion, the AEM data collected in the area are not capable of distinguishing between a chloride concentration below the standard (e.g., 200 mg/L) from a chloride concentration above the standard (e.g., 600 mg/L) given inherent uncertainties in AEM data interpretation and the complicating variable of lithologic influences on AEM data.

10. The GSP states, "South of the City of Marina, in a portion of the former Fort Ord, the 180-Foot Aquifer is separated into an "upper" zone of sandy deposits with some gravel and a "lower" zone of gravel with sand and clay lenses; the two zones are separated by a thin clay layer (Ahtna Engineering, 2013). Data collected within the former Fort Ord show that significant head differences exist between the upper and lower ones of the 180-Foot Aquifer." (Section 4.2.1.2, Principal Aquifers, p. 91).

HWG Comment: *The HWG agrees that the area where this conceptual model applies is in a portion of former Fort Ord to the south of the City of Marina. However, the GSP implies this conceptual model (illustrated in Figure 4-13) applies throughout the GSP Plan Area, including north of Reservation Road, which is not correct as documented in work by HWG that is not referenced in this GSP (e.g., HWG, November 2017).*

11. The GSP discussion of the "Middle (180/400) Aquitard" suggests it is not present beneath the majority of the Marina-Ord Area, and implies this conceptual model applies throughout the Monterey Subbasin as illustrated by Figure 4-13 (Section 4.2.1.2, Principal Aquifers, p. 91).

HWG Comment: *As noted above with other aspects of the conceptual model presented in Figure 4-13, the concept that the 180/400 Foot Aquitard is not present in northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is erroneous (see recent work by HWG not referenced in the GSP, as well as MCWD well logs). For example, HWG work demonstrates similar groundwater elevations in the upper and lower 180 Foot Aquifer (MW-6), and significantly different groundwater elevations and fluctuations in the 180 and 400 Foot Aquifers (multiple MPWSP monitoring wells).*

12. The GSP states, "The Lower 180-Foot Aquifer zone and the 400-Foot Aquifer in the vicinity of the City of Marina are functionally the same due to the missing Middle (180/400-Foot) Aquitard in this area." (Section 4.2.1.2, Principal Aquifers, p. 94).

HWG Comment: *As discussed above with other aspects of the Site Conceptual Model (Figure 4-13), this characterization does not apply to Northern Monterey Subbasin, contrary to what is stated/implied in the GSP.*

13. The GSP states, "Near the Monterey-Seaside subbasin boundary, a depression exists in the groundwater potentiometric surface of the 400-Foot Aquifer…These data suggest that a potential connection may exist between the 400-Foot Aquifer and the Deep Aquifer in this area." (Section 4.2.1.2, Principal Aquifers, p. 94.)

HWG Comment: *There is no geologic evidence provided in the GSP to support this statement. Preliminary review of geologic data (lithologic logs and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.*

14. The GSP states, "As shown in Section 6 below, groundwater flow direction in the 400-Foot Aquifer is strongly influenced by groundwater pumping in the Salinas Valley Groundwater Basin, inland of the Monterey Subbasin." (Section 4.2.1.2, Principal Aquifers, p. 94)

HWG Comment: *A primary theme of this GSP here and elsewhere is that pumping in the 180/400 Foot Aquifer Subbasin is essentially solely responsible for seawater intrusion in the 180-Foot Aquifer and 400-Foot Aquifer within Monterey Subbasin, and for depressed Deep Aquifer groundwater elevations in the within Monterey Subbasin. However, the history of groundwater development in the Monterey Subbasin demonstrates how groundwater production wells developed for MCWD and Fort Ord resulted in seawater intrusion in the 180-Foot Aquifer and 400-Foot Aquifers in Monterey Subbasin (for example, see quote below from Harding ESE, 2001). In addition, Deep Aquifer groundwater elevations were fluctuating around sea level prior to pumping of Deep Aquifer wells by MCWD that dropped Deep Aquifer groundwater elevations well below sea level. Thus, groundwater pumping from wells screened in the 180-Foot, 400-Foot, and Deep Aquifers within Monterey Subbasin have played a significant role in historical/current seawater intrusion and depressed groundwater elevations within Monterey Subbasin.*

Harding ESE (2001) states: "Seawater intrusion beneath the city of Marina was observed soon after installing several production wells in the 180-Foot Aquifer (MCWD-1, the first city well, was installed in

1956). Subsequent seawater intrusion into this area was closely related to ground water withdrawal by the city of Marina and former Fort Ord. Deteriorating water quality forced the city of Marina to discontinue pumping most of its 180-Foot Aquifer wells by the late 1970's and install water-supply wells in the 400-foot (MCWD-8, -8a, and -9) and Deep Aquifers (MCWD-10, -11, and-12)."

15. The GSP states with respect to the Deep Aquitard (otherwise known as 400 Foot/Deep Aquitard), "There is no analysis available for its spatial occurrence or geologic composition." (Section 4.2.1.2, Principal Aquifers, p. 95).

HWG Comment: *The GSP could have conducted the "missing" analysis of the aquitard for the Monterey Subbasin given that several MCWD production wells (e.g., MWCW 10, 11, 12) and other wells (e.g., USGS deep nested monitoring well, agricultural wells) have available lithologic and geophysical logs. Such an analysis would demonstrate the presence of a 200 to 300 foot thick clay layer (i.e., 400/Deep Aquitard) between the 400-Foot Aquifer and uppermost Deep Aquifer Zone. The lack of seawater intrusion in the Deep Aquifer, which has groundwater elevations on the order of 50 to 100 feet below sea level in the northern Monterey Subbasin area and a strong vertically downward gradient from the 400-Foot Aquifer, combined with high salinity in the 400-Foot Aquifer within and surrounding the northern Monterey Subbasin also shows the strong integrity of the aquitard between the 400-Foot Aquifer and Deep Aquifer. T*he large difference in water levels between the 400-Foot Aquifer and Deep Aquifers also provides evidence of a thick/tight aquitard separating these aquifer zones.

16. The GSP describes the Reliz Fault as displaced the Monterey Formation, which is the base of the Deep Aquifer, shifted downward on the northeast side by 1,000 feet. It then states the fault does not appear to impede groundwater flow within the Dune Sand Aquifer, 180-Foot Aquifer, or 400-Foot Aquifers (Section 4.2.1.3, Structural Restrictions to Flow, p. 98).

HWG Comment: *The GSP does not comment on the possibility of the Reliz Fault altering groundwater flow within the Deep Aquifer.*

17. This section of the GSP begins, "This Section presents a general discussion of the natural fresh groundwater quality in the Marina-Ord Area, focusing on general geochemistry (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *Given the significance of historical and ongoing seawater intrusion in the Dune Sand Aquifer, 180-Foot Aquifer, and 400-Foot Aquifer in the Marina-Ord Area, it is unclear why this section would only describe the fresh water within the Marina-Ord Area.*

18. With regard to the Dune Sand Aquifer, the GSP states, "Groundwater in this aquifer is primarily fresh; minimal seawater intrusion has occurred in this aquifer (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *The coastal Dune Sand Aquifer is intruded by seawater, as demonstrated by monitoring wells at the MCWD office on Reservation Road (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996, 2001) and in the vicinity of the CEMEX site (HWG, November 2017).*

19. The GSP states, "The Dune Sand Aquifer contributes recharge to the 180-Foot Aquifer…" (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *It should be noted that this recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is minimal (likely on the order of a few hundred acre-feet per year). This recharge has not stopped seawater intrusion from occurring in this area.*

Chapter 5 – Groundwater Conditions

1. The GSP notes data sources used in the GSP, which includes documents/data for Monterey Peninsula Landfill (Section 5.1.1, Data Sources, p. 6).

HWG Comment: *We note that Monterey Peninsula Landfill (MPL) is not located within Monterey Subbasin. In addition, if data from Monterey Peninsula Landfill are being used, why are data from MPWSP monitoring network not being used. Notably, later in Chapter 5, the GSP uses AEM data outside of Monterey Subbasin and within the area of MPWSP monitoring network data, yet there is no use of MPWSP data that contradicts the hydrogeologic interpretation of AEM data provided in the GSP.*

2. The GSP states that the Dune Sand Aquifer is a Principal Aquifer and that the 180-Foot Aquifer contains two distinct layers, known as the upper- and lower- 180-Foot Aquifer (Section 5.1.2.1, Marina-Ord Area, p.7).

HWG Comment: *The Dune Sand Aquifer should not be designated as a Principal Aquifer, and is in conflict with the 180/400 Foot Aquifer Subbasin GSP in this regard. Furthermore, the splitting of the 180-Foot Aquifer into two distinct aquifers only applies in the Fort Ord area, and does not apply in northern Monterey Subbasin (HWG, November 2017). While the entire thickness of the 180-Foot Aquifer is intruded by seawater near the coast and for a significant distance inland, the presence of less saline water within the upper portion of the 180-Foot Aquifer further inland is merely a function of the nature of seawater intrusion wedges, and not a function of the presence of an intermediate aquitard within the 180-Foot Aquifer in northern Monterey Subbasin.*

3. The GSP describes groundwater flow conditions in the 180-Foot Aquifer, and states, "…inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion." (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *Any groundwater flow that may occur from the Perched/Mounded portion of the inland Dune Sand Aquifer to the underlying 180-Foot Aquifer has historically not prevented seawater* *intrusion from occurring within the 180-Foot Aquifer, which has been and remains heavily intruded with seawater. Any claims to the contrary, such as in this referenced statement from the Monterey Subbasin GSP, are incorrect. As noted above, there are not geologically distinct Upper and Lower 180 Foot Aquifers in northern Monterey Subbasin. The amount of recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is small, as can easily be demonstrated by calculation of the amount of precipitation recharge in the Dune Sand Aquifer within the area west of the groundwater divide that has potential to recharge the 180-Foot Aquifer (e.g., on the order of a few hundred AFY, before subtracting Ford Ord remedial pumping). Furthermore, in order to dilute incoming seawater to a fresh water concentration, there would need to be over 30 times more fresh water than seawater in the mixing zone to create a net fresh water condition. Thus, a few hundred AFY of fresh water can effectively only dilute about 10 to 20 AFY of incoming seawater.*

4. The GSP states, "…the lower 180-Foot Aquifer is hydraulically connected to the 400-Foot Aquifer in the Marina-Ord Area due to the discontinuous nature of the 180/400-Foot Aquitard within this region…As such, groundwater elevation and gradients in the lower 180-Foot Aquifer are similar to those in the 400-Foot Aquifer in the Marina Ord Area of the Subbasin…" (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *This characterization of the discontinuous nature of the 180-400 Aquitard is not applicable to the northern portion of the Monterey Subbasin. Groundwater levels in the 180-Foot Aquifer and 400-Foot Aquifer are clearly different and distinct in the northern half of Monterey Subbasin and in the adjacent 180/400-Foot Aquifer Subbasin (HWG, November 2017). The Monterey Subbasin GSP does not demonstrate the similarity or difference in groundwater elevations to justify its characterization.*

5. Figures 5-1 and 5-5 show the western extent of the FO-SVA north of Monterey Subbasin as extending to MPWSP MW-3.

HWG Comment: *The extent of FO-SVA shown on the maps is outdated and also does not incorporate more recent data and analyses based on the MPWSP borehole/well data. We also note that groundwater elevation figures for all units except the Dune Sand Aquifer extend northward across the Monterey Subbasin/180-400 Foot Aquifer Subbasin boundary, even though many Dune Sand Aquifer well locations are available and shown on the figures for the MPWSP and MPL monitoring networks. In addition, there are several monitoring wells located at the MCWD District office headquarters and treatment plant on Reservation Road near the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996 and 2001).*

6. In describing groundwater elevations in the 400-Foot Aquifer the GSP states, "A local groundwater depression exists just north of the Monterey-Seaside Subbasin boundary where a potential connection between the 400-Foot Aquifer and the Deep Aquifers may be located ." (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *The GSP provides no geologic evidence for a potential connection at this location between the two aquifers. The GSP only cites to HLA (2001) for cross-sections in this area, but other geologic cross-sections are available to consider from previous reports (e.g., HWG, 2017; Yates et.al., 2005). The location of this depression, which is more centrally located within Monterey Subbasin than described in the GSP text, is only about 1.5 miles south of MCWD Deep wells where a thick (i.e., 200 to 300 feet) aquitard exists between the 400 Foot Aquifer and Deep Aquifer.*

7. GSP Figures 5-1 and 5-5 (Groundwater Level Contours in the Dune Sand Aquifer – Fall 2017 and Spring 2018) show locations of MPWSP and MPL wells, but do not use the data to prepare groundwater level contours.

HWG Comment: *It is not clear why the GSP maps would show these MPWSP/MPL well locations but not use the data. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or to develop an understanding of the geologic conditions for the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data.*

8. GSP Figures 5-2 and 5-5 (Groundwater Level Contours in the 180-Foot Aquifer – Fall 2017 and Spring 2018) show locations of only three of the MPWSP wells (MW-6, MW-8, and MW-9), and do not use data from MW-8 and MW-9.

HWG Comment: *It is not clear why the GSP maps only show selected MPWSP well locations and do not use most of the data from the selected wells that are shown on the maps. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or in developing an understanding of the geologic conditions underlying the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data. We also note that groundwater is indicated to flow inland from the ocean to a pumping center in the north central portion of Monterey Subbasin.*

9. Figures 5-3 and 5-7 (Groundwater level Contours in the 400-Foot Aquifer – Fall 2017 and Spring 2018) show a +10 feet MSL contour as the shoreline in Marina Subbasin.

HWG Comment: *There is no well control to support this +10 feet MSL contour line, or even the zero contour line. We note that groundwater elevations in the 400-Foot Aquifer for MPWSP MW-3 (very close to the shoreline) ranged from 0 to -15 feet NAVD88 during this time period. We also note that groundwater is indicated to flow inland from the ocean to a depressed area in the south central portion of Monterey Subbasin. The Fall 2017 groundwater levels show that the pumping depression in the southern central area of Monterey Subbasin contributes to a broader depression that extends to the 180/400 Foot Aquifer Subbasin. Spring 2018 groundwater levels appear to indicate occurrence of a temporal groundwater divide around the MCWD well field.*

10. The GSP states, "…water levels in the Dune Sand Aquifer increase and decrease during extended wet and dry periods." This statement is apparently in reference to Figure 5-11: Representative Groundwater Elevation Hydrographs in the Dune Sand Aquifer (Section 5.1.3.1, Long-Term Groundwater Elevation Trends, Marina-Ord Area, p. 21).

HWG Comment: *The seven hydrographs shown in Figure 5-11 do not appear to respond to wet and dry periods. The only short-term response observed is around the year 2000 in the hydrograph for MW-OU2-05-A. This apparent stability of groundwater levels in the Perched/Mounded portion of the Dune Sand Aquifer is quite unlike the seasonal fluctuations that occur in response to pumping in the underlying aquifers, and further confirms that the DSA is undeveloped and essentially undevelopable as a water supply and therefore not a Principal Aquifer.*

11. The GSP states, "Groundwater elevations in the Lower 180-Foot Aquifer are generally equivalent to those observed in the 400-Foot Aquifer…" (Section 5.1.3.1, Long-Term Groundwater elevation Trends, 180-Foot Aquifer, Lower 180-Foot Aquifer, p. 21).

HWG Comment: *The GSP provides no evidence that groundwater elevations in the Lower 180-Foot Aquifer are equivalent to those in the 400-Foot Aquifer. In addition, no geologic evidence is provided that defines distinct Upper and Lower 180-Foot Aquifers in terms of a continuous intermediate aquifer throughout the Monterey Subbasin. MPWSP monitoring well MW-6 is a nested well cluster with separate wells in the upper and lower 180-Foot Aquifer and shows essentially identical groundwater elevations and fluctuations – it is located along Blanco Road on the border of the Monterey Subbasin with the 180/400-Foot Aquifer Subbasin.*

12. The GSP states that groundwater elevation data for MPWMD#FO-10 and MPWMD#FO-11 suggest, "…(1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells." (Long-Term Groundwater Elevation Trends, 400-Foot Aquifer, p. 22).

HWG Comment: *Insufficient evidence is provided to make the stated conclusions; for example, no geologic evidence is provided to support these claims. In addition, more groundwater elevation data are needed to evaluate the gradient and flow direction in this portion of the aquifer. Preliminary review of geologic data (lithologic logs and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.*

13. GSP Figure 5-15 shows groundwater hydrographs for Deep Aquifer wells near the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary. Figure 5-16 shows Deep Aquifer groundwater pumping over time. In reference to the adjacent 180/400-Foot Aquifer Subbasin, the GSP states that, "…groundwater elevations in wells located near Cooper Road and Blanco Road have declined more than 5 ft/year over the past 15 years."

HWG Comment: *We note that the three wells in the 180/400-Foot Aquifer Subbasin have data through about 2020 and generally show fluctuating but overall stable groundwater elevations from about 2015 to 2020. Several of the MCWD wells within the Monterey Subbasin shown in the figure are lacking data from about 2017 to 2020, but the overall trend from available data appears to be declining groundwater elevations within Monterey Subbasin from 2015 to 2020. We note that Figure 5-16 shows significant increases in both agricultural and urban pumping from the Deep Aquifer after 2013, with urban pumping comprising approximately half of the total Deep Aquifer pumping over that time period. Figure 5-16 shows a doubling of urban pumping between 2013 and 2018, but no discussion/explanation of the sharp jump in urban pumping is provided in the text. Overall, the characterization of recent Deep Aquifer groundwater elevation trends between the two subbasins in the text appears to be inaccurate based on review of the figures.*

14. The GSP states, “These downward vertical gradients are caused by areal surface recharge, groundwater extraction from deeper aquifers, and laterally extensive aquitards, which exist in the Marina-Ord Area.” (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, pp. 31-32).

HWG Comment: *We note that the GSP references the presence of laterally extensive aquitards separating Principal Aquifers throughout Monterey Subbasin, a statement that we agree with, and yet the conceptual model described in GSP Chapters 4 and 5 provides for essentially no aquitard between the 180-Foot and 400-Foot Aquifers and a big hole in the thick aquitard between the 400-Foot Aquifer and Deep Aquifers.*

15. The GSP states that in the central Marina-Ord Area the groundwater elevations in the upper 180-Foot Aquifer are 70 feet lower than in the Dune Sand Aquifer (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, p. 32).

HWG Comment: *This 70 foot difference in groundwater elevation almost certainly reflects the presence of perched aquifer conditions in the Dune Sand Aquifer at this location, which is why the HWG refers to the portion of the so-called Dune Sand Aquifer overlying the FO-SVA as the Perched/Mounded Aquifer. This observation also begs the question of why the Dune Sand Aquifer is being classified as a Principal Aquifer in this GSP, when much of it is a thinly saturated perched aquifer.*

16. The GSP states, “Within the Monterey Subbasin, seawater intrusion has been documented in the northern portion of the lower 180-Foot and 400-Foot Aquifers.” (Section 5.3, Seawater Intrusion, p. 36).

HWG Comment: *As discussed other HWG comments in this letter, the designation of a geologically distinct lower 180-Foot Aquifer does not apply in the northern portion of the Monterey Subbasin. The entire thickness of the 180-Foot Aquifer is intruded at the coast and for some distance inland, with a seawater wedge having formed further inland (i.e., less saline water overlying more saline water due to density differences).*

17. The GSP describes data sources used in their analysis of seawater intrusion for the GSP, which include two airborne electromagnetic (AEM) surveys (Section 5.3.1, Seawater Intrusion, Data Sources, p. 36).

HWG Comment: *We note that the GSP utilizes an AEM profile entirely within the 180/400-Foot Aquifer Subbasin that passes through/near several MPWSP boreholes/wells, yet the GSP does not use the readily available MPWSP borehole/well data in its analysis. Furthermore, the HWG has conclusively demonstrated in previous documents (e.g., HWG, April 2019) that hydrogeologic interpretations derived from AEM data are flawed and inconsistent with borehole/well data.*

18. The GSP devotes several pages and two figures (5-26 and 5-27) to describing AEM surveys, primarily a profile entirely outside of the Monterey Subbasin (Section 5.3.1.2, Geophysical Data, pp. 36-38, 41-42, and 45-46).

HWG Comment: *It is not clear why the GSP relies so heavily on AEM data (primarily outside the Monterey Subbasin) in its discussion of seawater intrusion (and disregards borehole/well data for the same area) – especially given the flaws in the hydrogeologic and groundwater quality interpretations made using AEM data previously described in multiple HWG documents (e.g., January, March, April 2019). The hydrostratigraphy shown on the AEM profiles (Figures 5-26 and 5-27) is incorrect; particularly with regard to its depiction of aquitards (i.e., the presence of a continuous intermediate aquitard within the 180-Foot Aquifer and absence of a 180/400 Aquitard). In essence, the GSP is inappropriately trying to apply the Fort Ord hydrogeologic conceptual model (developed for a limited area south of Reservation Road) throughout the northern Monterey Subbasin and into the adjacent 180/400 Foot Aquifer Subbasin. Field borehole/well data demonstrate that application of the Fort Ord HCM to northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is incorrect. There is no evidence/basis to support the stratigraphic interpretations in Figures 5-26 and 5-27 related to the presence (or absence) of aquitards between various aquifers. We note that there are no control points for the majority of the cross-section in Figure 5-26, yet the figure implies an abundance of fresh water. Field water quality data from MW-7M do not match that indicated on the profile. The two profiles are inconsistent; where control points exist with a TDS color coded legend the profiles are not shaded accordingly; however, where no control points exist to validate AEM water quality the profiles are shaded.*

19. In describing the purpose of the AEM surveys, the GSP states, "The studies' goal was to evaluate the understanding of the hydrostratigraphy in the study area and to interpret that distribution of groundwater quality indicated by available well data." (Section 5.3.1.2, Geophysical Data, p. 37).

HWG Comment: *While this statement references "available well data", it does not actually cite or use available well data. Rather, the GSP interpretations of hydrostratigraphy and seawater intrusion in this section are based primarily on interpretations of AEM data that are at odds with well data (see various HWG documents such as January 2019, March 2019, and April 2019).*

20. The GSP describes how AEM data (i.e. electrical resistivity) are dependent on, "…the amount of clay, the amount of water, and/or the salinity of the water…" (Section 5.3.1.2, Geophysical Data, p. 37).

HWG Comment: *While we agree with this statement, these facts also point out the high level of uncertainty associated with interpretation of AEM data in this coastal seawater intruded setting where multiple variables are impacting recorded AEM (resistivity) values. This allows for multiple non-unique interpretations of AEM data to be made in such settings, which creates more uncertainty in those hydrostratigraphic and groundwater quality interpretations. The GSP itself acknowledges that water quality interpretation is "difficult to discern" for a wide range of AEM resistivity values. The GSP does not acknowledge that geochemical interpretation of AEM resistivity values even outside of the cited large range are still subject to uncertainties related to variation in lithologic/saturation conditions.*

21. The GSP states, "The AEM surveys have found that high salinity groundwater as a result of seawater intrusion exists within the lower 180-Foot Aquifer and 400-Foot Aquifers of the Monterey Subbasin. This volume of high salinity groundwater is overlain by fresh groundwater in the Dune Sand and upper 180-Foot Aquifers. The results of the AEM study are consistent with water quality data collected within the Subbasin (EKI, 2019)." (Section 5.3.1.2, Geophysical Data, p. 38).

HWG Comment: *Both the AEM data and borehole/well data demonstrate that the coastal Dune Sand Aquifer and essentially the entire thickness of the 180-Foot Aquifer are seawater intruded from the ocean shoreline to approximately one mile inland. At that point, the coastal Dune Sand Aquifer begins to transition to the Perched/Mounded Aquifer that overlies of FO-SVA that is generally not seawater intruded because it is an elevated thinly saturated perched aquifer further inland, and the fully seawater intruded area of the 180-Foot Aquifer transitions to a seawater intrusion wedge with less saline water overlying more saline water due to density differences. While the results of the AEM survey may be consistent with the primarily Perched/Mounded Aquifer groundwater quality data cited in EKI (2019), the AEM survey based hydrostratigraphic and groundwater quality interpretations are inconsistent with the groundwater quality data collected for the MPWSP (e.g., HWG, April 2019) and key MCWD and Seaside Basin wells.*

22. The GSP presents an analysis (Figure 5-23) that demonstrates the definition of 500 mg/L chloride as the threshold for defining seawater intrusion is equivalent to a TDS of 1,000 mg/L. The GSP also cites the State of California upper Secondary Maximum Contaminant Level of 1,000 mg/L for TDS (Section 5.3.2, Defining Seawater Intrusion, p. 40).

HWG Comment: *We concur with the use of 500 mg/L chloride (although a good argument can be made for use of 250 mg/L chloride as a better indicator) and 1,000 mg/L TDS as an appropriate standards/thresholds for drinking water and seawater intrusion. We note that the AEM studies (study authors and study proponents) continue to argue for a drinking water and seawater intrusion threshold of 3,000 mg/L TDS, but this is at odds with GSP stated seawater intrusion and drinking water standards/thresholds of 500 mg/L and 1,000 mg/L TDS. Furthermore, due to the significant uncertainties in AEM groundwater quality interpretations, the AEM studies primarily attempt to differentiate* *groundwater above and below 3,000 mg/L TDS. The use of AEM data with a lower cutoff value (e.g., 1,000 mg/L TDS) results in even greater uncertainty in interpreted results than are achieved using the already uncertain AEM interpretations based on a cutoff of 3,000 mg/L TDS. We note that the GSP adopts a double standard by saying seawater intrusion has occurred when TDS exceeds 1,000 mg/L or chloride exceeds 500 mg/L in the Deep Aquifer, yet concentrations of 3,000 mg/L TDS and over 1,000 mg/L chloride represent low-TDS groundwater that is considered a source of drinking water supply in the AEM studies cited in the GSP.*

23. In reference to the AEM profiles shown in Figures 5-26 and 5-27, the GSP states, "TDS and AEM data shown on these cross-sections confirm that seawater intrusion in the Monterey Subbasin primarily exists in the lower 180-Foot Aquifer and 400-Foot Aquifer, whereas groundwater in the Dune Sand and upper 180-Foot Aquifers remains fresh." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *While the statement refers to Monterey Subbasin, it should be noted that the Figure 5-26 is located entirely outside (north of) Monterey Subbasin, and Figure 5-27 contains very little data for the AEM profile within Monterey Subbasin. Furthermore, we have previously commented (in this letter and previous documents) on the flaws in the hydrostratigraphic and water quality interpretations shown on these AEM profiles (e.g., HWG, April 2019). Actual borehole/well data show the coastal Dune Sand Aquifer and entire thickness of the 180-Foot Aquifer are heavily intruded with seawater at the coast and for a significant distance inland. We recommend that AEM data only be used where results can be clearly validated with actual lithologic and water quality data. By not using this approach, the groundwater conditions are being misrepresented.*

24. In reference to the 180-Foot and 400-Foot Aquifers, the GSP states, "It appears that seawater intrusion in these two aquifers forms a unified intrusion wedge, due to the discontinuity of the 180/400-Foot Aquitard near the coast." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *The HWG has previously demonstrated the flaws and inaccuracies in the hydrostratigraphic/water quality interpretations from AEM data inherent in this statement (i.e., absence of 180/400 Aquitard) (see HWG, April 2019).*

25. The GSP states, "Based on available TDS and AEM data, Figure 5-28 depicts the estimated extent of seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *The area covered by Figure 5-28 does not include the AEM profile shown in Figure 5-26 and the AEM profile in Figure 5-27 provides very little data for the mapped area in Figure 5-28. Therefore, Figure 5-28 presumably is based essentially exclusively on TDS data. Furthermore, the area covered by Figure 5-28 has separate 180-Foot and 400-Foot Aquifers separated by an aquitard, so one map is mixing data from different aquifers and should be revised to be two separate figures as is done by the MCWRA.*

26. The GSP states, "…the 180-Foot Aquifer in the Subbasin is divided by an intermediate aquitard into an upper zone and a lower zone. There is no observed seawater intrusion in the upper portion of the 180-Foot Aquifer." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42).

HWG Comment: *As discussed previously in this letter, the area covered by Figure 5-28 does not have a continuous intermediate aquitard in the 180-Foot Aquifer, does have a 180/400-Foot Aquitard, and seawater intrusion is present in a significant zone along (and inland of) the ocean throughout the entire thickness of the 180-Foot Aquifer (see HWG, 2017; Staal, Gardner & Dunne, 1992; Fugro West 1996 and 2001).*

27. In reference to Figure 5-28, the GSP states, "The figure shows that depressed groundwater elevations in the 180/400 Foot Aquifer Subbasin are creating inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42).

HWG Comment: *It should be noted that there are also depressed groundwater elevations from groundwater pumping within the Monterey Subbasin that are contributing to inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin. In fact, the groundwater elevation contour map provided in Figure 5-28 indicates flow lines from the ocean end in a groundwater depression within the Monterey Subbasin. Furthermore, much greater historical pumping from Fort Ord and MCWD wells within the Monterey Subbasin created seawater intrusion within the Monterey Subbasin. Once seawater intrusion occurs, it requires many decades of maintaining seaward gradients to flush saline water back out of the aquifers.*

28. GSP Figure 5-24 purports to show TDS concentrations and the extent of seawater intrusion in Monterey Subbasin (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 43).

HWG Comment: *The dark blue zone in the Dune Sand Aquifer map extending approximately 0.5 miles inland from the shoreline suggests presence of fresh water coastal Dune Sand Aquifer, which is attributed to the 2018 AEM Survey report according to the map legend. The light blue zone that presumably attempts to define TDS concentrations below 1,000 mg/L includes a lobe that extends west of the FO-SVA extent that is not supported by any well data. On the contrary, available well data from the MCWD office site on Reservation Road for the Dune Sand Aquifer shows significant seawater intrusion has occurred in the area the AEM Survey report shown to be fresh water in the Dune Sand Aquifer along the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996a and 1996b; Fugro West, 2001).*

29. The GSP states, "…seawater continues to flow across the area that is intruded towards the 180/400 Foot Aquifer Subbasin, while there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 48.)

HWG Comment: *While the title of this GSP section refers to "Historical Progression of Seawater Intrusion", it fails to actually discuss the historical progress of seawater intrusion within Monterey Subbasin. As indicated in seawater intrusion maps prepared by MCWRA (Appendix 5B), a significant lobe of seawater intrusion into the 180-Foot Aquifer and 400-Foot Aquifer solely within Monterey Subbasin occurred south of Reservation Road in the 1970's and 1980's. This initial seawater intrusion into Monterey Subbasin occurred as a result of groundwater pumping from MCWD and Fort Ord wells screened in the 180-Foot Aquifer and 400-Foot Aquifer production zones, which were sequentially abandoned and moved inland and/or deeper as seawater intrusion moved inland in response to pumping of MCWD and Fort Ord production wells (Harding ESE, 2001). Most of the saline water that was induced to flow into Monterey Subbasin in the 1970s and 1980s still resides in Monterey Subbasin aquifers, and remains part of the overall area of seawater intrusion that exists today.*

30. Figure 5-29 of the GSP (Total Dissolved Solid Concentration Trends in the Lower 180-Foot, 400-Foot Aquifer) shows historical and recent TDS concentrations in various wells, including MCWD Wells MCWD-29 and MCWD-31. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 49).

HWG Comment: *Figure 5-29 indicates TDS concentrations of approximately 400 mg/L during 2019 in MCWD-29 and MCWD-31. Review of the 2019 AEM Survey Report Table 4-1 shows that AEM based TDS concentrations in the zone screened by these wells is estimated to be greater than 1,000 mg/L (about three times the field measured concentrations). Based on analysis (AEM data is a major data source of mapping sweater intrusion in the GSP) and relationships between chloride and TDS established in the GSP (e.g., chloride concentrations of 500 mg/L equate to TDS concentrations of approximately 1,000 mg/L), it seems that MCWD wells MCWD-29 and MCWD-31 should be included within the area of mapped seawater intrusion. In fact, this discrepancy demonstrates how interpretation of AEM data with regard to water quality can result in significant errors relative to field measured data. Interpreted AEM data has also been shown to significantly underpredict TDS/chloride concentrations (e.g., HWG, April 2019) is some areas.*

31. The GSP relies on a study conducted by WRA Environmental (2020) to conclude that 19.51 acres of aquatic and upland biological communities at six ponds are dependent upon groundwater (Section 5.7.1, Groundwater Dependent Ecosystems, Coastal Vernal Ponds within the City of Marina, p. 68).

HWG Comment: *We note that the five authors of the report by WRA Environmental are all biologists, with no apparent contribution from a hydrogeologist to help evaluate groundwater conditions and dependence of the plant communities on groundwater. The only investigation of groundwater in the report was digging a hole to 14 inches in depth to look for soil saturation; however, these field efforts are inadequate to determine groundwater conditions at the sites because there may be shallow fine-grained sediment layers supporting perched/saturated soils in the upper few feet of soil. The WRA report also cites the fact that their field efforts were conducted in June 2020, well after the end of the rainy season, and water was still observed in most of the ponds (implying it must be groundwater). However, review of monthly precipitation data for the 2019 and 2020 water years indicates the 2019 year was very wet (133% of normal) and the 2020 water year was wet (105% of normal). In addition, heavy rainfall* *occurred in March and April 2020 (about 6.5 inches or close to half the average annual rainfall) with smaller amounts of rainfall in May and June; therefore, it would be expected that surface runoff remained in the ponds with near surface saturation at the time of WRA's June 2020 site visits. We also note that the WRA Report relies on other studies such as Formation Environmental (April 2020) and the draft City of Marina GSA GSP (2020). The HWG has previously commented on these studies, and Geoscience/AECOM conducted the most recent study on the vernal pools (HWG, November 2019; Geoscience and AECOM, August 18, 2020). Summary Geoscience/AECOM comments on the Formation Environmental TM included: 1) very limited use of available groundwater data from MPWSP MW-4 and MW-7 to one point in time without considering entire record and impact of agricultural irrigation return flows in immediate vicinity; 2) relies solely on ET data to justify conclusion that Armstrong Ranch Ponds are groundwater dependent without consideration of alternative water sources such a seasonal surface water from rainfall; 3) failure to account for perched aquifer conditions underlying area; 4) failure to account for effects of urbanization surrounding six ponds in city of Marina that caused ponds to become primarily reliant of surface water runoff and leading to ponds becoming perennial. Furthermore, all six ponds in the Marina area are not hydraulically connected to the coastal Dune Sand Aquifer (thus, pumping from coastal Dune Sand Aquifer will not affect them); and all ponds received surface discharge from storm drains that empty into the ponds. Several ponds were found to have hardpan layers beneath them that limit percolation and likely account for WRA observations of shallow saturation. In addition, water quality data suggest that ponds are more influenced by stormwater runoff than groundwater from the perched aquifer system. Overall, it was found that the Formation Environmental study is fundamentally flawed , misrepresents potential impacts on ponds from pumping in the coastal Dune Sand Aquifer, and does not consider all available evidence concerned the nature of these pond resources and potential impacts to them from pumping. HWG comments on the City of Marina GSA Draft GSP state, "the fact that nearby GDEs are seasonally flooded and have a seasonal nature to them (and are associated with "a lens of less pervious soil") suggests a surface water source is most likely sustaining vegetation in these areas. The GSP evaluation to determine if potential GDEs are actual GDEs did not consider that shallow groundwater in these nearby potential GDE areas is saline or the likelihood that fresh surface water is the primary sustaining factor for these areas and (which means they are not GDEs)."*

32. We note that the City of Marina Draft GSP stated the following with regard to pumping from Marina Coast Water District Deep Aquifer wells, "The combined extraction from these wells was approximately 1,823 AFY in 2015, and is forecast to increase to 3,905 AFY by 2035…" (Section 3.1.8, page 3-17).

HWG Comment: *While the Monterey Subbasin GSP comments on the impacts of increasing pumping from the Deep Aquifer in the adjacent 180/400-Foot Aquifer Subbasin, it is silent on the issue of increased pumping from existing (and potential future new) MCWD Deep Aquifer wells. The cited MCWD Deep Aquifer pumping numbers represent a greater than doubling of the amount of current MCWD pumping from the Deep Aquifer, a pumping amount that already results in Deep Aquifer water levels within Monterey Subbasin on the order of 50-100 feet below sea level. Such increased pumping from the Deep Aquifer by MCWD and others is likely not sustainable.*

33. We note that the City of Marina Draft GSP stated, "In the Monterey Subbasin, groundwater demand from the Deep Aquifer by MCWD to supply the City of Marina is expected to increase….however, the increase is projected to be within MCWD's allocated pumping rights." (Section 3.3.10.4, page 3-69).

HWG Comment: *Regardless of the validity of allocated pumping rights (which is yet to be determined), it remains unclear if the proposed MCWD increase in pumping from the Deep Aquifer is sustainable. In addition, the increased pumping from the Deep Aquifer to the east to support agricultural expansion is based on overlying rights, not allocated (paper water) pumping rights, and are thereby presumably superior to MCWD rights.*

Monterey Subbasin GSP Comment Log (Prepared by SVBGSA)

1. In Comment 41 (dated 1/7/21) Tina Wang states, "…There is one thing we pointed out in that chapter, is the dune sand aquifer and the upper 180 foot aq is not SWI intruded, it is fresh."

HWG Comment: *As pointed out in our comments on GSP Chapters 4 and 5, the Fort Ord Site Conceptual Model (i.e., continuous intermediate aquitard within 180-Foot Aquifer and lack of a 180/400-Foot Aquitard) does not apply in northern Monterey Subbasin. Furthermore, available field data indicate that the Dune Sand Aquifer and upper portion of the 180-Foot Aquifer are seawater intruded (chloride greater than 500 mg/L) for a significant distance inland from the coast in the northern Monterey Subbasin and Southern 180/400-Foot Aquifer Subbasin. We also note that EKI's (and others) definition of fresh water in many previous documents related to the MPWSP has been TDS up to 3,000 mg/L; however, HWG have shown such levels of TDS also have greater than 1,000 mg/L chloride in the area, which is far in excess of the 500 mg/L standard applied by MCWRA for seawater intrusion. The Monterey Subbasin GSP uses AEM data outside of Monterey Subbasin (i.e., in southern 180/400-Foot Subbasin) to claim the presence of this so-called fresh water, yet actual field data show seawater intrusion has occurred at the coast and for a significant distance inland in this area (see HWG, 2017).*

2. In Comment 44 (dated 1/7/21) Derrik Williams responds to the commenter (Bob Jaques) that, "We have discussed the AEM data with some members of the blue ribbon panel…the didn't have too many concerns.'

HWG Comment: *If the commenter is referring to the Hydrogeologic Working Group, this statement by Derrik Williams is incorrect. The HWG has many concerns about the hydrogeologic interpretation of the AEM data and has documented our concerns in numerous documents (e.g., HWG, 2017; HWG, 2018; HWG, January 2019; HWG, March 2019; HWG, April 2019; HWG, June 2020).*

Sincerely,

The Hydrogeologic Working Group (Dennis Williams, Tim Durbin, Martin Feeney, Peter Leffler)

Dennis Williams

Tim Durbin

Martin Feeney

Peter Leffler

REFERENCES

California Public Utilities Commission (CPUC), CalAm Monterey Peninsula Water Supply Project Environmental Impact Report/Environmental Impact Statement, SCH#2006101004, March 2018.

City of Marina Groundwater Sustainability Agency, *Draft Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin*, October 2019.

City of Marina Groundwater Sustainability Agency, *Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin*, January 2020.

EKI Environment & Water, *Fresh Groundwater in Dune Sand and 180-Foot Aquifer South of Salinas River, 180/400 Foot Aquifer & Monterey Subbasins*, December 2019.

Formation Environmental, *Assessment and Protection of Groundwater-Dependent Ecosystems Near the Proposed Monterey Peninsula Water Supply Project Slant Wells, Marina, California*, Technical Memorandum prepared for City of Marina, April 12, 2020.

Fugro West, *Summary of Operations, Construction and Testing of Seawater Intake Well and Brine Injection Well*, Report prepared for Marina Coast Water District, April 1996.

Fugro West, *Marina Coast Water District Seawater Desalination Project; Initiation of Inland Groundwater Monitoring*, Letter Report prepared for Marina Coast Water District, December 31, 1996.

Fugro West, *Inland Groundwater Monitoring; Regional Water Quality Control Board Monitoring and Reporting Program No. 00-117; Third Quarter Sampling and Training Session for MCWD Staff*, Project Memorandum prepared for Marina Coast Water District, August 29, 2001.

Geoscience and AECOM, *Understanding the Influence of Subsurface Aquifer Drawdown Upon Surface Water and Wetlands for the Proposed Monterey Peninsula Water Supply Project*, Technical Memorandum prepare for California American Water, August 18, 2020.

Harding ESE, *Final Report, Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California*, Report prepared for Monterey County Water Resources Agency, April 12, 2001.

The Hydrogeologic Working Group (HWG), *Monterey Peninsula Water Supply Project – Test Slant Well Long Term Pumping Test and Coastal Development Permit #A-3-MRA-14-0050*, letter addressed to California Coastal Commission, July 23, 2015.

HWG, *HWG Hydrogeologic Investigation Technical Report*, November 6, 2017.

HWG, *Memorandum Responding to Comments on HWG Hydrogeologic Investigation Technical Report*, January 4, 2018.

HWG, *HWG Comments on Technical Appendices/Attachments to Letters Submitted by MCWD and City of Marina to the CPUC and MBNMS on April 19, 2018, Letter to John Forsythe/CPUC and Paul Michel/MBNMS*, August 15, 2018.

HWG, *HWG Comments on Technical Presentations and Letters/Memorandum Prepared by HGC, EKI, and MCWD for City of Marina Public Workshop on MPWSP Coastal Development Permit Held on January 8, 2019*, January 25, 2019.

HWG, *HWG Responses to Dr. Knight Letter Addressed to HWG and Submitted During City of Marina Planning Commission Hearing on MPWSP Coastal Development Permit Held on February 14, 2019*, March 6, 2019.

HWG, *HWG Comments on Remy Moose Manley Letter Attachments Prepared by HGC, EKI, and AGF for City of Marina Planning Commission Hearing Agenda Item #6A on MPWSP Coastal Development Permit Held on February 14*, 2019, April 12, 2019.

HWG, *HWG Comments on City of Marina Draft Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin Dated October 2019*, submitted to City of Marina Groundwater Sustainability Agency, November 1, 2019.

HWG, ESA, and HydroFocus, *Response to Tom Luster Email Dated January 30, 2020*, Responses to questions posed by Weiss Associates (third party independent reviewer for California Coastal Commission [CCC]) and Mr. Tom Luster in the CCC proceeding on the Monterey Peninsula Water Supply Project, February 20, 2020.

HWG, *HWG Comments on AGF Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District, Undated*, June 26, 2020; Exhibit 14 in Latham & Watkins LLLP, September 17, 2020, *Special Meeting Agenda Items Th3a & 4a: Monterey Peninsula Water Supply Project, Coastal Development Permit, Application No. 9-19-0918, and Appeal No. A-3-MRA-19-0034*.

Marina Coast Water District Well Logs – Wells 8A, 10, 11, 12, Well A, Well C.

Staal, Gardner & Dunne, *Feasibility Study, Seawater Intake Wells, Marina County Water District Wastewater Treatment Facility, Marina, California*, Report prepared for Marina County Water District, February 1991.

Staal, Gardner & Dunne, *Feasibility Study, Saline Ground Water Intake System, Monterey Sand Company Site, Marina, California*, Report prepared for Monterey Peninsula Water Management District, February 1992.

WRA Environmental, *Biological Resource and Groundwater Dependency Analysis of Marina Vernal Ponds*, Report prepared for City of Marina, July 30, 2020.

LIST OF ACRONYMS & ABBREVIATIONS

AEM	Aerial Electromagnetics
bgs	below ground surface
Cal Am or CalAm	California American Water Company
CPUC	California Public Utilities Commission
DSA	Dune Sand Aquifer
FO-SVA	Ford Ord Salinas Valley Aquitard
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
HWG	Hydrologic Working Group
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
MPL	Monterey Peninsula Landfill
mg/L	Milligrams per Liter
MGSA	Marina Groundwater Sustainability Agency
MPWSP	Monterey Peninsula Water Supply Project
MW	Monitoring Well
SGMA	Sustainable Groundwater Management Act
SVB	Salinas Valley Basin
TDS	Total Dissolved Solids
USGS	United States Geological Survey

Salinas Basin Water Alliance

Salinas Basin Water Alliance Board of Directors

George Fontes

David Bunn

Greg Scattini

Gary Tanimura

Tom Bengard

April 21, 2021

Dear Chair Hardgrave and Monterey Subbasin Committee Members,

As landowners, growers, and agricultural businesses throughout the Salinas Valley, we are writing to support the Monterey Subbasin's emphasis on closing water data gaps ahead of the draft GSP to achieve true sustainability both in the subbasin and the entire Salinas Valley.

As the chair and members of the public have noted, there is a clear lack of data to reflect the impact that activities in neighboring subbasins have on the Monterey subbasin. Without understanding those impacts (including pumping in the 180/400 subbasin or even the GSA's divvying up of agricultural and housing developments between neighboring subbasins), it will be difficult to define sustainability in the Monterey subbasin or have confidence that proposed projects or management actions will have any impact at all.

We are writing to encourage the GSA to address this data gap before pushing the subbasin committee to prematurely approve a draft GSP with projects and management actions. Achieving sustainability will require a true understanding of groundwater flow to and from the subbasin and will ensure community support and engagement if stakeholders see the clear and demonstrable benefits of proposed projects.

Our alliance represents more than 41,000 acres throughout the Salinas Valley. All of our producers carefully monitor and report their water usage and several have property in the Monterey Subbasin. We believe a universal reported metering system that relies on data, not merely estimates, is an essential aspect of groundwater storage monitoring and sustainability efforts.

Our alliance is dedicated to protecting groundwater supply for the long-term. That requires honest data throughout the valley. Closing the data gaps in the Monterey Subbasin is an critical step in that direction.

Sincerely,

George Fontes, President, Salinas Basin Water Alliance

Salinas Basin Water Alliance | P.O. Box 247 Salinas, CA 93902

From:	bobj83@comcast.net
To:	Patrick Breen; Tina Wang
Cc:	Bob Jaques; Laura Paxton; Jonathan Lear
Subject:	Monitoring Well FO-10 Induction Logging Results and Request
Date:	Thursday, April 22, 2021 5:33:23 PM
Attachments:	Martin Feeney FO-9 and FO-10 MW Logging_Rpt-final 4-5-21.pdf

Patrick and Tina,

Attached is the Tech Memo prepared by Martin Feeney after the recent completion of induction logging of monitoring wells FO-9 and FO-10.

As his Memo reports, he does not have an explanation for the findings in FO-10 in which the logging showed high conductivity over nearly the entire depth of the well, whereas the E-log from the original construction of this well did not show this. One theory, that there is leakage in this casing just as is believe to be the case in the casing of FO-9, does not bear out, since there are clearly different water level readings in the different depth wells at FO-10. That indicates that these wells are not cross-connected through casing leakage.

Our TAC asked that you please include investigating the cause of these findings in the GSP for this portion of the Monterey Subbasin, and developing any response action that the investigation finds should be taken.

With regard to FO-9 Shallow, MPWMD plans to video inspect this well, and also FO-10 Shallow, to confirm the suspected casing leakage in FO-9 Shallow and to determine the structural integrity of FO-10 Shallow. They plan to do that work in the next couple of weeks and I will share with you the results of that inspection.

If it is found that the casing in FO-9 Shallow is leaking, and that it is not feasible to repair it, MPWMD said that as the owner of the well they plan to destroy it to avoid having it be a cross-aquifer contamination source. Since water level and water quality data from that part of the Seaside Basin is important not only to the Watermaster and MPWMD, but also to MCWD to provide information for your development of the Monterey Subbasin GSP, if the well needs to be destroyed we would like to discuss with you a cost-sharing arrangement to have a replacement monitoring well installed near that location.

Thanks,

Robert S. Jaques, PE
Technical Program Manager
Seaside Basin Watermaster
83 Via Encanto
Monterey, CA 93940
Office: (831) 375-0517
Cell: (831) 402-7673

From: Martin Feeney
To: Jonathan Lear
Cc: bobj83@comcast.net; Tina Wang; Patrick Breen
Subject: Re: Monitoring Well FO-10 Induction Logging Results and Request
Date: Friday, April 23, 2021 4:06:27 PM

Yes, the plan is to do FO-9 Shallow and Deep. This scheduled for Wednesday.

Cheers

Martin

____

Martin B. Feeney PG CEG CHg
Consulting Hydrogeologist
831-915-1115

> On Apr 23, 2021, at 2:55 PM, Jonathan Lear <jlear@mpwmd.net> wrote:
>
> Martin's recommendation to the District was only to video log FO-09 because the fluid resistivity log from FO-10 proves the increased chloride in the samples taken from FO-10 are representative of water in the screens. In the TAC meeting I stated we were going to perform 2 video logs, but I was referring to FO-09 Shallow and Deep, not Fo-09 and FO-10.
>
> ---
>
> **From:** bobj83@comcast.net <bobj83@comcast.net>
> **Sent:** Friday, April 23, 2021 2:39 PM
> **To:** Jonathan Lear <jlear@mpwmd.net>
> **Cc:** Bob Jaques <bobj83@comcast.net>
> **Subject:** RE: Monitoring Well FO-10 Induction Logging Results and Request
>
> Jon,
> I thought you were going to check the structural integrity of FO-10 too, to make sure it didn't have any leaks.
> Bob
>
> ---
>
> **From:** Jonathan Lear <jlear@mpwmd.net>
> **Sent:** Friday, April 23, 2021 1:40 PM
> **To:** Tina Wang <twang@ekiconsult.com>; bobj83@comcast.net; Patrick Breen <pbreen@mcwd.org>
> **Cc:** Laura Paxton <watermasterlaura@sbcglobal.net>
> **Subject:** RE: Monitoring Well FO-10 Induction Logging Results and Request
>
> Hi,

One correction. The District is planning to video FO-09 shallow and deep and not FO-10.

-Jon

From: Tina Wang <twang@ekiconsult.com>
Sent: Friday, April 23, 2021 1:18 PM
To: bobj83@comcast.net; Patrick Breen <pbreen@mcwd.org>
Cc: Laura Paxton <watermasterlaura@sbcglobal.net>; Jonathan Lear <jlear@mpwmd.net>
Subject: RE: Monitoring Well FO-10 Induction Logging Results and Request

Bob – Thank you for this information and forwarding the request from the Seaside TAC. We'll review and incorporate them into the GSP.

Tina Wang, P.E.
EKI Environment & Water, Inc.
2001 Junipero Serra Boulevard, Suite 300
Daly City, California 94014
T: (650) 292-9100 | D: (650) 292-9050
twang@ekiconsult.com | www.ekiconsult.com

From: bobj83@comcast.net <bobj83@comcast.net>
Sent: Thursday, April 22, 2021 5:33 PM
To: Patrick Breen <pbreen@mcwd.org>; Tina Wang <twang@ekiconsult.com>
Cc: Bob Jaques <bobj83@comcast.net>; Laura Paxton <watermasterlaura@sbcglobal.net>; Jonathan Lear <jlear@mpwmd.net>
Subject: Monitoring Well FO-10 Induction Logging Results and Request

Patrick and Tina,

Attached is the Tech Memo prepared by Martin Feeney after the recent completion of induction logging of monitoring wells FO-9 and FO-10.

As his Memo reports, he does not have an explanation for the findings in FO-10 in which the logging showed high conductivity over nearly the entire depth of the well, whereas the E-log from the original construction of this well did not show this. One theory, that there is leakage in this casing just as is believe to be the case in the casing of FO-9, does not bear out, since there are clearly different water level readings in the different depth wells at FO-10. That indicates that these wells are not cross-connected through casing leakage.

Our TAC asked that you please include investigating the cause of these findings in the GSP for this portion of the Monterey Subbasin, and developing any response action that the investigation finds should be taken.

With regard to FO-9 Shallow, MPWMD plans to video inspect this well, and also FO-10 Shallow, to confirm the suspected casing leakage in FO-9 Shallow and to determine the structural integrity of FO-10 Shallow. They plan to do that work in the next couple of weeks and I will share with you the results of that inspection.

If it is found that the casing in FO-9 Shallow is leaking, and that it is not feasible to repair it, MPWMD said that as the owner of the well they plan to destroy it to avoid having it be a cross-aquifer contamination source. Since water level and water quality data from that part of the Seaside Basin is important not only to the Watermaster and MPWMD, but also to MCWD to provide information for your development of the Monterey Subbasin GSP, if the well needs to be destroyed we would like to discuss with you a cost-sharing arrangement to have a replacement monitoring well installed near that location.

Thanks,

Robert S. Jaques, PE
Technical Program Manager
Seaside Basin Watermaster
83 Via Encanto
Monterey, CA 93940
Office: (831) 375-0517
Cell: (831) 402-7673

Martin B. Feeney
Consulting Hydrogeologist

P.G. 4634
C.E.G. 1454
C.Hg 145

April 5, 2021

Seaside Basin Watermaster
PO Box 51502
Pacific Grove, CA
93950

Attention: Bob Jaques, PE

Subject: Geophysical Investigation Fort Ord Monitoring Wells FO-9 and FO-10 – Preliminary Findings

Dear Bob:

Two monitoring wells in the Seaside Basin monitoring program, FO-9 Shallow and FO-10 Shallow, have recently displayed increasing concentrations of chloride ions; raising the possibility that these data are indicative of advancement of seawater into the basin. However, these data are difficult to reconcile with other data from the more seaward Sentinel Wells that have seen no changes. The ad-hoc advisory team discussed this and generally believed that the data from the monitoring wells would benefit from further confirmation. It was suggested that the monitoring wells be induction logged and the data from the induction logs be compared to the original electric logs to assist in evaluating if there have been conductivity changes in the formation since the time of the well installations. This work has been completed and I'm pleased to provide the initial data and preliminary interpretations.

Background.
Monitoring Wells Clusters FO-9 and FO-10 were drilled in 1994 and 1996, respectively. The wells are nested completions with multiple casings of varying lengths in the same borehole. FO-9 has two completions - a shallow completion in the Paso Robles Formation and a deeper completion in the Santa Margarita Sandstone. FO-10 has 3 completions - one in the Paso Robles Formation, one in the Santa Margarita Sandstone and a third completion in an intermediate depth. The details of well construction are shown on Figures 1 and 2.

Findings

Prior to the recent field work, the original elogs from both of the borings were digitized so the original elogs could be easily compared to the inverse of the induction logs (elog measures resistivity, induction log measures the inverse, i.e., conductivity). After acquiring digital versions of the elogs, the wells were geophysically logged on March 23, 2021. Both induction logs and temperature/fluid resistivity logs were performed. The induction logging measures the bulk conductivity of a sphere of earth materials (including the borehole contents - gravel envelope and casings) of approximately 6 feet in diameter. The temperature/fluid resistivity measures temperature/resistivity of the fluid in the casing. The temperature data allows for the resistivity data to be corrected for temperature. At each location, the deepest accessible well was induction logged while the shallow well was temperature/fluid resistivity logged. The data from the logging and the well construction are attached as Figure 1 and 2.

<u>FO-09</u>

- Both of the completions (shallow and deep) at this site have debris (airlift pipe, suction pipe?) in the bottom of the wells so we were not able to get to bottom or even into perforations.

- As can be seen in the Fluid Resistivity log for this well, FO-09 Shallow is leaking poor quality water into the well at about 185 feet bgs (about -40 ft msl). The data suggest the well has a structural flaw (crack, open joint?) at this depth.
- Below this depth, water quality is impacted but as the log approaches the perforations, the quality improves.
- The induction logging matches the original elog reasonably well. Although the magnitude of the recent trace appears higher than the original, no area looks more conductive than it was in 1994. The higher magnitude of the recent trace is likely a function relating to the legacy elog to which it is compared, which reflects the higher conductivity fluid in the borehole at the time of original logging. The drilling mud had a conductivity (EC) of about 625 μS at time of drilling whereas now the water (where not impacted by the leak) in the well (and formation) is closer to 400 μS.
- The elevated chloride values in the water quality samples from this well are the result of the entry of water from higher in the casing, not recently advancing SWI.

FO-10

- The induction tool was not able descend in the deep well as the upper section has a bend in the casing that is too tight for passage. The intermediate and shallow wells were successfully logged to bottom.
- The induction log is severely muted when compared with the original elog. At first glance it looks like seawater intrusion, but on further reflection the shift is along the entire profile, which is considered unlikely. The reason for the muted response is unclear. Discussions with the geophysical contractor suggest that all the intermediate well seals are leaking and allowing poor quality water from above. Whereas that theory would explain the data, it again is consider highly unlikely because water level data from these wells consistently show significant differences between shallow and deep completions.
- The fluid resistivity logs show elevated EC in the screen section relative to the standing water in the casing, suggesting the quality in the screen section may be changing and the water quality samples from this well maybe valid.

The two shallow wells were displaying elevated chloride values. The new data confirms that the water quality samples from FO-09 Shallow are impacted by a structural flaw in the casing that is allowing poor quality water to enter the casing and contaminate the perforated area from which samples are taken. The recent samples are not representative of the in-situ aquifer water from the screened interval at this location. It is recommended that this well be video surveyed to assess the nature of the flaw. After confirmation of the nature of the structural flaw, the well should be repaired or destroyed to prevent continued contamination of the Paso Robles Formation at this location.

The data also confirms that the recent increase in chlorides in FO-10 Shallow is representative of the water in the perforations. The reason for the increase is not known. Ongoing routine sampling may assist in better determining water quality trends and any additional well investigative recommendations at this location.

The opportunity to perform this work is appreciated. Please call if you have any questions.

Sincerely,

Figure 1

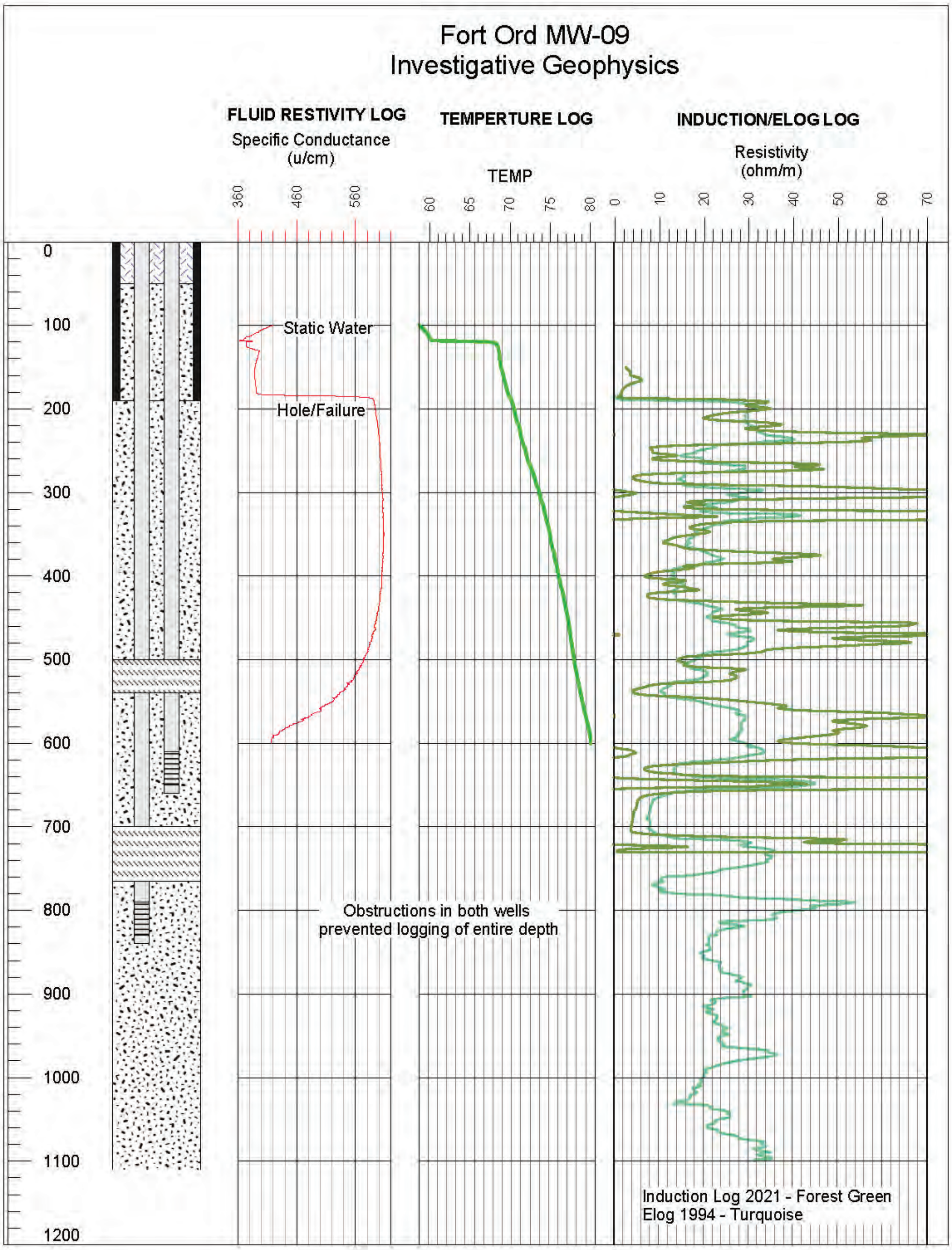
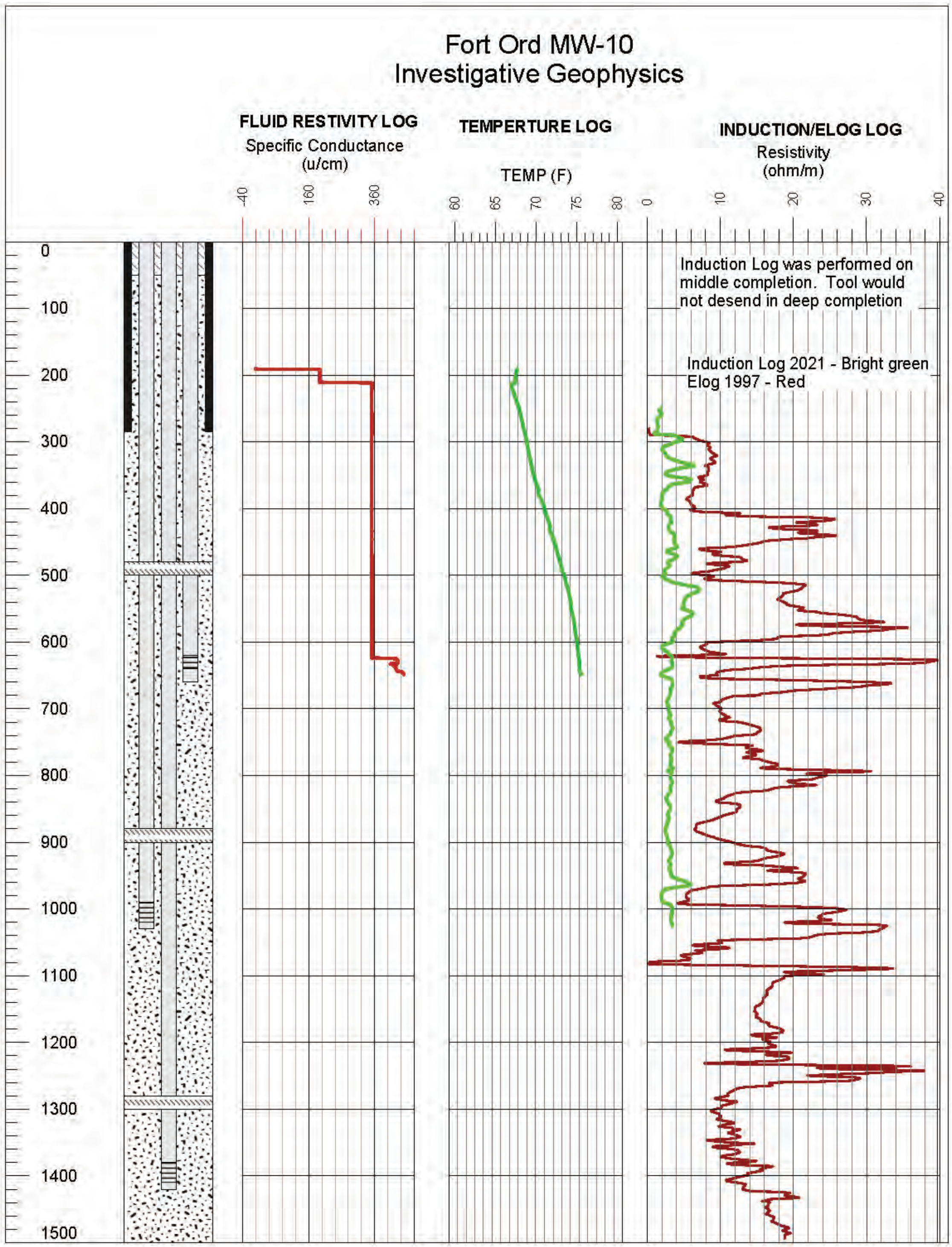

Fort Ord MW-09
Investigative Geophysics
FLUID RESTIVITY LOG
Specific Conductance
(u/cm)
360
460
560
TEMPERTURE LOG
TEMP
60
65
70
75
80
INDUCTION/ELOG LOG
Resistivity
(ohm/m)
0
10
20
30
40
50
60
70
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Static Water
Hole/Failure
Obstructions in both wells
prevented logging of entire depth
Induction Log 2021 - Forest Green
Elog 1994 - Turquoise

Figure 2


Fort Ord MW-10
Investigative Geophysics
FLUID RESTIVITY LOG
Specific Conductance
(u/cm)
-40
160
360
TEMPERTURE LOG
TEMP (F)
60
65
70
75
80
INDUCTION/ELOG LOG
Resistivity
(ohm/m)
0
10
20
30
40
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
Induction Log was performed on middle completion. Tool would not desend in deep completion
Induction Log 2021 - Bright green
Elog 1997 - Red

COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

San Jerardo Cooperative, Inc.

April 23, 2021

Salinas Valley Basin Groundwater Sustainability Agency

Submitted electronically to:

Emily Gardner, Deputy General Manager

Donna Meyers, General Manager

Subject Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins

Dear Salinas Valley Basin Groundwater Sustainability Agency:

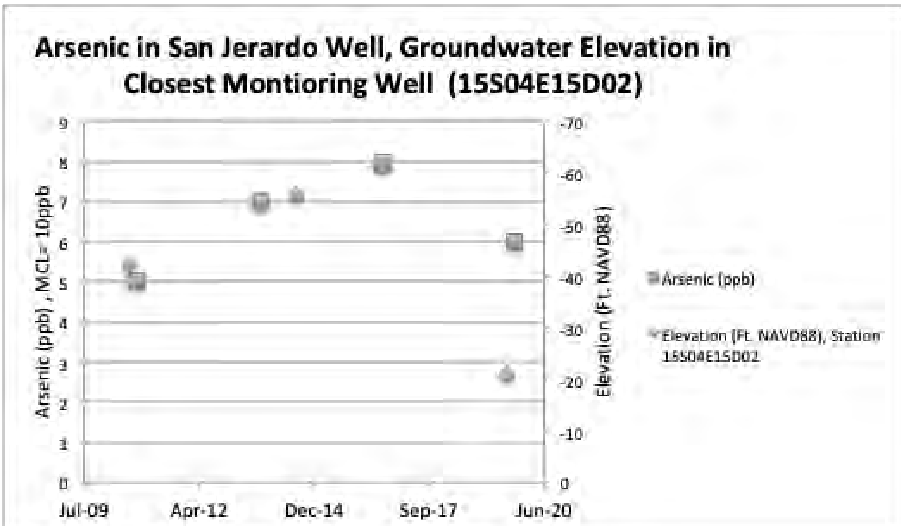
The Community Water Center (CWC) and the San Jerardo Cooperative would like to offer comments and recommendations in response to the draft Groundwater Sustainability Plans (GSPs) Chapter 1-8 for the Langley, East Side, Forebay, and Upper Valley Subbasins as well as Chapters 1-5 and 7 for the Monterey Subbasin that were released in 2020 and early 2021 by the Salinas Valley Basin Groundwater Sustainability Agency (SVB GSA). In addition, we offer preliminary comments on the draft Chapter 9 Implementation Actions that were shared with subbasin committees in April 2020. These comments are intended to add to the public record and are submitted in addition to previous written and spoken comments.

The challenges facing San Jerardo and similar communities throughout all the subbasins in the Salinas Valley are the foundation of our comments in this letter. The San Jerardo Cooperative's well is highly vulnerable to changes in groundwater levels and groundwater quality. Over decades of living and working at San Jerardo Cooperative, Horacio Amezquita has observed firsthand how the irrigation practices on properties surrounding the cooperative impact the water quality in their current and former wells. The San Jerardo Cooperative receives drinking water from a small public water system (CA2701904) and is very concerned that pumping, irrigation practices, and groundwater management in the East Side Subbasin will cause their drinking water well, which currently meets all drinking water standards, to exceed the maximum contaminant levels for arsenic and/or nitrate. Unfortunately, data from the State Water Board indicates increasing levels of nitrate and arsenic in their well with a high arsenic level of 8 ppb on 8/22/2016 that also corresponds to a low groundwater elevation of -61.5 in Station 15S04E15D02, the closest monitoring well to the San Jerardo Cooperative's well (See CWC Figures 1 and 2).[1] While there are too few monitoring data points to draw significant conclusions, CWC Figure 1 does suggest that arsenic levels are higher when groundwater levels are lower. Scientifics studies confirm that contaminants like arsenic, uranium, and chromium (including hexavalent chromium)

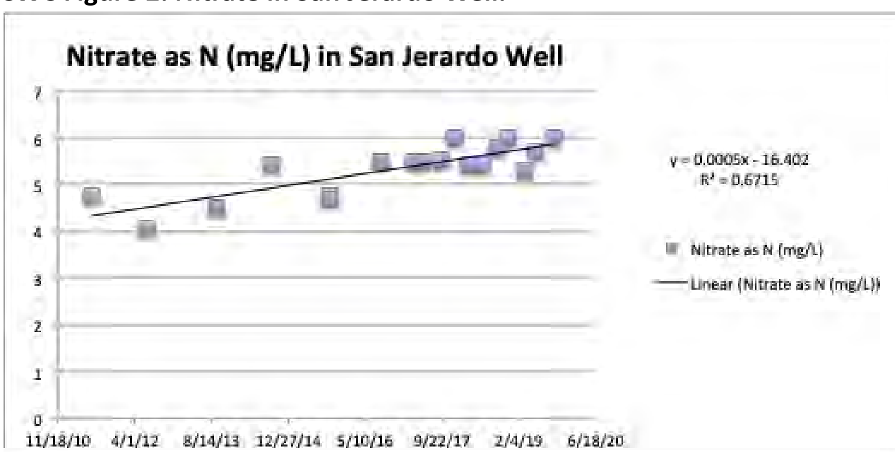
[1] CWC Figure 1 contains all available arsenic data from the State Water Board's Drinking Water Watch online database (https://sdwis.waterboards.ca.gov/PDWW/) which was collected in October 2010, 9/11/13, 8/22/16, and 9/23/19. We then added the monitoring data for Station 15S04E15D02 for the dates most close to the arsenic sampling dates (August 2010, August 2014, August 2016, and August 2019). CWC Figure 2 data was also downloaded from the same online database.

are more likely to be released under certain geochemical conditions influenced by pumping rates, geological materials, and water level fluctuations.[2]

CWC Figure 1: Arsenic in San Jerardo Well, Groundwater Elevation in Closest Monitoring Well
(Note: The groundwater elevation y-axis is reversed to illustrate that lower groundwater elevations are associated with higher arsenic levels.)



CWC Figure 2: Nitrate in San Jerardo Well.



We provide more specific chapter-by-chapter comments in this comment letter. We recommend the GSP should be revised throughout to acknowledge the science showing that groundwater pumping and groundwater level changes can influence water quality.

We strongly recommend that the GSPs incorporate a more robust and representative monitoring network and minimum thresholds to protect vulnerable communities like San Jerardo and those

[2] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

dependent on shallow domestic drinking water wells. This network should include state and local small water systems.

We also firmly agree with the State Water Board's December 8, 2020 comments to the Department of Water Resources on the 180/400 Foot Aquifer GSP, have included them as a reference throughout this comment letter, and recommend that the SVB GSA implement their recommendations in all the other Subbasins GSPs currently in development.[3]

Thank you for reviewing this letter and for the consideration of our comments on the draft GSP chapters. We look forward to working with the SVB GSA to ensure that the GSPs are protective of the drinking water sources of vulnerable, and often underrepresented, groundwater stakeholders. Please do not hesitate to contact us with any questions or concerns. We also look forward to meeting with you in the future to further discuss issues raised in this and past comments.

Sincerely,

Heather Lukacs
Community Water Center

Horacio Amezquita
General Manager, San Jerardo Cooperative, Inc.

Justine Massey
Community Water Center

Mayra Hernandez
Community Water Center

GSP Chapter 3: Description of Plan Area

The description of the plan area can be improved by clarifying the descriptions of the drinking water users in the area. In order to develop a GSP that addresses the needs of all beneficial users, it is critical that the location and groundwater needs of Disadvantaged Communities (DACs) and all drinking water users including domestic well communities are explicitly addressed early on in the GSP. In addition to comments previously submitted to the GSA on July 10, 2020, we recommend the following updates to this chapter:

- **Include a map of all disadvantaged communities (DACs) and their drinking water sources in the subbasin including private wells** as determined both by census data (block groups, census designated places, and census tracts) and median household income surveys conducted in accordance with state and federal agency guidelines. We appreciate that the SVB GSA added "Appendix 11E Disadvantaged Communities" to the 180/400 foot aquifer GSP (Pages 928-941, January 3, 2020) with important information about the location and drinking water challenges, both water quality and seawater intrusion, facing DACs. This information is critical to inform the

[3] DWR SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29.

rest of the GSP. We recommend that it be moved into Chapters 3 and 5 and augmented in the ways described in this section.

- **Correct small error in text in Section 3.2.1 Water Source Types** that incorrectly states that "small state water systems" are included in the Tracking California database. The Tracking California database only includes public water systems serving 15 or more connections.
- **Clarify the number and type of public water systems in the subbasins throughout the entire plan.** In each subbasin plan, there are discrepancies between types and numbers of public water systems in different chapters. For example, the East Side GSP lists the following:
    - Table 3-2 Well Count Summary shows "Public Supply= **24 wells**"
    - Table 5-3 GAMA Water Quality Summary shows "Number of Existing Wells in Monitoring Network Sampled in Water Year 2019" to be **41** for 123-TCP, **46** for Nitrate, and 9 for TDS.
    - Section 7.5 "All the municipal supply wells in the Subbasin are part of the RMS network." A total of **51 public supply** wells were sampled in WY 2019.
    - Table 8-4 Groundwater Quality Minimum Thresholds - **No well count shown**.

  We recognize that different data sources have different limitations and recommend using the best available data consistently throughout the plan.
- **Add a table of all public water systems, their names, locations, number of connections, and number of active wells** in the text or in an appendix that is consistent with the numbers of wells in Table 3-2, Table 5-3, Section 7.5, and other locations where mentioned in the GSPs.
- **Add state and local small water systems to Figure 3-5.** While these systems are currently not in Figure 3-5, their services areas do appear on the SVB GSA GIS portal (svbgsa.maps.arcgis.com) and are labeled as "Parcels served by small water systems (fewer than 15 connections).
- Consider using the same terminology as the Monterey County Department of Health for the state and local small water systems serving 2-14 connections and not using "small public water systems" in Section 3.4.4.2 and throughout the plan. Some definitions of small public water systems include water systems serving up to 199 or even 3300 connections.[4]
- **Revise Section 3.6.3 on the Agricultural Order to indicate that Agricultural Order 4.0 was adopted in April 2021 and include monitoring requirements including on-farm domestic well monitoring of nitrate and 123-trichloropropane, as well as irrigation well monitoring of nitrate.**

GSP Chapter 4: Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a key component of the basin setting. The basin setting represents the baseline assumptions that the GSA relies on throughout the GSP when choosing minimum thresholds, measurable objectives, and undesirable results, as well as when planning projects and management actions. We recommend that the GSA:

- **Revise Section 4.6 on Water Quality to acknowledge that "natural groundwater quality in the Subbasin" can be influenced by pumping and the way groundwater is managed.**[5] As indicated

---

[4] California Code, Health and Safety Code - HSC § 116275

[5] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

in our cover letter, this is of particular importance for the San Jerardo Cooperative who has experienced increases in nitrate and arsenic in their well.

GSP Chapter 5: Groundwater Conditions

In Chapter 5, we recommend that the GSA make the following changes to all subbasin GSPs (East Side, Langley, Monterey, Upper Valley, and Forebay). The goal is to clearly represent current and past water quality conditions in the subbasin in order to inform the monitoring network sustainable management criteria, planning, management actions, and projects.

Groundwater Quality Distribution and Trends

- **Clearly state in the introduction to Section 5.4 that the amount and location of pumping can impact groundwater quality distribution and trends.** We recommend including this language in the letter submitted by the State Water Board to DWR regarding the 180/400 foot aquifer GSP (Dec. 2020): "Not all water quality impacts to groundwater must be addressed in the GSP, but significant and unreasonable water quality degradation due to groundwater conditions occurring throughout the subbasin, and that were not present prior to January 1, 2015, must be addressed in the GSP's minimum thresholds."[6] High rates of groundwater pumping can pull in contaminant plumes towards drinking water wells, cause the release of arsenic from the strata in the ground, and when shallow wells go dry or are too contaminated to use, new wells must be drilled into deeper portions of the aquifer where they are more likely to encounter high arsenic levels.[7] As previously mentioned, this is of direct concern to the San Jerardo Cooperative who has observed increasing arsenic levels in their relatively new drinking water well, which was drilled to replace a more shallow well contaminated with nitrate and 123-trichloropropane.
- **Include trend data for drinking water wells in the subbasins.** In some places, nitrate and other contaminants are increasing in drinking water wells. It is important to understand current contamination values and also whether well water quality is improving, staying the same or declining as well as the relationship of water quality to other sustainability indicators. As indicated by the data provided in this section, Monterey County maintains an exceptional dataset of water quality data for over 900 state and local small water systems serving 2-14 connections that should be utilized throughout the GSPs. Monterey County has sampled many small water systems for decades. CWC Figures 3 and 4 show nitrate concentrations increasing over time in two state small water systems in the East Side sub basin with high levels in one of the systems (Middlefield Rd. Water System #4) in 2015. Figure 5 illustrates arsenic concentrations in the Metz Road Water System #4 in the Forebay Subbasin. In some cases, data shows fluctuations and peaks in concentrations during the 2015-2016 timeframe. This is similar to the San Jerardo example shared previously. Further, the Central Coast Regional Water Board has analyzed data from their Irrigated Lands Regulatory Program to show that many wells across the region are showing increasing levels of nitrate concentrations.[8]

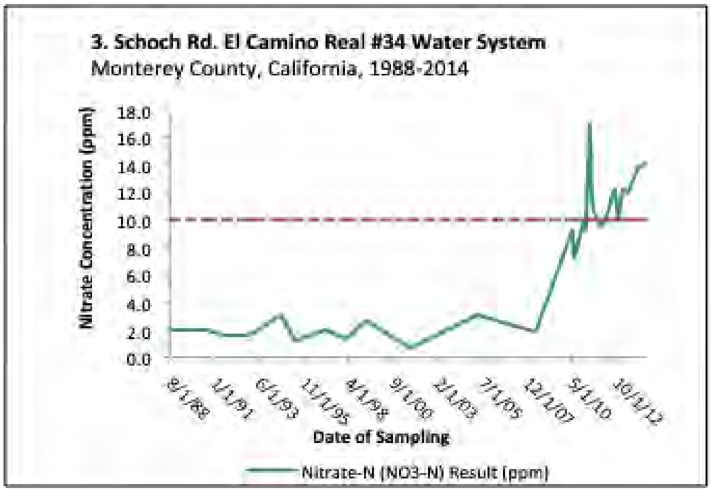
---

[6] DWR SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29

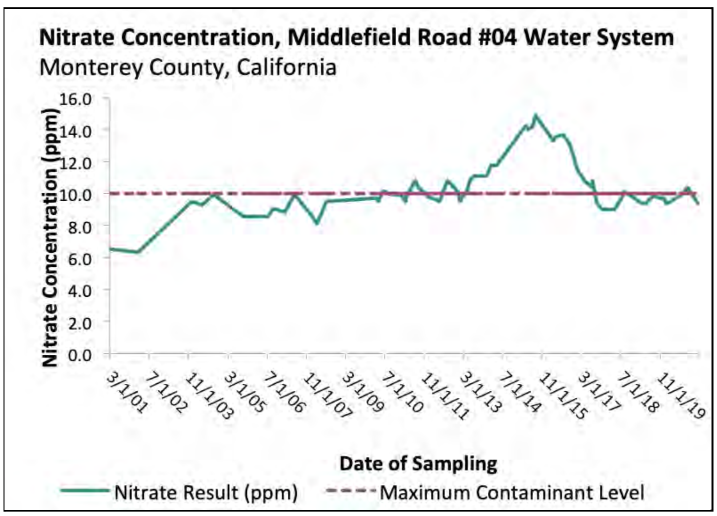
[7] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information. Available at: https://www.communitywatercenter.org/sgmaresources

[8] Draft Ag Order, Attachment A, 141-143, https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order4_renewal/2021april/pao4_att_a_clean.pdf.

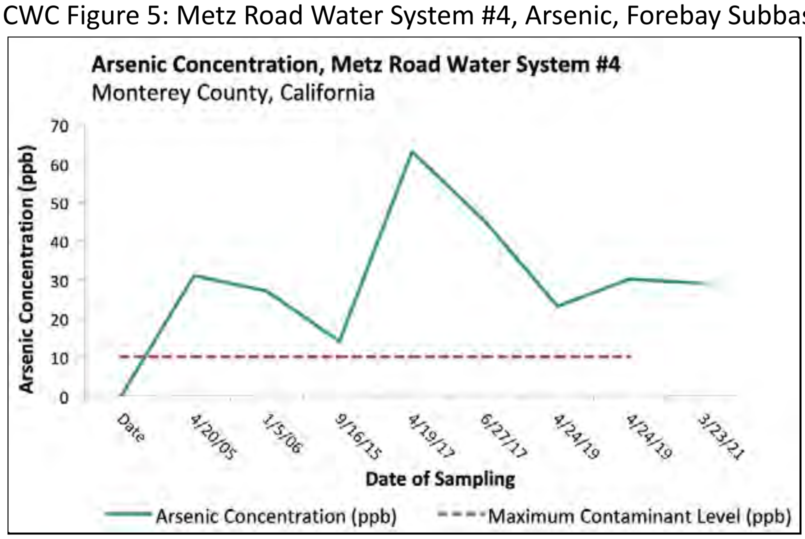
CWC Figure 3: El Camino Real WS #34 - Nitrate as N, East Side Subbasin



CWC Figure 4: Middlefield Road WS #4 - Nitrate as N, East Side Subbasin



CWC Figure 5: Metz Road Water System #4, Arsenic, Forebay Subbasin



- **Revise Section 5.4 to include a specific discussion, supported by maps and charts, of the spatial or temporal water quality trends for all constituents that have been detected in the subbasin and may affect drinking water beneficial users, as required under 23 CCR § 354.16(d).** This section should include water quality data (both in map and tabular form) for all constituents (where available) with primary drinking water standards that have been detected in the subbasin including, but not limited to, **nitrate, 123-trichloropropane, hexavalent chromium,**[9] **arsenic, uranium, and perchlorate for all public drinking water wells, state and local small water system wells, and private domestic wells.** It is especially important for all groundwater stakeholders to be able to understand and visualize the location of contaminant hotspots throughout each subbasin.
    - **Present maps and supporting data for all constituents of concern.** The review of water quality data in the groundwater conditions section of the draft Section 5.4 in the subbasin GSPs is focused primarily on nitrate. The GSPs identify numerous constituents that have been detected in groundwater above drinking water standards, but, with the exception of nitrate, do not present this data spatially. Even though the subbasin GSPs set water quality minimum thresholds for additional constituents (See Tables 8-4 and 8-5), the supporting data is not all presented, and no analyses of spatial or temporal water quality trends are presented. This does not present a clear and transparent assessment of current water quality conditions in the subbasin with respect to drinking water beneficial use (23 CCR § 354.16(d)).
    - **Augment and clarify data presented in Table 5-3 GAMA Water Quality Data Summary and Section 5.4.1 in the following ways:**
        - **Add all state and local small water systems data.** Table 5-3 should include all state and local small water system data for nitrate, arsenic, hexavalent chromium, and any other contaminants that Monterey County monitors in the subbasin.
        - **Include additional contaminants that have been detected in the subbasin(s) to be consistent with Tables 8-5 and 8-6.** Our review of publicly available data on drinking water wells of all types (private domestic wells, state/local small water systems, and public water systems) indicate that there are additional constituents of concern beyond those currently listed. We included CWC Figure 6 (page 9) to highlight the spatial distribution of arsenic in public water system wells in the **East Side, Langley and Monterey Subbasins**, and CWC Figure 7 (page 10) to highlight the spatial distribution of hexavalent chromium in in public water system wells in the **Langley Subbasin**. We recommend a more comprehensive analysis of all other constituents in the subbasins, including, but not limited to the following[10]:

[9] The maximum contaminant level for hexavalent chromium should be reinstated in 2021. Data is available from the State Water Resources Control Board and Monterey County Environmental Health Bureau (public water system data, state/local small water system data) as well as on GAMA from the Central Coast Regional Water Quality Control Board's private well testing program.

[10] All Monterey County data shared in this section was collected by the small water system program. https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local
It was downloaded from the Greater Monterey County Community Water Tool on April 22, 2021: http://www.greatermontereyirwmp.org/documents/disadvantaged-community-plan-for-drinking-water-and-wastewater/

- **East Side Subbasin:** Table 5-3 presents data on two primary contaminants in drinking water: nitrate and 123-trichloropropane, but arsenic is also of particular concern to San Jerardo Cooperative and others in the subbasin. GAMA shows that four public water system wells have exceedances of the arsenic MCL in the past three years (CWC Figure 8), and state/local small water system out of compliance lists from the Monterey County Health Department (2021) show that both Old Stage Rd WS #6 and Old Stage Rd WS #7 are out of compliance for arsenic and that at least five other state or local small water systems have between 6-8 ppb of arsenic, which means they are similar to San Jerardo Cooperative in terms of their vulnerability to water level fluctuations or other changes.
- **Forebay Subbasin:** While arsenic is less common in the Forebay than in the Langley, Monterey, and East Side Subbasins, our review of the Monterey County Health Department data indicates that 17 state or local smalls had arsenic at levels above 1 ppb in the 2015-2017 time period, and at least two of these had levels above the MCL. See CWC Figure 5 (page 8) which illustrates trends in one of the out-of-compliance small water systems, Metz Road Water System #4. In addition, three systems monitored by Monterey County as part of their Local Primacy Program for public water systems serving 15-199 connections had hexavalent chromium detections of 2.8 ppb, 3.4 ppb, and 2.1 ppb in the 2014-2017 timeframe.
- **Upper Valley Subbasin:** Although arsenic is not as common in the Upper Valley as other subbasins, it has been detected in levels between 3.2 and 5 ppb in six small water systems monitored by Monterey County.

■ Clarify what is meant by "DDW wells" in Table 5-3. If these are "public supply wells" in GAMA, please clearly state this.

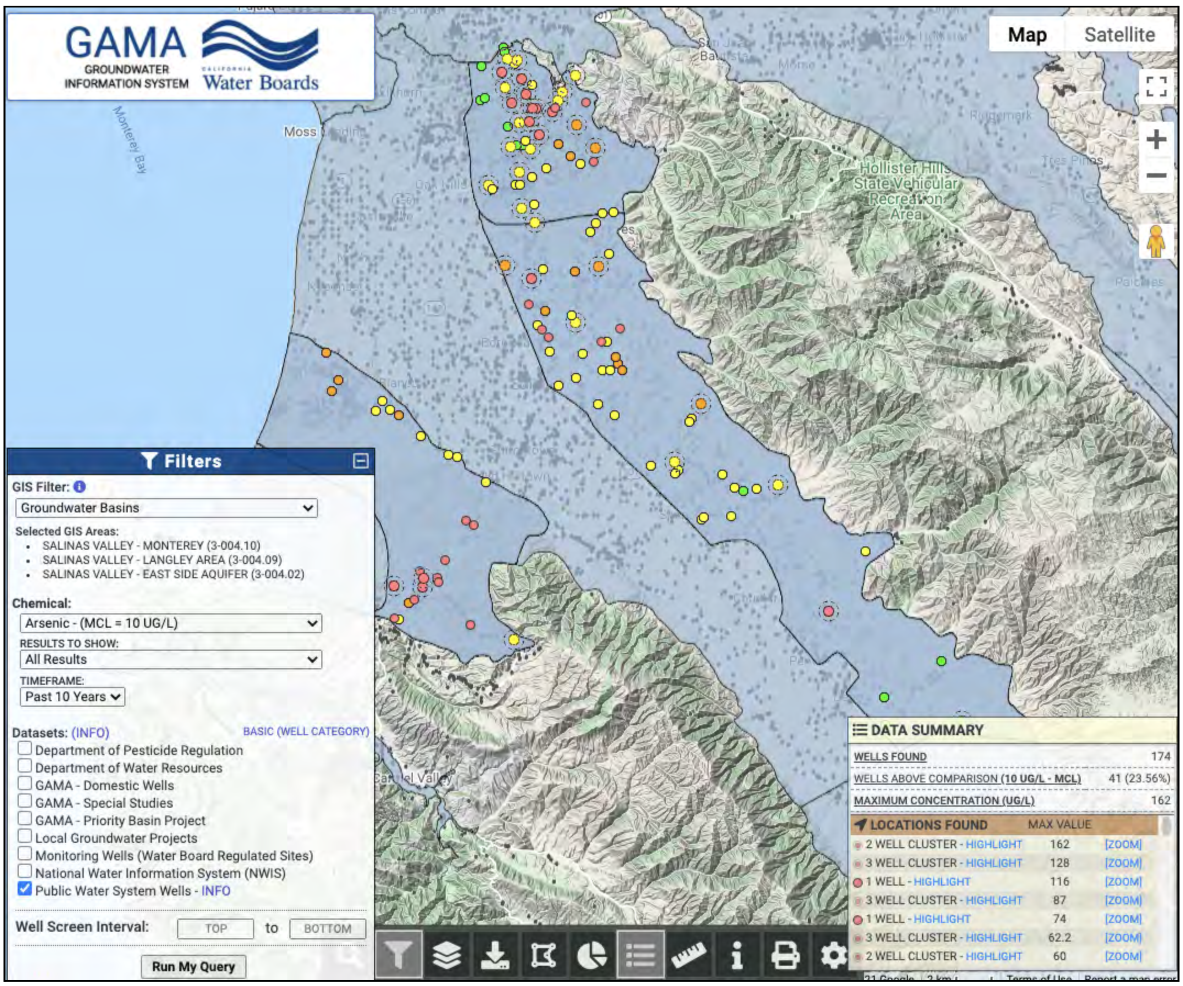
■ **Include the following in Table 5-3: (1) total number of wells of each type, (2) the total number of wells sampled for each constituent, and (3) Of the total number sampled, the number of systems that are out-of-compliance with drinking water standards.** Since public water systems and ILRP wells are monitored on different schedules, there are significant data gaps and inconsistencies when comparing one year to the next in the way that drinking water contaminants are currently represented in GSPs Chapters 5, 7, and 8. For example, we were surprised to see only 15 ILRP Domestic Wells included in Table 5-3 the East Side Subbasin GSP. GAMA shows that there were 139 ILRP wells in the East Side Subbasin sampled for nitrate in the past 3 years, 331 sampled in the last 10 years, and only 8 sampled in the last year. Moreover, CWC Figure 8 illustrates 43 Public Water System Wells in the East Side Subbasin with arsenic data in the past 3 years. On CWC Figure 8, San Jerardo Cooperative's well is shown in orange to indicate that it is at-risk but has not yet exceeded the MCL. However, only 18 Public Water System Wells have sampling data for arsenic from the past year, and during this timeframe, San Jerardo Cooperative's well is not represented (See CWC Figure 9).

■ **Use the compliance status or most recent sample result instead of using the "Number of Wells Exceeding Regulatory Standard in Regulatory Year 2019"**

This is especially important for Table 8-4 and Table 8-5 but also applies to Table 5-3. We recommend the following for different types of drinking water systems:

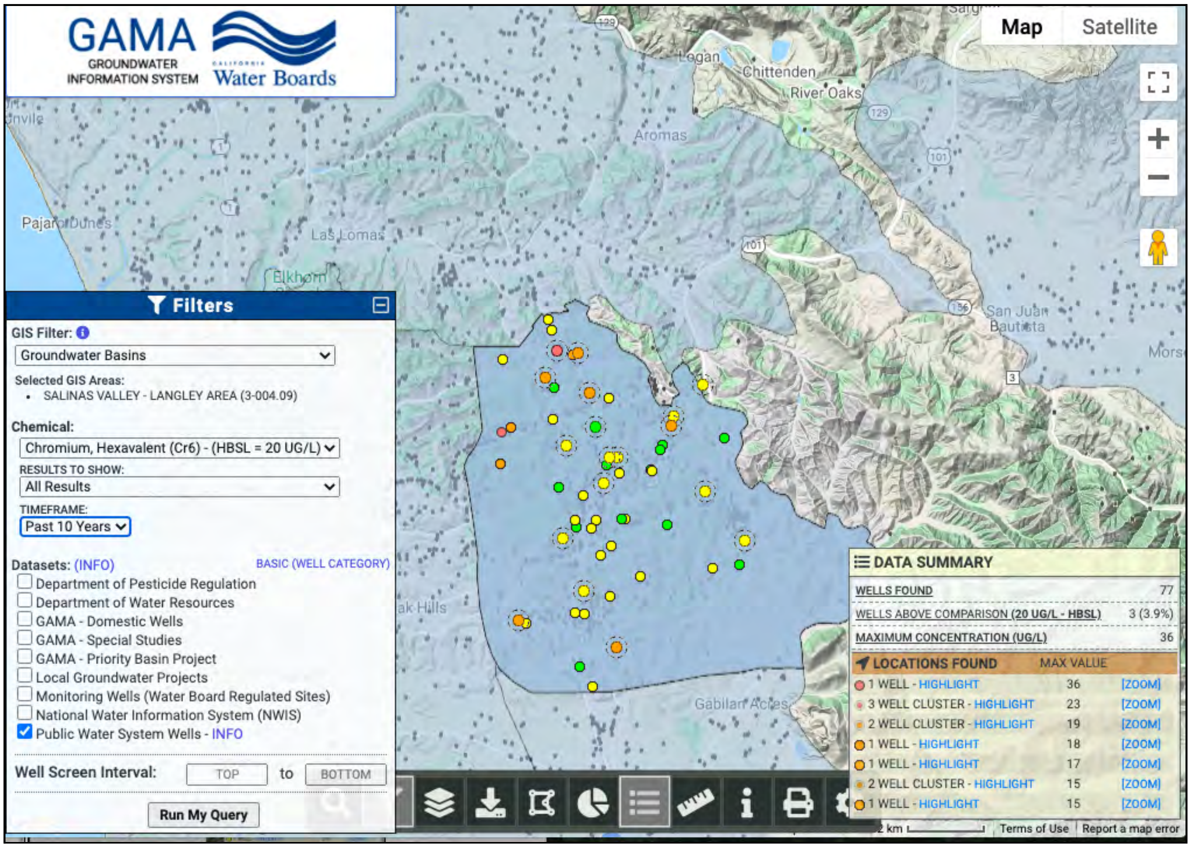
- For public water systems, we recommend using the State Water Board's determination regarding compliance status.
- For state and local small water systems, we recommend using the Monterey County Health Department list of out-of-compliance systems, which is published on their website and available by request on an annual basis based on the most recent sample collected.[11]
- For ILRP wells, we recommend the GSA consider an approach similar to Monterey County and show the most recent sample result for each monitoring well (and not only those sampled in the past year).

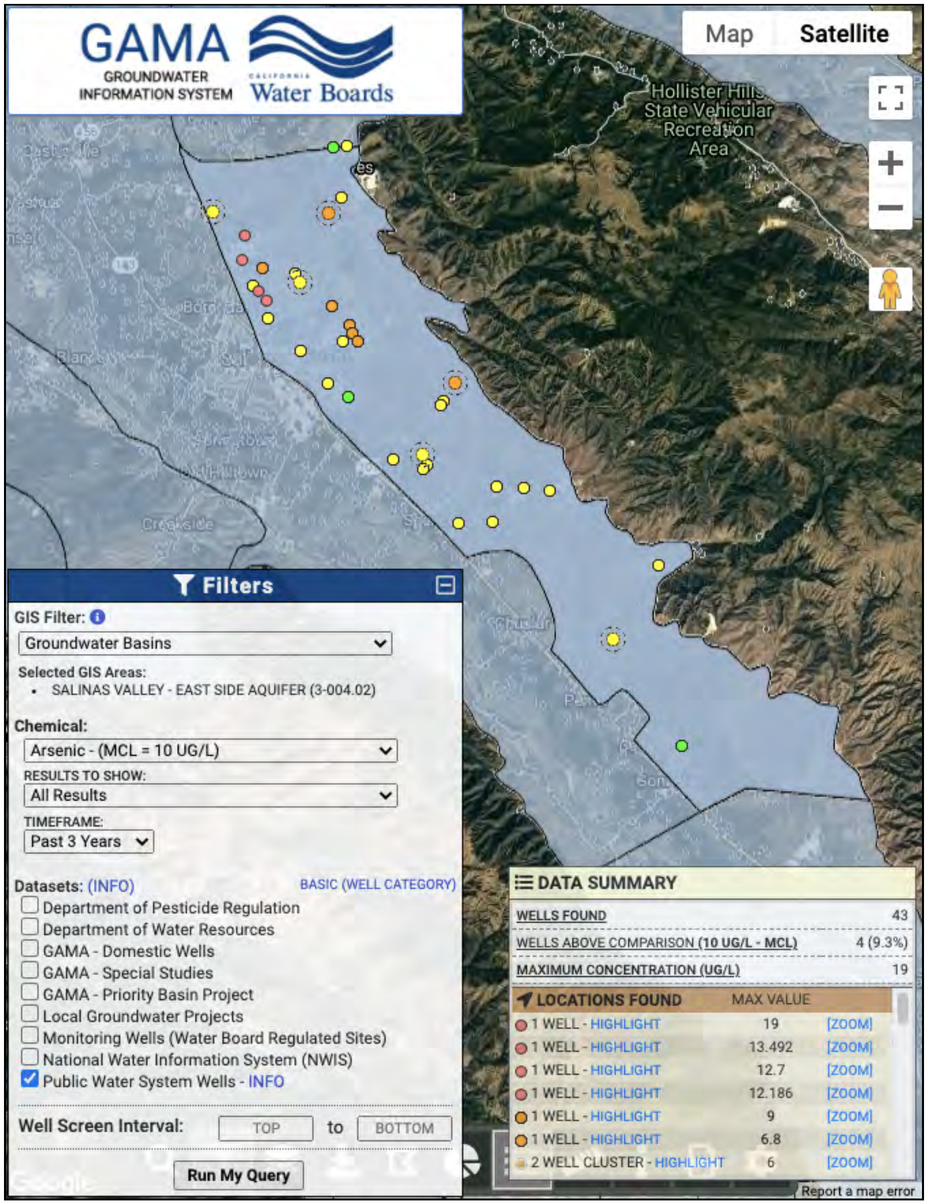
CWC Figure 6: Arsenic Concentrations in Public Water System Wells, Monterey, Langley East Side Subbasins (Red dots = >10 ppb, Orange = 5-9.9 ppb, Yellow = 0.6-5.9 ppb, Green= non-detect)



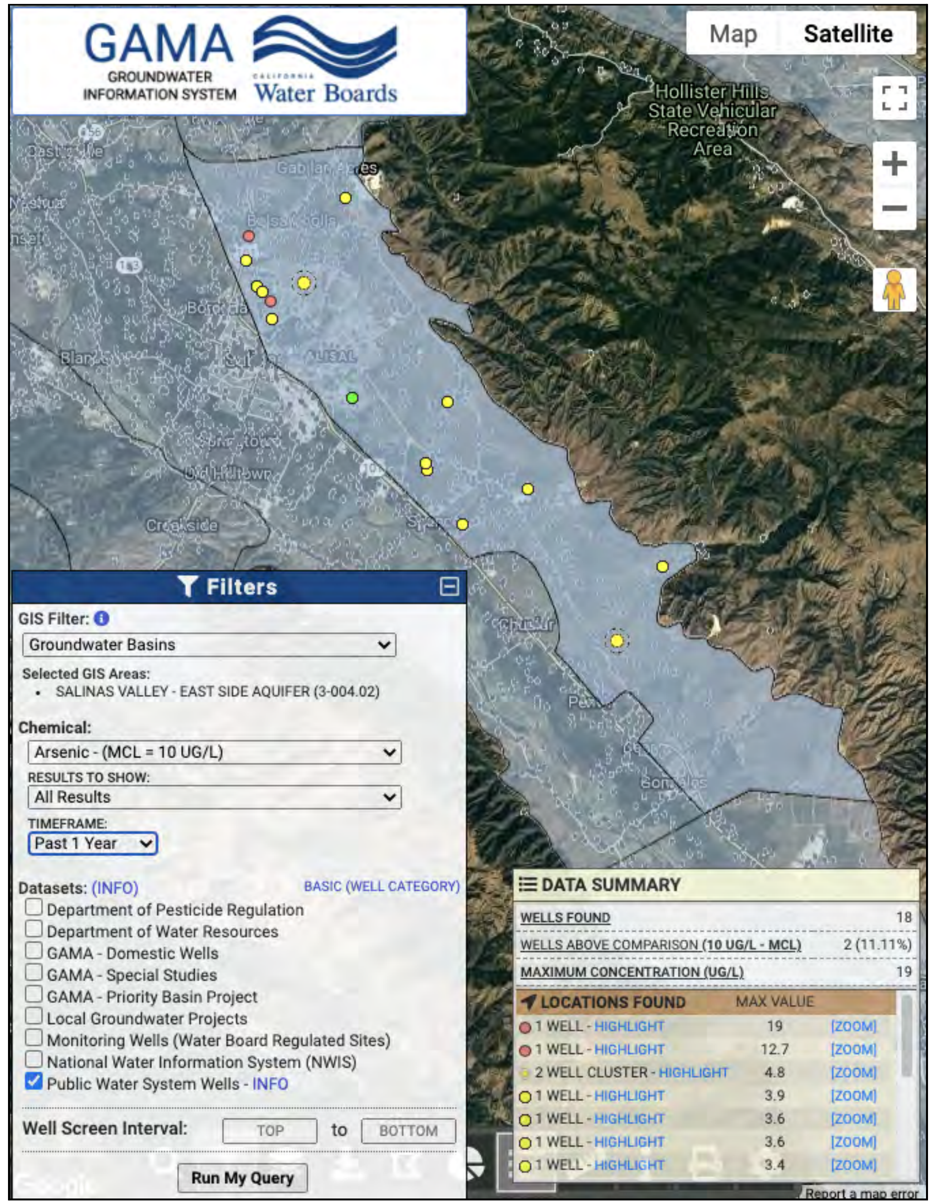
[11]https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local.

CWC FIgure 7: Hexavalent Chromium Concentrations in Public Water System Wells, Langley Subbasin





CWC Figure 8: 43 Public Water System Wells have arsenic data in the past 3 years. One well at San Jerardo Cooperative appears orange on this map.



CWC Figure 9: Only 18 Public Water Systems Wells have arsenic data in the past year. San Jerardo Cooperative's wells are not shown on this map.

GSP Chapter 6: Water Budgets

SGMA requires a GSP to quantify the water budget in sufficient detail in order to build local understanding of how historic changes have affected the six sustainability indicators in the basin.[12] Ultimately, this information is intended to be used to predict how these same variables may affect or guide future management actions.[13] GSAs must provide adequate water budget information to demonstrate that the GSP adheres to all SGMA and GSP regulation requirements, that the GSA will be able to achieve the sustainability goal within 20 years, and be able to maintain sustainability over the 50 year planning and implementation horizon.[14]

We are concerned that the calculations of sustainable yield and the water budget in this chapter may *overestimate the actual sustainable yield and water availability of the subbasins*. We highlight points of concern below and recommended changes.

6.4 Projected Water Budgets

The SVB GSA Subbasin GSPs explain that "[p]rojected water budgets are extracted from the SVOM, which simulates future hydrologic conditions with assumed climate change. Two projected water budgets are presented, one incorporating estimated 2030 climate change projections and one incorporating estimated 2070 climate change projections. … The climate change projections are based on data provided by DWR (2018)."[15] Including climate change scenarios in water planning is an important step for California's increased resiliency, however, which scenarios to include is a critical question.

Climate change is changing when, where, and how the state receives precipitation.[16] Impacts to water supply, particularly drinking water supply, could be devastating if planning is inadequate or too optimistic. GSAs must adequately incorporate climate change scenarios in water budgets. As such, the DWR Climate Change Guidance[17] makes recommendations to GSAs for how to conduct their climate change analysis while preparing water budgets. DWR also provides climate data for a 2030 Central Tendency scenario and 2070 Central Tendency, 2070 Dry-Extreme Warming (DEW), and 2070 Wet-Moderate Warming (WMW) scenarios. While DWR's Guidance should be improved with more specific guidelines and requirements, the current Guidance specifically encourages GSAs to analyze the more extreme DEW and WMW projections for 2070 to plan for likely events that may have costly outcomes. Therefore, we recommend that the SVB GSA subbasin GSPs:

- **Include water budget analyses based on DWR's 2070 DEW and WMW scenarios in order to analyze the full range of likely scenarios[18] that the region faces.**

---

[12] 23 CCR § 354.18.
[13] California Department of Water Resources (DWR), 2016. Best Management Practices for the Sustainable Management of Groundwater, Modeling (BMP #5), December 2016.
[14] 23 CCR § 354.24.
[15] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True.
[16] Union of Concerned Scientists. Troubled Waters: Preparing for Climate Threats to California's Water System, 2020. https://www.ucsusa.org/resources/troubled-waters#top.
[17] See DWR (2018) reference above.
[18] Terminology used in the California Climate Change Assessment, 2019. (Table 3). https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

- Currently, the SVB GSA's exclusive use of the "central tendency" climate scenario predicts an increase in surface water availability, as represented in the tables in Section 6.4.3 of the subbasin GSPs. The Projected Groundwater Budgets show increases in deep percolation of stream flow, deep percolation of precipitation, and irrigation. The subbasin GSPs are relying on this presumed increase for their water budgets. However, the 2070 DEW scenario provided by DWR could likely result in a significant decrease in precipitation and increase in evapotranspiration, which would have substantial effects on the subbasin water budgets. By analyzing only the central tendency scenario and not other likely scenarios such as the extremely dry and wet scenarios provided by DWR, the SVB GSA is ignoring the specific 2070 DEW and WMW scenarios provided by DWR as well as an increasing trend in drought frequency. In doing so, the GSP could be overestimating groundwater recharge or underestimating water demands, inadequately planning, and jeopardizing groundwater sustainability. This will waste precious time to prepare and reduce the vulnerability of the basin's agriculture and already vulnerable communities.
- DWR's guidance (2018) states that the central tendency scenarios *might* be considered most likely future conditions -- that is not a clear endorsement of a higher statistical probability. It appears that they are calling it the central tendency merely because it falls in the middle of the other two projections, not because it's significantly more probable.
- DWR (2018) explicitly encourages GSAs to plan for more stressful future conditions:
  - "GSAs should understand the uncertainty involved in projecting future conditions. The recommended 2030 and 2070 central tendency scenarios describe what might be considered most likely future conditions; there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios. Therefore, GSAs are encouraged to plan for future conditions that are more stressful than those evaluated in the recommended scenarios by analyzing the 2070 DEW and 2070 WMW scenarios."[19]
- Including the DEW and WMW climate scenarios as part of the 2070 water budget analysis is necessary to meet the statutory requirement to use the "best available information and best available science."[20] Sustainable planning must include planning for foreseeable negative and challenging scenarios. The extreme scenarios provided by DWR are certainly foreseeable, as they have been modeled and made available to the GSA for analysis.
- It is important for the SVB GSA to include the 2070 DEW and WMW scenarios, because shallow drinking water wells in the area are particularly vulnerable to various extreme conditions, especially drought.

[19] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. Section 4.7.1. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True. (In red is a statement about the central tendency scenarios referenced in SVB GSA public meetings and email communications by the GSA's engineering consultant, and in blue is the important text accompanying it, urging GSAs to analyze the more extreme scenarios. CWC staff cited this complete paragraph in email communications with the consultant and GSA staff on April 8, 2021. CWC also raised this point at Forebay and Upper Valley Subbasin Committee meetings in March and at the April SVB GSA Board Meeting.)
[20] See 23 CCR § 355.4(b)(1).

- **Share water budget results based on the 2070 central tendency, DEW and WMW scenarios that DWR has provided with the Subbasin committees, the Advisory Committee, and the GSA board**. This should be done at a *minimum* to see what the difference in outcomes could be, and to provide a transparent process for selecting the preferred scenario. This analysis is particularly important because of the drastic differences between the dry and wet scenarios for this region. Drought and/or intensified rainfall (more water falling over a shorter period of time) would pose severe challenges[21] to the Subbasins' plans for recharge, which is a critical component of their plans to reach sustainability.
- **Plan for potential adverse climate conditions when determining Projects and Management Actions.** The results of limited-scope planning will be detrimental to beneficial users throughout the SVB GSA. "If water planning continues to fail to account for the full range of likely climate impacts, California risks wasted water investments, unmet sustainability goals, and increased water supply shortfalls."[22] This is true not just generally across California, but also specifically on the Central Coast. "Without effective adaptations, projected future extreme droughts will challenge the management of the Central Coast region's already stressed water supplies, including existing local surface storage and groundwater recharge as well as imported surface water supplies from the State Water Project which will become less reliable, and more expensive."[23]

GSP Chapter 7: Monitoring Network

Robust monitoring networks are critical to ensuring that the GSP is on track to meet sustainability goals. GSAs undertaking recharge, significant changes in pumping volume or location, conjunctive management or other forms of active management as part of GSP implementation must consider the interests of all beneficial users, including domestic well owners and S/DACs. We have the following overarching recommendations for this chapter and provide more details for sub-sections below:

- **Require well registration and metering for all wells in the Salinas Valley, and begin implementation of a well registration and metering program in early 2022 with a dedicated budget.** We voice our strong support, with modifications indicated in our comments below, for proposed "Implementation Action 12: Well Registration" in Section 9.1 of Chapter 9 released in April 2021 and recommend that this action be updated and moved to Chapter 7. We agree with the SVB GSA's statement in Section 7.3.2 Groundwater Storage Monitoring Data Gaps that: "Accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. During implementation, the SVB GSA will finalize a database of existing and active groundwater wells in the Eastside Aquifer Subbasin." This is essential for the plan to achieve sustainability for all beneficial users and influences many different chapters including:

---

[21] Union of Concerned Scientists. Inter-model agreement on projected shifts in California hydroclimate characteristics critical to water management. 2020, p. 13. https://link.springer.com/content/pdf/10.1007/s10584-020-02882-4.pdf.

[22] See Union of Concerned Scientists. Troubled Waters (2020) cited above.

[23] Regional Climate Change Assessment for the Central Coast, 2019. (Discussing drought pp. 21-23. Internal citations omitted). https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-006_CentralCoast_ADA.pdf.

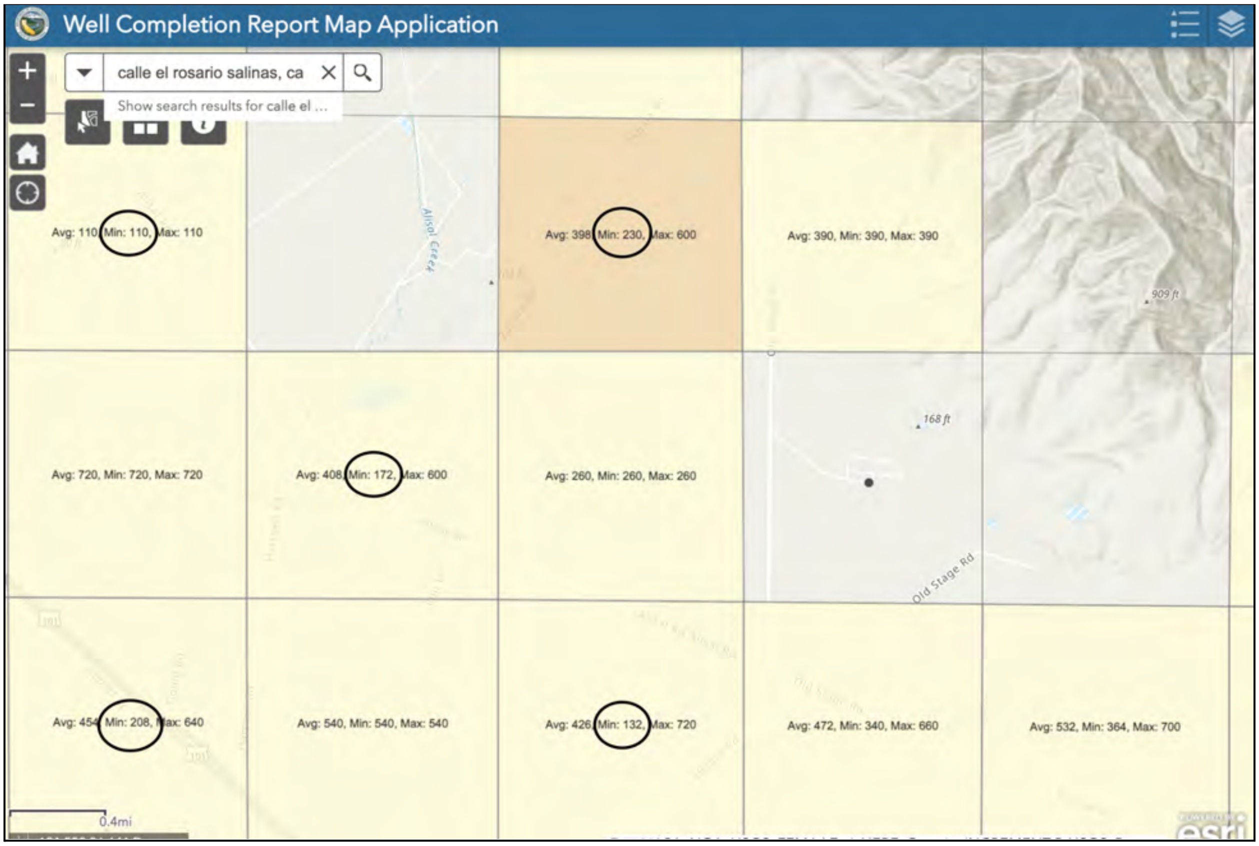
- Monitoring networks: In order to develop a monitoring network that is representative, it will be essential to understand the number, location, well construction, and type (domestic, irrigation, other) of all wells located in the subbasins.
- Water budget and minimum thresholds: Understanding the amount and location of pumping of all water users will be essential for creating an accurate water budget and minimum thresholds consistent with achieving sustainability.
- Projects and management actions: Section 9.2.1 Well Registration and Metering is a key management action and component of the Water Charges Framework (in the 180/400 foot aquifer) and forthcoming subbasin GSPs. This will underpin the funding structure for many future projects.

- **Require flowmeter calibration to ensure consistent and fair monitoring among all agricultural groundwater users (Section 7.3.1).** Rather than "consider the value of developing protocols for flowmeter calibration," the GSPs should require flowmeter calibration. The water budget and sustainable yield calculation depend on reliable and fair monitoring and reporting of pumping.
- **Provide a plan and schedule for data gap resolution in forthcoming Chapter 10 of the subbasin GSPs.** In the 180/400 foot aquifer GSP, there was not a clear plan or schedule for the resolution of data gaps in Chapter 7 even though it indicated that this would be included in Chapter 10.
- **Revise GSP monitoring chapters such that monitoring networks for groundwater storage (pumping), groundwater elevation, and groundwater quality adequately monitor how groundwater management actions could impact vulnerable communities including those reliant on domestic wells and shallow portions of the aquifers** (see more detail below).

7.2 Groundwater Elevation Monitoring Network

- **Include groundwater elevation monitoring sites in the network that are representative in terms of the depth and geographic distribution of private domestic wells, and that takes into account areas of high agricultural pumping and wells vulnerable to groundwater decline.**
  - The draft East Side Subbasin GSP Table 7-1 of "Eastside Aquifer Groundwater Elevation Representative Monitoring Site Network" shows all irrigation and observation wells (and no domestic wells) which range in depth from 299 to 1122 feet.[24] Yet, the DWR Well Completion Report Map Application[25] shows that 1 mile by 1 mile square sections near San Jerardo Cooperative include private domestic wells with the following minimum depths: 110 ft, 210 ft, 172 ft, 208 ft, and 132 ft which are more shallow than all the wells in the current monitoring network (See CWC Figure 10).
- **Overlay the private well density map (Figure 3-7), the DWR Well Completion Report Map Application (with minimum, average, and maximum depths), the water level monitoring network (with well depths), and available pumping data to better illustrate if and how representative the proposed groundwater elevation monitoring network is of private domestic wells and which areas are vulnerable to water elevation changes.** The GSPs state: "The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors. " This will also help to better visualize where there are gaps in the monitoring network which the GSAs can address.

[24] One well shows "0" depth but that must be an error or missing value.
[25] https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports



CWC Figure 10: Screenshot of DWR Well Completion Report Map application in the area near San Jerardo Cooperative highlighting that several 1 mi. by 1 mi. square sections include private domestic wells less than 250 feet deep.

7.5 Water Quality Monitoring Network

- **Clarify the number of public water system wells that will be included in the water quality monitoring network.** We strongly support the GSPs inclusion stated in Section 7.5 that "All the municipal supply wells in the Subasin are part of the RMS network." As indicated in Chapter 3 and Chapter 5 comments, the GSPs should also clearly identify the number of public supply wells as well as the number of public supply wells that are out of compliance and at risk in each subbasin. Section 7.5 currently states that "A total of 51 public supply wells were sampled in WY 2019" and indicates that all wells are listed in Appendix 7E (which is not publicly available at this time). This section and appendix should be consistent with the total number of wells represented in Table 8-4 which includes groundwater quality minimum thresholds.
- **Representative Water Quality Monitoring Wells for the shallow aquifer should be established in the GSPs based on all currently available data sources with direct agreements with landowners or public entities established.**
    - **Develop long-term access agreements for Representative Monitoring Wells (RMWs) that use private wells.** Collecting data from private wells is not a reliable approach due to access challenges, lack of well construction information, and unreliable accounting of

pumping or non-pumping measurements. The GSPs should specifically identify the RMW owners and operators, include signed long-term access agreements, and identify a plan to obtain adequate monitoring data, if for any reason the well owners decide to not grant access to the wells or provide associated data to the SVB GSA. In order to maintain consistency for future sustainability analyses, the SVB GSA should also consider conducting its own water quality analysis of wells where access agreements have already been established to water quality RMWs.

- **Clarify that state and local small water systems will be added to the water quality monitoring network and that well construction information is no longer needed in order to fill this data gap.** Monterey County Environmental Health Bureau permits and monitors over 900 state and local small water systems in the County and have managed the data collected for decades. This dataset has advantages over the ILRP domestic well dataset in that it includes data on contaminants like arsenic and hexavalent chromium in addition to nitrate. Local small water systems serve 2-4 households and are much more similar to private domestic wells than public water systems in terms of depth, well construction, age, size, and maintenance - thus this data would provide a broader representation of shallow drinking water wells. State and local small water systems are located in areas of irrigated agricultural lands as well as rural residential and other land uses. This dataset should complement and not replace ILRP domestic well data.
  - **Clearly add state and local small water system data as a data gap in Section 7.5.2.** In Section 7.5 Water Quality Monitoring Network, the draft GSPs state: “These [state and local small] wells are not in the current monitoring system because well location coordinates and construction information are currently missing. SVB GSA will work with the County to fill this data gap. When location and well construction data become available, these wells will be added to the monitoring network and included in Appendix 7E and Figure 7-4." However Section 7.5.2 Groundwater Quality Monitoring Data Gaps states: "There is adequate spatial coverage to assess impacts to beneficial uses and users."
- **Do not rely solely on ILRP well data to represent private domestic wells (which are often more shallow than public water system wells).** Similar to CASGEM, the current groundwater quality monitoring network includes monitoring points on private property including ILRP domestic and irrigation wells, but it should not be restricted to ILRP sites only. While on-farm domestic and irrigation wells monitored through the ILRP provide a potentially useful, though limited, source of water quality information, additional representative monitoring wells in the shallow aquifer are important to include for several reasons: (1) The ILRP network only includes wells located on agricultural irrigated lands, and not all ILRP properties include domestic wells. Agricultural land use is not the primary land use in the Langley and Monterey Subbasins so this monitoring network offers very limited coverage. While agricultural land use is the primary land use in the East Side, Upper Valley, and Forebay Subbasins, there are private domestic wells in areas with different primary land uses (e.g. rural), and SGMA requires that monitoring networks are geographically representative. Monitoring network wells must also be sufficiently representative to cover all uses and users in the basin, (2) There are other, more robust networks established by USGS, GAMA, and Monterey County that could be drawn on and included to make the groundwater quality monitoring network more comprehensive and representative of conditions in the shallow aquifer, (3) Ag Order 4.0 was adopted on April 15, 2021, which means the first year of monitoring data will not be

available until late 2022, (4) The GSA has no authority to determine the robustness or enforcement of monitoring in the irrigated lands network, and (5) while Ag Order 4.0 proposes to require testing for 1,2,3-TCP as well as nitrate, the current ILRP domestic well data only samples for nitrate, and neither Order tests for other contaminants found in the region. In our experience, not all growers are consistent with their water quality and other reporting, despite the regulatory requirements in place.

- **Update Domestic ILRP and Irrigation ILRP wells in a different color on Figure 7-5 Locations of ILRP Wells Monitored under Ag Order 3.0.** Since these wells are monitored for different constituents and serve different beneficial users, it is important to illustrate them separately.

GSP Chapter 8: Sustainable Management Criteria

We have grouped our comments in this section into general recommendations related to all sustainable management criteria (SMCs) followed by a section specific to the water quality SMCs. We recommend that the Salinas Valley GSA implement the following recommendations in the subbasin GSPs:

- **Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds, proposed undesirable results, and potential interim conditions.** Include this analysis during the annual reporting process. We disagree with the assumption included in all draft GSPs that the exact location of wells needs to be known in order to include them in a drinking water well impact analysis. In the 180/400 Foot Aquifer Subbasin GSP, the SVB GSA included a domestic well impact analysis. Although the SVB GSA did not describe the methods used in this analysis,[26] it is CWC's understanding that the analysis was based on Public Land Survey System (PLSS) section location data, demonstrating that such an analysis is feasible. Similar analyses in the Water Foundation Whitepaper (June 2020)[27] and in the Kings River East GSP[28] were completed using the same PLSS section location data for private domestic wells that is available to the SVB GSA. The current analysis is incomplete as it includes very few wells in all subbasins. The current analysis is also substantially inaccurate as it relies on the "average computed depth of domestic wells in the Subbasin," and groundwater elevations vary significantly across the subbasin and also on an annual basis. For example, only 8 of the 154 domestic wells in the Forebay GSP with an average depth of 292.45 feet, and only 20 of 2016 domestic wells in the East Side GSP with an average depth of 365.5 feet were included. CWC Figure 10 illustrates that the average computive depth is not representative of conditions in shallow domestic wells. Therefore, we recommend revising Section 8.5.2.2 Minimum Threshold Impact on Domestic wells following the process explained below:
    - **Include a map of potentially impacted wells so the public can better assess well impacts specific to DACs, small water systems, or other beneficial users of water.**

---

[26] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012

[27] The Water Foundation Whitepaper, April 2020: "Estimated Numbers of Californians Reliant on Domestic Wells Impacted as a Result of the Sustainability Criteria Defined in Selected San Joaquin Valley Groundwater Sustainability Plans and Associated Costs to Mitigate Those Impacts." April 9, 2020.
http://waterfdn.org/wp-content/uploads/2020/05/Domestic-Well-Impacts_White-Paper_2020-04-09.pdf

[28] Kings River East Groundwater Sustainability Agency. Groundwater Sustainability Plan. Adopted December 13, 2019.

- **Quantify impacts for all drinking water wells in the subbasin for which approximate location (PLSS section) and well depth are available.** Similar analyses based on the PLSS section location of private domestic wells have been completed by Water Foundation (June 2020)[29] and in the Kings River East GSP[30].
- **Account for well screen and pump depth when available.** When not available, well screen and pump depth should be estimated conservatively to capture potential impacts to well operability under water scarcity conditions.
- **Quantify impacts for potential unfavorable interim conditions, such as droughts and short-term lowering of groundwater levels while implementation measures are put in effect.**
- **Quantify the elevation difference (in feet) between current groundwater levels and well bottoms, screens, and pumps.** If current groundwater levels are nearing well bottoms, screens or pumps, that indicates that the wells are vulnerable to interim lowering of groundwater levels.
- **Quantify the elevation difference (in feet) between the minimum threshold groundwater levels and well bottoms, screens, and pumps.** If the minimum threshold is near the well bottom, screen or pump, that well will be impacted if groundwater levels in the vicinity drop below the minimum threshold (even if minimum thresholds are met at 90 percent of monitoring wells and an undesirable result has not technically occurred).
- **Quantify the number of potentially impacted wells of each well type (irrigation, domestic, state/local small water system, public water system) for water quality, water levels, and sea water intrusion MTs.**
- **Quantify the costs associated with impacted wells including desalinization/treatment, lowering pumps, well replacement and increased pumping costs associated with the increased lift at the projected water levels.**

Groundwater Quality

We are pleased that the Salinas Valley Subbasin GSPs establish minimum thresholds based on maximum contaminant levels (MCLs) for contaminants of concern for drinking water supply systems. There are however other areas in regards to groundwater quality sustainable management criteria that are not clear and could cause significant impacts to drinking water users if not adequately addressed. Therefore, we recommend the following revisions:

- **Revise Section 8.3 General Process for Establishing Sustainable Management Criteria to include a sensitivity analysis around "average hydrogeologic conditions" following our recommendations outlined in Chapter 6.**
- **Add state and local small water systems to the monitoring network with the same water quality minimum thresholds and measurable objectives for reasons stated in Chapter 7 comments.** A table for state and local small water system minimum thresholds was included in the 180/400 foot aquifer GSP, but in the draft subbasin GSPs, there is no such table and Table 8-1 only mentions public supply and on-farm domestic wells.

[29] See previous reference.
[30] See previous reference.

- **If a contaminant was already above the MCL as of January 1, 2015, subbasin GSPs should set a MT to prevent further degradation or aim to improve groundwater quality conditions where possible.** Increased contamination levels can require water systems to utilize more expensive treatment methods and/or to purchase additional alternative supplies as blending may become more difficult or impossible. Communities reliant on domestic wells who are aware of contamination in their water and use point of use/point of entry (POU/POE) treatment systems may no longer be able to use their devices if contaminate levels rise too high. Higher contaminant levels can also result in higher costs of waste disposal from certain types of treatment systems. Further, residents who rely upon domestic wells, state small water systems, or local small water systems may not even know what contaminants are in their water and at what levels. Users of these drinking water sources are not required to conduct testing, and many times do not have the resources necessary to conduct regular testing. Rising contaminant levels put these users and their health at serious risk. Increased contamination levels result in unreasonable impacts to access to safe and affordable water and are, thus, inconsistent with SGMA and the Human Right to Water. This recommendation is consistent with the State Water Board's recommendations regarding this topic in their letter to DWR regarding the 180/400 foot aquifer GSP in which they state: "Increasing concentrations of nitrate, arsenic, and other constituents at monitoring wells with existing exceedances may represent worsening of existing conditions due to groundwater pumping. Staff recommend setting concentration threshold levels for these wells in order to determine if impacts due to pumping are occurring."[31]
    - **Develop management areas to protect areas where drinking water wells have water quality that are vulnerable, including the San Jerardo area.**
- **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSPs should set MOs at 75% of the MCLs.** Subbasin GSPs should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold exceedance at a representative monitoring well. This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. If the GSA waits until the minimum threshold is exceeded, it may be too late or difficult for actions to be effective. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded. *We also recommend that groundwater quality and trigger levels at 75% are added to Section 9.1.3 Implementation Action 11: Local Groundwater Elevation Trigger (April 2021 draft) which currently only includes groundwater elevations.*
- **Clearly identify and describe past and present levels of contamination and salinity at each representative monitoring well (RMW) and attribute specific numeric values for MTs/MOs at each RMW for each contaminant of concern.** Quantitative values need to be established for MTs/MOs for each applicable sustainability indicator at each RMW as required by 23 CCR § 354.28 and 23 CCR § 354.30. The GSPs should include a map and tables that include each individual RMW along with water quality data for each RMW (this data is currently summarized in Table 8-4 and Table 8-5). This information should be presented clearly so that both the public can determine how the proposed monitoring network and sustainable management criteria (SMCs) relate to their own drinking water well or water supply system.

[31] State Water Board comments to DWR on 180/400 Foot Aquifer GSP (Dec. 2020). Downloaded from SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29

- **Include hexavalent chromium as a contaminant of concern and plan to add contaminants of emerging concern to the monitoring network.** While there is currently not a Maximum Contaminant Level for hexavalent chromium, there is still a Public Health Goal and public health threat posed by this contaminant in drinking water. The State is required to adopt an MCL for chromium-6 again and is in the process of updating the MCL. In addition to including hexavalent chromium, the GSPs must explain how the Plans will be updated to align groundwater monitoring efforts and the sustainable management criteria with any contaminants of emerging concern in the basin and any future new MCLs.
- **Include an analysis of the relationship between changes in groundwater levels and groundwater quality concentrations.** Section 8.5.2.3 of the draft GSPs discusses the relationship between individual minimum thresholds and other sustainability indicators, and states: "Decreasing groundwater elevations can cause wells to draw poor-quality groundwater from deeper zone. No additional poor groundwater quality issues were identified due to low groundwater elevations when groundwater elevations were previously at minimum threshold levels." We ask that justification is provided to backup the second statement or that it is removed until an analysis is conducted. It is our understanding that groundwater quality issues did, in fact, worsen during low groundwater elevations years. Arsenic in the San Jerardo well was at its highest during the lowest groundwater elevation measurement (See CWC Figure 1). The text should acknowledge that groundwater pumping can not only cause the movement of contaminant plumes, but can also cause the release of naturally occurring contaminants such as arsenic and chromium. In order to clearly evaluate the relationship between changes in groundwater levels and groundwater quality, SVB GSA should undertake an analysis of the change in water quality constituent concentrations relative to change in water levels,[32] particularly over drought periods, to evaluate the potential relationship between water quality and groundwater management activities.[33]
- **Add the total number of wells in each category that will be included in the water quality monitoring network and have SMCs evaluated to Table 8-4. For each constituent of concern, add the number of wells included in the chart and the number exceeding the MT/MO based on the latest sample.** This comment has the same goal as the comment we provided in Chapter 7. SMCs should be set at every public drinking water well and a representative network of drinking water wells that rely on more shallow aquifers. It is essential to track the same wells each year in the monitoring network. If a well is no longer active, it should be removed from the network. In the current representation, it is not clear which wells are included in the monitoring

---

[32] See P.A.M. Bachand et. al. Technical Report: Modeling Nitrate Leaching Risk from Specialty Crop Fields During On-Farm Managed Floodwater Recharge in the Kings Groundwater Basin and the Potential for its Management https://suscon.org/wp-content/uploads/2018/10/Nitrate_Report_FInal.pdf. See also, Groundwater Recharge Assessment Tool, created by Sustainable Conservation to help groundwater managers make smart decisions in recharging overdrafted basins, including modeling whether a particular recharge project would result in short or long term benefits or harms to water quality, http://www.groundwaterrecharge.org/.

[33] More information about groundwater quality and the relationship between changes in groundwater levels can be found in the following resources:

Stanford, 2019. A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act. Community Water Center, 2019. Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858

Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

network, which wells have data for each constituent, and which wells are exceeding the regulatory standard.

- **Engage stakeholders and scientists in a transparent discussion regarding "the process the GSAs would use to decide whether or not an exceedance of an MT for water quality degradation was caused by GSP implementation."**[34] The State Water Board recommended that the 180/400 foot aquifer GSP outline this process "otherwise, it is difficult to judge how adequately the GSP addresses undesirable results related to water quality degradation." This relates to the undesirable result for water quality which currently reads: "There shall be no additional minimum threshold exceedances beyond existing groundwater quality conditions during any one year as a direct result of projects or management actions taken as part of GSP implementation."

[34] State Water Board comments to DWR on 180/400 Foot Aquifer GSP (Dec. 2020). Downloaded from SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29 .

April 28, 2021

Salinas Valley Basin Groundwater Sustainability Agency

Submitted electronically to:

Emily Gardner, Deputy General Manager

Donna Meyers, General Manager

Re: Comments on Draft Chapter 9 Project and Management Actions for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins

Dear Salinas Valley Basin Groundwater Sustainability Agency:

The Community Water Center (CWC) offers the following comments and recommendations regarding key components of the draft Chapter 9 Projects and Management Actions (Implementation Actions) that were shared with SVB GSA subbasin committees in April 2020. These comments are intended to add to the public record and are submitted in addition to previous written and spoken comments.

Chapter 9 Projects and Management Actions

During the April 7, 2021 East Side and Upper Valley subbasin committee meetings, feedback was requested on a draft list of project and management actions. As outlined in the April 7 meeting materials, "[p]rojects implement the GSP and enable the subbasin to reach sustainability by 2042, then maintain sustainability for another 30 years." Both groundwater levels and water quality degradation can have adverse impacts on drinking water users and disadvantaged communities (DACs), who are protected as beneficial users under SGMA[1]. Therefore, projects and management actions (also referred to as implementation actions) should address sustainability issues facing drinking water and other domestic water uses, in order to ensure their continued availability.

As this chapter is further revised for the East Side and Upper Valley subbasins and as potential projects and management actions are considered for the Forebay, Langley, and Monterey, the GSPs should (1) clearly identify potential impacts to water quality from all projects and management actions, (2) include management actions that respond to immediate needs and (3) develop a more robust implementation schedule and funding plan for projects and management actions. We acknowledge that the implementation actions are currently in the beginning stages of design but encourage incorporating these elements early on.

9.1.3 Implementation Action: Local Groundwater Elevation Trigger

The Local Groundwater Elevation Trigger is a significant start to tracking and addressing impacts to domestic wells. We support the inclusion of a "notification system whereby well owners can notify the GSA or relevant partner agency if their well goes dry." Because SVB GSA defines its sustainability criteria in a way that potentially allows for drinking water well impacts and because there is so much uncertainty regarding potential domestic well impacts, we recommend that this implementation action be updated to incorporate a **Robust Drinking Water Well Mitigation Program.** This program should include the Local Groundwater Elevation Trigger as well as (1) a plan to prevent impacts to drinking water users from

[1] WAT § **10723.2.**

dewatering, increases in contaminant levels and increases in salinity, and (2) a plan to mitigate the drinking water impacts that occur even when precautions are taken.

CWC together with other organizations published a Framework for a Drinking Water Well Mitigation Program (2020) that we recommend the SVB GSA uses as a guide when further developing this implementation action. We are also interested in sharing more with staff and are willing to provide a presentation to SVB GSA staff, board members, and/or the advisory committee on this Framework. The framework describes the importance of adaptive management and affirms the intent of the draft Local Groundwater Elevation Trigger management action and states, "Developing a protective warning system... can alert groundwater managers when groundwater levels and groundwater quality are dropping to a level that could potentially negatively affect drinking water users. These "triggers" are essential for groundwater management and can be adjusted to fit the needs of different management actions as well as the basin as a whole."[2] We also support the provision in the draft "Local Groundwater Elevation Trigger" Implementation Action that offers "referral to assistance with short-term supply solutions, technical assistance to assess why it went dry, and/or long-term supply solutions." This type of adaptive management implementation action is crucial to ensuring that all beneficial users within the basin are protected under the GSP. As we have highlighted in previous comments[3]:

> A GSP that lacks a mitigation program to curtail the effects of projects and management actions as to the safety, quality, affordability, or availability of domestic water, violates both SGMA itself and the Human Right to Water (HR2W).[4] The California legislature has recognized that water used for domestic purposes has priority over all other uses since 1913[5] in Water Code § 106, which declares it, "established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation."[6] The passage of the Safe and Affordable Drinking Water Fund by Governor Newsom indicates a clear State-level commitment to provide safe and affordable drinking water to California's most vulnerable residents.[7] To ensure compliance with the Legislature's long established position, the HR2W requires that agencies, including the Department of Water Resources and the State Water Board, must consider the effects on domestic water users when reviewing and approving GSPs.[8] Therefore, GSPs that cause disparate impacts to domestic water use are in violation of the HR2W, SGMA, and Water Code § 106.6.

In order to effectively protect drinking water users during GSP implementation, we recommend that the GSA's **Drinking Water Well Impact Mitigation Program Implementation Action,** in line with and expanding upon the currently proposed Local Groundwater Elevation Trigger, should include the following components:

---

[2] *See* Self-Help Enterprises, Leadership Counsel for Justice and Accountability, Community Water Center (2020) *Framework for a Drinking Water Well Impact Mitigation Program*.
https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ca9389712b732279e5296/1597811008129/Well_Mitigation_English.pdf.

[3] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

[4] WAT § 106.3 (a).

[5] Senate Floor Analysis, AB 685, 08/23/2012.

[6] This policy is also noted in the Legislative Counsel's Digest for AB 685.

[7] SB 200 (Monning, 2019).

[8] WAT § 106.3 (b).

- **Include a vulnerability analysis of Disadvantaged Communities (DACs) and drinking water supplies in order to protect drinking water for these vulnerable beneficial uses and users.** Although rural domestic and small water system demand does not contribute substantially to the overdraft conditions, drinking water users could face significant impacts, particularly if the region faces another drought. Without a clear commitment and timeline for actions regarding establishing groundwater allocations or reductions in groundwater pumping, the SVB GSA may create disparate impacts on already vulnerable communities. See comments submitted by CWC and San Jerardo Cooperative on April 23, 2021 regarding Chapter 8 of SVB GSA Subbasin GSPs for further recommendations for conducting well impact analyses.
- **Develop the trigger system in collaboration with stakeholders, in particular groups that are more susceptible to groundwater elevation and quality changes, and then connect stakeholder recommendations back to quantifiable measures such as the GSP measurable objectives, MCLs, and numbers of partially or fully dry drinking water wells.**[9]
- **Ensure that the monitoring network is representative of conditions in all aquifers in general, including the shallow aquifer upon which domestic wells rely.** This comment aligns with comments submitted April 23, 2021 regarding Chapter 7 of the SVB GSA Subbasin GSPs, and is particularly crucial as part of a "Trigger" Management Action (or Well Impact Mitigation Program).
- **Routinely monitor for all contaminants that could impact public health (not only nitrate, but also chromium-6, arsenic, 123-TCP, uranium, and DBCP) through the representative water quality monitoring network.** Contaminated drinking water can cause both acute and long-term health impacts and can affect the long-term viability of impacted regions.[10] Among other causes, groundwater contamination can result through the use of man-made chemicals, fertilizers, or naturally-occurring elements in soils and sediments.[11] Routinely monitoring for contaminants will allow the GSA to accurately monitor for impacts on the most vulnerable beneficial users, and protect DACs' and domestic well owners' access to safe and affordable drinking water.[12]
    - **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSP should set MOs at 75% of the MCLs.** The GSP should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold exceedance at a representative monitoring well.[13] This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. As discussed in previous

[9] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

[10] Community Water Center. Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. (2019). https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

[11] See previous Community Water Center (2019) reference.

[12] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

[13] This recommendation was also made previously in a comment letter to SVB GSA from CWC and San Jerardo Cooperative regarding Chapter 8 of the 180/400 ft Aquifer GSP on November 25, 2020, as well as in our comments to the SVB GSA on April 23, 2021 regarding Chapter 8 of drafts for the SVB GSA Subbasin GSPs.

submitted comments, water quality impacts can intensify as water levels decrease.[14] If the GSA waits until the minimum threshold is exceeded, it may be too late or difficult for actions to be effective. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded.

- **Include a combination of different strategies for mitigation including: replacing impacted wells with new, deeper wells, connecting domestic well users to a nearby public water system, or providing interim bottled water.**
- **Include an implementation timeframe, budget, and funding source**.[15] As currently written, the Local Groundwater Elevation Trigger suggests convening "a working group to assess the groundwater situation if the number of wells that go dry in a specific area cross a specified threshold." We support emergency response if one or more wells are impacted, and also request that this section be updated to include strategies to prevent impacts from occuring in the first place. Additionally, plans to address and mitigate those impacts should be solidified beforehand so resources can be mobilized in a timely manner. Drinking water users cannot afford to wait for interim plans to be developed once their primary sources of water for drinking, cooking and hygiene are compromised.

9.1.3 Implementation Action: Domestic Water Partnership

CWC would like to voice preliminary support for the Domestic Water Partnership Implementation Action, as a step towards coordinating local and regional responses to water quality issues. However, we reiterate that the GSA remains directly responsible for recognizing and resolving water quality degradation that results from its policies and projects. We also would like to affirm our previous comments encouraging the SVB GSA to include - without delay - Monterey County water quality data for state and local small water systems. This data is readily available and would add significantly to the proposed water quality monitoring network in draft subbasin Chapters 7. We do not want this potential partnership implementation action to delay the incorporation of this important data source. This action can and should, however, integrate this County data into current draft subbasin plans in order to identify potentially vulnerable populations and create management actions to protect them. We will offer further comments and recommendations on this subject as future drafts are released. To echo recommendations made previously regarding Suggested Partnerships for Multi-Benefit Remediation Projects:

- **The GSA should work with local and regional water agencies or the county to implement groundwater quality remediation projects that could improve both quality as well as levels and to ensure groundwater management does not cause further degradation of groundwater**

[14] Community Water Center and Stanford University. Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium. (2019). https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.
[15] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

quality.[16] The strategic governance structure of GSAs can uniquely leverage resources, provide local empowerment, centralize information, and help define a regional approach to groundwater quality management unlike any other regional organization. When implemented effectively, GSPs have the potential to be instrumental in reducing levels of contaminants in their regions, thus reducing the cost of providing safe drinking water to residents. GSAs are the regional agency that can best comprehensively monitor and minimize negative impacts of declining groundwater levels and degraded groundwater quality that would directly impact rural domestic well users and S/DACs within their jurisdictions. When potential projects are proposed, SVB GSA should consider how projects could potentially both positively and negatively impact groundwater quality conditions and should take leadership in coordinating regional solutions.

[16] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

From: Emily Gardner
To: Patrick Breen (pbreen@mcwd.org); Tina Wang; Abby Ostovar; Bonnie Gradillas
Subject: Fwd: My additional input on GSP for Monterey Subbasin
Date: Tuesday, April 27, 2021 9:28:35 PM
Attachments: Monterey Subbasin GSP - Coppernoll.docx

Monterey Subbasin Comments

---------- Forwarded message ---------
From: <mcopperma@aol.com>
Date: Tue, Apr 27, 2021 at 9:15 PM
Subject: My additional input on GSP for Monterey Subbasin
To: gardnere@svbgsa.org <gardnere@svbgsa.org>

Hello Emily,

Thank you so much for your kind message. I am attaching the edits I promised along with a few questions/observations. If you have any questions, please let me know. I hope the input is helpful re the edits.

We all appreciate all the conscientious hard work that has been invested in these GSP chapters, which represent a solid, substantial beginning to assist us in developing further information and projects. Bravissimo to the authors.

Very respectfully,
Margaret-Anne Coppernoll

--

Monterey Subbasin GSP:

Edits recommended:

1. Page 41: last paragraph before item 3.2.2.5, 2nd sentence: implementation **of** other options. Add word "of" which is missing in the sentence.
2. Page 43: paragraph 3.3, 2nd sentence: the word "by" seems misplaced: recommend change place of the word by: with a conjunctive use component under development **by** MPWMD – not under by development.
3. Page 44: 2nd paragraph, 1st sentence: Fort Ord lead by the Army began in 1986 – should be **led** by the Army…
4. Page 44: 2nd paragraph, 2nd sentence: the cleanup activities at Ft Ord has included groundwater … should be "activities **have** included groundwater…"
5. Page 44: last paragraph, 1st sentence: "…limitations are in place **at the** such as zoning… **at the** are extra words to be deleted" "…limitations are in place such as zoning".
6. Page 49: PS 3.12: Remove the extra **d.** at beginning of d)
7. Page 53: 3.5.1.3 City of Seaside: 2nd paragraph, 2nd line: "MCWRA, which is **as** the entity responsible…." Should be "MCWRA which is the entity responsible."
8. Page 54: 3.5.1.4: 1st sentence: Ft Ord, which cover…. Should be **covers…**
9. Page 55: 3.5.1.5: Ca Coastal Act: 2nd paragraph, last line: "islocated" should be "**is located".**

Questions/Observations:

1. The HWG comment letter diminishes the importance of the Dune Sand Aquifer which is a Principal Aquifer. Along with the Perched Dune Sand Aquifer this aquifer provides freshwater groundwater and is considered a Principal Aquifer, per my understanding. The AEM scientific research technology that provides data on groundwater and aquifer/aquitard conditions is a very important tool used worldwide to explore underground information with amazing accuracy.
2. Do current agriculture enterprises use the most advanced water conservation technology to irrigate crops?
3. How can we monitor private domestic wells (drinking water systems) with less than 15 residential service connections, industrial, and irrigation wells, that are not regulated by the DDW? Their pumping does impact aquifer health, so it seems there should be a way to include these wells in a monitoring system to obtain their usage data. Even if the impact is minor, this impact, when added to all the other pumping, could exceed sustainability yet we would not be including that factor in water use assessments.
4. Does testing/monitoring for water quality include herbicides/pesticides, pharmaceuticals, etc., such as glyphosate?

From:	Emily Gardner
To:	Patrick Breen (pbreen@mcwd.org); Tina Wang
Subject:	Fwd: CWC and San Jerardo Cooperative Comments on draft subbasin GSP Chapters 1-8
Date:	Monday, April 26, 2021 10:27:39 PM
Attachments:	CWC and San Jerardo Cooperative_Salinas Valley Subbasin GSP Ch 1-8 comments 4.23.21.pdf

Good evening,

I have attached a comment letter that is addressed to the Monterey Subbasin.

Sincerely,

Emily Gardner

---------- Forwarded message ---------
From: **Heather Lukacs** <heather.lukacs@communitywatercenter.org>
Date: Fri, Apr 23, 2021 at 6:32 PM
Subject: CWC and San Jerardo Cooperative Comments on draft subbasin GSP Chapters 1-8
To: Emily Gardner <gardnere@svbgsa.org>
Cc: Donna Meyers <meyersd@svbgsa.org>, Mayra Hernandez <mayra.hernandez@communitywatercenter.org>, Justine Massey <justine.massey@communitywatercenter.org>, Horacio Amezqutia <horacioamezquita@yahoo.com>

Dear Emily and Donna,

Please see the attached comments and recommendations submitted on behalf of the Community Water Center (CWC) and San Jerardo Cooperative to the Salinas Valley Basin Groundwater Sustainability Agency on draft GSP Chapters 1-8 for the Langley, East Side, Forebay, and Upper Valley Subbasins as well as draft Chapters 1-5 and 7 for the Monterey Subbasin.

We look forward to continuing to work with the SVB GSA to ensure that the GSPs are protective of the drinking water sources of vulnerable, and often underrepresented, groundwater stakeholders. Please do not hesitate to contact us with any questions or concerns. We also look forward to meeting with you in the future to further discuss issues raised in these and past comments.

Best,

Heather Lukacs, CWC
Horacio Amezquita, San Jerardo Cooperative
Justine Massey, CWC
Mayra Hernandez, CWC

--
Heather Lukacs, PhD
Pronouns: She/Her/Hers
Director of Community Solutions

Community Water Center

Watsonville Office:
406 Main Street, Suite 421, Watsonville, CA 95076
Tel: (831) 500-2828 (voice/text)
Sacramento Office:
716 10th St. Suite 300 Sacramento, CA 95814
Tel: (916) 706-3346
Visalia Office:
900 W. Oak Avenue, Visalia, CA 93291
Tel. (559)733-0219 Fax (559)733-8219
www.communitywatercenter.org

All CWC staff are currently working remotely. Please reach all staff via email and cell phone.

--

COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

San Jerardo Cooperative, Inc.

April 23, 2021

Salinas Valley Basin Groundwater Sustainability Agency

Submitted electronically to:

Emily Gardner, Deputy General Manager

Donna Meyers, General Manager

Subject Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins

Dear Salinas Valley Basin Groundwater Sustainability Agency:

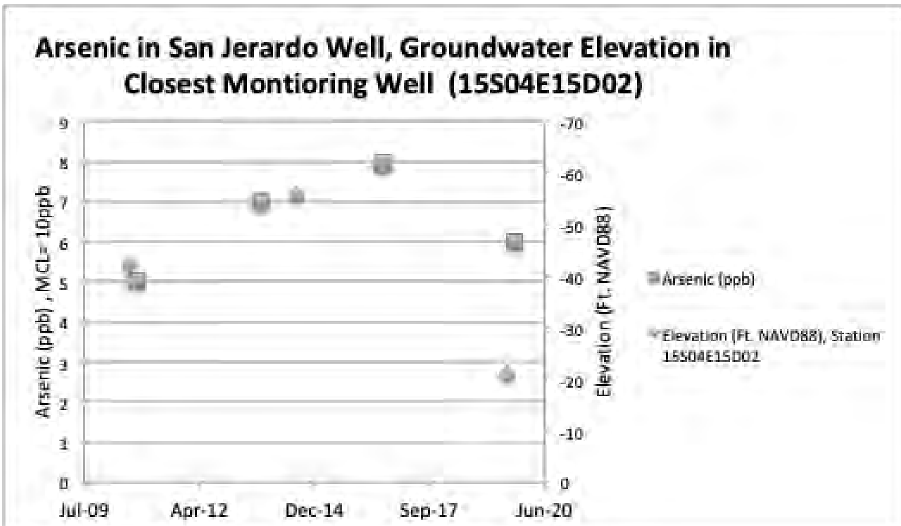
The Community Water Center (CWC) and the San Jerardo Cooperative would like to offer comments and recommendations in response to the draft Groundwater Sustainability Plans (GSPs) Chapter 1-8 for the Langley, East Side, Forebay, and Upper Valley Subbasins as well as Chapters 1-5 and 7 for the Monterey Subbasin that were released in 2020 and early 2021 by the Salinas Valley Basin Groundwater Sustainability Agency (SVB GSA). In addition, we offer preliminary comments on the draft Chapter 9 Implementation Actions that were shared with subbasin committees in April 2020. These comments are intended to add to the public record and are submitted in addition to previous written and spoken comments.

The challenges facing San Jerardo and similar communities throughout all the subbasins in the Salinas Valley are the foundation of our comments in this letter. The San Jerardo Cooperative's well is highly vulnerable to changes in groundwater levels and groundwater quality. Over decades of living and working at San Jerardo Cooperative, Horacio Amezquita has observed firsthand how the irrigation practices on properties surrounding the cooperative impact the water quality in their current and former wells. The San Jerardo Cooperative receives drinking water from a small public water system (CA2701904) and is very concerned that pumping, irrigation practices, and groundwater management in the East Side Subbasin will cause their drinking water well, which currently meets all drinking water standards, to exceed the maximum contaminant levels for arsenic and/or nitrate. Unfortunately, data from the State Water Board indicates increasing levels of nitrate and arsenic in their well with a high arsenic level of 8 ppb on 8/22/2016 that also corresponds to a low groundwater elevation of -61.5 in Station 15S04E15D02, the closest monitoring well to the San Jerardo Cooperative's well (See CWC Figures 1 and 2).[1] While there are too few monitoring data points to draw significant conclusions, CWC Figure 1 does suggest that arsenic levels are higher when groundwater levels are lower. Scientifics studies confirm that contaminants like arsenic, uranium, and chromium (including hexavalent chromium)

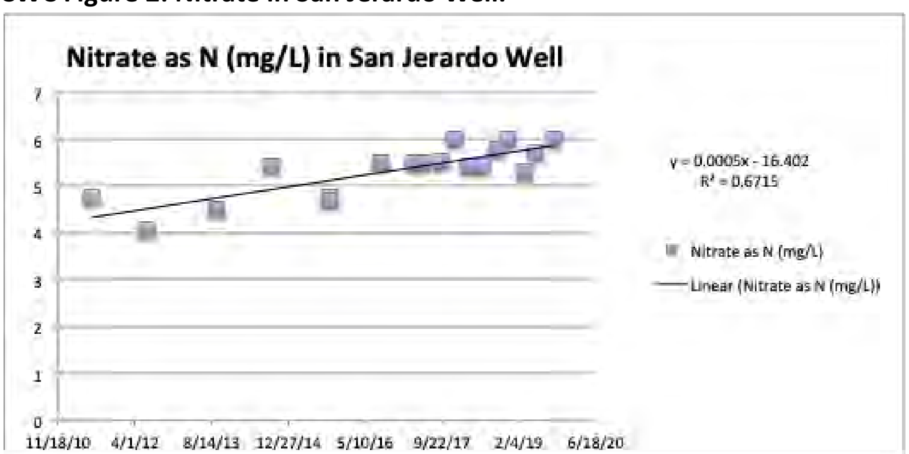
[1] CWC Figure 1 contains all available arsenic data from the State Water Board's Drinking Water Watch online database (https://sdwis.waterboards.ca.gov/PDWW/) which was collected in October 2010, 9/11/13, 8/22/16, and 9/23/19. We then added the monitoring data for Station 15S04E15D02 for the dates most close to the arsenic sampling dates (August 2010, August 2014, August 2016, and August 2019). CWC Figure 2 data was also downloaded from the same online database.

are more likely to be released under certain geochemical conditions influenced by pumping rates, geological materials, and water level fluctuations.[2]

CWC Figure 1: Arsenic in San Jerardo Well, Groundwater Elevation in Closest Monitoring Well
(Note: The groundwater elevation y-axis is reversed to illustrate that lower groundwater elevations are associated with higher arsenic levels.)



CWC Figure 2: Nitrate in San Jerardo Well.



We provide more specific chapter-by-chapter comments in this comment letter. We recommend the GSP should be revised throughout to acknowledge the science showing that groundwater pumping and groundwater level changes can influence water quality.

We strongly recommend that the GSPs incorporate a more robust and representative monitoring network and minimum thresholds to protect vulnerable communities like San Jerardo and those

[2] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

dependent on shallow domestic drinking water wells. This network should include state and local small water systems.

We also firmly agree with the State Water Board's December 8, 2020 comments to the Department of Water Resources on the 180/400 Foot Aquifer GSP, have included them as a reference throughout this comment letter, and recommend that the SVB GSA implement their recommendations in all the other Subbasins GSPs currently in development.[3]

Thank you for reviewing this letter and for the consideration of our comments on the draft GSP chapters. We look forward to working with the SVB GSA to ensure that the GSPs are protective of the drinking water sources of vulnerable, and often underrepresented, groundwater stakeholders. Please do not hesitate to contact us with any questions or concerns. We also look forward to meeting with you in the future to further discuss issues raised in this and past comments.

Sincerely,

Heather Lukacs
Community Water Center

Horacio Amezquita
General Manager, San Jerardo Cooperative, Inc.

Justine Massey
Community Water Center

Mayra Hernandez
Community Water Center

GSP Chapter 3: Description of Plan Area

The description of the plan area can be improved by clarifying the descriptions of the drinking water users in the area. In order to develop a GSP that addresses the needs of all beneficial users, it is critical that the location and groundwater needs of Disadvantaged Communities (DACs) and all drinking water users including domestic well communities are explicitly addressed early on in the GSP. In addition to comments previously submitted to the GSA on July 10, 2020, we recommend the following updates to this chapter:

- **Include a map of all disadvantaged communities (DACs) and their drinking water sources in the subbasin including private wells** as determined both by census data (block groups, census designated places, and census tracts) and median household income surveys conducted in accordance with state and federal agency guidelines. We appreciate that the SVB GSA added "Appendix 11E Disadvantaged Communities" to the 180/400 foot aquifer GSP (Pages 928-941, January 3, 2020) with important information about the location and drinking water challenges, both water quality and seawater intrusion, facing DACs. This information is critical to inform the

[3] DWR SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29.

rest of the GSP. We recommend that it be moved into Chapters 3 and 5 and augmented in the ways described in this section.

- **Correct small error in text in Section 3.2.1 Water Source Types** that incorrectly states that "small state water systems" are included in the Tracking California database. The Tracking California database only includes public water systems serving 15 or more connections.
- **Clarify the number and type of public water systems in the subbasins throughout the entire plan.** In each subbasin plan, there are discrepancies between types and numbers of public water systems in different chapters. For example, the East Side GSP lists the following:
  - Table 3-2 Well Count Summary shows "Public Supply= **24 wells**"
  - Table 5-3 GAMA Water Quality Summary shows "Number of Existing Wells in Monitoring Network Sampled in Water Year 2019" to be **41** for 123-TCP, **46** for Nitrate, and 9 for TDS.
  - Section 7.5 "All the municipal supply wells in the Subbasin are part of the RMS network." A total of **51 public supply** wells were sampled in WY 2019.
  - Table 8-4 Groundwater Quality Minimum Thresholds - **No well count shown**.

  We recognize that different data sources have different limitations and recommend using the best available data consistently throughout the plan.
- **Add a table of all public water systems, their names, locations, number of connections, and number of active wells** in the text or in an appendix that is consistent with the numbers of wells in Table 3-2, Table 5-3, Section 7.5, and other locations where mentioned in the GSPs.
- **Add state and local small water systems to Figure 3-5.** While these systems are currently not in Figure 3-5, their services areas do appear on the SVB GSA GIS portal (svbgsa.maps.arcgis.com) and are labeled as "Parcels served by small water systems (fewer than 15 connections).
- Consider using the same terminology as the Monterey County Department of Health for the state and local small water systems serving 2-14 connections and not using "small public water systems" in Section 3.4.4.2 and throughout the plan. Some definitions of small public water systems include water systems serving up to 199 or even 3300 connections.[4]
- **Revise Section 3.6.3 on the Agricultural Order to indicate that Agricultural Order 4.0 was adopted in April 2021 and include monitoring requirements including on-farm domestic well monitoring of nitrate and 123-trichloropropane, as well as irrigation well monitoring of nitrate.**

GSP Chapter 4: Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a key component of the basin setting. The basin setting represents the baseline assumptions that the GSA relies on throughout the GSP when choosing minimum thresholds, measurable objectives, and undesirable results, as well as when planning projects and management actions. We recommend that the GSA:

- **Revise Section 4.6 on Water Quality to acknowledge that "natural groundwater quality in the Subbasin" can be influenced by pumping and the way groundwater is managed.**[5] As indicated

[4] California Code, Health and Safety Code - HSC § 116275

[5] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

in our cover letter, this is of particular importance for the San Jerardo Cooperative who has experienced increases in nitrate and arsenic in their well.

GSP Chapter 5: Groundwater Conditions

In Chapter 5, we recommend that the GSA make the following changes to all subbasin GSPs (East Side, Langley, Monterey, Upper Valley, and Forebay). The goal is to clearly represent current and past water quality conditions in the subbasin in order to inform the monitoring network sustainable management criteria, planning, management actions, and projects.

Groundwater Quality Distribution and Trends

- **Clearly state in the introduction to Section 5.4 that the amount and location of pumping can impact groundwater quality distribution and trends.** We recommend including this language in the letter submitted by the State Water Board to DWR regarding the 180/400 foot aquifer GSP (Dec. 2020): "Not all water quality impacts to groundwater must be addressed in the GSP, but significant and unreasonable water quality degradation due to groundwater conditions occurring throughout the subbasin, and that were not present prior to January 1, 2015, must be addressed in the GSP's minimum thresholds."[6] High rates of groundwater pumping can pull in contaminant plumes towards drinking water wells, cause the release of arsenic from the strata in the ground, and when shallow wells go dry or are too contaminated to use, new wells must be drilled into deeper portions of the aquifer where they are more likely to encounter high arsenic levels.[7] As previously mentioned, this is of direct concern to the San Jerardo Cooperative who has observed increasing arsenic levels in their relatively new drinking water well, which was drilled to replace a more shallow well contaminated with nitrate and 123-trichloropropane.
- **Include trend data for drinking water wells in the subbasins.** In some places, nitrate and other contaminants are increasing in drinking water wells. It is important to understand current contamination values and also whether well water quality is improving, staying the same or declining as well as the relationship of water quality to other sustainability indicators. As indicated by the data provided in this section, Monterey County maintains an exceptional dataset of water quality data for over 900 state and local small water systems serving 2-14 connections that should be utilized throughout the GSPs. Monterey County has sampled many small water systems for decades. CWC Figures 3 and 4 show nitrate concentrations increasing over time in two state small water systems in the East Side sub basin with high levels in one of the systems (Middlefield Rd. Water System #4) in 2015. Figure 5 illustrates arsenic concentrations in the Metz Road Water System #4 in the Forebay Subbasin. In some cases, data shows fluctuations and peaks in concentrations during the 2015-2016 timeframe. This is similar to the San Jerardo example shared previously. Further, the Central Coast Regional Water Board has analyzed data from their Irrigated Lands Regulatory Program to show that many wells across the region are showing increasing levels of nitrate concentrations.[8]

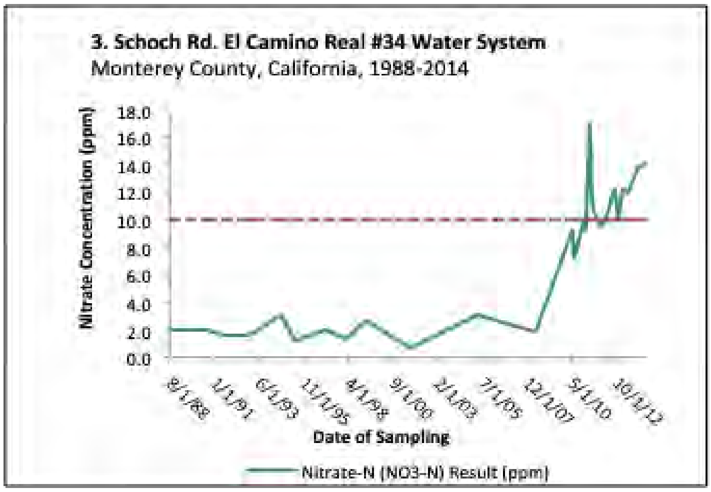
---

[6] DWR SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29

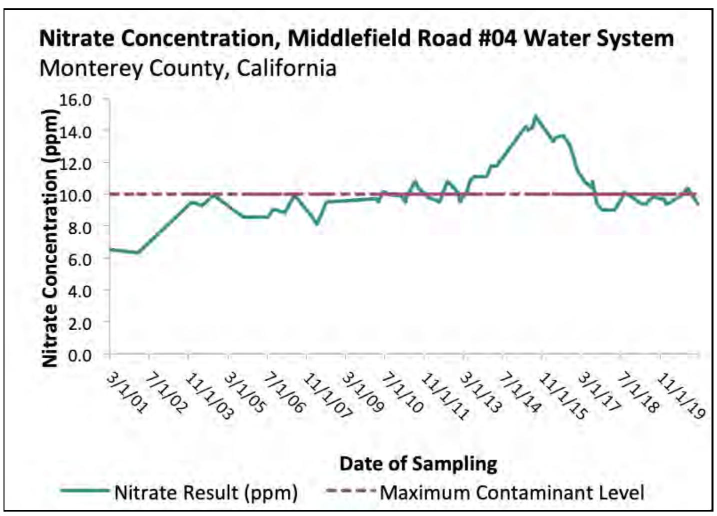
[7] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information. Available at: https://www.communitywatercenter.org/sgmaresources

[8] Draft Ag Order, Attachment A, 141-143, https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order4_renewal/2021april/pao4_att_a_clean.pdf.

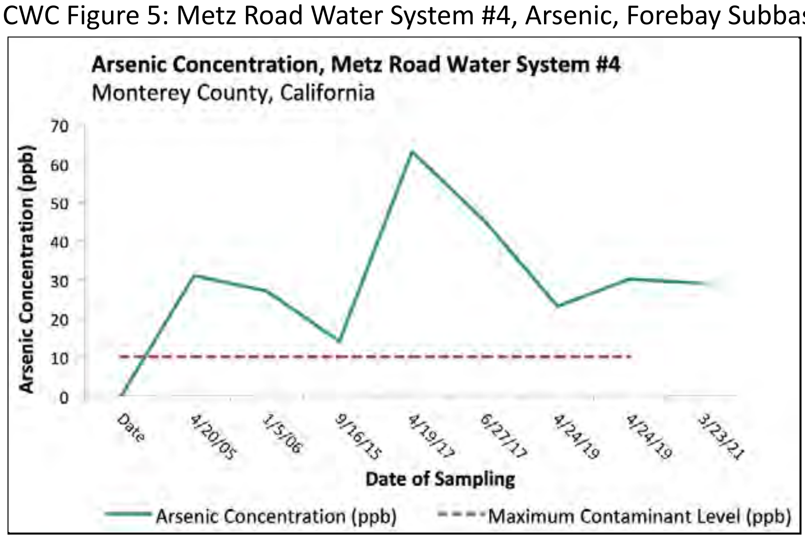
CWC Figure 3: El Camino Real WS #34 - Nitrate as N, East Side Subbasin



CWC Figure 4: Middlefield Road WS #4 - Nitrate as N, East Side Subbasin



CWC Figure 5: Metz Road Water System #4, Arsenic, Forebay Subbasin



- **Revise Section 5.4 to include a specific discussion, supported by maps and charts, of the spatial or temporal water quality trends for all constituents that have been detected in the subbasin and may affect drinking water beneficial users, as required under 23 CCR § 354.16(d).** This section should include water quality data (both in map and tabular form) for all constituents (where available) with primary drinking water standards that have been detected in the subbasin including, but not limited to, **nitrate, 123-trichloropropane, hexavalent chromium,**[9] **arsenic, uranium, and perchlorate for all public drinking water wells, state and local small water system wells, and private domestic wells.** It is especially important for all groundwater stakeholders to be able to understand and visualize the location of contaminant hotspots throughout each subbasin.
    - **Present maps and supporting data for all constituents of concern.** The review of water quality data in the groundwater conditions section of the draft Section 5.4 in the subbasin GSPs is focused primarily on nitrate. The GSPs identify numerous constituents that have been detected in groundwater above drinking water standards, but, with the exception of nitrate, do not present this data spatially. Even though the subbasin GSPs set water quality minimum thresholds for additional constituents (See Tables 8-4 and 8-5), the supporting data is not all presented, and no analyses of spatial or temporal water quality trends are presented. This does not present a clear and transparent assessment of current water quality conditions in the subbasin with respect to drinking water beneficial use (23 CCR § 354.16(d)).
    - **Augment and clarify data presented in Table 5-3 GAMA Water Quality Data Summary and Section 5.4.1 in the following ways:**
        - **Add all state and local small water systems data.** Table 5-3 should include all state and local small water system data for nitrate, arsenic, hexavalent chromium, and any other contaminants that Monterey County monitors in the subbasin.
        - **Include additional contaminants that have been detected in the subbasin(s) to be consistent with Tables 8-5 and 8-6.** Our review of publicly available data on drinking water wells of all types (private domestic wells, state/local small water systems, and public water systems) indicate that there are additional constituents of concern beyond those currently listed. We included CWC Figure 6 (page 9) to highlight the spatial distribution of arsenic in public water system wells in the **East Side, Langley and Monterey Subbasins**, and CWC Figure 7 (page 10) to highlight the spatial distribution of hexavalent chromium in in public water system wells in the **Langley Subbasin**. We recommend a more comprehensive analysis of all other constituents in the subbasins, including, but not limited to the following[10]:

[9] The maximum contaminant level for hexavalent chromium should be reinstated in 2021. Data is available from the State Water Resources Control Board and Monterey County Environmental Health Bureau (public water system data, state/local small water system data) as well as on GAMA from the Central Coast Regional Water Quality Control Board's private well testing program.

[10] All Monterey County data shared in this section was collected by the small water system program. https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local
It was downloaded from the Greater Monterey County Community Water Tool on April 22, 2021: http://www.greatermontereyirwmp.org/documents/disadvantaged-community-plan-for-drinking-water-and-wastewater/

- **East Side Subbasin:** Table 5-3 presents data on two primary contaminants in drinking water: nitrate and 123-trichloropropane, but arsenic is also of particular concern to San Jerardo Cooperative and others in the subbasin. GAMA shows that four public water system wells have exceedances of the arsenic MCL in the past three years (CWC Figure 8), and state/local small water system out of compliance lists from the Monterey County Health Department (2021) show that both Old Stage Rd WS #6 and Old Stage Rd WS #7 are out of compliance for arsenic and that at least five other state or local small water systems have between 6-8 ppb of arsenic, which means they are similar to San Jerardo Cooperative in terms of their vulnerability to water level fluctuations or other changes.
- **Forebay Subbasin:** While arsenic is less common in the Forebay than in the Langley, Monterey, and East Side Subbasins, our review of the Monterey County Health Department data indicates that 17 state or local smalls had arsenic at levels above 1 ppb in the 2015-2017 time period, and at least two of these had levels above the MCL. See CWC Figure 5 (page 8) which illustrates trends in one of the out-of-compliance small water systems, Metz Road Water System #4. In addition, three systems monitored by Monterey County as part of their Local Primacy Program for public water systems serving 15-199 connections had hexavalent chromium detections of 2.8 ppb, 3.4 ppb, and 2.1 ppb in the 2014-2017 timeframe.
- **Upper Valley Subbasin:** Although arsenic is not as common in the Upper Valley as other subbasins, it has been detected in levels between 3.2 and 5 ppb in six small water systems monitored by Monterey County.

■ Clarify what is meant by "DDW wells" in Table 5-3. If these are "public supply wells" in GAMA, please clearly state this.

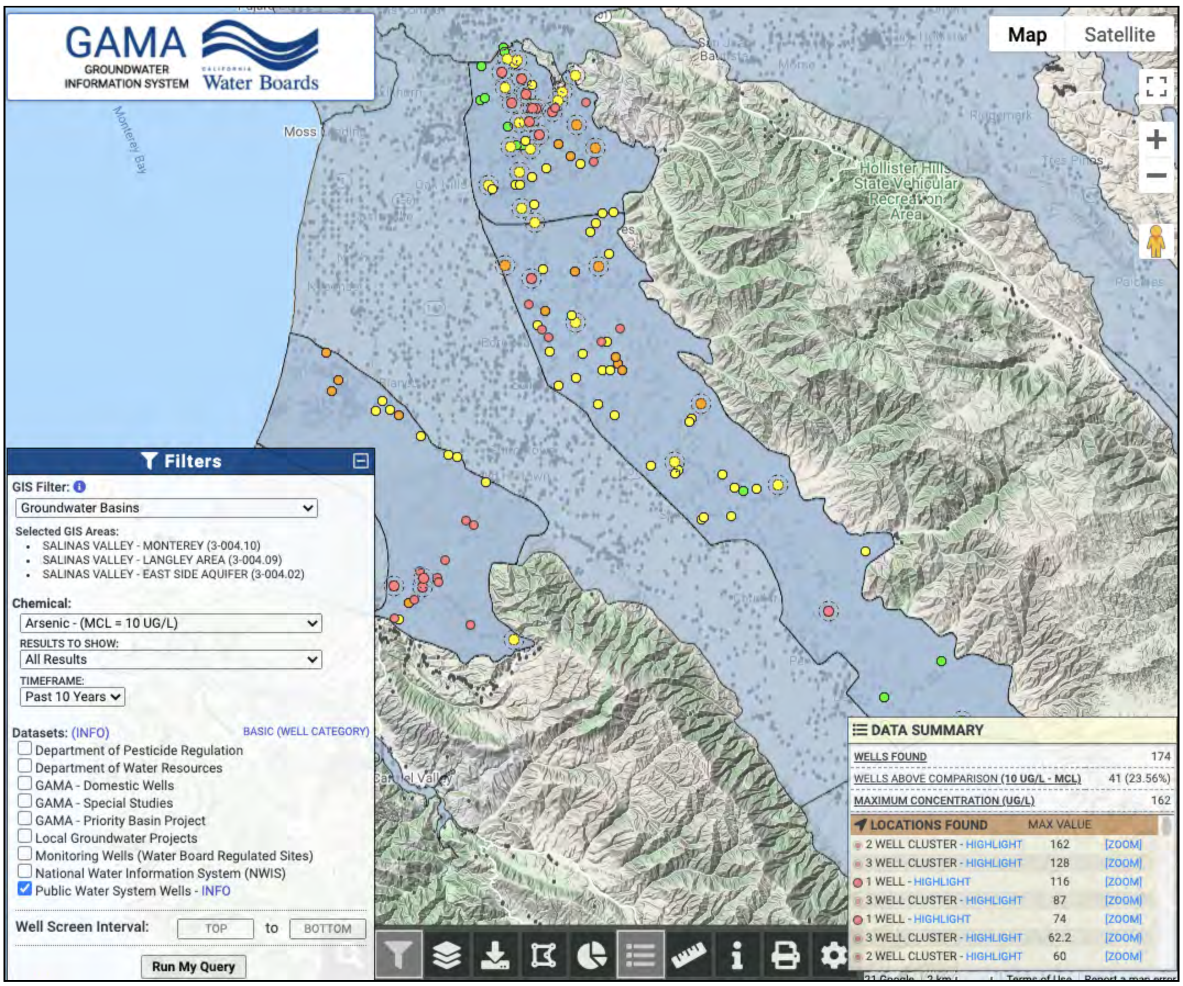
■ **Include the following in Table 5-3: (1) total number of wells of each type, (2) the total number of wells sampled for each constituent, and (3) Of the total number sampled, the number of systems that are out-of-compliance with drinking water standards.** Since public water systems and ILRP wells are monitored on different schedules, there are significant data gaps and inconsistencies when comparing one year to the next in the way that drinking water contaminants are currently represented in GSPs Chapters 5, 7, and 8. For example, we were surprised to see only 15 ILRP Domestic Wells included in Table 5-3 the East Side Subbasin GSP. GAMA shows that there were 139 ILRP wells in the East Side Subbasin sampled for nitrate in the past 3 years, 331 sampled in the last 10 years, and only 8 sampled in the last year. Moreover, CWC Figure 8 illustrates 43 Public Water System Wells in the East Side Subbasin with arsenic data in the past 3 years. On CWC Figure 8, San Jerardo Cooperative's well is shown in orange to indicate that it is at-risk but has not yet exceeded the MCL. However, only 18 Public Water System Wells have sampling data for arsenic from the past year, and during this timeframe, San Jerardo Cooperative's well is not represented (See CWC Figure 9).

■ **Use the compliance status or most recent sample result instead of using the "Number of Wells Exceeding Regulatory Standard in Regulatory Year 2019"**

This is especially important for Table 8-4 and Table 8-5 but also applies to Table 5-3. We recommend the following for different types of drinking water systems:

- For public water systems, we recommend using the State Water Board's determination regarding compliance status.
- For state and local small water systems, we recommend using the Monterey County Health Department list of out-of-compliance systems, which is published on their website and available by request on an annual basis based on the most recent sample collected.[11]
- For ILRP wells, we recommend the GSA consider an approach similar to Monterey County and show the most recent sample result for each monitoring well (and not only those sampled in the past year).

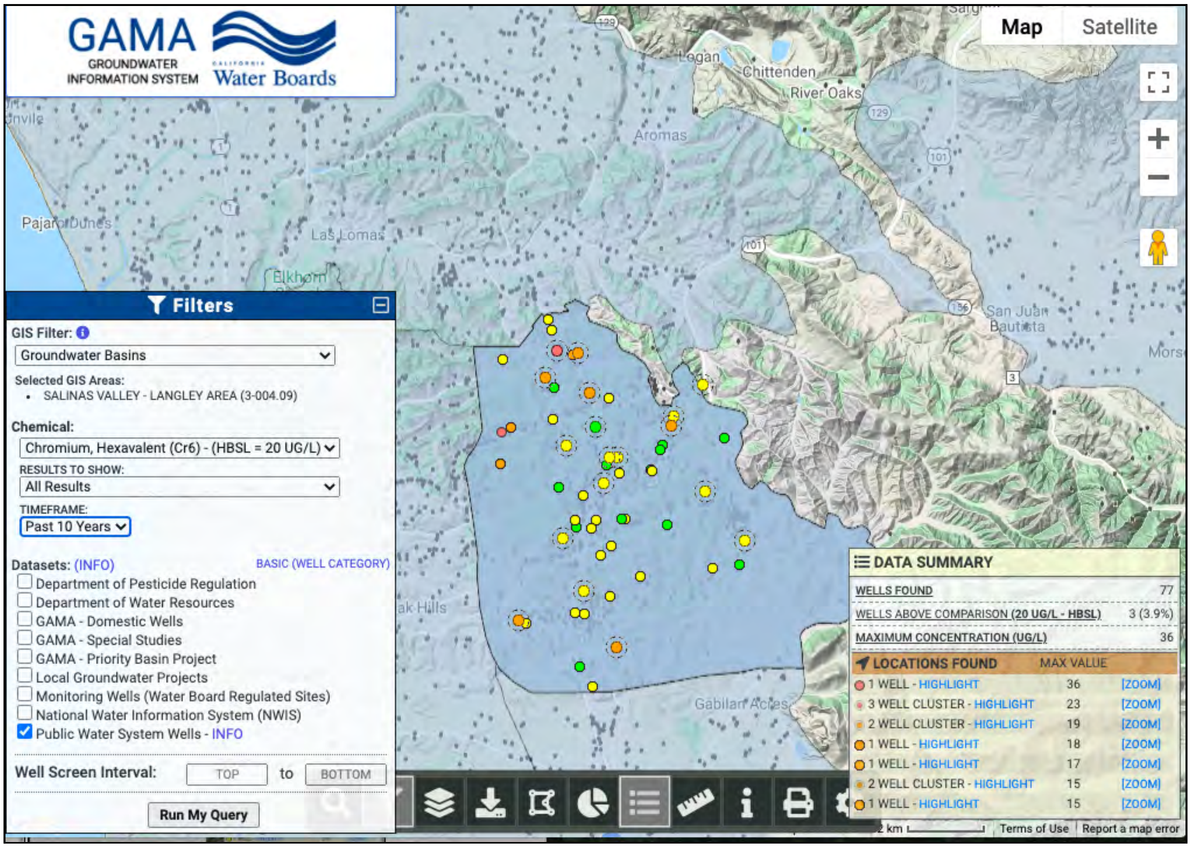
CWC Figure 6: Arsenic Concentrations in Public Water System Wells, Monterey, Langley East Side Subbasins (Red dots = >10 ppb, Orange = 5-9.9 ppb, Yellow = 0.6-5.9 ppb, Green= non-detect)

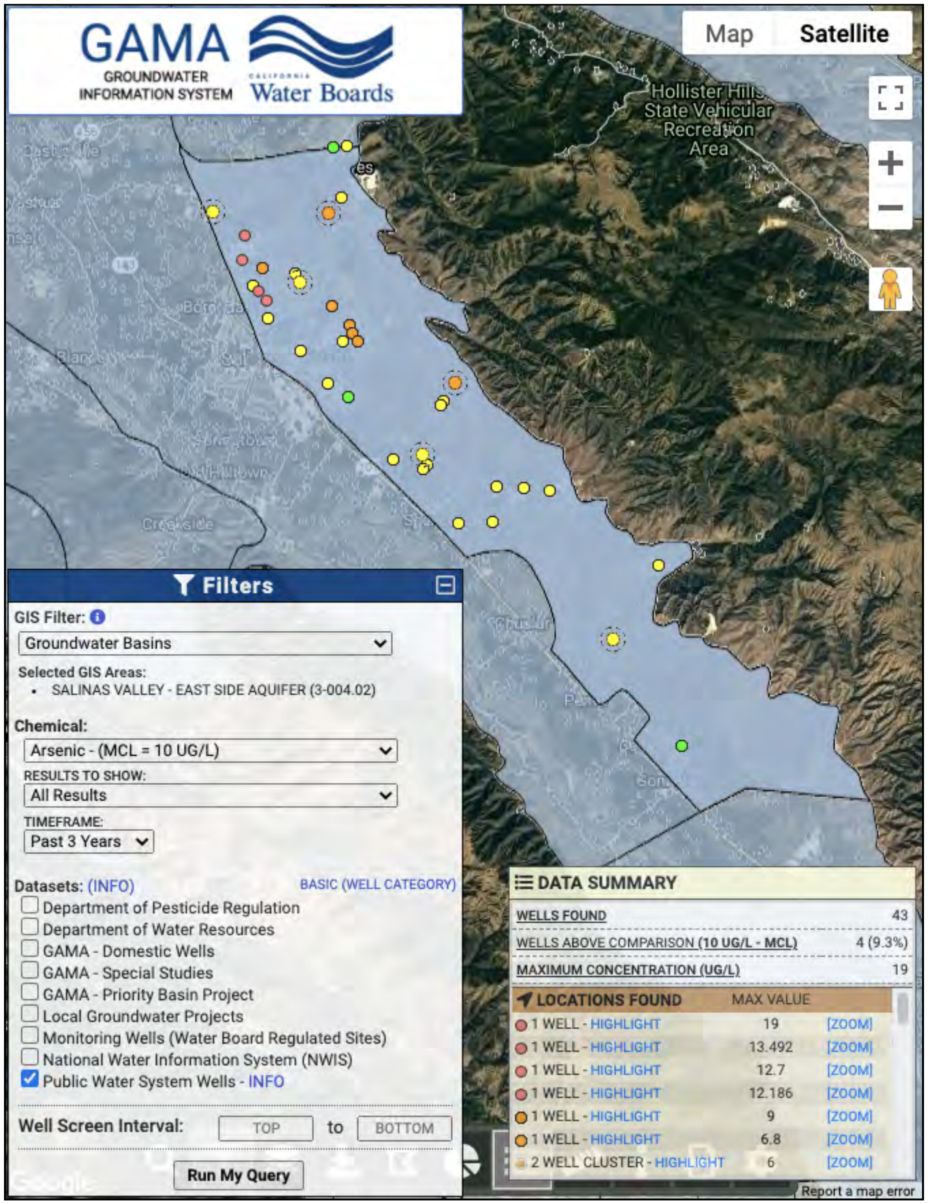


---

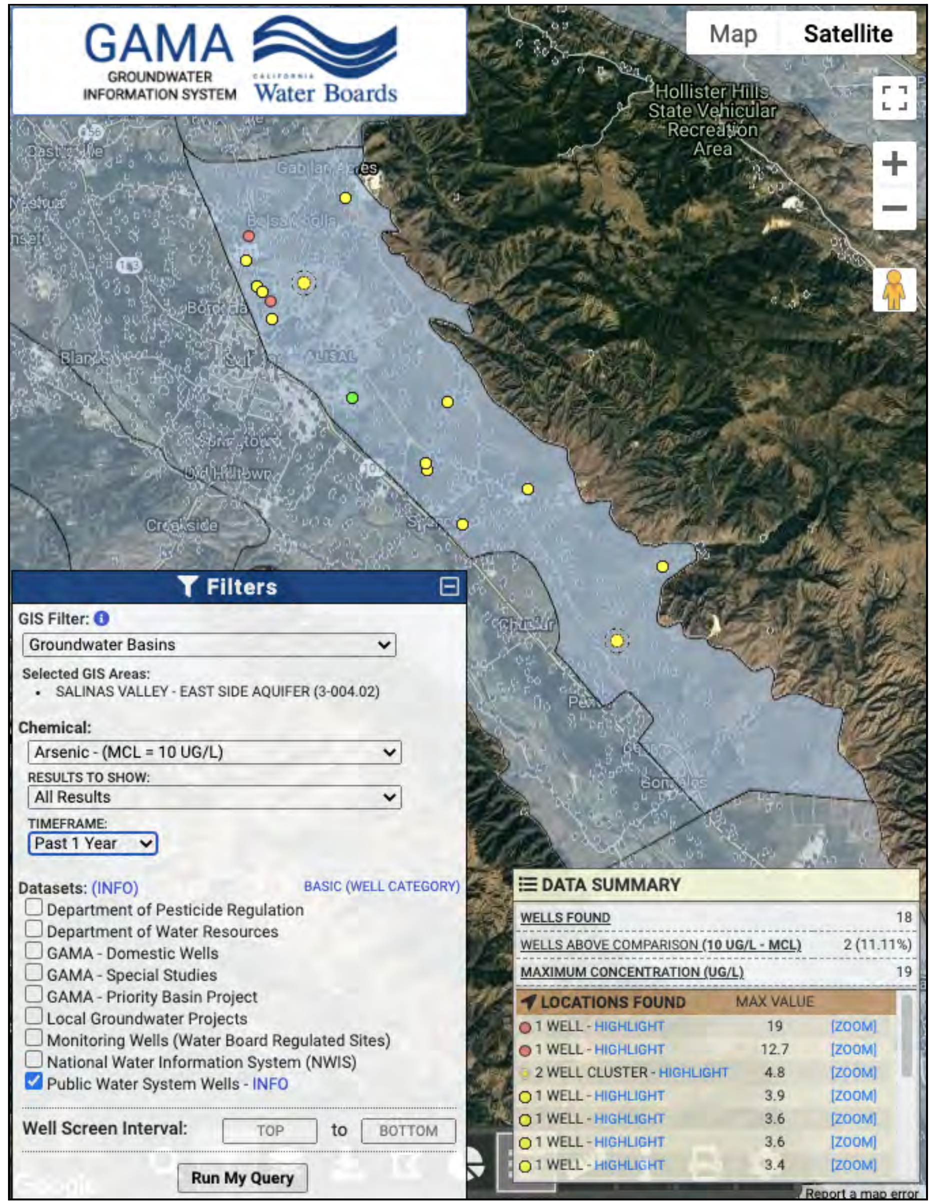
[11] https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local.

CWC FIgure 7: Hexavalent Chromium Concentrations in Public Water System Wells, Langley Subbasin





CWC Figure 8: 43 Public Water System Wells have arsenic data in the past 3 years. One well at San Jerardo Cooperative appears orange on this map.



CWC Figure 9: Only 18 Public Water Systems Wells have arsenic data in the past year. San Jerardo Cooperative's wells are not shown on this map.

GSP Chapter 6: Water Budgets

SGMA requires a GSP to quantify the water budget in sufficient detail in order to build local understanding of how historic changes have affected the six sustainability indicators in the basin.[12] Ultimately, this information is intended to be used to predict how these same variables may affect or guide future management actions.[13] GSAs must provide adequate water budget information to demonstrate that the GSP adheres to all SGMA and GSP regulation requirements, that the GSA will be able to achieve the sustainability goal within 20 years, and be able to maintain sustainability over the 50 year planning and implementation horizon.[14]

We are concerned that the calculations of sustainable yield and the water budget in this chapter may *overestimate the actual sustainable yield and water availability of the subbasins*. We highlight points of concern below and recommended changes.

6.4 Projected Water Budgets

The SVB GSA Subbasin GSPs explain that "[p]rojected water budgets are extracted from the SVOM, which simulates future hydrologic conditions with assumed climate change. Two projected water budgets are presented, one incorporating estimated 2030 climate change projections and one incorporating estimated 2070 climate change projections. … The climate change projections are based on data provided by DWR (2018)."[15] Including climate change scenarios in water planning is an important step for California's increased resiliency, however, which scenarios to include is a critical question.

Climate change is changing when, where, and how the state receives precipitation.[16] Impacts to water supply, particularly drinking water supply, could be devastating if planning is inadequate or too optimistic. GSAs must adequately incorporate climate change scenarios in water budgets. As such, the DWR Climate Change Guidance[17] makes recommendations to GSAs for how to conduct their climate change analysis while preparing water budgets. DWR also provides climate data for a 2030 Central Tendency scenario and 2070 Central Tendency, 2070 Dry-Extreme Warming (DEW), and 2070 Wet-Moderate Warming (WMW) scenarios. While DWR's Guidance should be improved with more specific guidelines and requirements, the current Guidance specifically encourages GSAs to analyze the more extreme DEW and WMW projections for 2070 to plan for likely events that may have costly outcomes. Therefore, we recommend that the SVB GSA subbasin GSPs:

- **Include water budget analyses based on DWR's 2070 DEW and WMW scenarios in order to analyze the full range of likely scenarios[18] that the region faces.**

---

[12] 23 CCR § 354.18.

[13] California Department of Water Resources (DWR), 2016. Best Management Practices for the Sustainable Management of Groundwater, Modeling (BMP #5), December 2016.

[14] 23 CCR § 354.24.

[15] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True.

[16] Union of Concerned Scientists. Troubled Waters: Preparing for Climate Threats to California's Water System, 2020. https://www.ucsusa.org/resources/troubled-waters#top.

[17] See DWR (2018) reference above.

[18] Terminology used in the California Climate Change Assessment, 2019. (Table 3). https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

- Currently, the SVB GSA's exclusive use of the "central tendency" climate scenario predicts an increase in surface water availability, as represented in the tables in Section 6.4.3 of the subbasin GSPs. The Projected Groundwater Budgets show increases in deep percolation of stream flow, deep percolation of precipitation, and irrigation. The subbasin GSPs are relying on this presumed increase for their water budgets. However, the 2070 DEW scenario provided by DWR could likely result in a significant decrease in precipitation and increase in evapotranspiration, which would have substantial effects on the subbasin water budgets. By analyzing only the central tendency scenario and not other likely scenarios such as the extremely dry and wet scenarios provided by DWR, the SVB GSA is ignoring the specific 2070 DEW and WMW scenarios provided by DWR as well as an increasing trend in drought frequency. In doing so, the GSP could be overestimating groundwater recharge or underestimating water demands, inadequately planning, and jeopardizing groundwater sustainability. This will waste precious time to prepare and reduce the vulnerability of the basin's agriculture and already vulnerable communities.
- DWR's guidance (2018) states that the central tendency scenarios *might* be considered most likely future conditions -- that is not a clear endorsement of a higher statistical probability. It appears that they are calling it the central tendency merely because it falls in the middle of the other two projections, not because it's significantly more probable.
- DWR (2018) explicitly encourages GSAs to plan for more stressful future conditions:
    - "GSAs should understand the uncertainty involved in projecting future conditions. The recommended 2030 and 2070 central tendency scenarios describe what might be considered most likely future conditions; there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios. Therefore, GSAs are encouraged to plan for future conditions that are more stressful than those evaluated in the recommended scenarios by analyzing the 2070 DEW and 2070 WMW scenarios."[19]
- Including the DEW and WMW climate scenarios as part of the 2070 water budget analysis is necessary to meet the statutory requirement to use the "best available information and best available science."[20] Sustainable planning must include planning for foreseeable negative and challenging scenarios. The extreme scenarios provided by DWR are certainly foreseeable, as they have been modeled and made available to the GSA for analysis.
- It is important for the SVB GSA to include the 2070 DEW and WMW scenarios, because shallow drinking water wells in the area are particularly vulnerable to various extreme conditions, especially drought.

---

[19] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. Section 4.7.1. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True. (In red is a statement about the central tendency scenarios referenced in SVB GSA public meetings and email communications by the GSA's engineering consultant, and in blue is the important text accompanying it, urging GSAs to analyze the more extreme scenarios. CWC staff cited this complete paragraph in email communications with the consultant and GSA staff on April 8, 2021. CWC also raised this point at Forebay and Upper Valley Subbasin Committee meetings in March and at the April SVB GSA Board Meeting.)

[20] See 23 CCR § 355.4(b)(1).

- **Share water budget results based on the 2070 central tendency, DEW and WMW scenarios that DWR has provided with the Subbasin committees, the Advisory Committee, and the GSA board**. This should be done at a *minimum* to see what the difference in outcomes could be, and to provide a transparent process for selecting the preferred scenario. This analysis is particularly important because of the drastic differences between the dry and wet scenarios for this region. Drought and/or intensified rainfall (more water falling over a shorter period of time) would pose severe challenges[21] to the Subbasins' plans for recharge, which is a critical component of their plans to reach sustainability.
- **Plan for potential adverse climate conditions when determining Projects and Management Actions.** The results of limited-scope planning will be detrimental to beneficial users throughout the SVB GSA. "If water planning continues to fail to account for the full range of likely climate impacts, California risks wasted water investments, unmet sustainability goals, and increased water supply shortfalls."[22] This is true not just generally across California, but also specifically on the Central Coast. "Without effective adaptations, projected future extreme droughts will challenge the management of the Central Coast region's already stressed water supplies, including existing local surface storage and groundwater recharge as well as imported surface water supplies from the State Water Project which will become less reliable, and more expensive."[23]

GSP Chapter 7: Monitoring Network

Robust monitoring networks are critical to ensuring that the GSP is on track to meet sustainability goals. GSAs undertaking recharge, significant changes in pumping volume or location, conjunctive management or other forms of active management as part of GSP implementation must consider the interests of all beneficial users, including domestic well owners and S/DACs. We have the following overarching recommendations for this chapter and provide more details for sub-sections below:

- **Require well registration and metering for all wells in the Salinas Valley, and begin implementation of a well registration and metering program in early 2022 with a dedicated budget.** We voice our strong support, with modifications indicated in our comments below, for proposed "Implementation Action 12: Well Registration" in Section 9.1 of Chapter 9 released in April 2021 and recommend that this action be updated and moved to Chapter 7. We agree with the SVB GSA's statement in Section 7.3.2 Groundwater Storage Monitoring Data Gaps that: "Accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. During implementation, the SVB GSA will finalize a database of existing and active groundwater wells in the Eastside Aquifer Subbasin." This is essential for the plan to achieve sustainability for all beneficial users and influences many different chapters including:

---

[21] Union of Concerned Scientists. Inter-model agreement on projected shifts in California hydroclimate characteristics critical to water management. 2020, p. 13. https://link.springer.com/content/pdf/10.1007/s10584-020-02882-4.pdf.

[22] See Union of Concerned Scientists. Troubled Waters (2020) cited above.

[23] Regional Climate Change Assessment for the Central Coast, 2019. (Discussing drought pp. 21-23. Internal citations omitted). https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-006_CentralCoast_ADA.pdf.

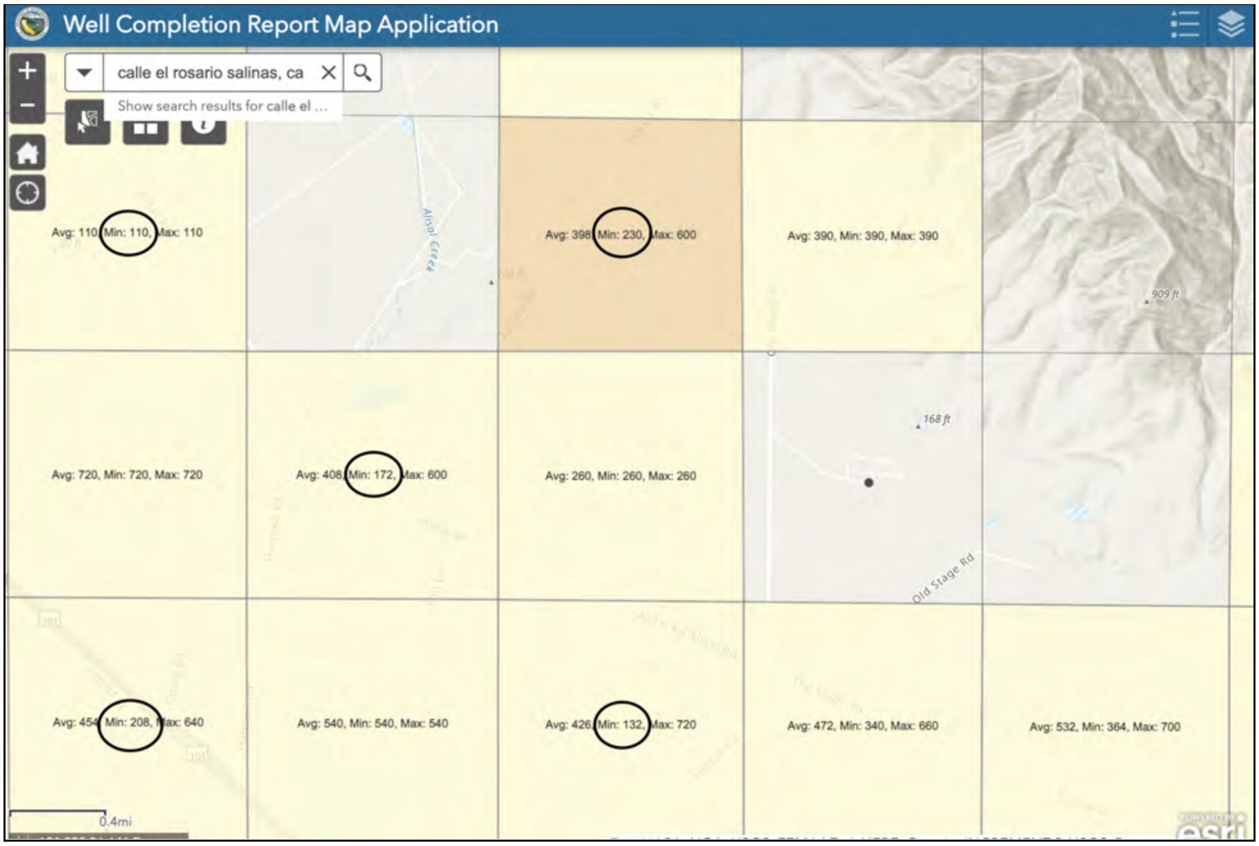
    - Monitoring networks: In order to develop a monitoring network that is representative, it will be essential to understand the number, location, well construction, and type (domestic, irrigation, other) of all wells located in the subbasins.
    - Water budget and minimum thresholds: Understanding the amount and location of pumping of all water users will be essential for creating an accurate water budget and minimum thresholds consistent with achieving sustainability.
    - Projects and management actions: Section 9.2.1 Well Registration and Metering is a key management action and component of the Water Charges Framework (in the 180/400 foot aquifer) and forthcoming subbasin GSPs. This will underpin the funding structure for many future projects.
- **Require flowmeter calibration to ensure consistent and fair monitoring among all agricultural groundwater users (Section 7.3.1).** Rather than "consider the value of developing protocols for flowmeter calibration," the GSPs should require flowmeter calibration. The water budget and sustainable yield calculation depend on reliable and fair monitoring and reporting of pumping.
- **Provide a plan and schedule for data gap resolution in forthcoming Chapter 10 of the subbasin GSPs.** In the 180/400 foot aquifer GSP, there was not a clear plan or schedule for the resolution of data gaps in Chapter 7 even though it indicated that this would be included in Chapter 10.
- **Revise GSP monitoring chapters such that monitoring networks for groundwater storage (pumping), groundwater elevation, and groundwater quality adequately monitor how groundwater management actions could impact vulnerable communities including those reliant on domestic wells and shallow portions of the aquifers** (see more detail below).

7.2 Groundwater Elevation Monitoring Network

- **Include groundwater elevation monitoring sites in the network that are representative in terms of the depth and geographic distribution of private domestic wells, and that takes into account areas of high agricultural pumping and wells vulnerable to groundwater decline.**
    - The draft East Side Subbasin GSP Table 7-1 of "Eastside Aquifer Groundwater Elevation Representative Monitoring Site Network" shows all irrigation and observation wells (and no domestic wells) which range in depth from 299 to 1122 feet.[24] Yet, the DWR Well Completion Report Map Application[25] shows that 1 mile by 1 mile square sections near San Jerardo Cooperative include private domestic wells with the following minimum depths: 110 ft, 210 ft, 172 ft, 208 ft, and 132 ft which are more shallow than all the wells in the current monitoring network (See CWC Figure 10).
- **Overlay the private well density map (Figure 3-7), the DWR Well Completion Report Map Application (with minimum, average, and maximum depths), the water level monitoring network (with well depths), and available pumping data to better illustrate if and how representative the proposed groundwater elevation monitoring network is of private domestic wells and which areas are vulnerable to water elevation changes.** The GSPs state: "The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors. " This will also help to better visualize where there are gaps in the monitoring network which the GSAs can address.

---

[24] One well shows "0" depth but that must be an error or missing value.
[25] https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports



CWC Figure 10: Screenshot of DWR Well Completion Report Map application in the area near San Jerardo Cooperative highlighting that several 1 mi. by 1 mi. square sections include private domestic wells less than 250 feet deep.

7.5 Water Quality Monitoring Network

- **Clarify the number of public water system wells that will be included in the water quality monitoring network.** We strongly support the GSPs inclusion stated in Section 7.5 that "All the municipal supply wells in the Subasin are part of the RMS network." As indicated in Chapter 3 and Chapter 5 comments, the GSPs should also clearly identify the number of public supply wells as well as the number of public supply wells that are out of compliance and at risk in each subbasin. Section 7.5 currently states that "A total of 51 public supply wells were sampled in WY 2019" and indicates that all wells are listed in Appendix 7E (which is not publicly available at this time). This section and appendix should be consistent with the total number of wells represented in Table 8-4 which includes groundwater quality minimum thresholds.
- **Representative Water Quality Monitoring Wells for the shallow aquifer should be established in the GSPs based on all currently available data sources with direct agreements with landowners or public entities established.**
  - **Develop long-term access agreements for Representative Monitoring Wells (RMWs) that use private wells.** Collecting data from private wells is not a reliable approach due to access challenges, lack of well construction information, and unreliable accounting of

pumping or non-pumping measurements. The GSPs should specifically identify the RMW owners and operators, include signed long-term access agreements, and identify a plan to obtain adequate monitoring data, if for any reason the well owners decide to not grant access to the wells or provide associated data to the SVB GSA. In order to maintain consistency for future sustainability analyses, the SVB GSA should also consider conducting its own water quality analysis of wells where access agreements have already been established to water quality RMWs.

- **Clarify that state and local small water systems will be added to the water quality monitoring network and that well construction information is no longer needed in order to fill this data gap.** Monterey County Environmental Health Bureau permits and monitors over 900 state and local small water systems in the County and have managed the data collected for decades. This dataset has advantages over the ILRP domestic well dataset in that it includes data on contaminants like arsenic and hexavalent chromium in addition to nitrate. Local small water systems serve 2-4 households and are much more similar to private domestic wells than public water systems in terms of depth, well construction, age, size, and maintenance - thus this data would provide a broader representation of shallow drinking water wells. State and local small water systems are located in areas of irrigated agricultural lands as well as rural residential and other land uses. This dataset should complement and not replace ILRP domestic well data.
  - **Clearly add state and local small water system data as a data gap in Section 7.5.2.** In Section 7.5 Water Quality Monitoring Network, the draft GSPs state: “These [state and local small] wells are not in the current monitoring system because well location coordinates and construction information are currently missing. SVB GSA will work with the County to fill this data gap. When location and well construction data become available, these wells will be added to the monitoring network and included in Appendix 7E and Figure 7-4." However Section 7.5.2 Groundwater Quality Monitoring Data Gaps states: "There is adequate spatial coverage to assess impacts to beneficial uses and users."
- **Do not rely solely on ILRP well data to represent private domestic wells (which are often more shallow than public water system wells).** Similar to CASGEM, the current groundwater quality monitoring network includes monitoring points on private property including ILRP domestic and irrigation wells, but it should not be restricted to ILRP sites only. While on-farm domestic and irrigation wells monitored through the ILRP provide a potentially useful, though limited, source of water quality information, additional representative monitoring wells in the shallow aquifer are important to include for several reasons: (1) The ILRP network only includes wells located on agricultural irrigated lands, and not all ILRP properties include domestic wells. Agricultural land use is not the primary land use in the Langley and Monterey Subbasins so this monitoring network offers very limited coverage. While agricultural land use is the primary land use in the East Side, Upper Valley, and Forebay Subbasins, there are private domestic wells in areas with different primary land uses (e.g. rural), and SGMA requires that monitoring networks are geographically representative. Monitoring network wells must also be sufficiently representative to cover all uses and users in the basin, (2) There are other, more robust networks established by USGS, GAMA, and Monterey County that could be drawn on and included to make the groundwater quality monitoring network more comprehensive and representative of conditions in the shallow aquifer, (3) Ag Order 4.0 was adopted on April 15, 2021, which means the first year of monitoring data will not be

available until late 2022, (4) The GSA has no authority to determine the robustness or enforcement of monitoring in the irrigated lands network, and (5) while Ag Order 4.0 proposes to require testing for 1,2,3-TCP as well as nitrate, the current ILRP domestic well data only samples for nitrate, and neither Order tests for other contaminants found in the region. In our experience, not all growers are consistent with their water quality and other reporting, despite the regulatory requirements in place.

- **Update Domestic ILRP and Irrigation ILRP wells in a different color on Figure 7-5 Locations of ILRP Wells Monitored under Ag Order 3.0.** Since these wells are monitored for different constituents and serve different beneficial users, it is important to illustrate them separately.

GSP Chapter 8: Sustainable Management Criteria

We have grouped our comments in this section into general recommendations related to all sustainable management criteria (SMCs) followed by a section specific to the water quality SMCs. We recommend that the Salinas Valley GSA implement the following recommendations in the subbasin GSPs:

- **Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds, proposed undesirable results, and potential interim conditions.** Include this analysis during the annual reporting process. We disagree with the assumption included in all draft GSPs that the exact location of wells needs to be known in order to include them in a drinking water well impact analysis. In the 180/400 Foot Aquifer Subbasin GSP, the SVB GSA included a domestic well impact analysis. Although the SVB GSA did not describe the methods used in this analysis,[26] it is CWC's understanding that the analysis was based on Public Land Survey System (PLSS) section location data, demonstrating that such an analysis is feasible. Similar analyses in the Water Foundation Whitepaper (June 2020)[27] and in the Kings River East GSP[28] were completed using the same PLSS section location data for private domestic wells that is available to the SVB GSA. The current analysis is incomplete as it includes very few wells in all subbasins. The current analysis is also substantially inaccurate as it relies on the "average computed depth of domestic wells in the Subbasin," and groundwater elevations vary significantly across the subbasin and also on an annual basis. For example, only 8 of the 154 domestic wells in the Forebay GSP with an average depth of 292.45 feet, and only 20 of 2016 domestic wells in the East Side GSP with an average depth of 365.5 feet were included. CWC Figure 10 illustrates that the average computive depth is not representative of conditions in shallow domestic wells. Therefore, we recommend revising Section 8.5.2.2 Minimum Threshold Impact on Domestic wells following the process explained below:
    - **Include a map of potentially impacted wells so the public can better assess well impacts specific to DACs, small water systems, or other beneficial users of water.**

[26] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012

[27] The Water Foundation Whitepaper, April 2020: "Estimated Numbers of Californians Reliant on Domestic Wells Impacted as a Result of the Sustainability Criteria Defined in Selected San Joaquin Valley Groundwater Sustainability Plans and Associated Costs to Mitigate Those Impacts." April 9, 2020.
http://waterfdn.org/wp-content/uploads/2020/05/Domestic-Well-Impacts_White-Paper_2020-04-09.pdf

[28] Kings River East Groundwater Sustainability Agency. Groundwater Sustainability Plan. Adopted December 13, 2019.

- **Quantify impacts for all drinking water wells in the subbasin for which approximate location (PLSS section) and well depth are available.** Similar analyses based on the PLSS section location of private domestic wells have been completed by Water Foundation (June 2020)[29] and in the Kings River East GSP[30].
- **Account for well screen and pump depth when available.** When not available, well screen and pump depth should be estimated conservatively to capture potential impacts to well operability under water scarcity conditions.
- **Quantify impacts for potential unfavorable interim conditions, such as droughts and short-term lowering of groundwater levels while implementation measures are put in effect.**
- **Quantify the elevation difference (in feet) between current groundwater levels and well bottoms, screens, and pumps.** If current groundwater levels are nearing well bottoms, screens or pumps, that indicates that the wells are vulnerable to interim lowering of groundwater levels.
- **Quantify the elevation difference (in feet) between the minimum threshold groundwater levels and well bottoms, screens, and pumps.** If the minimum threshold is near the well bottom, screen or pump, that well will be impacted if groundwater levels in the vicinity drop below the minimum threshold (even if minimum thresholds are met at 90 percent of monitoring wells and an undesirable result has not technically occurred).
- **Quantify the number of potentially impacted wells of each well type (irrigation, domestic, state/local small water system, public water system) for water quality, water levels, and sea water intrusion MTs.**
- **Quantify the costs associated with impacted wells including desalinization/treatment, lowering pumps, well replacement and increased pumping costs associated with the increased lift at the projected water levels.**

Groundwater Quality

We are pleased that the Salinas Valley Subbasin GSPs establish minimum thresholds based on maximum contaminant levels (MCLs) for contaminants of concern for drinking water supply systems. There are however other areas in regards to groundwater quality sustainable management criteria that are not clear and could cause significant impacts to drinking water users if not adequately addressed. Therefore, we recommend the following revisions:

- **Revise Section 8.3 General Process for Establishing Sustainable Management Criteria to include a sensitivity analysis around "average hydrogeologic conditions" following our recommendations outlined in Chapter 6.**
- **Add state and local small water systems to the monitoring network with the same water quality minimum thresholds and measurable objectives for reasons stated in Chapter 7 comments.** A table for state and local small water system minimum thresholds was included in the 180/400 foot aquifer GSP, but in the draft subbasin GSPs, there is no such table and Table 8-1 only mentions public supply and on-farm domestic wells.

[29] See previous reference.
[30] See previous reference.

- **If a contaminant was already above the MCL as of January 1, 2015, subbasin GSPs should set a MT to prevent further degradation or aim to improve groundwater quality conditions where possible.** Increased contamination levels can require water systems to utilize more expensive treatment methods and/or to purchase additional alternative supplies as blending may become more difficult or impossible. Communities reliant on domestic wells who are aware of contamination in their water and use point of use/point of entry (POU/POE) treatment systems may no longer be able to use their devices if contaminate levels rise too high. Higher contaminant levels can also result in higher costs of waste disposal from certain types of treatment systems. Further, residents who rely upon domestic wells, state small water systems, or local small water systems may not even know what contaminants are in their water and at what levels. Users of these drinking water sources are not required to conduct testing, and many times do not have the resources necessary to conduct regular testing. Rising contaminant levels put these users and their health at serious risk. Increased contamination levels result in unreasonable impacts to access to safe and affordable water and are, thus, inconsistent with SGMA and the Human Right to Water. This recommendation is consistent with the State Water Board's recommendations regarding this topic in their letter to DWR regarding the 180/400 foot aquifer GSP in which they state: "Increasing concentrations of nitrate, arsenic, and other constituents at monitoring wells with existing exceedances may represent worsening of existing conditions due to groundwater pumping. Staff recommend setting concentration threshold levels for these wells in order to determine if impacts due to pumping are occurring."[31]
    - **Develop management areas to protect areas where drinking water wells have water quality that are vulnerable, including the San Jerardo area.**
- **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSPs should set MOs at 75% of the MCLs.** Subbasin GSPs should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold exceedance at a representative monitoring well. This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. If the GSA waits until the minimum threshold is exceeded, it may be too late or difficult for actions to be effective. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded. *We also recommend that groundwater quality and trigger levels at 75% are added to Section 9.1.3 Implementation Action 11: Local Groundwater Elevation Trigger (April 2021 draft) which currently only includes groundwater elevations.*
- **Clearly identify and describe past and present levels of contamination and salinity at each representative monitoring well (RMW) and attribute specific numeric values for MTs/MOs at each RMW for each contaminant of concern.** Quantitative values need to be established for MTs/MOs for each applicable sustainability indicator at each RMW as required by 23 CCR § 354.28 and 23 CCR § 354.30. The GSPs should include a map and tables that include each individual RMW along with water quality data for each RMW (this data is currently summarized in Table 8-4 and Table 8-5). This information should be presented clearly so that both the public can determine how the proposed monitoring network and sustainable management criteria (SMCs) relate to their own drinking water well or water supply system.

---

[31] State Water Board comments to DWR on 180/400 Foot Aquifer GSP (Dec. 2020). Downloaded from SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29

- **Include hexavalent chromium as a contaminant of concern and plan to add contaminants of emerging concern to the monitoring network.** While there is currently not a Maximum Contaminant Level for hexavalent chromium, there is still a Public Health Goal and public health threat posed by this contaminant in drinking water. The State is required to adopt an MCL for chromium-6 again and is in the process of updating the MCL. In addition to including hexavalent chromium, the GSPs must explain how the Plans will be updated to align groundwater monitoring efforts and the sustainable management criteria with any contaminants of emerging concern in the basin and any future new MCLs.
- **Include an analysis of the relationship between changes in groundwater levels and groundwater quality concentrations.** Section 8.5.2.3 of the draft GSPs discusses the relationship between individual minimum thresholds and other sustainability indicators, and states: "Decreasing groundwater elevations can cause wells to draw poor-quality groundwater from deeper zone. No additional poor groundwater quality issues were identified due to low groundwater elevations when groundwater elevations were previously at minimum threshold levels." We ask that justification is provided to backup the second statement or that it is removed until an analysis is conducted. It is our understanding that groundwater quality issues did, in fact, worsen during low groundwater elevations years. Arsenic in the San Jerardo well was at its highest during the lowest groundwater elevation measurement (See CWC Figure 1). The text should acknowledge that groundwater pumping can not only cause the movement of contaminant plumes, but can also cause the release of naturally occurring contaminants such as arsenic and chromium. In order to clearly evaluate the relationship between changes in groundwater levels and groundwater quality, SVB GSA should undertake an analysis of the change in water quality constituent concentrations relative to change in water levels,[32] particularly over drought periods, to evaluate the potential relationship between water quality and groundwater management activities.[33]
- **Add the total number of wells in each category that will be included in the water quality monitoring network and have SMCs evaluated to Table 8-4. For each constituent of concern, add the number of wells included in the chart and the number exceeding the MT/MO based on the latest sample.** This comment has the same goal as the comment we provided in Chapter 7. SMCs should be set at every public drinking water well and a representative network of drinking water wells that rely on more shallow aquifers. It is essential to track the same wells each year in the monitoring network. If a well is no longer active, it should be removed from the network. In the current representation, it is not clear which wells are included in the monitoring

---

[32] See P.A.M. Bachand et. al. Technical Report: Modeling Nitrate Leaching Risk from Specialty Crop Fields During On-Farm Managed Floodwater Recharge in the Kings Groundwater Basin and the Potential for its Management https://suscon.org/wp-content/uploads/2018/10/Nitrate_Report_FInal.pdf. See also, Groundwater Recharge Assessment Tool, created by Sustainable Conservation to help groundwater managers make smart decisions in recharging overdrafted basins, including modeling whether a particular recharge project would result in short or long term benefits or harms to water quality, http://www.groundwaterrecharge.org/.

[33] More information about groundwater quality and the relationship between changes in groundwater levels can be found in the following resources:

Stanford, 2019. A Guide to Water Quality Requirements Under the Sustainable Groundwater Management Act. Community Water Center, 2019. Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858

Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

network, which wells have data for each constituent, and which wells are exceeding the regulatory standard.

- **Engage stakeholders and scientists in a transparent discussion regarding "the process the GSAs would use to decide whether or not an exceedance of an MT for water quality degradation was caused by GSP implementation."**[34] The State Water Board recommended that the 180/400 foot aquifer GSP outline this process "otherwise, it is difficult to judge how adequately the GSP addresses undesirable results related to water quality degradation." This relates to the undesirable result for water quality which currently reads: "There shall be no additional minimum threshold exceedances beyond existing groundwater quality conditions during any one year as a direct result of projects or management actions taken as part of GSP implementation."

[34] State Water Board comments to DWR on 180/400 Foot Aquifer GSP (Dec. 2020). Downloaded from SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29 .

From:	Emily Gardner
To:	Patrick Breen (pbreen@mcwd.org); Tina Wang
Cc:	Abby Ostovar; Bonnie Gradillas
Subject:	Fwd: CWC Comments on Draft Subbasin GSP Chapter 9
Date:	Wednesday, April 28, 2021 2:19:07 PM
Attachments:	CWC_Salinas Valley Subbasin GSP Ch 9 comments 4.28.21.pdf

Good afternoon,

Attached you will find a comment letter for the Monterey Subbasin.

Thanks,

Emily

---------- Forwarded message ---------
From: **Justine Massey** <justine.massey@communitywatercenter.org>
Date: Wed, Apr 28, 2021 at 12:45 PM
Subject: CWC Comments on Draft Subbasin GSP Chapter 9
To: Emily Gardner <gardnere@svbgsa.org>, Donna Meyers <meyersd@svbgsa.org>
Cc: Heather Lukacs <heather.lukacs@communitywatercenter.org>, Mayra Hernandez <mayra.hernandez@communitywatercenter.org>

Dear Emily and Donna,

Please see the attached comments and recommendations submitted on behalf of Community Water Center regarding Chapter 9 of the SVB GSA Subbasin GSPs.

We hope that these comments can inform the ongoing development of the Subbasins' Projects and Management Actions (Implementation Actions), and we are available for further discussion.

In particular, we would like to explore the possibility of presenting on the Drinking Water Well Impact Mitigation Framework to SVB GSA staff, Board members, and/or Committee members in the coming months. We look forward to continuing to work together.

Best regards,
Justine

--
Justine Massey, J.D.
Policy Advocate
Community Water Center
716 10th St., Suite 300, Sacramento, CA 95814
Office: 916-706-3346 | Cell: 916-717-4880
www.communitywatercenter.org
Facebook Twitter Instagram

All CWC staff are currently working remotely. Please reach all staff via email and phone.

--

April 28, 2021

Salinas Valley Basin Groundwater Sustainability Agency

Submitted electronically to:

Emily Gardner, Deputy General Manager

Donna Meyers, General Manager

Re: Comments on Draft Chapter 9 Project and Management Actions for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins

Dear Salinas Valley Basin Groundwater Sustainability Agency:

The Community Water Center (CWC) offers the following comments and recommendations regarding key components of the draft Chapter 9 Projects and Management Actions (Implementation Actions) that were shared with SVB GSA subbasin committees in April 2020. These comments are intended to add to the public record and are submitted in addition to previous written and spoken comments.

Chapter 9 Projects and Management Actions

During the April 7, 2021 East Side and Upper Valley subbasin committee meetings, feedback was requested on a draft list of project and management actions. As outlined in the April 7 meeting materials, "[p]rojects implement the GSP and enable the subbasin to reach sustainability by 2042, then maintain sustainability for another 30 years." Both groundwater levels and water quality degradation can have adverse impacts on drinking water users and disadvantaged communities (DACs), who are protected as beneficial users under SGMA[1]. Therefore, projects and management actions (also referred to as implementation actions) should address sustainability issues facing drinking water and other domestic water uses, in order to ensure their continued availability.

As this chapter is further revised for the East Side and Upper Valley subbasins and as potential projects and management actions are considered for the Forebay, Langley, and Monterey, the GSPs should (1) clearly identify potential impacts to water quality from all projects and management actions, (2) include management actions that respond to immediate needs and (3) develop a more robust implementation schedule and funding plan for projects and management actions. We acknowledge that the implementation actions are currently in the beginning stages of design but encourage incorporating these elements early on.

9.1.3 Implementation Action: Local Groundwater Elevation Trigger

The Local Groundwater Elevation Trigger is a significant start to tracking and addressing impacts to domestic wells. We support the inclusion of a "notification system whereby well owners can notify the GSA or relevant partner agency if their well goes dry." Because SVB GSA defines its sustainability criteria in a way that potentially allows for drinking water well impacts and because there is so much uncertainty regarding potential domestic well impacts, we recommend that this implementation action be updated to incorporate a **Robust Drinking Water Well Mitigation Program.** This program should include the Local Groundwater Elevation Trigger as well as (1) a plan to prevent impacts to drinking water users from

[1] WAT § **10723.2.**

dewatering, increases in contaminant levels and increases in salinity, and (2) a plan to mitigate the drinking water impacts that occur even when precautions are taken.

CWC together with other organizations published a Framework for a Drinking Water Well Mitigation Program (2020) that we recommend the SVB GSA uses as a guide when further developing this implementation action. We are also interested in sharing more with staff and are willing to provide a presentation to SVB GSA staff, board members, and/or the advisory committee on this Framework. The framework describes the importance of adaptive management and affirms the intent of the draft Local Groundwater Elevation Trigger management action and states, "Developing a protective warning system... can alert groundwater managers when groundwater levels and groundwater quality are dropping to a level that could potentially negatively affect drinking water users. These "triggers" are essential for groundwater management and can be adjusted to fit the needs of different management actions as well as the basin as a whole."[2] We also support the provision in the draft "Local Groundwater Elevation Trigger" Implementation Action that offers "referral to assistance with short-term supply solutions, technical assistance to assess why it went dry, and/or long-term supply solutions." This type of adaptive management implementation action is crucial to ensuring that all beneficial users within the basin are protected under the GSP. As we have highlighted in previous comments[3]:

> A GSP that lacks a mitigation program to curtail the effects of projects and management actions as to the safety, quality, affordability, or availability of domestic water, violates both SGMA itself and the Human Right to Water (HR2W).[4] The California legislature has recognized that water used for domestic purposes has priority over all other uses since 1913[5] in Water Code § 106, which declares it, "established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation."[6] The passage of the Safe and Affordable Drinking Water Fund by Governor Newsom indicates a clear State-level commitment to provide safe and affordable drinking water to California's most vulnerable residents.[7] To ensure compliance with the Legislature's long established position, the HR2W requires that agencies, including the Department of Water Resources and the State Water Board, must consider the effects on domestic water users when reviewing and approving GSPs.[8] Therefore, GSPs that cause disparate impacts to domestic water use are in violation of the HR2W, SGMA, and Water Code § 106.6.

In order to effectively protect drinking water users during GSP implementation, we recommend that the GSA's **Drinking Water Well Impact Mitigation Program Implementation Action,** in line with and expanding upon the currently proposed Local Groundwater Elevation Trigger, should include the following components:

---

[2] *See* Self-Help Enterprises, Leadership Counsel for Justice and Accountability, Community Water Center (2020) *Framework for a Drinking Water Well Impact Mitigation Program*.
https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ca9389712b732279e5296/1597811008129/Well_Mitigation_English.pdf.

[3] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

[4] WAT § 106.3 (a).

[5] Senate Floor Analysis, AB 685, 08/23/2012.

[6] This policy is also noted in the Legislative Counsel's Digest for AB 685.

[7] SB 200 (Monning, 2019).

[8] WAT § 106.3 (b).

- **Include a vulnerability analysis of Disadvantaged Communities (DACs) and drinking water supplies in order to protect drinking water for these vulnerable beneficial uses and users.** Although rural domestic and small water system demand does not contribute substantially to the overdraft conditions, drinking water users could face significant impacts, particularly if the region faces another drought. Without a clear commitment and timeline for actions regarding establishing groundwater allocations or reductions in groundwater pumping, the SVB GSA may create disparate impacts on already vulnerable communities. See comments submitted by CWC and San Jerardo Cooperative on April 23, 2021 regarding Chapter 8 of SVB GSA Subbasin GSPs for further recommendations for conducting well impact analyses.
- **Develop the trigger system in collaboration with stakeholders, in particular groups that are more susceptible to groundwater elevation and quality changes, and then connect stakeholder recommendations back to quantifiable measures such as the GSP measurable objectives, MCLs, and numbers of partially or fully dry drinking water wells.**[9]
- **Ensure that the monitoring network is representative of conditions in all aquifers in general, including the shallow aquifer upon which domestic wells rely.** This comment aligns with comments submitted April 23, 2021 regarding Chapter 7 of the SVB GSA Subbasin GSPs, and is particularly crucial as part of a "Trigger" Management Action (or Well Impact Mitigation Program).
- **Routinely monitor for all contaminants that could impact public health (not only nitrate, but also chromium-6, arsenic, 123-TCP, uranium, and DBCP) through the representative water quality monitoring network.** Contaminated drinking water can cause both acute and long-term health impacts and can affect the long-term viability of impacted regions.[10] Among other causes, groundwater contamination can result through the use of man-made chemicals, fertilizers, or naturally-occurring elements in soils and sediments.[11] Routinely monitoring for contaminants will allow the GSA to accurately monitor for impacts on the most vulnerable beneficial users, and protect DACs' and domestic well owners' access to safe and affordable drinking water.[12]
    - **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSP should set MOs at 75% of the MCLs.** The GSP should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold exceedance at a representative monitoring well.[13] This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. As discussed in previous

---

[9] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

[10] Community Water Center. Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. (2019). https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

[11] See previous Community Water Center (2019) reference.

[12] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

[13] This recommendation was also made previously in a comment letter to SVB GSA from CWC and San Jerardo Cooperative regarding Chapter 8 of the 180/400 ft Aquifer GSP on November 25, 2020, as well as in our comments to the SVB GSA on April 23, 2021 regarding Chapter 8 of drafts for the SVB GSA Subbasin GSPs.

submitted comments, water quality impacts can intensify as water levels decrease.[14] If the GSA waits until the minimum threshold is exceeded, it may be too late or difficult for actions to be effective. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded.

- **Include a combination of different strategies for mitigation including: replacing impacted wells with new, deeper wells, connecting domestic well users to a nearby public water system, or providing interim bottled water.**
- **Include an implementation timeframe, budget, and funding source**.[15] As currently written, the Local Groundwater Elevation Trigger suggests convening "a working group to assess the groundwater situation if the number of wells that go dry in a specific area cross a specified threshold." We support emergency response if one or more wells are impacted, and also request that this section be updated to include strategies to prevent impacts from occuring in the first place. Additionally, plans to address and mitigate those impacts should be solidified beforehand so resources can be mobilized in a timely manner. Drinking water users cannot afford to wait for interim plans to be developed once their primary sources of water for drinking, cooking and hygiene are compromised.

9.1.3 Implementation Action: Domestic Water Partnership

CWC would like to voice preliminary support for the Domestic Water Partnership Implementation Action, as a step towards coordinating local and regional responses to water quality issues. However, we reiterate that the GSA remains directly responsible for recognizing and resolving water quality degradation that results from its policies and projects. We also would like to affirm our previous comments encouraging the SVB GSA to include - without delay - Monterey County water quality data for state and local small water systems. This data is readily available and would add significantly to the proposed water quality monitoring network in draft subbasin Chapters 7. We do not want this potential partnership implementation action to delay the incorporation of this important data source. This action can and should, however, integrate this County data into current draft subbasin plans in order to identify potentially vulnerable populations and create management actions to protect them. We will offer further comments and recommendations on this subject as future drafts are released. To echo recommendations made previously regarding Suggested Partnerships for Multi-Benefit Remediation Projects:

- **The GSA should work with local and regional water agencies or the county to implement groundwater quality remediation projects that could improve both quality as well as levels and to ensure groundwater management does not cause further degradation of groundwater**

[14] Community Water Center and Stanford University. Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium. (2019). https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

[15] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

quality.[16] The strategic governance structure of GSAs can uniquely leverage resources, provide local empowerment, centralize information, and help define a regional approach to groundwater quality management unlike any other regional organization. When implemented effectively, GSPs have the potential to be instrumental in reducing levels of contaminants in their regions, thus reducing the cost of providing safe drinking water to residents. GSAs are the regional agency that can best comprehensively monitor and minimize negative impacts of declining groundwater levels and degraded groundwater quality that would directly impact rural domestic well users and S/DACs within their jurisdictions. When potential projects are proposed, SVB GSA should consider how projects could potentially both positively and negatively impact groundwater quality conditions and should take leadership in coordinating regional solutions.

[16] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020. https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

Draft Chapter 7 – Comments from Seaside Basin Watermaster 5-10-21

Page	Section	Comment
7-6	7.3	This section states in part "The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells." The list of entities that monitor the 390 wells mentioned here does not include the Watermaster. The Watermaster has numerous wells that are adjacent to the Corral de Tierra subarea, and some that are adjacent to the Marina-Ord subarea. Those should be included in order for the GSP to be able to see how its management actions are affecting the adjacent subbasin.
7-7	7.3	The 3rd bullet on this page states "RMS wells should facilitate monitoring along the existing seawater intrusion front to verify that water levels in these areas are not declining and increasing the risk of seawater intrusion." Monitoring Well FO-9 is within the Seaside subbasin, just south of the boundary with the Monterey subbasin, and is near the known seawater intrusion front. Therefore, it should be included as an RMS well.
7-12, 7-13,	7.3	Figures 7-4 and 7-5 should include Monitoring Well FO-9 Shallow and/or FO-9 Deep for the reasons stated above.
7-14	7.3	Figure 7-6 should include adjacent monitoring wells in the eastern portion of the Laguna Seca subarea of the Seaside subbasin to see how Corral de Tierra management actions are affecting the adjacent subbasin. Montgomery & Associates has maps showing the names and locations of those wells.
7-18	7.3.2	The statement from one of the reports cited in this section that 0.2 to 10 wells per 100 square miles is the recommended monitoring well density is ridiculous for purposes of performing any type of reliable groundwater modeling. Far greater well density is necessary for that purpose.
7-19	7.3.2	On this page there is the statement "…additional wells are necessary to provide additional groundwater elevation data near the ocean in areas subject to sea water intrusion." It also states that the generalized locations for monitoring wells was based on "Demonstrating conditions at Subbasin boundaries." For the reasons stated above Monitoring Well FO-9 should be included.
7-19	7.3.2	On this page it states "A higher density of monitoring wells is recommended near residential areas or other locations where groundwater withdrawal is significant" and that this is the case in the Corral de Tierra subarea. Per the comment above on page 7-14 the adjacent monitoring wells in the Laguna Seca subarea should be included.
7-20	7.3.2	Although not within the area identified on Figure 7-7 as a "data gap" area, Monitoring Well FO-9 Shallow should be included to help fill that gap.
7-21	7.3.2	Although not within the area identified on Figure 7-8 as a "data gap" area, Monitoring Well FO-9 Deep should be included to help fill that gap.
7-22	7.3.2	Per the comment above on page 7-14, the adjacent monitoring wells in the Laguna Seca subarea should be included in Figure 7-9.
7-23	7.3.3	In the top para on this page it appears that the word "parallel" should be "perpendicular." In the 2nd para after the words "…Monterey Subbasin…" the words "…or into any adjacent subbasins…" should be inserted. In that same para the word "southeastern" should be replaced with the word "southern." In the last para on

		this page, after the words "Monterey Subbasin" the words "…and in the adjacent Seaside Subbasin…" should be inserted.
7-25	7.3.3	In Figure 7-10 in the Legend this is a symbol for "Area of Potential Seawater Intrusion." It would be helpful to discuss in the text how that area was determined.
7-28	7.5	In the top para the words "…and the Seaside Groundwater Basin Watermaster…" should be added after the word "MPWMD." In that same para it states "Additional sites are added to the RMS network to facilitate monitoring of significant and unreasonable groundwater conditions…" This supports the need to add monitoring wells in the adjacent Seaside subbasin.
7-29	7.5	The Seaside Groundwater Basin Watermaster should be added to the list of monitoring agencies on this page.
7-33	7.5	Per comments above Monitoring Well FO-9 Shallow should be added to Figure 7-15.
7-34	7.5	Per comments above Monitoring Well FO-9 Deep should be added to Figure 7-16.
7-36	7.5	Per comments above Monitoring Wells FO-9 Shallow and Deep should be added to Table 7-4.
7-37	7.5	Sentinel MW#1 is also monitored by the Seaside Groundwater Basin Watermaster via induction logging and datalogger groundwater elevation monitoring.
7-37	7.5.1	In the 2nd bullet in this section correct the wording to read "The Seaside Basin Watermaster Monitoring and Management Program…"
7-37	7.5.2	In the 1st and 2nd bullets in this section add that Monitoring Well FO-9 should be included.
7-2 (note the page numbering needs to be corrected starting with page 7-1 at this point in the Chapter)	7.6	In Figure 7-17 monitoring wells in the eastern portion of the Laguna Seca subarea should be added to the wells in the groundwater quality monitoring network.
7-3	7.6.2	The statement that the network cannot be expanded by drilling new wells (i.e. monitoring wells) does not make sense.

T0: Salinas Valley Groundwater Sustainability Agency

From: Fred Nolan as public commentary

(montereyfred@gmail.com)

Subject: Suggested Solution to the groundwater sustainability in Monterey County

As I no longer use pen and pencil nor do I type due to Parkinson's disease I am dictating this with Dragon NaturallySpeaking.

The solution to all groundwater sustainability is not desalinisation. It is the reuse of the water we already have. The largest water reuse facility in the world is right here in California. Orange County produces in their ground water replenishment system enough drinkable water for 2 1/2 million people. On a vastly smaller scale we can do the same thing.

Recycling water is one third the cost desalinated ocean water. Building a desalinisation length costs approximately $200 million dollars. The probability of raising that kind of money in central California is ZERO.

I suggest we study Orange County's impressive recycling system. They have a number of very illuminating websites. The time has come to get over unscientific reservations about recycled water. The time for recycled water is here. Plant in Marina produces a small amount of high quality recycled water right now. By dramatically increasing the output of this desirable commodity we can meet our water needs indefinitely. If we are scientifically capable of putting robots on Mars we are capable of producing exquisite water over and over again.

Fred Nolan

Frederick Ernest Nolan Jr.
2280 David Avenue
Monterey ,California 93940

SAN JOSE CA 950
11 MAY 2021 PM 1 L

SVBGSA
P.O. Box 1350
Carmel VAlley CA
93924

93924-135050

SALINAS BASIN
AGRICULTURAL WATER ASSOCIATION

SALINAS BASIN AGRICULTURAL WATER ASSOCIATION, INC.
1140 Abbott St., Ste. C
Salinas, CA 93901
831/751-3100

May 12, 2021

Salinas Valley Basin Groundwater Sustainability Agency
Board of Directors
P.O. Box 1385
Carmel Valley, CA 93924

VIA: Email to SVBGSA General Manager

RE: Groundwater Sustainability Plans – Water Quality Objectives

Dear SVBGSA Chair Adcock and Directors:

Salinas Basin Agricultural Water Association is a coalition of agricultural organizations tasked with overseeing the implementation of the Sustainable Groundwater Management Act (SGMA) and the development of the groundwater sustainability plans for the Salians Valley groundwater aquifer. Our organization has been integrally involved in groundwater management since this passage of SGMA and the formation of the SVBGSA.

Watching the development of the groundwater sustainability plans for the five sub-basins, due in January 2022, there appears to be attention drawn by various stakeholders to specific groundwater quality references that are under the jurisdiction of the Central Coast Regional Water Board (RWB).

On April 15, 2021, a new Irrigation Lands Regulatory Program was adopted by the RWB, also knows as Ag Order 4.0. This program manages farming activities to specific water quality objectives, including the amounts of nitrogen that can be either applied or discharged from production fields, to either surface or groundwaters. Farming operations will be required to calculate their "Applied-Removed ratio" for each crop produced, meeting specific compliance standards that are ratcheted down each successive year. Additionally, each domestic-use well located on a farming operation must be tested annually for a broad set of water quality constituents.

Water quality objectives are heavily managed by Ag Order 4.0 and will be costly for farming operations and their landowners to implement. Record keeping, annual compliance reporting, and cooperative monitoring fees will add heavily to the burden of farm management and financial sustainability.

As the groundwater sustainability plans are developed, discussed by the Sub-basin Committees, and ultimately brought to the Advisory Committee and SVBGSA Board for approval, it should be clearly stated within those forums that water quality objectives for farming operations are managed under Ag Order 4.0 by the RWB, and that SVBGSA should not set any additional water quality parameters within the groundwater sustainability plans.

Conflicting and duplicative water quality objectives, if included in the groundwater sustainability plans, would lead to unnecessary costs for farming operations and landowners. Due consideration should be given to the Ag Order 4.0 program and how water quality objectives will be managed on-farm going forward, limiting groundwater sustainability plans to manage the balance of extractions and recharge for each respective sub-basin.

Thanks for your consideration.

Sincerely,

Norman C. Groot
President

m|r|wolfe
& associates, p.c.
attorneys-at-law

July 12, 2021

Via email

Marina Coast Water District
11 Reservation Road Marina,
CA 93933 Attn: Patrick Breen, Water Resources Manager
Email: pbreen@mcwd.org

Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Attn: Emily Gardner, Deputy General Manager and Derrik Williams, GSP Project Manager Email: gardnere@svbgsa.org; dwilliams@elmontgomery.com

Re: Draft Chapter 8 of Monterey Subbasin Groundwater Sustainability Plan

Dear Mr. Breen, Ms. Gardner, and Mr. Williams:

I write on behalf of LandWatch Monterey County to comment on draft Chapter 8 of the Monterey Subbasin Groundwater Sustainability Plan (GSP).

The sustainable management criteria (SMCs), including the minimum threshold (MT) and measurable objective (MO) for chronic lowering of groundwater levels for the Monterey Subbasin may suffer from the same defect as in the 180/400-Foot Aquifer Subbasin Groundwater Sustainability Plan. That defect is that the groundwater level SMCs are not supported by consideration of their effects on other sustainability indicators, in particular, seawater intrusion. There appears to be no evidence that the groundwater level SMCs and their associated interim milestones will support attainment of the seawater intrusion threshold, particularly since the interim milestone would permit continued declines in historic groundwater levels and would not reach the SMCs for almost 20 years.

Furthermore, setting Corral de Tierra subarea groundwater level SMCs at historic levels would cause chronic lowering of groundwater levels in the neighboring Seaside Subbasin. According to the Seaside Basin Watermaster, pumping reductions and groundwater level increases are required in the Corral de Tierra subarea to remedy falling groundwater levels in the Laguna Seca Subarea.

Finally, the water quality sustainable management criteria should not be limited to effects caused by "direct GSA action" through GSA projects. The GSA must also limit excessive third party extractions that cause undesirable water quality results.

A. Groundwater level sustainable management criteria and interim milestones fail to support the seawater intrusion criteria.

1. The groundwater level minimum threshold must support the seawater intrusion minimum threshold.

SGMA requires that each minimum threshold must avoid *each* undesirable result because SGMA requires that "basin conditions at each minimum threshold will avoid undesirable results for *each of* the sustainability indicators." (23 CCR § 354.28(b)(2), emphasis added.) For example, the groundwater level minimum threshold must be "supported by" the "[p]otential effects on *other* sustainability indicators." (23 CCR 354.28(c)(1)(B), emphasis added.) This means that each minimum threshold, especially the groundwater level minimum threshold, must be coordinated to ensure that *all* undesirable results are avoided.

2. The proposed seawater intrusion SMCs do not permit any additional intrusion.

The draft Monterey Subbasin Chapter 8 sets the MT and MO for seawater intrusion for the "lower" 180-Foot Aquifer and the 400-Foot Aquifer at the line of advancement as of 2015. (Monterey Subbasin GSP, draft Chap. 8 ("Chap. 8."), p. 8-55 to 8-56.) Chapter 8 sets the MT and MO for seawater intrusion to the Deep Aquifers at Highway 1, based on the observation that there is limited intrusion in these aquifers. (*Id.*, pp. 8-51, 8-55 to 8-56.) In effect, Chapter 8 commits the GSP not to permit any additional seawater intrusion in these aquifers. This is a proper goal in light of the clear impacts to beneficial users.

3. The groundwater level SMCs and groundwater level interim milestones are set based on their effects on seawater intrusion.

The draft Monterey Subbasin Chapter 8 acknowledges that the MT and MO for groundwater levels must support attainment of the seawater intrusion MT and MO because it identifies the primary consideration in setting the groundwater level MT and MO is the effect on seawater intrusion:

> As discussed in Section 3.1.6, groundwater use within the Marina-Ord Area is almost exclusively limited to generation of municipal supplies by MCWD. Groundwater elevations are significantly higher than municipal production well screen elevations in all aquifers in the Marina-Ord Area, and there is limited concern regarding the potential dewatering of groundwater production wells. Therefore, *groundwater levels that could cause undesirable results associated*

> *with other locally relevant sustainability indicators, such as the lateral or vertical expansion of the existing seawater intrusion extent and/or eventual migration of saline water into Deep Aquifer wells, have been used to define groundwater level minimum thresholds in the Marina-Ord Area*.

(Chap. 8, p. 8-16, emphasis added.) Chapter 8 also provides that

> . . . undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion and other locally relevant sustainability indicators. *These sustainability indicators have been considered when defining groundwater level minimum thresholds in the Marina-Ord Area*.

(Chap. 8, p. 8-18, emphasis added.)

4. **Setting the groundwater level SMCs at historic 1995-2015 conditions is purportedly justified by the stability of the lateral extent of seawater intrusion in the Monterey Subbasin during that historic period.**

Chapter 8 contends that setting the groundwater level MT and MO for the 180- and 400-Foot Aquifers on the basis of the 1995 to 2015 groundwater levels is justified because the lateral extent of seawater intrusion in the Monterey Subbasin has been "generally stable" in that period:

> As discussed in the preceding sections, the potential effects of undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion. *The observed lateral extent of seawater intrusion within the Subbasin appears to have been generally stable within the 180- and 400-Foot Aquifers between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers*.. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient.

(Chap. 8, p. 8-29.)

There are several problems with this contention, discussed below.

5. **The "stability" rationale for setting groundwater level SMC's based on historic conditions is undercut by Chapter 8's projections that groundwater levels will actually continue to decline and remain below historic conditions and by the interim milestones that permit such declines.**

First, the contention that groundwater level SMCs are justified by historic conditions ignores the GSP's own projection that groundwater levels will continue to decline until at least 2033 and will not attain the MO until 2042. Chapter 8 documents and projects in its "Example Trajectory for Groundwater Elevation Interim Milestones" that groundwater levels for a Marina-Ord well fell below the MT in 2019, will continue to fall until 2033, will not rise above the MT until 2039, and will not attain the MO until 2042. (Chap. 8, pp. 8-40 to 8-41, Figure 8-12.) The interim milestones for wells in the 400-Foot Aquifer and the Deep Aquifers assume and permit that groundwater levels will remain below historic levels and the MT for most of the next 20 years:

> Within the Monterey Subbasin, for wells in the 400-Foot Aquifer, Deep, and El Toro Primary Aquifer System Aquifers where groundwater levels have been declining, groundwater elevation interim milestones are defined based on a trajectory informed by current (fourth quarter of 2020) groundwater levels, historical groundwater elevation trends [footnote], and measurable objectives. This trajectory allows for and assumes a continuation of historical groundwater elevation trends during the first 5-year period of GSP implementation, a deviation from that trend over the second 5-year period, and a recovery towards the measurable objectives in the third and fourth (last) 5- year period.

(Chap. 8, p. 8-40.) The proposed interim milestones for wells in the 180-Foot and Deep Aquifers permit substantial declines in groundwater levels from 2020 conditions in the years 2027 and 2032. (*Id*., p. 8-43, Table 8-3.)

Allowing groundwater levels to fall below historic levels is purportedly justified because "there are large volumes of freshwater in the Subbasin that provide additional time and flexibility to reach identified SMCs while projects and management actions are implemented." (*Id.*) However, the draft GSP provides no evidence to suggest that groundwater levels that fall and remain below the historic conditions in the Marina-Ord area will not induce further seawater intrusion in the interim, resulting in a failure to meet the seawater intrusion SMCs.

The historic "stability" rationale cannot be extrapolated to claim that groundwater levels well *below* the historic record will continue to result in a stable areal extent of seawater intrusion. It makes no sense to contend that setting the MT and MO on the basis of historic conditions will not result in seawater intrusion when the GSP *would effectively fail to maintain those historic conditions for the next twenty years* during which the GSP is supposed to attain sustainability.

The historic stability rationale also ignores the fact that Deep Aquifer groundwater levels began dropping in 2014, have continued to drop, and are projected to continue to drop due to increased levels of extractions. MCWRA reported in 2020 that Deep Aquifer groundwater levels have been falling since 2014, are well below sea-level, and that induced vertical migration of contaminated water to the Deep Aquifers themselves is in fact occurring:

> As is the case with the 180-Foot and 400-Foot Aquifers, groundwater levels in the Deep Aquifers are predominantly below sea level. Beginning around 2014, groundwater levels in the Deep Aquifers began declining and are presently at a deeper elevation than groundwater levels in the overlying 400-Foot Aquifer based on comparisons of multiple well sets at selected locations, meaning that there is a downward hydraulic gradient between the impaired 400-Foot Aquifer and the Deep Aquifers (Figure 16 and Figure 17). This decrease in groundwater levels coincides with a noticeable increase in groundwater extractions from the Deep Aquifers (Figure 16 and Figure 17). The potential for inducing additional leakage from overlying impaired aquifers is a legitimate concern documented by previous studies and is something that would be facilitated by the downward hydraulic gradient that has been observed between the 400-Foot Aquifer and Deep Aquifers.
>
> Seawater intrusion has not been observed in the Deep Aquifers. However, the Agency has documented the case of one well, screened in the Deep Aquifers, that is enabling vertical migration of impaired groundwater into the Deep Aquifers. The Agency is working with the well owner on destruction of this well.[1]

In addition to the threat to contaminate the Deep Aquifers, the induced vertical migration of upper aquifer groundwater to the Deep Aquifers aggravates seawater intrusion in those upper aquifers. A 2003 study for MCWD concluded that increasing pumping of the Deep Aquifers from the 2002 baseline level of 2,400 AFY to just 4,000 AFY would (1) induce further seawater intrusion into the upper aquifers (the 180-Foot and 400-Foot Aquifers), which were vertically connected, and (2) risk contamination of the Deep Aquifers themselves.[2] Deep Aquifer pumping is now in excess of 10,000 AFY.[3]

And, in fact, Chap 8 admits that falling groundwater levels in the Deep Aquifer threatens to contaminate the Deep Aquifers and to induce seawater intrusion in the upper aquifers:

---

1 Monterey County Water Resources Agency (MCWRA), Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin: 2020 Update, May 2020, p. 31, https://www.co.monterey.ca.us/home/showdocument?id=90578

2 WRIME, Deep Aquifer Investigative Study, May 2003, pp. 4-7, 4-11 to 4-12, pdf available upon request.

3 Monterey County Water Resources Agency (MCWRA), Well Permit Application Activities Update, prepared for May 17, 2021 MCWRA Board of Directors meeting, https://monterey.legistar.com/View.ashx?M=F&ID=9381226&GUID=34ED34CD-3A39-4851-87A3-298BE70D383C

> Seawater intrusion has not been observed in the Deep Aquifer to date. However, groundwater elevations have been declining and are significantly below sea level. The declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPMWD#FO-10S and MPMWD#FO-11S). Although there is some uncertainty whether the Deep Aquifer is subject to seawater intrusion from the ocean, continued decline of groundwater elevations in the Deep Aquifers could increase the risk of seawater intrusion and may eventually cause vertical migration of saline water from overlying aquifers into the Deep Aquifers. As such, minimum thresholds for the Deep Aquifers are set to historically observed minimum groundwater elevations between 1995 and 2015, which is equivalent to the groundwater elevations observed in 2015 for most Deep Aquifer wells.

(Chap. 8, p. 8-40.) Again, setting the groundwater level MT and MO to historic levels but then allowing 20 years to pass before the interim milestones actually require attainment of these historic levels cannot demonstrably ensure that there is no further advancement of seawater intrusion. However, that is precisely what is required by the seawater intrusion MT and MO.

6. **Chapter 8 fails to assess the effects on other subbasins of setting groundwater level SMCs based on historic conditions or allowing groundwater levels to decline further through relaxed interim milestones.**

As Chapter 8 acknowledges, the interconnectivity between the 180/400-Foot Aquifer Subbasin and the Monterey Subbasin requires coordination of the sustainable management criteria for both subbasins. (*Id.*, p. 8-35.) Coordination is required in order to meet SGMA's requirement that the SMC's for one subbasin do not prevent another subbasin from meeting its sustainability goal.

Setting the groundwater level MT and MO at historic levels and then effectively ignoring these criteria through use of relaxed interim guidelines for 20 years may very well impair attainment of the seawater intrusion criteria for the 180/400-Foot Aquifer GSP, which are also set at a level that permits no further advancement of the seawater intrusion front.

However Chapter 8 provides no analysis of that possibility. Chapter 8 proposes to defer the assessment of the impact of the Monterey Subbasin's groundwater level MTs on the Deep Aquifers in the neighboring 180400-foot Aquifer Subbasin until after completion of the long-delayed Deep Aquifers Study and the eventual establishment of Deep Aquifer SMCs for the 180400-foot Aquifer Subbasin.

The Deep Aquifer Study, recommended almost four years ago, has neither been funded nor initiated.

Furthermore, there is no reason that an assessment of the effects of the Monterey Subbasin's groundwater level MTs should be limited to its effects on the Deep Aquifers in the 180/400-Foot Subbasin. The assessment should also include an assessment of the effects of the Monterey Subbasin's groundwater level MTs on seawater intrusion of each of the principle aquifers in that neighboring subbasin. The Monterey Subbasin GSP argues that pumping in the 180/400-Foot Aquifer Subbasin has caused seawater intrusion in the Monterey Subbasin. In turn, the Monterey Subbasin GSP must assess the reciprocal effects of its own pumping, SMCs, and interim milestones on the 180/400-Foot Aquifer Subbasin.

SGMA's mandate to use the best available science is not an invitation to let the perfect be an enemy of the good pending completion of the Deep Aquifer study. Chapter 8 must use the whatever science is now available to provide some discussion and assessment of the effect on the neighboring subbasins of allowing continued reductions in Monterey Subbasin groundwater levels below historic conditions through relaxed interim thresholds.

Again, it is not reasonable to extrapolate beyond the historic data to assume that lower-than-historic groundwater levels in the Monterey Subbasin will not impair adjacent basins. The purported stability of the lateral extent of seawater intrusion in the Monterey Subbasin from 1995 to 2015 was certainly not matched in the 180/400-Foot Aquifer Subbasin. Chapter 8 provides no evidence to justify the assumption that allowing lower-than-historic groundwater levels in the Monterey Subbasin will not contribute to the continuing seawater intrusion in the neighboring subbasin.

Finally, the Monterey Subbasin GSP must also evaluate and address the effects of reduced groundwater levels in the Corral de Tierra Subarea on the Seaside Subasin. Again, there is no evidence in the record that merely maintaining historic groundwater levels is sufficient to support groundwater levels in the Seaside Subbasin. To the contrary, comments by the Seaside Basin Watermaster indicate that chronic lowering of groundwater levels in the Laguna Seca Subarea of the Seaside Subbasin can only be corrected by *reducing* existing pumping in the Corral de Tierra, i.e., *increasing* groundwater levels *above* historic levels. (Robert Jacques, PE, email to Sarah Hardgrave, et al., March 22, 2021.) Setting Monterey Subbasin groundwater level SMC's at historic levels violates SGMA because it will prevent attainment of groundwater level objectives in the adjacent Seaside Subbasin.

B. Water quality sustainable management criteria should not be limited to effects caused by "direct GSA action;" the GSP must also limit extractions that cause undesirable results.

Chapter 8 purports to limit significant and unreasonable conditions related to groundwater quality degradation to "[l]ocally defined significant and unreasonable changes in groundwater quality resulting from *direct GSA action*." (Chap. 8, p. 8-56, italics added.) Thus, Chapter 8 contends that the GSP need only address water quality degradation that is a "direct result of projects or management actions conducted pursuant to GSP implementation:"

> For the Subbasin, any groundwater quality degradation that leads to an exceedance of MCLs or SMCLs in potable water supply wells or a reduction in crop production in agricultural wells that is a direct result of GSP implementation is unacceptable. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities they do not constitute an undesirable result. Therefore, the degradation of groundwater quality undesirable result is:
>
> > *Any exceedances of minimum thresholds during any one year as a direct result of projects or management actions conducted pursuant to GSP implementation is considered as an undesirable result.*

(*Id.*, underlining added.)

This language does not define what constitutes "a "direct result" of GSP implementation or "direct GSA action." Elsewhere, Chapter 8 gives three examples of conditions that may lead to an undesirable result and that the GSA is presumably prepared to address:

> • Required Changes to Subbasin Pumping. If the location and rates of groundwater pumping change *as a result of projects implemented under the GSP*, these changes could alter hydraulic gradients and associated flow directions, and cause movement of constituents of concern towards a supply well at concentrations that exceed relevant standards.
>
> • Groundwater Recharge. *Active recharge of imported water or captured runoff* could modify groundwater gradients and move constituents of concern towards a supply well in concentrations that exceed relevant limits.
>
> • Recharge of Poor-Quality Water. *Recharging the Subbasin* with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result.

(Chap. 8, p. 8-57.) Significantly, none of these three conditions that might trigger GSA action include *excessive pumping* by other parties that may cause water quality degradation; each condition includes only the secondary effects of the GSA's own projects. The GSA's failure to take management action, e.g., its failure to restrict excessive extractions, may also cause water quality degradation. Chapter 8 should be revised to acknowledge that the GSA has both the authority and duty to address groundwater quality degradation caused by excessive pumping.

Chapter 8 contends that because other agencies have authority over groundwater quality, the GSA's role is somehow limited:

> The powers granted to GSAs to effect sustainable groundwater management under SGMA generally revolve around managing the quantity, location, and timing of groundwater pumping. SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the SWRCB Division of Drinking Water and Monterey County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities.
>
> Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur.

(*Id*., pp. 8-59 to 8-60.) The fact that the County *and* the RWQCB also have authority and responsibility to address water quality degradation demonstrates that the statutory scheme does not rely on the regulatory actions of any single agency. Nothing in SGMA's mandate that the GSP address water quality degradation permits the GSA to consider only the direct effect of GSA projects and only those projects that *move* pollutants. The GSP must also address the effects of its *regulatory omissions*, including omissions that move or *concentrate* existing pollutants by permitting excessive extractions.

DWR has made it clear in its imposition of corrective actions on the 180/400-Foot Aquifer Subbasin GSP that "groundwater management *and extraction*" may result in degraded water quality:

> RECOMMENDED CORRECTIVE ACTION 5 Coordinate with the appropriate groundwater users, including drinking water, environmental, and irrigation users as identified in the Plan, and water quality regulatory agencies and programs in the Subbasin to understand and develop a process for determining if groundwater management *and extraction* is resulting in degraded water quality in the Subbasin.[4]

Accordingly, the GSP cannot limit its concern to the effects of its own projects without taking responsibility for the effects of unregulated extractions on water quality degradation.

For example, if, in the Corral de Tierra Subarea, there is evidence that arsenic concentrations are increased by excessive extractions, then the GSP must manage extractions to avoid undesirable results from increased concentrations. Chapter 8 cannot simply state that "no clear correlation that can be established between groundwater levels and groundwater quality at this time" as if that disposes of the matter. (Chap. 8, p. 8-57.) Indeed, at the July GSA Board meeting, staff acknowledged that lowering groundwater levels *could* cause water quality degradation, specifically referencing Corral de Tierra.

---

[4] Department of Water Ressources, GSP Assessment Staff Report Salinas Valley – 180/400 Foot Aquifer (Basin No. 3-004.01), June 3, 2021, p. 37, emphasis added available at https://sgma.water.ca.gov/portal/gsp/assessments/29.

The GSA must investigate, apply the best available science, and manage the resource to prevent undesirable contaminant concentrations caused by excessive extractions.

M. R. WOLFE & ASSOCIATES, P.C.

John Farrow

MRW:hs

Cc: Sarah Hardgrave, Chair, Monterey Subbasin Committee
Michael DeLapa, Executive Director, LandWatch Monterey County

Draft Chapter 8 – Comments from Seaside Basin Watermaster 7-13-21

Page	Section	Comment
8-8	8.4	The 3rd para on this page talks about SMCs in this subarea and their potential to impact SMCs in adjacent subbasins (in this case the Seaside subbasin). It goes on the say that SMCs for the Monterey subbasin will be set so as to be consistent with SMCs in those adjacent subbasins, so that adjacent subbasins will be able to be sustainable. For this reason it would be appropriate (as mentioned in other comments below) for the monitoring network of the Monterey subbasin to include some monitoring and/or production wells in the Seaside subbasin that are near the border between the two subbasins. Data from those wells can be provided to the SVBGSA at no cost, so the SVBGSA can determine what impact the Monterey subbasin's SMCs are having on the Laguna Seca subarea of the Seaside subbasin, which is the portion of the Seaside subbasin that abuts the Corral de Tierra subarea. This para also mentions that modeling will be one of the means of determining the impacts of the Corral de Tierra SMCs on the adjacent subbasin. The Monterey subbasin model being developed for the MCWDGSA by its consultant EKI should incorporate modeling information from the Seaside Watermaster's Seaside Basin Model (prepared by HydroMetrics) to ensure that the two models are consistent at the boundary between the subbasins.
8-10	Table 8-1	The Corral de Tierra area MT and MO groundwater elevations (2015 and 2008) are believed, based on modeling performed for the Watermaster by HydroMetrics, to be so low that they are causing water to (1) be drained out of the Seaside subbasin's Laguna Seca Subarea by creating an eastward sloping hydraulic gradient and/or (2) preventing the natural westward flow of groundwater from replenishing the Laguna Seca Subarea, resulting in falling groundwater levels in that subarea. The GSP should mention this and ensure that its SMCs prevent this adverse condition from continuing.
8-16	8.7.1	Reword the first bullet on this page to read "Groundwater elevations at or below those observed in 2015. Lower groundwater elevations could lead to inadequate water production in a significant number of domestic and small water system wells, not only in the Corral de Tierra subarea but also in the Laguna Seca subarea of the adjacent Seaside subbasin.
	8.7.2.1	This Section discusses a minimum threshold of 20% exceedances of groundwater levels. As mentioned in the comment above on page 8-8, some monitoring wells in the Laguna Seca subarea, which is directly impacted by groundwater levels in the Corral de Tierra subarea, should be included in *Representative Monitoring Sites* for the Corral de Tierra subarea when making the 20% calculation.
8-18	8.7.2.3	The bottom para on this page mentions undesirable results caused by chronic lowering of groundwater levels within the Corral de Tierra subarea. The following language should be inserted at the appropriate place in this para "These same undesirable effects will occur in the adjacent Laguna Seca subarea from chronic lowering of groundwater levels in the Corral de Tierra subarea."

Page	Section	Comment
8-19	8.7.2.3	The top para on this page mentions the term "clustering". A better explanation of what would constitute "clustering" should be added to this para, since this is apparently going to be one of the criteria to determine if a significant and unreasonable effect is occurring.
8-21	Table 8-2	Many of the wells in this table also have common names which appear on maps in various reports that have been prepared for the Corral de Tierra and Laguna Seca subareas. A column should be added to this Table titled "Well Common Name" to include that information for the reader's ease of knowing which well in located at the Monitoring Site. Also, as mentioned in the comment above on page 8-8, some monitoring wells in the Seaside subbasin should be included in this Table. Suggested wells for inclusion are: MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-6D, Seca Place, MPWMD#FO-9S, MPWMD #FO-9D,
8-25 and 8-26	Figures 8-4 and 8-5	The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-9S and MPWMD #FO-9D) should be added to these figures to monitor the effectiveness of the SMCs in the Marina-Ord subarea on preventing seawater intrusion from flowing into the Seaside Subbasin.
8-27	Figure 8-6	The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-6D, and Seca Place) should be added to these figures to monitor the effectiveness of the SMCs in the Corral de Tierra subarea on preventing chronic lowering of groundwater levels in the Seaside Subbasin.
8-29	8.7.3.1	The next to the last para on this page states "The declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPMWD#FO-10S and MPMWD#FO-11S)." An explanation to support this hypothesis should be included as this is not intuitively apparent.
8-30	8.7.3.1	In the top two paras there are two small typos to correct: (1) in the first para the word "elevations" should be singular; (2) in the second para the last sentence should be reworded in part to read "…Deep Aquifer's wells as well as…"
8-31	8.7.3.1	The second bullet on this page mentions historical groundwater elevation data from wells monitored by MCWRA. This language should be expanded to include historical groundwater elevation data from wells monitored by the Seaside Basin Watermaster.
8-36	8.7.3.5	Add at the end of the first sentence at the top of this page the following wording "…including the occurrence of "Material Injury" (as defined in the Seaside Basin adjudication decision) in the Laguna Seca subarea due to lowered groundwater levels."
8-37	8.7.4.1	Correct "MPMWD" to read "MPWMD" for the wells mentioned in this Section and the footnote at the bottom of this page. Also, update the language in the footnote to read as follows: "Chloride concentration measured from MPMWD#FO-10S and MPMWD#FO-09S in September 2020 were 89.9 mg/L and 90.4 mg/L, respectively. An investigation performed by MPWMD into the cause of this in mid-2021 concluded that there was leakage in the upper portion of the casing that was allowing salty shallow dune sand water to flow downward in this well, thus causing these increases in chloride readings. As part of GSP implementation, the Subbasin

Page	Section	Comment
		GSAs intend to investigate possible seawater intrusion near the southwestern portion of the Marina-Ord Area in collaboration of the Seaside Watermaster."
8-40	8.7.4.2	In the 2nd para on this page there is discussion about groundwater elevation trends continuing to fall in the early part of the implementation period and then recovering in the latter part of that period. It would helpful to the reader to have an explanation included as to how the rate of recovery of the fallen groundwater levels was determined, and what the level of confidence is in these projections. In other words, is it certain that the projects that will be included in Chapter 9 of the GSP will be able to bring groundwater levels up as shown in the figures in Appendix 8B?
8-47	8.8.3.1	There is a table showing estimated groundwater storage in the Marina-Ord area, but I did not see a similar table for the El Toro area.
8-48	8.8.3.4	This para discusses the setting of minimum thresholds to avoid dropping below recent levels of storage. The existing groundwater levels in the Corral de Tierra subarea are already causing a loss of groundwater in the Laguna Seca subarea of the Seaside subbasin. Therefore, the Corral de Tierra groundwater levels need to be raised, not just kept from falling further.
8-56	8.10.1 and 8.10.2	Question: If a water quality problem already exists and therefore the affected part of the subbasin is not sustainable as a potable water supply due to that problem (example of arsenic) doesn't SGMA require GSPs to include projects and management actions to remedy the problem in order to achieve sustainability?
8=59	8.10.3.1	Small typo to correct in the first para of this Section: put a comma rather than a period after "Monterey County" and make the word "because" not be capitalized.
8-61	8.10.3.1	Under the "Public water system supply wells regulated by the SWRCB DDW" shouldn't the smaller private systems that are not regulated by DDW, of which there are many in the Corral de Tierra subarea, also be included in the development of the SMCs because of their cumulative impact on the subbasin?
None shown	Figure 8A-9 and 8A-10 in Appendix A	The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-9S and MPWMD #FO-9D) should be added to these figures to monitor the effectiveness of the SMCs in the Marina-Ord subarea on preventing seawater intrusion from flowing into the Seaside Subbasin.
None shown	Figure 8A-11 and 8A-12 in Appendix A	The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-6D, and Seca Place) should be added to this figure to monitor the effectiveness of the SMCs in the Corral de Tierra subarea on preventing chronic lowering of groundwater levels in the Seaside Subbasin.

Gmail

Emily Gardner <gardnere@svbgsa.org>

Problems with SVBGSA projects

Yahoo Mail <sangjames@yahoo.com> Tue, Jul 20, 2021 at 10:24 AM
Reply-To: Yahoo Mail <sangjames@yahoo.com>
To: [redacted]

Hello All,

Can you forward this email to all sub-basin commitee members and anyone interested in the groundwater sustainability problem? Can you also forward this letter to Landwatch and George Fontes of Salinas Valley Water Coalition?

The problem with the SVBGSA plans is that they are a solution for the sustainability of the entire basin and not for the individual wells. Sustainability means that the goal is make sure that the amount of water being pumped out of the ground is equal or less than the amount of water entering the groundwater in each individual sub basin. But the focus of the plans should be to increase the levels of each farmers well water level, because the minimum threshold and the measurable objective of each well is what will determine whether the SVBGSA or the County of Monterey will determine if they need to take action to close the wells that may be running dry. Even if the SVBGSA meets it's goals of sustainability for the sub-basin, individual wells may be running dry. So the goal should be to raise the well water levels for each well, not to just reach sustainability for each sub-basin.

For example in the Eastside sub-basin, a plan for managed aquifer recharge on individual land owners and a plan for flood plain soaking from the creeks are being planned, but even if this happens, this plan may not have an effect on wells that are a distance away. That means that the well water may not be replenished because the source of infiltrating water will not reach the well water source. Two other plans for groundwater recharge are a diversion at Chualar at a cost of $56,000,000.00 and a diversion at Soledad at a cost of $105,000,000.00. These will divert excess stream water . The problem with these two plans are that they do not have a way to connect this water with the individual wells. They will probably direct the water to a basin, which will connect to an aquifer and not to any particular well. This diversion of water will fill a large area of groundwater but not all wells. You have to realize that each well is at a different area and connected to different water sources. You can determine this because each well has a different minimum threshold and measurable objective. For example monitoring well (14S/03E-06R01) has a MT of -29.7 and a MO of -24.9, while monitoring well {14S/03E-25C02} has a MT of -65.4 and a MO of -42.2. This means that each well has a different water source and cannot probably be replenish by delivering water from a far away infiltrating water basin. The other problem with these diversion plans are that they are dependent on excess stream water before there is allowed any diversion. If there is no excess water, there is no water being redirected! There are two other plans Eastside irrigation Water Supply Project at a cost of ($140,000,000.00) and a Surface Water Diversion from Gabilan Creek at a cost of ($10,000,000.00). Both have the same problem of delivering to the individual well. In the foreseeable drought that we have, I do not see these as reliable sources of water!

The Eastside Sub-basin is the most overdrawn of all the sub-basins. I presented a plan which I believe will solve the delivery of water and the supply of water to the wells at a greatly reduced cost. My plan involves the harvesting of rainwater during the rainy season of Monterey County during the wettest months of December, January and February. The rainy season of Monterey County involves the 5 months of November to March. Our rainfall varies between 5 inches to 30 inches per year. On an average we should be able to get 12 inches per year. In the Eastside Sub-basin their are 34,000 irrigated acres. The sub-basin is short about 10,000 to 20,000 acre feet of water per year. During wet season, when the farmers are not planting crops, they can subsoil plow their land to a depth of 24 to 36 inches. This will have the effect of capturing all the rainfall and prevent the precipitation from evaporating. The deeper the depth of plowing, the less evaporation. It is also important to subsoil plow close to their well, so that there is a better chance of this plowing to refill their well water. So if the farmer will subsoil plow at least 60 percent of their land during the wet season of December to February. They will capture enough rainfall to fill that 20,000 acre feet deficit for the basin. After the wet season is over, the farmer can plow his land normally and use it as he wishes. This strategy should work for any farmland whether you are in the Salinas Valley or the Central Valley. You may want to incentivize this in order to encourage the grower to do this strategy. In the Pajaro Valley, the growers are paid for the collection of rainwater by infiltrating basins. This plan will prevent fallowing of farm land, prevent the buying of farmland, prevent the reduction of economic activity and the lay off of farm workers! I hope this plan is accepted! [ref. You Tube video "Deep Soil Ripping for Water Conservation" by Megan Clayton]

The advantages of subsoil plowing to a depth of at least 24 inches in order to capture rainwater will achieve these goals: It will deliver water close to the individual wells in order to raise well water levels. It will be a yearly constant supply of water. It is cheaper than spending over $500,000,000.00 for all the plans presented to all of the sub-basins. It will incentivize the farmer to subsoil, if Monterey County or SVBGSA will reimburse him for the subsoiling. It may substantially raise the water aquifer levels and groundwater levels. Even all unirrigated lands may also be subsoiled in order to raise aquifer levels.

I want to address another issue. Land Watch presented a plan to stop the drilling of new wells in the deep aquifers. The Advisory Committee voted no and decided to do some more studies. George Fontes who represents the Salinas Valley Water Coalition, a group of growers of 80,000 acres in the Salinas Valley does not want this. I want to present a compromise . I think that we can allow them to drill new wells, but they have to agree to harvesting the rainwater at the method , that I suggested for The Eastside sub-basin. This will help replenish any water that will be pumped out of the deep aquifers.

Thanks to all for reading this!

James Sang sangjames@yahoo.com

Draft Chapter 8 – Supplemental Comments from Seaside Basin Watermaster 7-30-21

These are comments provided by the Watermaster's hydrogeologic consultant, Montgomery & Associates. They supplement the Watermaster's comments dated 7-13-21.

Page	Section	Comment
None shown	Figure 8-6	The Robley wells are the ones to focus on to understand what would happen in the Seaside Basin than the wells on Figure 8-6 that are much farther away from the Seaside Basin. The minimum threshold for the Robley wells are just above record lows in 2020 on the hydrographs (levels this year are undoubtedly going to be even lower!). The GSA has 20 years to get levels at or above the minimum threshold, so levels can still fall lower than they are now between now and 2042.
8- 33 and 8-39	Figures 8-9 and 8-10	We don't find the contours on Figures 8-10 and 8-11 very useful because we don't have contours generated the same way for the Seaside Basin (i.e., based on an assumed future condition). The flow direction from the contours is similar to current conditions (see Chapter 5, Figures 5-9 and 5-10) so there is no expected change in flow directions to what has happened in the past. What I found more informative was Figure 8-6 which shows historical hydrographs for the Robley wells together with minimum threshold (elevation that they should not really be going below) and the measurable objective (elevation where they would like to be). Note that the measurable objective is not enforceable but the minimum threshold is.
8-41	Figure 8-12	The example well in Figure 8-12 shows a continuing drop in groundwater levels, with levels only increasing to measurable objectives after 2030 when project benefits are projected to kick in.
8-43 and 8-44	Table 8-3	Table 8-3 provides interim milestone every five years to show how they project levels will eventually meet measurable objectives. This all indicates that groundwater levels in the Laguna Seca subarea will continue to fall for at least the next 10 years.
8-35 and 8-36	8.7.3.5	Effect of Minimum Thresholds on Neighboring Basins and Subbasins is an important section to look at – I do not feel they have adequately addressed effects on the Seaside Basin from the minimum thresholds. They do not mention the ongoing declines in the Laguna Seca subarea and what the minimum thresholds will do for that nor the impacts that will occur when levels are allowed to fall lower than the minimum threshold over the next 10 years. There is only one sentence addressing Seaside Basin and it reads "The Seaside Subbasin is an adjudicated basin and not subject to SGMA. The subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside basin from meeting its adjudication requirements."
N/A	N/A	There is still the ongoing issue in the Coral de Tierra subarea of poor pumping records. This means they still don't understand exactly what is causing the ongoing declines. Derrik mentioned that they are talking about expanding the County groundwater extraction monitoring (GEMS) into the Corral de Tierra subarea, but that section of the GSP has not been posted yet (probably Chapter 10).

Draft Chapter 8 – Supplemental Comments from Seaside Basin Watermaster 7-30-21

These are comments provided by the Watermaster's hydrogeologic consultant, Montgomery & Associates. They supplement the Watermaster's comments dated 7-13-21.

Page	Section	Comment
None shown	Figure 8-6	The Robley wells are the ones to focus on to understand what would happen in the Seaside Basin than the wells on Figure 8-6 that are much farther away from the Seaside Basin. The minimum threshold for the Robley wells are just above record lows in 2020 on the hydrographs (levels this year are undoubtedly going to be even lower!). The GSA has 20 years to get levels at or above the minimum threshold, so levels can still fall lower than they are now between now and 2042.
8- 33 and 8-39	Figures 8-9 and 8-10	We don't find the contours on Figures 8-10 and 8-11 very useful because we don't have contours generated the same way for the Seaside Basin (i.e., based on an assumed future condition). The flow direction from the contours is similar to current conditions (see Chapter 5, Figures 5-9 and 5-10) so there is no expected change in flow directions to what has happened in the past. What I found more informative was Figure 8-6 which shows historical hydrographs for the Robley wells together with minimum threshold (elevation that they should not really be going below) and the measurable objective (elevation where they would like to be). Note that the measurable objective is not enforceable but the minimum threshold is.
8-41	Figure 8-12	The example well in Figure 8-12 shows a continuing drop in groundwater levels, with levels only increasing to measurable objectives after 2030 when project benefits are projected to kick in.
8-43 and 8-44	Table 8-3	Table 8-3 provides interim milestone every five years to show how they project levels will eventually meet measurable objectives. This all indicates that groundwater levels in the Laguna Seca subarea will continue to fall for at least the next 10 years.
8-35 and 8-36	8.7.3.5	Effect of Minimum Thresholds on Neighboring Basins and Subbasins is an important section to look at – I do not feel they have adequately addressed effects on the Seaside Basin from the minimum thresholds. They do not mention the ongoing declines in the Laguna Seca subarea and what the minimum thresholds will do for that nor the impacts that will occur when levels are allowed to fall lower than the minimum threshold over the next 10 years. There is only one sentence addressing Seaside Basin and it reads "The Seaside Subbasin is an adjudicated basin and not subject to SGMA. The subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside basin from meeting its adjudication requirements."
N/A	N/A	There is still the ongoing issue in the Coral de Tierra subarea of poor pumping records. This means they still don't understand exactly what is causing the ongoing declines. Derrik mentioned that they are talking about expanding the County groundwater extraction monitoring (GEMS) into the Corral de Tierra subarea, but that section of the GSP has not been posted yet (probably Chapter 10).

Salinas Valley Water Coalition

33 El Camino Real • Greenfield, CA 93927
(831) 674-3783 • FAX (831) 674-3835

TRANSMITTED VIA EMAIL

Salinas Valley Groundwater Sustainability Agency
Board of Directors

12 August, 2021

Dear Board Members;

This letter is submitted on behalf of the Salinas Valley Water Coalition ("Coalition") and is in response to preliminary comments to the Groundwater Sustainability Plans ("GSPs") for the Eastside, Forebay, Langley, Monterey and Upper Valley Subbasins made by members of the public. Said public comments suggest an immediate implementation of the 180/400 Foot Aquifer GSP specific to the proposed Integrated Plan. Should the Salinas Valley Basin Groundwater Sustainability Agency ("SVBGSA") elect to begin implementation of the 180/400 Foot Aquifer GSP, shouldn't the SVBGSA implement *all* of the management actions proposed therein? This recommendation is particularly in light of the existing legal question on whether continuing to pump from sea-water intruded, overdrafted areas is considered reasonable and beneficial use of water.

As to the proposed Integrated Plan, the Coalition has previously stated, and is now again stating, that the SVBGSA does not have the proper tools to develop that plan. The Salinas Valley Integrated Hydrologic Model ("SVIHM") is not only provisional and not available for public vetting, but it has significant calibration issues causing it to be unreliable. Thus, the modeling performed using the SVIHM is not "sufficient to calibrate and reduce [its] uncertainty" (23 CCR §354.18) and is not likely to be properly calibrated for public vetting before these GSPs are due to the Department of Water Resources and thus, cannot be relied upon to make any decision, including taking any regulatory action or for developing the Integrated Plan.

That is, because the results from the SVIHM are provisional and uncertain and are subject to change in future GSP updates after the SVIHM is released by the USGS and unless and until (1) the SVIHM has been made publicly available and publicly vetted; (2) its inputs reflect the current operations of the reservoirs, including the operations of the Salinas Valley Water Project as reflected in its Engineer's Report and the MCWRA water right permits and other water rights; and (3) its calibration results meet industry standard of five percent (5%) to ten percent (10%), the model results cannot be used as basis to develop the Integrated Plan or to determine the flows between subbasins within the Salinas Valley Groundwater Basin because the results are only orders of magnitude approximates and not best available science.

Mission Statement: The water resources of the Salinas River Basin should be managed properly in a manner that promotes fairness and equity to all landowners within the basin. The management of these resources should have a scientific basis, comply with all laws and regulations, and promote the accountability of the governing agencies.

That said, these subbasins have been the subject of many decades of studies and these studies are considered the best available science for reliance by the SVBGSA for inclusion in the GSPs. These studies include the 1988 USGS Water-Resources Investigation Report 87-4066, Simulated Effects of Ground-Water Management Alternatives for the Salinas Valley, California; and the Brown-Caldwell's State of the Salinas River Groundwater Basin Report, dated January 16, 2015. The executive summary of the Brown Caldwell Report and a USGS abstract summary are included as Exhibits A, Exhibit B respectively and the entire reports are included herein by reference and can be found at the following links: **https://www.co.monterey.ca.us/home/showpublisheddocument/61920/636547362391570000** and **https://doi.org/10.3133/wri874066** . Both studies placed "a specific focus on the effect of pumping changes on seawater intrusion" and found that "seawater intrusion could be cut by more than half (from about 18,000 to 8,000 afy) over a 20 year period by decreasing pumping in the Pressure and East Side Subareas by 30%; whereas reducing pumping the Forebay and Upper Valley Subareas had *minimal to no effect on seawater intrusion."* (Emphasis added.) The best available science concludes minimal impacts by Forebay and Upper Valley subbasins on seawater intrusion in the northern subbasin, which must be relied upon by the SVBGSA.

Finally, the Coalition has supported, and continues to support, projects to address the sea water intrusion and overdraft facing the northern subbasins. The Coalition has offered several solutions including using the Monterey County Water Resources Agency ("MCWRA") 11043 permit to develop excess surface water for the Pressure and East Side Subareas. The Coalition also supports the consideration of an extraction barrier in the Pressure Area that could provide an alternate water supply not only to agriculture but also to the urban areas in that subarea. Developing and implementing management actions and a project or projects should be the primary focus rather than more modeling using a known erroneous model that does not fall within SGMA standards.

Thank you for your consideration of the foregoing comments.

Sincerely,

Nancy Isakson, President
Keith Roberts, Chair
Roger Moitoso, Vice- Chair
Rodney Braga, Director
Lawrence Hinkle, Director
Bill Lipe, Director
David Gill, Director
Steve McIntyre, Director
Brad Rice, Director
Jerry Rava, Director
Grant Cremers, Director
Allan Panziera, Director
Michael Griva, Past-Chair

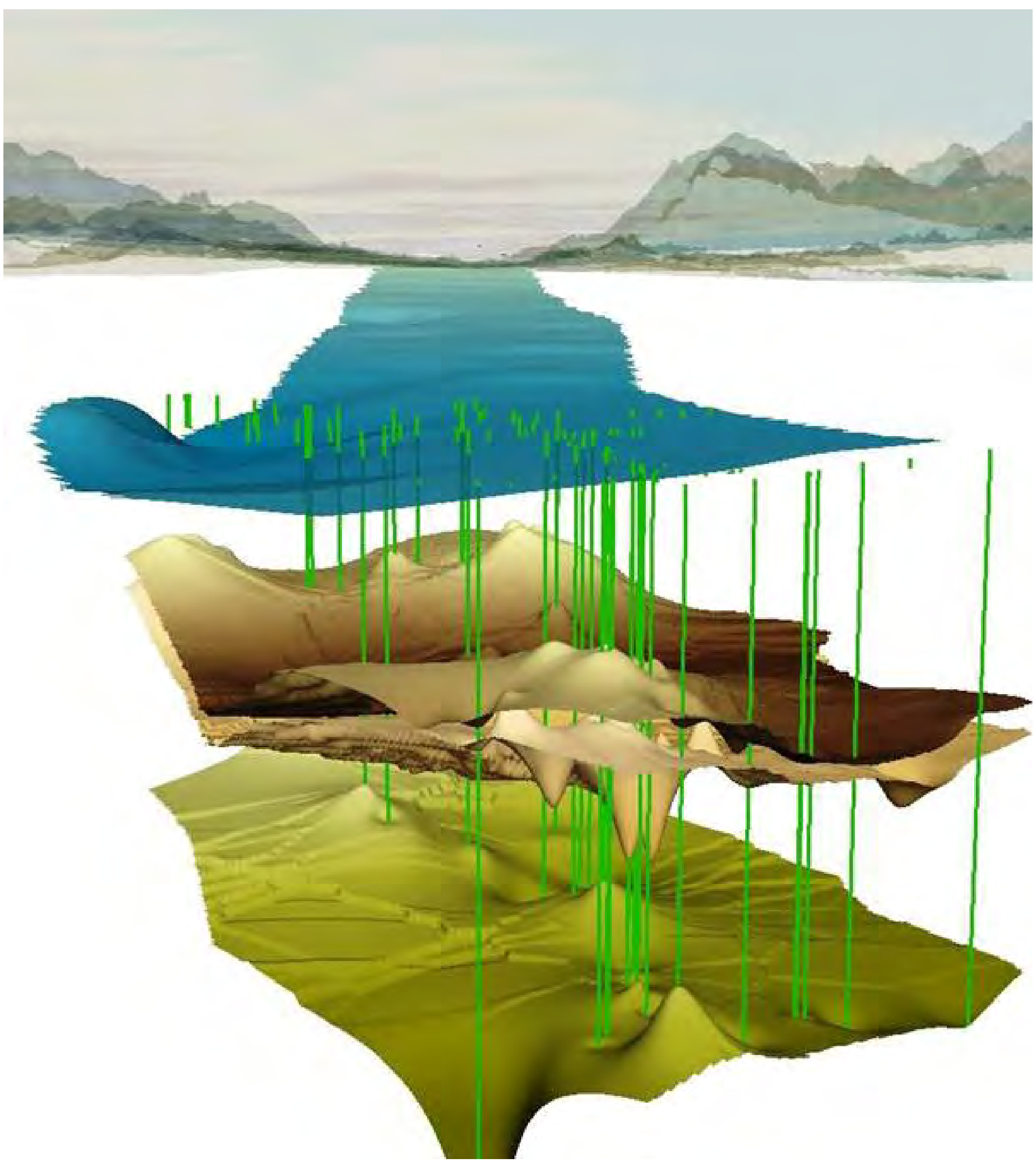
EXHIBIT 'A'

Brown AND Caldwell

Prepared for Monterey County Resource Management Agency
Salinias, CA

State of the Salinas River Groundwater Basin

January 16, 2015



FINAL

State of the Salinas River Groundwater Basin

Prepared for

Monterey County Resource Management Agency

Salinas, CA

January 26, 2015

FINAL

State of the Salinas River Groundwater Basin

Prepared for

Monterey County Resource Management Agency
Carl P. Holm, AICP
Interim Director
168 W. Alisal, 2nd Floor
Salinas, CA 93901

January 26, 2015

Prepared by:

Matthew Baillie, Brown and Caldwell
Principal Hydrogeologist, California P.G.# 8811, C.H.G.#977

Les Chau, Brown and Caldwell
Project Manager, Geologist

Geologist of Record

Joseph Turner, Brown and Caldwell
Chief Hydrogeologist, California P.G.# 5125, C.H.G.#484

PROFESSIONAL GEOLOGIST
JOSEPH TURNER
NO. 5125
EXPIRES 10/31/15
STATE OF CALIFORNIA

This document was prepared solely for Monterey County Resource Management Agency (County) in accordance with professional standards at the time the services were performed and in accordance with the Professional Services Agreement between the County and Brown and Caldwell. This document is governed by the specific scope of work authorized. We have relied on information or instructions provided by the County, the only intended beneficiary of this work. Except as expressly agreed to between Brown and Caldwell and County, no other party should rely on the information presented herein.

The findings, recommendations, specification, or professional opinions are presented within the limits described by the County, in accordance with generally accepted professional engineering and geologic practice. No warranty is expressed or implied.

Brown AND Caldwell

201 North Civic Drive, Suite 115
Walnut Creek, CA 94596

Acknowledgements

Brown and Caldwell acknowledges the valuable contributions made by the Monterey County Water Resources Agency (MCWRA) in conducting this near-term assessment of the health and status of Zone 2C of the Salinas River Groundwater Basin.

Specifically, the project team recognizes the following MCWRA technical staff for their efforts:

Howard Franklin	Senior Hydrologist
Peter Kwiek	Hydrologist
German Criollo	Associate Hydrologist
Tamara Voss	Hydrologist
Amy Woodrow	Hydrologist

The Brown and Caldwell project team members include:

Les Chau	Project Manager, Geologist
Joe Turner	Chief Hydrogeologist
Tim Godwin	Principal Hydrogeologist
Matt Baillie	Principal Hydrogeologist
Alex Johnson	Environmental Engineer
Kelsi Oshiro	Engineer-In-Training
Tina Crawford	Geographer
Kim Stubblefield	Project Analyst

Table of Contents

List of Figures

List of Plates

List of Tables

List of Technical Concepts Reviewed in Appendix A

List of Abbreviations

af	acre-feet
afy	acre-feet per year
BC	Brown and Caldwell
Cl	chloride
CSIP	Castroville Seawater Intrusion Project
DWR	California Department of Water Resources
ft/yr	feet per year
gpm	gallons per minute
MCWRA	Monterey County Water Resources Agency
mg/L	milligrams per liter
MSL	mean sea level
MTBE	Methyl Tertiary Butyl Ether
Na	sodium
P-180	Pressure 180-Foot
P-400	Pressure 400-Foot
PERC	perchlorate
SRDF	Salinas River Diversion Facility
SVA	Salinas Valley Aquitard
SVIGSM	Salinas Valley Integrated Groundwater Surface Water Model
SVWP	Salinas Valley Water Project
SWI	seawater intrusion
TCE	trichloroethylene
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound

Executive Summary

An examination of the state of the Salinas River Groundwater Basin (Basin) was conducted by Brown and Caldwell in the last half of 2014 as part of the larger Basin Investigation requested by the County of Monterey. This State of the Basin Report addresses the ramifications of prolonged drought by considering likely changes in groundwater head elevations, groundwater storage, and seawater intrusion in the event that the current drought continues. In addition, some steps are presented that could be taken to help alleviate the consequences of further depleting groundwater storage.

This study was conducted for Monterey County under County Professional Agreement 14-714, dated 1 July 2014, in response to the Monterey County Board of Supervisors Referral No. 2014.01. The work was carried out with oversight provided by the Monterey County Water Resources Agency (MCWRA).

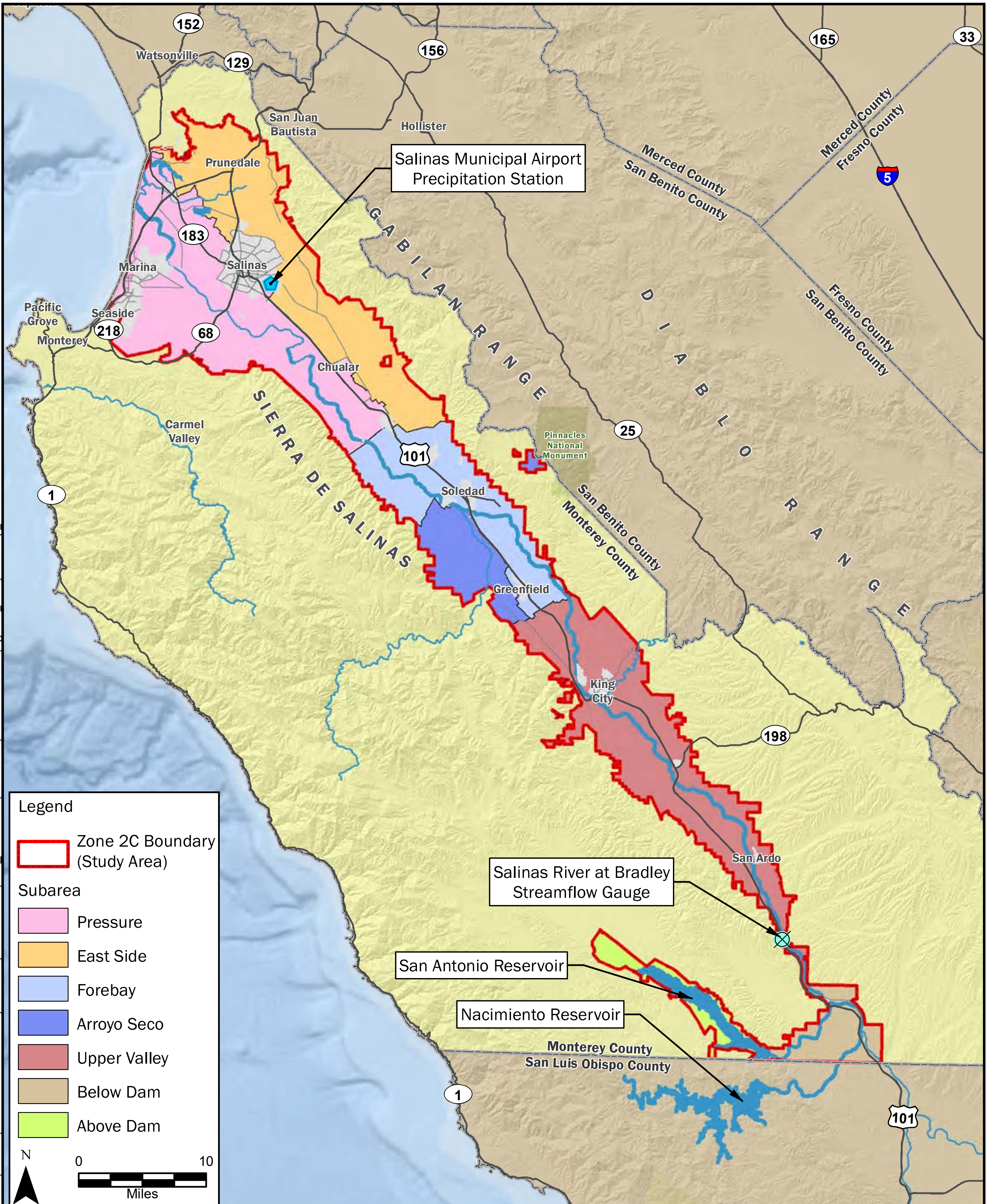
Study Area

The study area for this report is MCWRA Benefit Zone 2C (Zone 2C), which largely straddles the Salinas River within Monterey County (Figure ES-1). Zone 2C consists of 7 subareas named as follows: Above Dam, Below Dam, Upper Valley, Arroyo Seco, Forebay, East Side, and Pressure. The analyses detailed in this report cover the four primary water-producing subareas, the Pressure, East Side, Forebay (including the Arroyo Seco), and Upper Valley Subareas. These four subareas include most of the land area and account for nearly all of the reported groundwater usage within Zone 2C.

The Salinas River Groundwater Basin is the largest coastal groundwater basin in Central California. It lies within the southern Coast Ranges between the San Joaquin Valley and the Pacific Ocean, and is drained by the Salinas River. The valley extends approximately 150 miles from the La Panza Range north-northwest to its mouth at Monterey Bay, draining approximately 5,000 square miles in Monterey and San Luis Obispo Counties. The valley is bounded on the west by the Santa Lucia Range and Sierra de Salinas and on the east by the Gabilan and Diablo Ranges. The Monterey Bay acts as the northwestern boundary of the Basin.

The Salinas Valley has a Mediterranean climate. Summers are generally mild, and winters are cool. Precipitation is almost entirely rain, with approximately 90 percent falling during the six-month period from November to April. Rainfall is highest on the Santa Lucia Range (ranging from 30 to 60 inches per year) and lowest on the valley floor (about 14 inches per year). Very dry years are common and droughts can extend over several years, such as the eight-year drought of Water Years (WY) 1984 to 1991.

Major land uses in the Salinas Valley include agriculture, rangeland, forest, and urban development. Mixed forest and chaparral shrub cover the mountain upland areas surrounding the valley, while the rolling hills are covered with coastal scrub and rangeland. Agricultural and urban land uses are predominant on the valley floor.



Document Path: BCSAC01 P:\46000\146430 - Salinas Valley GW Study - Simulation\GIS_MAPDOCS\WORKING\StateoftheBasin\FigES-1_StudyAreaMap_20150116.mxd

DATE	PROJECT	SITE
01/16/15	146430	Salinas River Groundwater Basin Investigation

Brown AND Caldwell

TITLE

Study Area Map

Figure ES-1

Historically, irrigated agriculture began with surface water diversions in 1773 on Mission Creek, and diversions from the Salinas River were first recorded in 1797. Groundwater pumping began as early as 1890, and expanded greatly through about 1920 as enabled by several developments such as widespread electrical lines, the development of better well pumps, and the replacement of grain crops with vegetable crops. Groundwater is currently the source of nearly all agricultural and municipal water demands in the Salinas Valley, and agricultural use represents approximately 90 percent of all water used in the Basin. In addition to groundwater, other sources of water for agricultural production include surface water diverted from the Arroyo Seco, recycled municipal waste water supplied by the Monterey County Water Recycling Projects, and surface water diverted from the Salinas River north of Marina as part of the Salinas Valley Water Project.

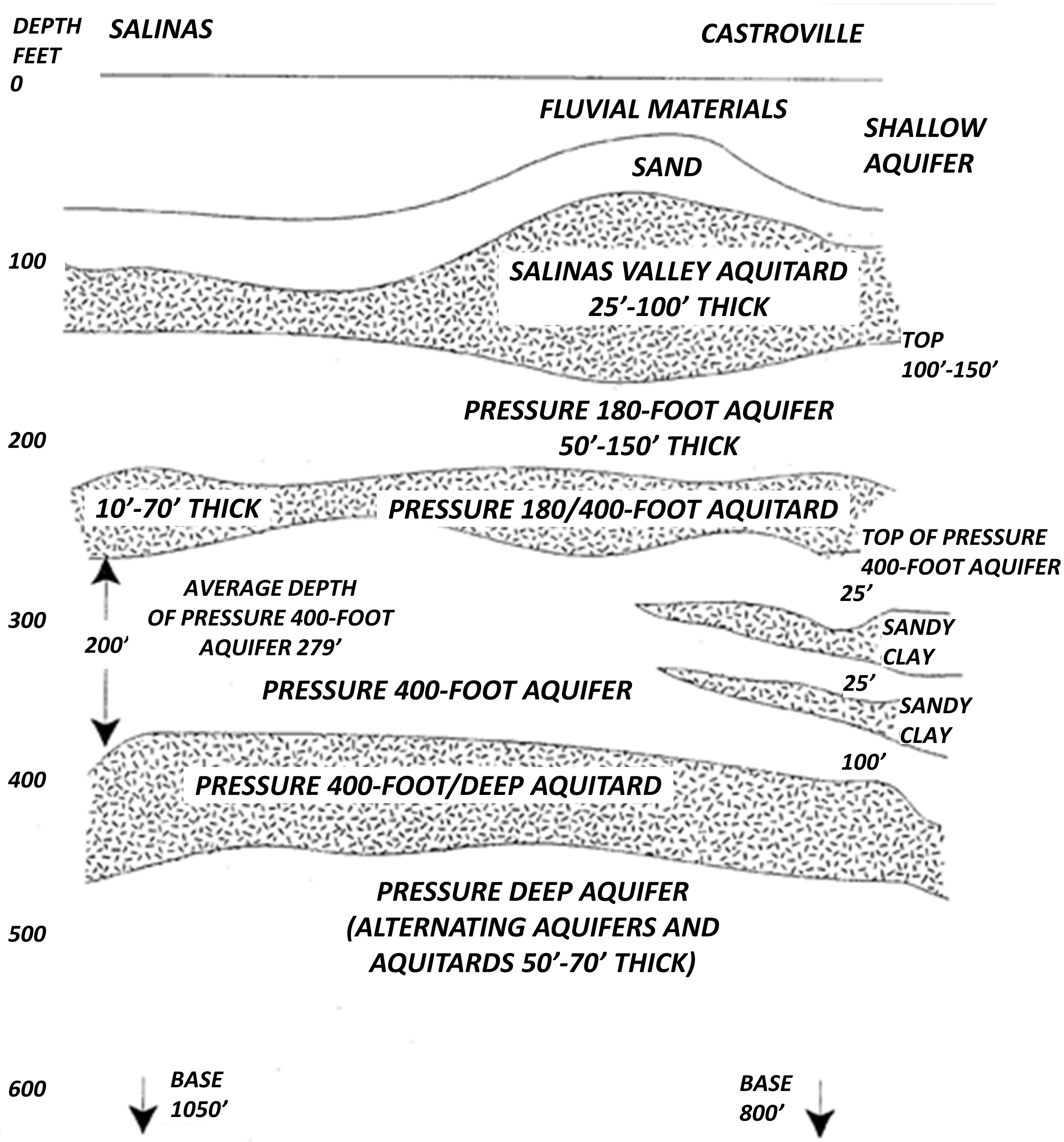
By 1944, groundwater pumping in the entire valley was estimated at about 350,000 acre-feet per year (afy), with about 30 percent of the pumping occurring within the Pressure Subarea, 10 percent in the East Side Subarea, 35 percent in the Forebay Subarea, and 25 percent in the Upper Valley Subarea. Groundwater use in the Salinas Valley peaked in the early 1970’s and then started declining, due primarily to changes in crop patterns, continued improvements in irrigation efficiency, and some conversion of agricultural lands to urban land uses.

Seawater intrusion was detected in coastal wells as early as the 1930’s, resulting from declining groundwater head elevations in the Pressure and East Side Subareas. Seawater intrusion has continued so that it now reaches as far as 8 miles inland within the Pressure Subarea. The declining head and intruding seawater helped lead to the construction of the Nacimiento and San Antonio Dams (releases beginning in 1957 and 1965, respectively), which are used for flood control, maintenance of groundwater head elevations, multi-year storage, and recreation. Today, as urbanization increases in the valley, alternative sources of urban water supplies and relocation of groundwater pumping are being evaluated and implemented by the Marina Coast Water District and various communities in the northern Salinas Valley.

Hydrogeology

The Salinas Valley Groundwater Basin is a structural basin (i.e., formed by tectonic processes) consisting of up to 10,000 to 15,000 feet of terrigenous and marine sediments overlying a basement of crystalline bedrock. The sediments are a combination of gravels, sands, silts, and clays that are organized into sequences of relatively coarse-grained and fine-grained materials. When layers within these sequences are spatially extensive and continuous, they form aquifers, which are relatively coarse-grained and are able to transmit significant quantities of groundwater to wells, and aquitards, which are relatively fine-grained and act to slow the movement of groundwater. Figure ES-2 is a generalized schematic cross-section across the Pressure Subarea illustrating its general hydrostratigraphy.

Groundwater flow in the Basin is generally down the valley, from the southern end of the Upper Valley Subarea toward Monterey Bay, up to about Chualar (Figure ES-3). North of Chualar, groundwater flows in a north to east direction toward a trough of depressed groundwater head on the northeastern side of Salinas. This trough is especially pronounced in August, the approximate time of the seasonal peak groundwater pumping.

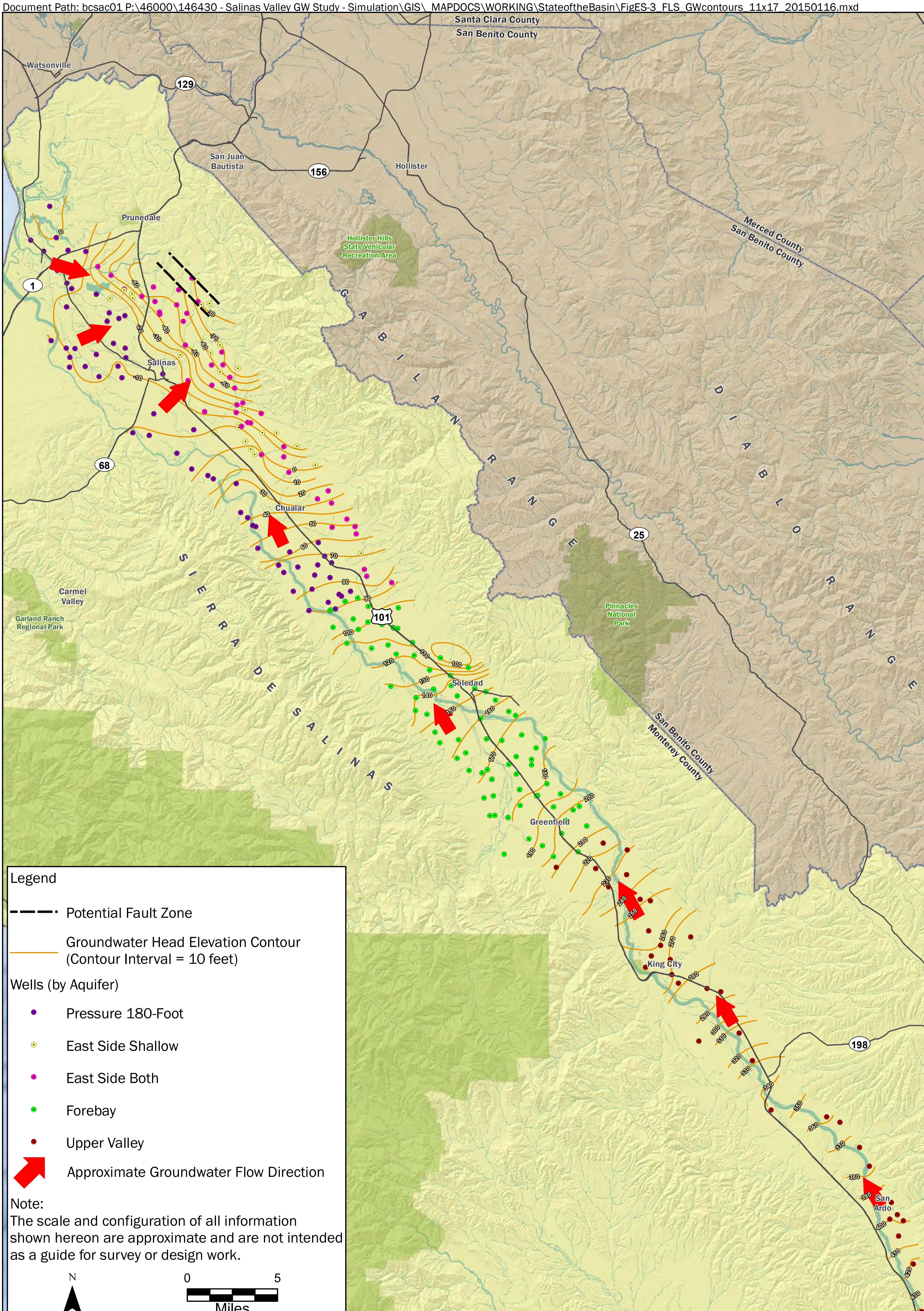


Modified from Hall and Earthware of California, 1992.

DATE	SITE	Figure
01/16/15	Salinas River Groundwater Basin Investigation	ES-2
PROJECT 146430	TITLE Conceptual Hydrostratigraphic Section in the Pressure Subarea	

Brown AND Caldwell

Document Path: bcsac01 P:\46000\146430 - Salinas Valley GW Study - Simulation\GIS_MAPDOCS\WORKING\StateoftheBasin\FigES-3_FLS_GWcontours_11x17_20150116.mxd



SITE

Salinas River Groundwater Basin Investigation

TITLE

Lines of Equal Groundwater Head Elevation in the Pressure 180-Foot East Side Shallow/Both, Forebay, and Upper Valley Aquifers - Fall 2013

Brown AND Caldwell	DATE 01/16/15	**Figure ES-3**
	PROJECT 146430	

Water Balance

A water balance is a quantitative accounting of the various components of flow entering and leaving a groundwater system. Typical outflows include evapotranspiration, surface runoff that leaves the system, groundwater pumping, and groundwater outflow to a neighboring groundwater system. Typical inflows include recharge from infiltration of precipitation, releases from reservoirs (which receive runoff from precipitation), recharge from leaky aquitards, and groundwater inflow. The difference between inflows and outflows represents the change in groundwater storage. Because precipitation constitutes the major input of water to the Basin, rainfall records from the Salinas Municipal Airport gauge from 1873 to the present were analyzed. Based on the mean precipitation of 13.4 inches and standard deviation of 4.8 inches, each year's precipitation total was assigned to one of seven, "wetness levels," as follows: Extremely Dry, Very Dry, Dry, Normal, Wet, Very Wet, or Extremely Wet. In general, dry years are more common than wet years, but Extremely Dry years are less common than Extremely Wet years. The drought period from WY 1984 to 1991 included three Very Dry years, four Dry years, and one Normal year; this period was used in this study as a comparative period for predicting future changes in groundwater head and storage. Based on provisional data, the WY 2014 precipitation of about 5.9 inches represents a Very Dry year and the third-driest water year on record. The current drought of WY 2012 to 2014 includes two Dry years and one Very Dry year; over this three-year period, the total rainfall was about 15 inches below the period of record average.

This study emphasizes the importance of cumulative precipitation surplus, which quantifies precipitation on timescales longer than a year to examine the impacts of multi-year dry and wet periods. The cumulative precipitation surplus reached a high of about 41 inches at the end of WY 1958, and declined to zero by the end of WY 2013. During the extended drought from WY 1984 to 1991, the cumulative precipitation surplus declined by about 36 inches, an average of about 4.5 inches per year. The major declines in cumulative precipitation surplus had and continue to have negative effects on groundwater storage in Basin aquifers (see Storage Change discussion below). Figure ES-4 shows a time series of annual and cumulative precipitation surplus.

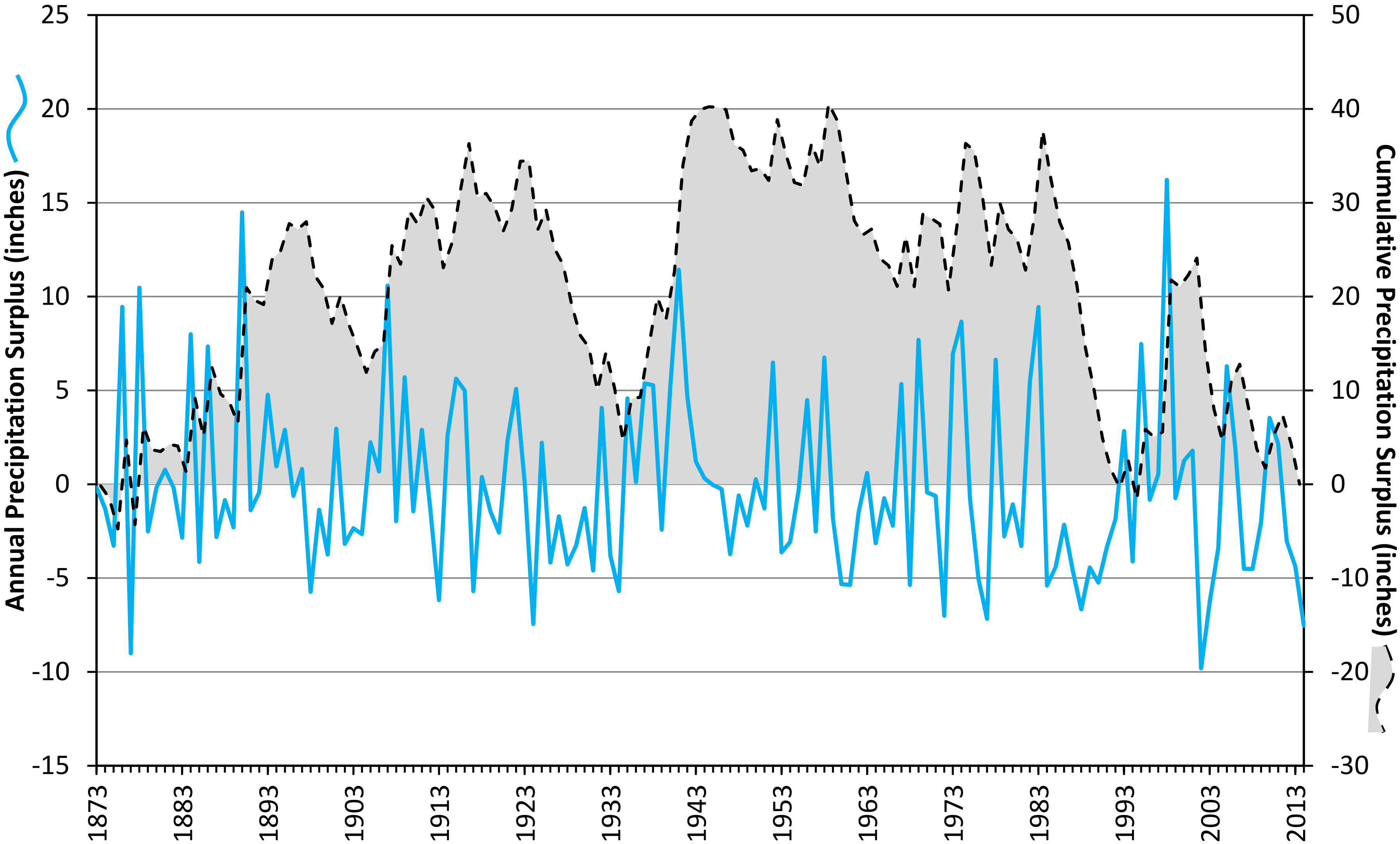
Inflows

Out of an estimated total of about 504,000 afy of inflow to the Basin, about 50 percent occurs as stream recharge, 44 percent occurs as deep percolation from agricultural return flows and precipitation, and 6 percent occurs as subsurface inflow from adjacent groundwater basins (MW, 1998). Table ES-1 summarizes the inflow components of the water budget, as reported by MW (1998).

Table ES-1. Water Budget Components by Subarea

Subarea	Average of WY 1958-1994 (from MW, 1998)				2013 Groundwater Pumping (reported by MCWRA)[c]
	Inflow		Outflow		
	Natural Recharge[a]	Subsurface Inflow	Groundwater Pumping[b]	Subsurface Outflow	
Pressure	117,000	17,000	130,000	8,000	118,000
East Side	41,000	17,000	86,000	0	98,000
Forebay	154,000	31,000	160,000	20,000	148,000
Upper Valley	165,000	7,000	153,000	17,000	145,000

Note: All estimates in acre-feet per year (afy).
[a] Includes agricultural return flow, stream recharge, and precipitation.
[b] Groundwater pumping as reported by MW (1998) is presented to provide a complete water budget.
[c] The 2013 groundwater pumping totals are provided for comparison.



Note: The annual precipitation surplus represents the difference between the annual precipitation and the long-term mean.

Brown AND Caldwell	DATE 01/16/15	SITE Salinas River Groundwater Basin Investigation	Figure ES-4
	PROJECT 146430	TITLE Annual and Cumulative Precipitation Surplus at Salinas Municipal Airport	

Within the Pressure Subarea, inflow is largely made up of subsurface inflow from the Forebay Subarea; prior to development, additional subsurface inflow occurred from the East Side Subarea, but this flow had been reversed by declining groundwater head elevations in the East Side Subarea. An additional inflow to the Pressure Subarea is seawater intrusion, which could account for between about 11,000 and 18,000 afy.

Inflow to the East Side Subarea is made up of a combination of infiltration along the small streams on the west side of the Gabilan Range, direct recharge of precipitation on the valley floor, and subsurface inflow from the Pressure and Forebay Subareas.

Inflow to the Forebay Subarea is made up of infiltration along Arroyo Seco, Reliz Creek, and the Salinas River as well as agricultural return flow, direct recharge of precipitation on the valley floor, subsurface inflow from the Upper Valley Subarea, and mountain front recharge along the eastern and western Subarea boundaries.

Inflow to the Upper Valley Subarea is made up of infiltration along the Salinas River and its tributaries, with lesser amounts entering the subarea via direct recharge of precipitation on the valley floor and agricultural return flow, plus minor quantities entering via subsurface inflow from the Panch Rico Formation to the east and along drainages tributary to the Salinas River.

Outflows

Groundwater pumping is, by far, the largest component of outflow from the Basin. Of an estimated total of 555,000 afy of outflow, about 90 percent is groundwater pumping, with the remainder occurring as evapotranspiration along riparian corridors (Ferriz, 2001). Table ES-1 summarizes the outflow components of the water budget, as reported by MW (1998).

In general, groundwater pumping in the study area increased over the first 14 years of the available period of record (1949 to 2013), from about 380,000 afy in 1949 to about 620,000 afy in 1962, the highest pumping year on record. Pumping began to decline after about 1972, when pumping was about 530,000 afy, and fell to about 430,000 afy by 1982 before averaging about 500,000 afy over the rest of the period of record. Reported pumping for 2013 totaled about 509,000, acre-feet (af).

While annual pumping totals were relatively steady in the Pressure and East Side Subareas after about 1962, pumping in the Forebay and Upper Valley Subareas continued to increase until the early 1970's, then decreased slightly through the mid-1980's. On average, from 1949 to 2013, about 25 percent of basinwide pumping occurred in the Pressure Subarea, 17 percent in the East Side Subarea, 30 percent in the Forebay Subarea, and 28 percent in the Upper Valley Subarea.

Within the Pressure Subarea, outflow occurs as a combination of groundwater pumping and subsurface outflow to the East Side Subarea. In the East Side Subarea, outflow is made up entirely of groundwater pumping, since the reversal of the groundwater head gradient curtailed the natural subsurface outflow to the Pressure Subarea. In the Forebay Subarea, outflow is dominated by groundwater pumping, with a small amount of subsurface outflow to the Pressure and East Side Subareas. Outflow from the Upper Valley Subarea is largely made up of groundwater pumping, with a small amount of subsurface outflow to the Forebay Subarea.

Groundwater Storage

Estimated Basin groundwater storage is summarized in Table ES-2. The reported total stored volume of groundwater in the Basin is about 16.4 million af, and the reported aquifer storage capacity is approximately 19.8 million af (DWR, 2003). These values suggest that there is an unfilled storage capacity of about 3.3 million af.

Storage Change

The estimation of groundwater storage changes in the Basin calculated for this project is a measure of aquifer response to the natural hydrologic cycle (e.g. precipitation) and human-induced effects (e.g. pumping). The analysis of storage change was accomplished by considering subarea-averaged annual groundwater head elevation changes reported by MCWRA from 1944 to 2013. The accuracy of this analysis relies directly on the accuracy of the estimates of head change and of the values of storage coefficient and land area used. For this analysis, the storage coefficients reported by DWR (2003) were used[1]. Figure ES-5 shows a time series of calculated storage change for the Basin, color-coded by subarea. When compared with Figure ES-4, it is clear that there is a strong correlation between the pattern of the cumulative precipitation surplus and that of storage change. The storage change analysis included a statistical comparison between subarea storage change and annual precipitation surplus, reservoir releases, streamflow (at the Salinas River gauge near Bradley), and groundwater pumping. In all four subareas, annual storage change was correlated most strongly to annual precipitation surplus. The results of the storage change analysis are summarized in Table ES-3.

Table ES-2. Groundwater Storage

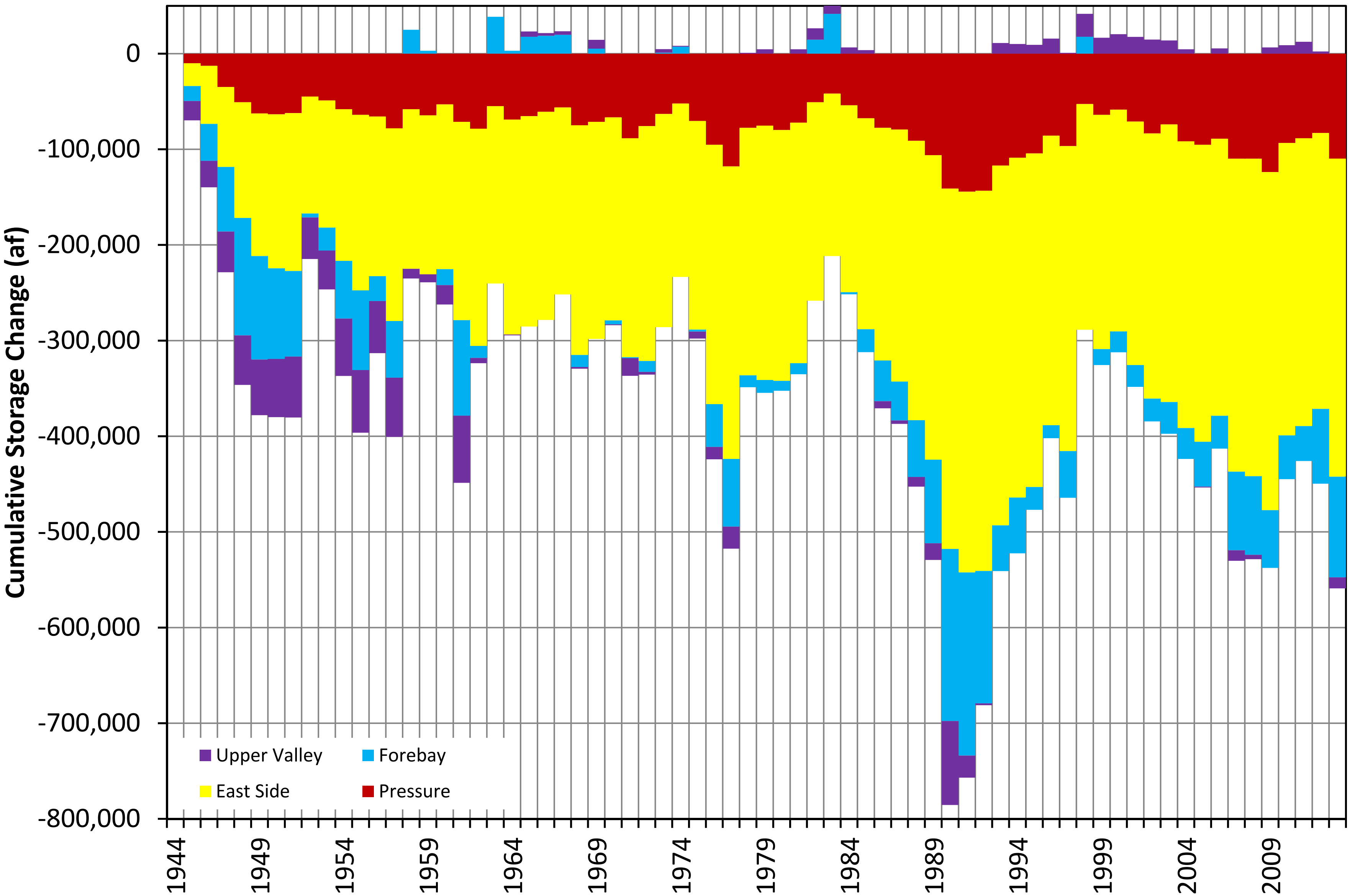
Subarea	Storage Coefficient (ft^3/ft^3)[a]	Land Area (acres)[b]	Storage Capacity (acre-feet)[a]	Groundwater in Storage (acre-feet)[a]	Available Storage (acre-feet)
Pressure	0.036	126,000	7,240,000	6,860,000	380,000
East Side	0.08	75,000	3,690,000	2,560,000	1,130,000
Forebay	0.12	87,000	5,720,000	4,530,000	1,190,000
Upper Valley	0.10	92,000	3,100,000	2,460,000	640,000
Total	--	380,000	19,750,000	16,410,000	3,340,000

[a] *From DWR (2003).*

[b] *From the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM).*

1 The storage calculation presented in this Executive Summary is based on the storage coefficients published in DWR (2003). In the main body of the Report, the storage calculation is based on the DWR (2003) data and an additional and smaller storage coefficient that could be representative of the confined portions of the Pressure Subarea aquifer system.

Path: \\bcsac01\projects\46000\146430 - Salinas Valley GW Study - Simulation\Reports\State of the Basin\Figures\LandscapeFigs_20150116.pptx



Brown AND Caldwell	DATE 01/16/15	SITE Salinas River Groundwater Basin Investigation	Figure ES-5
	PROJECT 146430	TITLE Cumulative Storage Change by Subarea	

Table ES-3. Calculated Storage1 Change by Subarea, 1944 to 2013						
Subarea	Minimum Annual (af)	Maximum Annual (af)	Annual Average (afy)	Minimum Cumulative (af)	2013 Cumulative (af)	Predicted Change If Drought Continues (afy)
Pressure	-35,000	+44,000	-2,000	-144,000 (1991)	-110,000	-10,000 to -20,000
East Side	-58,000	+83,000	-5,000	-398,000 (1991)	-333,000	-25,000 to -35,000
Forebay[a]	-93,000	+98,000	-2,000	-192,000 (1991)	-105,000	-10,000 to -15,000
Forebay[a]	-93,000	+98,000	-2,000	-192,000 (1991)	-105,000	-80,000 to -90,000
Upper Valley[a]	-70,000	+65,000	-200	-88,000 (1990)	-12,000	-5,000 to -15,000
Upper Valley[b]	-70,000	+65,000	-200	-88,000 (1990)	-12,000	-50,000 to -70,000
Zone 2C[a]	-256,000	+217,000	-8,000	-786,000 (1990)	-559,000	-50,000 to -85,000
Zone 2C[b]	-256,000	+217,000	-8,000	-786,000 (1990)	-559,000	-165,000 to -215,000

Note: af = acre-feet; afy = acre-feet per year

[a] Based on calculated storage changes over the extended drought of WY 1984 to 1991

[b] Based on calculated storage changes for years with very low reservoir release (WYs 1961 and 1990)

Pressure Subarea

Using the storage coefficient value of 0.036, as reported by DWR (2003), calculated storage change in the Pressure Subarea from 1944 to 2013 was about -110,000 af, averaging about -2,000 afy. Based on storage changes during the extended drought of WY 1984 to 1991, storage in the Pressure Subarea could be expected to decline by about 10,000 to 20,000 afy under continued dry conditions.

East Side Subarea

Calculated storage change in the East Side Subarea from 1944 to 2013 was about -333,000 af, averaging about -5,000 afy. Based on storage changes during the extended drought of WY 1984 to 1991, storage in the East Side Subarea could be expected to decline by about 25,000 to 35,000 afy under continued dry conditions.

Forebay Subarea

Calculated storage change in the Forebay Subarea from 1944 to 2013 was about -105,000 af, averaging about -2,000 afy. The pattern of storage change in the Forebay Subarea is quite dissimilar to that in the Pressure and East Side Subareas, being much closer to zero storage change over much of the period of record and appearing to be strongly affected by years of very low reservoir releases, which lead to very large storage declines in this Subarea. Based on storage changes during the extended drought of WY 1984 to 1991, storage in the Forebay Subarea could be expected to decline by about 10,000 to 15,000 afy under continued drought conditions. However, if reservoir releases are severely curtailed (as occurred in WYs 1961 and 1990), storage changes may be much greater in magnitude, on the order of 80,000 to 90,000 afy, or about 50 to 60 percent of annual pumping in the Forebay Subarea.

Upper Valley Subarea

Calculated storage change in the Upper Valley Subarea from 1944 to 2013 was about -12,000 af, averaging about -200 afy. The pattern of storage change is similar to that of the Forebay Subarea, with a similar apparent reliance on reservoir releases. Based on storage changes during the extended drought of WY 1984 to 1991, storage in the Upper Valley Subarea could be expected to decline by about 5,000 to 15,000 afy under continued drought conditions. However, if reservoir releases are severely curtailed, storage losses may be much larger, on the order of about 50,000 to 70,000 afy, or about 30 to 50 percent of annual pumping in the Upper Valley Subarea.

Zone 2C

Based on the numbers presented above, calculated storage change from 1944 to 2013 in all of Zone 2C was about -559,000 af, averaging about -8,000 afy. The pattern of storage change follows the pattern of the precipitation surplus, but is also affected by reservoir releases, which typically replenish approximately 35 percent of annual pumping as aquifer recharge. During years of exceptionally low reservoir releases, such as 1991, drought-related aquifer storage depletion is amplified.

Storage under continued dry conditions can be expected to decline by about 50,000 to 85,000 afy, comparable to past dry years. However, if reservoir releases are severely curtailed, as occurred in WYs 1961 and 1990, storage losses could be expected to be much larger, on the order of about 165,000 to 215,000 afy.

Over the period from 1959 to 2013 (the period for which groundwater pumping data are available and the reservoirs have been operating), the average reported annual pumping in Zone 2C was about 523,000 afy. During this same time period, the average annual storage change (calculated using groundwater head changes) was about -6,000 afy. An additional loss of storage due to seawater intrusion has occurred, and has been estimated at between 11,000 and 18,000 afy. This suggests that, overall, Zone 2C is out of groundwater balance by about 17,000 to 24,000 afy. The total calculated storage change over this period (not including seawater intrusion) was about -349,000 af, about 50 percent more than the storage change experienced prior to the beginning of operations of the reservoirs (about -210,000 af from 1944 to 1958), indicating that the reservoirs have greatly slowed storage losses in the Basin. However, the existing storage deficit has continued to grow over the period of record, and must be remedied before the deleterious effects of storage declines, such as seawater intrusion and the drying of wells, can be reversed. In addition, the volume of storage lost due to seawater intrusion must be better quantified.

State of the Basin – Water Supply in Zone 2C

Based on the calculations conducted for this project as discussed above, the Basin is currently out of hydrologic balance by approximately 17,000 to 24,000 afy. However, the estimated volume of groundwater in reserve (i.e. storage) is about 6.8 million acre-feet in the aquifers of the Pressure Subarea (Table ES-2), and the total volume of groundwater stored in Zone 2C is about 16.4 million acre-feet.

The goal of the water supply analyses presented in this report was to provide a postulation of how groundwater supply may change in the future should the current drought conditions continue. This was accomplished by assessing how and why groundwater head elevations and groundwater storage have changed in the past. Independent hydrologic variables (precipitation, groundwater pumping, reservoir releases, and streamflow) were compared with the groundwater head and storage changes to provide insight (or correlations) into which of these factors is driving these changes. Lastly, this study then provides professional opinions on the consequences of using more groundwater than the estimated yield on both the short-term Basin conditions and long-term sustainability.

An analysis of historical groundwater head elevation at a selected set of 25 locations indicated that, overall, groundwater head changes are correlated most strongly to the annual precipitation surplus in the Pressure, East Side, and Forebay Subareas. Head changes in the Upper Valley Subarea are not well-correlated to any independent variable, whereas the storage changes discussed above are statistically correlated to annual precipitation surplus.

Based on statistical correlations and comparison with the extended drought from WY 1984 to WY 1991, representative head changes at the Subarea scale could range from:

- -5.3 to -1.1 feet per year in the Pressure Subarea (for all three aquifers),
- -9.6 to -3.0 feet per year in the East Side Subarea,
- -5.6 to -1.8 feet per year in the Forebay Subarea, and
- -2.0 to +0.2 feet per year[2] in the Upper Valley Subarea.

Storage changes are also strongly affected by the occurrence of very low reservoir releases, which have historically resulted in storage declines. The cumulative storage loss over the period from 1944 to 2013, not including storage volume lost to seawater intrusion, was about 559,000 af for all of Zone 2C. About 40 percent of the storage loss occurred in the 14 years before Nacimiento Reservoir began releasing water, while about 60 percent occurred over the 55 years from 1959 to 2013. Estimates of storage decline in future dry years range from about 50,000 to 215,000 afy (Table ES-3), depending on the level of reservoir releases that occur. This storage loss, added to the existing storage deficit built up over the history of groundwater development in the study area, will exacerbate the problem of seawater intrusion in the Pressure Subarea.

State of the Basin – Seawater Intrusion

The water quality analysis in this study was undertaken to determine the extent of seawater intrusion into the coastal aquifers in 2013 and to analyze how it is likely to evolve in the future, should the current dry conditions continue into the coming years. The extent of seawater intrusion into the Pressure 180-Foot and Pressure 400-Foot Aquifers (Figures ES-6 and ES-7, respectively) in 2013 was not different from the extents mapped in 2011, indicating that the first two years of current drought did not have an apparent effect on the movement of the seawater intrusion front.

In assessing other markers of seawater intrusion, the sodium to chloride (Na/Cl) ratios[3] indicate that numerous wells on the landward side of the seawater intrusion front have likely been affected by seawater intrusion, even though the chloride concentration has not increased to the 500 mg/L level used by MCWRA to delineate seawater intrusion. Wells screened in the Pressure 400-Foot Aquifer that are several miles landward of the mapped seawater intrusion extent may have been impacted by seawater intrusion in the past. The landward seawater mixing with deeper groundwater can possibly be attributed to the vertical movement of groundwater from the Pressure 180-Foot Aquifer into the lower Pressure 400-Foot zone. Possible mechanisms include: a) natural leakage through areas of thin or absent aquitard between the two aquifers, b) via wells screened across both aquifers, and c) along faulty or compromised well casings acting as conduits.

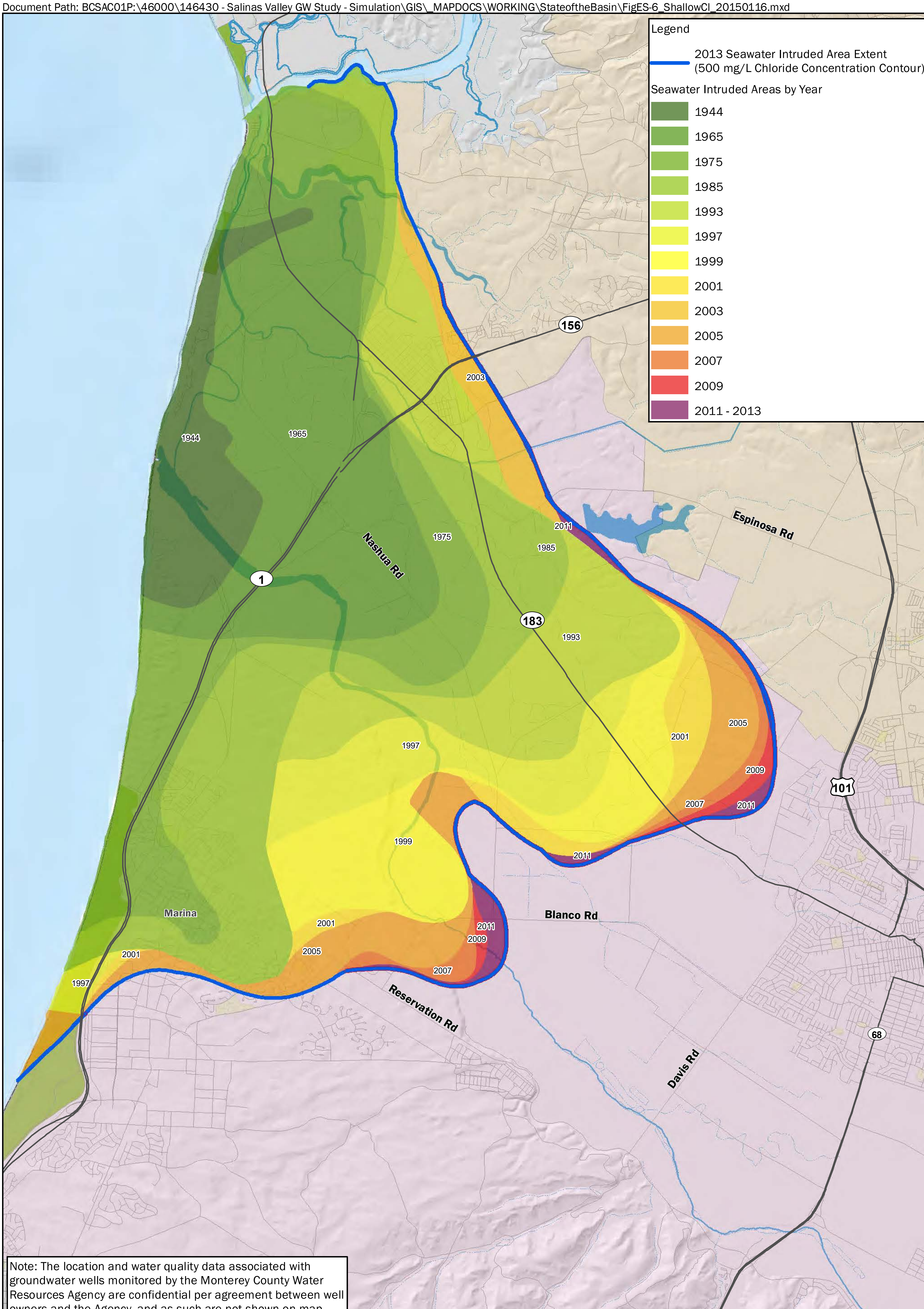
The accelerated rate of seawater intrusion in 1984 can be attributed to the seven-year drought that started in 1984, the extent of which is depicted in Figures ES-6 and ES-7. The apparent rate of seawater intrusion in the period peaked from 1997 to 1999, despite the fact that the groundwater head elevations began to recover before this time from the declines experienced during the WY 1984 to 1991 drought. If this latent response to an extended drought is repeated in the Basin, water quality impacts stemming from the current drought may not manifest for several years. Chloride concentrations in affected wells increased by up to 100 mg/L from the beginning of the extended drought to 1999, and similar concentration changes may be expected in wells near the seawater intrusion front over the coming years.

---

2 Positive head changes in individual wells are reflective of increases in head that occurred in select wells during the WY 1984 to 1991 drought, and are not reflective of the average head change in the Upper Valley Subarea during the same period. It is considered unlikely that continued drought conditions will result in an overall increase in head in the Upper Valley Subarea, although individual wells may see head increases, depending on local conditions.

3 Calculated from historical water quality data at selected monitoring wells

Document Path: BCSAC01P:\46000\146430 - Salinas Valley GW Study - Simulation\GIS_MAPDOCS\WORKING\StateoftheBasin\FigES-6_ShallowCl_20150116.mxd



Note: The location and water quality data associated with groundwater wells monitored by the Monterey County Water Resources Agency are confidential per agreement between well owners and the Agency, and as such are not shown on map.

SITE
Salinas River Groundwater Basin Investigation

TITLE
Pressure 180-Foot and East Side Shallow/Both Aquifer 500 mg/L Chloride Contours - 2013

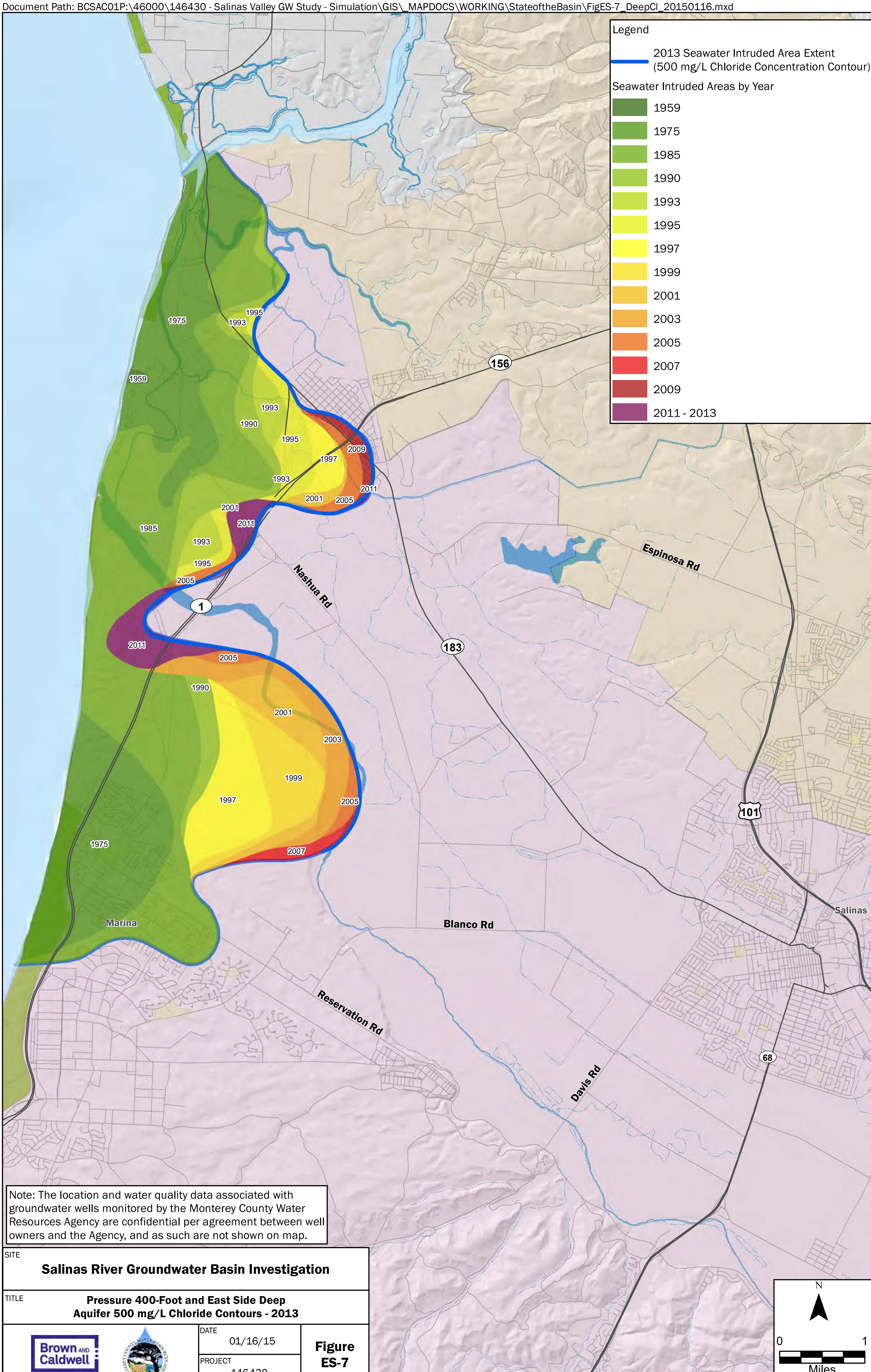
Brown AND Caldwell

DATE 01/16/15

PROJECT 146430

Figure ES-6

Document Path: BCSAC01P:\46000\146430 - Salinas Valley GW Study - Simulation\GIS_MAPDOCS\WORKING\StateoftheBasin\FigES-7_DeepCl_20150116.mxd



Note: The location and water quality data associated with groundwater wells monitored by the Monterey County Water Resources Agency are confidential per agreement between well owners and the Agency, and as such are not shown on map.

SITE
Salinas River Groundwater Basin Investigation

TITLE
Pressure 400-Foot and East Side Deep Aquifer 500 mg/L Chloride Contours - 2013

Brown AND Caldwell

DATE 01/16/15

PROJECT 146430

Figure ES-7

Options to Address Water Supply under Continued Drought Conditions

Based on the analyses discussed above, the Basin appears to be out of hydrologic balance. The average annual groundwater extraction for the four primary water-producing subareas that compose Zone 2C was about 523,000 afy from 1959 to 2013. The average annual change in storage was about -17,000 to -24,000 afy, including seawater intrusion. This implies that the yield for Zone 2C is on the order of about 501,000 to 508,000 afy; the deficit is essentially the storage change (loss) stated above. It is important to note that the Basin does have an estimated volume of groundwater in storage of about 16 million af (Table ES-2), which could represent a significant groundwater reserve – as compared to the current estimated storage loss of 17,000 to 24,000 afy – and could be used to offset temporary overdraft conditions in the future.

Based on the continued large storage declines in the East Side and Pressure Subareas (and resulting groundwater head declines and seawater intrusion), the current distribution of groundwater extractions is not sustainable. Seawater intrusion can account for up to 18,000 afy of the total storage loss of 24,000 afy. Sustainable use of groundwater can only be achieved by aggressive and cooperative water resources planning to mitigate seawater intrusion and groundwater head declines.

The consequences of no-action under continued drought conditions will be the imminent advancement of seawater intrusion within the next few years and the continued decline of groundwater head. Both of these conditions would necessitate the drilling of deeper groundwater wells to produce the quantity and quality of water needed for consumptive use and irrigation. The installation of deeper wells may not be feasible in some areas because of lower groundwater yield and water quality in the Pressure Deep Aquifer. A more sustainable and long term management practice would encourage a Basin-wide redistribution and reduction of groundwater pumping, which would require cooperative and aggressive resource management. The unsustainability of the current distribution of groundwater extractions has long been recognized by various investigators, and Basin-wide redistribution and reduction of pumping have been recommended previously (e.g. DWR, 1946).

Technical Option 1

The large storage declines that have occurred in the Basin in the past, especially in the East Side Subarea, have created a significant landward groundwater head gradient that must be reversed before seawater intrusion can be halted. Reduction of pumping in the Pressure and East Side Subareas could help mitigate some of the anticipated effects of extended drought on groundwater storage and water quality in the study area. Shifting of pumping to areas farther away from the coast would also be helpful, as long as it is shifted south of the current head trough (Figure ES-3) that exists in the East Side Subarea. While not currently consistent with County Policy, shifting pumping to areas that are both south of the seawater intrusion zone and hydraulically connected to the Salinas River does represent a physical option for addressing seawater intrusion.

DWR (1946) recommended that pumping be curtailed in the Pressure and East Side Subareas and substituted with extraction in the Forebay and Upper Valley Subareas, which are strongly connected to (and interact with) the Salinas River. Yates (1988) performed a numerical modeling analysis of the Basin, with a specific focus on the effect of pumping changes on seawater intrusion, and calculated that seawater intrusion could be cut by more than half (from about 18,000 to 8,000 afy) over a 20-year period by decreasing pumping in the Pressure and East Side Subareas by 30 percent[4]; whereas, reducing pumping in the Forebay and Upper Valley Subareas had minimal to no effect on seawater intrusion.

4 Note that Yates (1988) assumed an agricultural pumping rate of 512,200 afy, based on the results of a land use survey performed in the Salinas Valley in 1976. Recent pumping rates are slightly lower (around 500,000 afy), in part due to the operation of the Monterey County Water Recycling Projects.

Technical Option 2

The shifting of some pumping from the Pressure 180-Foot and Pressure 400-Foot Aquifers to the Pressure Deep Aquifer would reduce the storage deficit in the shallower aquifers; however, this would necessarily lead to head declines in the Pressure Deep Aquifer. Unlike the Pressure 180-Foot and Pressure 400-Foot Aquifers, it is uncertain if the Pressure Deep Aquifer is hydraulically connected to the ocean in Monterey Bay, so it is not known whether this pumping shift would lead to the onset of seawater intrusion into the Pressure Deep Aquifer. Also unknown is the likelihood of localized interaquifer seawater mixing between the Pressure 400-Foot Aquifer and the Pressure Deep Aquifer. Hence, this Management Option requires more investigation to determine its feasibility.

Evaluation of Potential Solutions

The numerical modeling analysis to be performed as the second part of this Basin Investigation will consider the effects of various management decisions on the water supply and water quality in the study area. The primary questions to be assessed for each scenario are: 1) what will be the rate of groundwater head decline; and, 2) what will be the rate of increase in acreage with impaired water quality due to the advancement of the seawater intrusion front. Based on this analysis, an assessment of the economic effects of 1) and 2) due to water supply wells becoming inoperable (i.e. dry), and the further loss of aquifer storage capacity due to the advancement of seawater intrusion can be conducted.

The numerical model should be used to predict groundwater head declines under different management scenarios, including implementing targeted pumping rates and optimizing the distribution of pumping. Future declines in groundwater head must be evaluated by simulated groundwater conditions so that “trigger (groundwater) head levels” can be used as a measure of safe yield and an early alert system as part of Basin Management Objectives. That analysis will extend the discussions and conclusions presented in this report.

EXHIBIT 'B'

Simulated effects of ground-water management alternatives for the Salinas Valley, California

Water-Resources Investigations Report 87-4066

By: E.B. Yates

https://doi.org/10.3133/wri874066

Links

- Document: **Document** (pdf)
- Download citation as: RIS | Dublin Core

Abstract

A two-dimensional digital groundwater flow model was developed to analyze the geohydrology of the groundwater basin in the Salinas Valley. The model was calibrated for steady-state and transient simulations by comparing simulated with measured or estimated inflows, outflows, and water levels for 1970-81. Preliminary estimates of hydraulic properties and some inflows and outflows were adjusted during model calibration. The simulated mean annual water budget for the basin was 559,500 acre-ft/yr each of outflow and inflow. Inflow components consisted of Salinas River recharge (38.3%), percolation of irrigation water (34.0%), small stream and Arroyo Seco recharge (20.9%), seawater intrusion (3.4%), and other sources (3.4%). Outflow components consisted of agricultural pumpage (91.5%), municipal pumpage (4.0%), and riparian phreatophyte evapotranspiration (4.5%). For the steady-state calibration, 70% of the simulated water levels were within 9 ft of measured water levels for 1970-81. A sensitivity analysis determined the overall stability of the model results. The model input variable that probably contributes most to the uncertainty of the results is the quantity of groundwater recharge contributed by irrigation-return flow to the unconfined aquifer. A 15% change in the estimate of this variable causes an 11% change in the simulated river-seepage rate and a 6% change in the simulated seawater intrusion rate. The calibrated model was used to investigate several water resources management alternatives. Projected pumpage increase at a rate of 1%/yr for 20 yr caused declines in mean annual water levels of 10 to 20 ft in some areas and an increase in seawater intrusion from 18,900 to 23 ,600 acre-ft/yr. Pumpage decreases in the coastal area decreased seawater intrusion more effectively than pumpage decreases farther inland. When pumpage was decreased uniformly throughout the valley, the decrease in seawater intrusion was only one-fourteenth the decrease in pumpage. Simulations indicated that replacement of groundwater pumpage with imported surface water in a 9,000 acre service area near the coast would result in a decrease in seawater intrusion equaling nearly one-half the quantity of imported water. (Author 's abstract)

Additional publication details

Publication type	Report
Publication Subtype	USGS Numbered Series
Title	Simulated effects of ground-water management alternatives for the Salinas Valley, California
Series title	Water-Resources Investigations Report
Series number	87-4066
DOI	10.3133/wri874066
Edition	-
Year Published	1988
Language	ENGLISH
Publisher	U.S. Geological Survey,
Description	vii, 79 p. :ill., maps ;28 cm.
Google Analytic Metrics	Metrics page

Part or all of this report is presented in Portable Document Format (PDF). For best results viewing and printing PDF documents, it is recommended that you download the documents to your computer and open them with Adobe Reader. PDF documents opened from your browser may not display or print as intended. Download the latest version of Adobe Reader, free of charge. More information about viewing, downloading, and printing report files can be found here.

Brownstein Hyatt
Farber Schreck

August 12, 2021

Stephanie O. Hastings
Attorney at Law
805.882.1415 tel
shastings@bhfs.com

VIA E-MAIL – BOARD@SVBGSA.ORG

Board of Directors
Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924

RE: Preliminary Comment on Draft GSPs for the Eastside, Forebay, Langley, Monterey and Upper Valley Subbasins of the Salinas Valley Basin

Dear Chair Pereira and Members of the Board of Directors:

This office represents the Salinas Basin Water Alliance ("Alliance"), a California nonprofit mutual benefit corporation formed to preserve the viability of agriculture and the agricultural community in the greater Salinas Valley. Alliance members include agricultural businesses and families that own and farm more than 80,000 acres within the Salinas Valley. Many Alliance members have been farming in the Salinas Valley for generations. As such, the Alliance has a significant interest in the long-term sustainability of the Salinas Valley Basin.

The Alliance greatly appreciates the difficult work this Board, together with the Salinas Valley Basin Groundwater Sustainability Agency (GSA) staff and consultant team, has undertaken to implement the Sustainable Groundwater Management Act (SGMA) in Monterey County, including the time-consuming but extremely beneficial engagement with all stakeholders. The Alliance applauds the Salinas Valley Basin GSA's recent success in obtaining approval of the Department of Water Resources (DWR) for the first groundwater sustainability plan (GSP) required to be prepared for the six Salinas Valley Subbasins within the jurisdiction of the Salinas Valley Basin GSA. Further, the Alliance acknowledges and wholeheartedly supports the Board's commitment to coordinate and implement all of the GSPs for the Salinas Valley Basin within its jurisdiction in an integrated manner pursuant to the proposed Integrated Sustainability Plan, or as it may otherwise be titled.[1] It is with this objective—integrated groundwater management—in mind that the

[1] See Joint Exercise of Powers Agreement Establishing the Salinas Valley Basin GSA § 2.2 ("The purpose of Agency is to . . . develop[], adopt[], and implement[] a GSP that achieves groundwater sustainability in the Basin."); § 4.1(c) (The JPA has the power to "develop, adopt and implement a GSP for the Basin.); § 4.1(l) (The JPA has the power to "establish and administer projects and programs for the benefit of the Basin."); Salinas Valley Groundwater Basin 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan [180/400 GSP] at 9-10 ("This GSP is part of an integrated plan for managing groundwater in all six subbasins of the Salinas Valley Groundwater Basin that are managed by the SVBGSA. The projects and management actions described in this GSP constitute an integrated management program for the entire Valley."); 180/400 GSP at 10-14 ("The SVBGSA oversees all or part of six subbasins in the Salinas Valley Groundwater Basin. Implementing the 180/400-Foot Aquifer Subbasin GSP must be integrated with the implementation of the five other GSPs in the Salinas Valley Groundwater Basin . . . The implementation

Alliance offers these preliminary comments on the draft GSPs for the Eastside, Forebay, Langley, Monterey and Upper Valley Subbasins.[2]

As this Board well knows, SGMA not only requires the Salinas Valley Basin GSA to develop a GSP for each priority subbasin within its jurisdiction to ensure the long-term sustainability of those subbasins, but it also mandates that the GSA consider the impacts each GSP may have on the ability of adjacent subbasins to achieve their sustainability goal.[3] In enacting SGMA, the legislature intended to provide for the sustainable management of all groundwater basins and expressly provided for the coordination of management between and among basins.[4] Any GSP that interferes with an adjacent basin's sustainability goal cannot satisfy SGMA.[5] Moreover, in the event the GSPs for the subbasins disproportionately allocate the burden of sustainability across the Salinas Valley Basin, they could impair groundwater users' rights in and to the Salinas Valley Basin in violation of SGMA and common law water rights.[6]

The Alliance's preliminary review of the draft GSPs suggests that there are significant data gaps and uncertainty with respect to the quantification of flows between subbasins within the Salinas Valley Basin that should be addressed.[7] Specifically, the Alliance is concerned that the existing water budget analyses in the draft GSPs may not provide a complete picture of the downgradient impacts caused by groundwater pumping. Accordingly, the Alliance requests that the Salinas Valley Basin GSA conduct additional simulations with the Salinas Valley Integrated Hydrologic Model (SVIHM) that are specifically focused on the issue of inter-subbasin groundwater flows, as more specifically described in aquilogic's August 11, 2021 memorandum attached to this letter. In light of the fact that the Integrated Sustainability Plan appears to have been delayed until after completion of the subbasin GSPs, the requested additional simulations should be conducted prior to the Salinas Valley Basin GSA's adoption of the subbasin GSPs.

The requested additional model simulations are consistent with and support SGMA's and DWR's requirements that all GSPs be based on the best available science.[8] They will enable an understanding of

---

schedule reflects the significant integration and coordination needed to implement all six GSPs in a unified manner."); see also Salinas Valley Groundwater Basin Draft Upper Valley Aquifer Subbasin Groundwater Sustainability Plan at 10-16; Salinas Valley Groundwater Basin Draft Eastside Aquifer Subbasin Groundwater Sustainability Plan at 9-1, 10-7, 10-8, 10-16; Salinas Valley Groundwater Basin Draft Forebay Aquifer Subbasin Groundwater Sustainability Plan at 2-4, 9-2, 9-4, 10-7, 10-9, 10-17; Salinas Valley Groundwater Basin Draft Langley Aquifer Subbasin Groundwater Sustainability Plan at 2-4, 9-1, 9-4, 10-8, 10-9, 10-16.

[2] Following publication of the final draft GSPs for these subbasins, the Alliance may have additional comments.

[3] Wat. Code § 10733(c).

[4] Wat. Code §§ 10720.1(a); 10727; 10727.6

[5] See Wat. Code § 10733(c); 23 Cal. Code Regs. §§ 350.4, 351(h), 354.8(d), 354.18(b)(3), (c)(2)(B), (e), 354.28(b)(3), 354.44(a)(6), (c), 355.4(b)(7), 356.4(j), 357.2(b)(3); DWR, Monitoring Networks and Identification of Data Gaps BMP at pp. 6, 8, 27; DWR, Water Budget BMP at pp. 7, 12, 16, 17, 36; DWR, Modeling BMP at pp. 21-22; DWR, Sustainable Management Criteria BMP at pp. 9, 31.

[6] Wat. Code 10720.1(b) (declaring legislature's intention to preserve the security of water rights in the state to the greatest extent possible consistent with the sustainable management of groundwater); see also Water Code §§ 10720.5(b).

[7] 23 Cal. Code Regs. § 351.

[8] See 23 CCR § 354.18 ("A quantitative assessment of the historical water budget, starting with the most recently available information and extending back a minimum of 10 years, ***or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used*** to estimate and project future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon." (emphasis added).)

the amount of Basin-wide groundwater discharge that is and has been captured by pumping, which, depending on the results, may require modification of each subbasin's proposed water budget. In the absence of this analysis, there is a significant level of uncertainty in the water budgets that has the potential to undermine the adequacy of the GSPs and also to impair the Salinas Valley Basin GSA's ability to achieve its sustainability goal in each subbasin and throughout the Salinas Valley Basin within its jurisdiction.[9]

The Alliance has endeavored to make this comment and request at the earliest opportunity to allow the Salinas Valley Basin GSA sufficient time to conduct the additional SVIHM simulations. The Alliance does not wish to delay the successful completion and adoption of the subbasin GSPs. Rather, the Alliance anticipates that the additional simulations can feasibly be accomplished and incorporated into the draft GSPs consistent with the Salinas Valley Basin GSA's goal of adopting the subbasin GSPs in accordance with SGMA's deadlines.

The Alliance appreciates the Board's careful consideration of this issue and urges the Board to direct the Salinas Valley Basin GSA staff and consultant team to undertake the requested further analyses and incorporate the results into the draft GSP for each of the subbasins. The Alliance strongly believes that removing existing uncertainties with respect to inter-subbasin flows is a critical component to ensuring both transparency in the GSP development process and equity in the resulting plans, both of which are essential to promoting healthy Basin-wide dialogue and collaboration in obtaining sustainable groundwater management of the Salinas Valley Basin within the Salinas Valley Basin GSA's jurisdiction.

As the Board may direct, the Alliance would welcome the opportunity to discuss the requested additional consideration of inter-subbasin flows in more detail with the Salinas Valley Basin GSA's staff and consultant team.

Respectfully submitted,

Stephanie Osler Hastings

Attachment: August 11, 2021 aquilogic, inc. memorandum

cc: Donna Meyers, Senior Consultant / General Manager (meyersd@svbgsa.org)
Emily Gardner, Senior Advisor / Deputy General Manager (gardnere@svbgsa.org)
Derrik Williams, Montgomery & Assoc. (dwilliams@elmontgomery.com)
Leslie Girard, Monterey County Counsel (GirardLJ@co.monterey.ca.us)

---

[9] DWR's June 3, 2021 determination that it does not appear that the GSP for the 180-400 Aquifer Subbasin will adversely affect the ability of an adjacent basin to implement its GSP or impede achievement of sustainability goals in an adjacent basin does not mean that the Salinas Valley GSA should assume that DWR will reach the same conclusion with respect to the remaining subbasin GSPs.

aquilogic, Inc.
environment • water • strategy

245 Fischer Avenue, Suite D-2
Costa Mesa, CA 92626
Tel. +1.714.770.8040
Web: www.aquilogic.com

August 11, 2021

MEMORANDUM

To: Stephanie Hastings, Brownstein Hyatt Farber Schreck (BHFS)
Sent via email: SHastings@bhfs.com
From: Robert H. Abrams, PhD, PG, CHg, Principal Hydrogeologist, aquilogic, Inc.
Anthony Brown, CEO & Principal Hydrologist, aquilogic, Inc.

Subject: **Assessment of Groundwater Flows between Subbasins of the Salinas Valley Groundwater Basin (SVGB)**
Project No.: 018-09

Aquilogic, Inc. (**aquilogic**) is pleased to provide this memorandum on behalf of our mutual client, the Salinas Basin Water Alliance (SBWA), outlining the justification and necessity for conducting additional simulations with the Salinas Valley Integrated Hydrologic Model (SVIHM),[1] which is being used by the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) for groundwater sustainability plan (GSP) development.

Aquilogic hypothesizes that pumping has captured significant portions of groundwater discharge that would otherwise migrate as underflow from the Upper Valley Subbasin to the Forebay Subbasin, from the Forebay Subbasin to the 180/400-Ft Aquifer Subbasin and East Side Subbasin, and potentially from the 180/400-Ft Aquifer Subbasin to the Monterey Subbasin and the Salinas River. Our primary concern is that the existing water budget analyses in at least three of the SVBGSA's draft GSPs may not provide a complete picture of the downgradient impacts caused by groundwater pumping.[2]

It should be noted that groundwater sustainability was a pertinent issue for water managers long before the advent of California's Sustainable Groundwater Management Act. There is

---

[1] The SVIHM is a provisional, unpublished model not currently available to the general public.

[2] Bredehoeft, J.D., Papadopulos, S.S., and Cooper, H.H. Jr. (1982). The water budget myth. *In* Scientific Basis of Water Resource Management, Studies in Geophysics, 51-57. Washington, D.C. National Academy Press;
Bredehoeft, J.D. (1997). Safe yield and the water budget myth. Ground Water, Vol. 35, No. 6, p. 929;
Bredehoeft, J.D. (2002). The water budget myth revisited: why hydrogeologists model. Ground Water, Vol. 40, No. 4, p. 340-345;
Bredehoeft, J.D. and Durbin, T. (2009). Groundwater development: the time to full capture problem. Ground Water, Vol. 47, No. 4, p. 506-514;
Bredehoeft, J.D. (2011). Monitoring regional groundwater extraction: the problem. Ground Water, Vol. 49, No. 6, p. 808-814.

ample support in the groundwater literature for considering multiple aspects of sustainability and undesirable results, including economic and social impacts and the contravention of water rights.[3]

ADDITIONAL SIMULATIONS

As stated in "SVIHM Frequently Asked Questions,"[4] one of the many questions that can be addressed by a model is: How much groundwater flows between subareas? Clearly, the SVIHM developers recognized the importance of this question and anticipated that it would be asked. On behalf of the SBWA, **aquilogic** requests that the SVBGSA utilize the SVIHM to conduct additional simulations that are specifically focused on the issue of inter-subbasin groundwater flows. The requested simulations will enable an improved understanding of the amount of Valley-wide groundwater discharge that is and has been captured by pumping, which may be needed to ensure the adequacy of the GSPs for each of the subbasins and important to their implementation.

Aquilogic recommends a type of "superposition" analysis, in which the results of two simulations are compared. In such an analysis, the two simulations are identical except for the process under examination, in this case groundwater pumping. Pumping would be selectively turned off in one simulation and left as currently configured in the SVIHM in the other simulation. A similar superposition analysis was done to assess pumping-induced streamflow depletion, as described in Chapter 5 of the GSPs for the Forebay Subbasin and the East Side Subbasin.

The inter-subbasin flows would then be compared, which would semi-quantitatively estimate the impact of pumping, within the limiting assumptions and uncertainties associated with the SVIHM. Ideally, the analysis should be conducted with the initial conditions of the no-pumping scenario representing a "full" SVGB. The analysis would provide an estimate of the impact of pumping on inter-subbasin groundwater flows.

Specifically, using the calibrated SVIHM historical model, **aquilogic** recommends the following outline for conducting simulations, the details of which would be worked out in consultation with the SVBGSA:

1. Develop reasonable initial conditions for the hydraulic head distribution for the no-pumping simulation. This entails turning off all pumping in the model domain while

[3] Todd, D.K. (1959). Groundwater Hydrology. Wiley, New York, 336 p.;
Domenico, P. (1972). Concepts and Models in Groundwater Hydrology. McGraw-Hill, New York, 405 p.;
Freeze, R.A. and Cherry, J.A. (1979). Groundwater. Prentice-Hall, 604 p.;
Alley, W.M., Reilly, T.E., and Franke, O.L. (1999). Sustainability of ground-water resources. U.S. Geological Survey Circular 1186, 79 p.

[4] https://www.co.monterey.ca.us/home/showdocument?id=31292

leaving all other inflows and outflows unchanged. Because the time for simulated water levels to recover may be longer than the SVIHM simulation period of 51 years (1967-2018), the simulation may have to be run multiple times before an average steady-state condition can be achieved. In this case, the hydraulic head distribution at the last time step of the previous simulation would be used as the initial condition of the subsequent simulation. This process would be repeated until the hydraulic head distribution at the last time step of a subsequent simulation is substantially identical to the last time step of the previous simulation. This would indicate that an average steady-state condition is being simulated. We assume here that the surface water inflows and reservoir releases for the 1967-2018 period would be sufficient to eventually "refill" the SVGB after several model runs.

2. When the average, no-pumping steady-state condition has been achieved with the modified SVIHM, simulated groundwater flow should occur from the East Side Subbasin to the 180/400-Ft Subbasin, and from the 180/400-Ft Subbasin to Monterey Bay, conditions that are now reversed.

3. From the final results of the no-pumping simulation, in which average steady-state conditions have been achieved, compute the inter-subbasin groundwater flows between each adjoining subbasin. Compare these flows with the inter-subbasin flows from the historical, unmodified SVIHM. The differences in inter-subbasin flows and induced recharge from the surface water system represent a semi-quantitative estimate of the impact of Valley-wide pumping.

4. Additional superposition analyses can be conducted to assess the impact of one subbasin's pumping on basin-wide groundwater levels and inter-subbasin groundwater flows, by turning on pumping in one subbasin at a time in the modified SVIHM (and leaving pumping turned off in all other subbasins) and comparing the results to the scenario with no pumping throughout the SVGB. The differences in inter-subbasin flows and groundwater levels represent a semi-quantitative estimate of the impact of one subbasin's pumping on the other subbasins.

Tuesday, August 24, 2021

Salinas Valley Basin Groundwater Sustainability Agency

SVBGSA Public Comments Form

Name	Robert Jaques
Organization	Seaside Groundwater Basin Watermaster
Email Address	bobj83@comcast.net
Subbasin	Monterey
Chapter	9
Section	Various
Page Number	Various
Comments	See attached table of comments
File Upload	docx Comments on Draft Chapter 9 8-23-21.docx

Draft Chapter 9 – Comments from Seaside Basin Watermaster 8-23-21

Page	Section	Comment
9-5	9.1	In the next to last sentence in the first para of this Section please insert after the words "Corral de Tierra Management Areas" the words "and the adjacent Seaside Subbasin".
9-9	Table 9-1	Multi-basin project R3 states that multi-basin benefits have not been quantified. Without some indication of the level of benefit a Project may be able to provide, decision-makers will not know which ones are the most desirable projects to pursue.
9-9 thru 9-15	Table 9-1	General comment and recommendation: Many of the Projects and Management Actions do not have estimated Costs or estimated Unit Costs provided for them. Recognizing that some projects are essentially only conceptual at this point, nevertheless, an effort should be made, even if it is as simple as "rule of thumb," to estimate what the range of unit costs might be for each project. Without estimated costs it will be impossible for an operating budget for the GSP to be developed, or for fees or water-use related charges to be developed. As was commented on, and I believe correctly so, by some in the SWIG when Derrik presented a summary of the comments received from the TAC for the SWIG when they discussed various projects that would help mitigate seawater intrusion, it is appropriate to do a "reality check" on projects in terms of getting a sense of how financially feasible they may be. Something like a cost-benefit ratio for example. Without sufficient estimated costs and benefits for each project, time and effort will be wasted evaluating projects that have such high cost-to-benefit ratios that they should be dropped out of the Project list early-on. As a corollary, years ago when projects that could help to solve the water-shortage problem of the Monterey Peninsula were being discussed, and no project was supposed to be rejected out-of-hand even if it seemed extremely unlikely, a project to tow icebergs from the Arctic to Monterey Bay so the water could be melted and used as a water supply for the Peninsula was proposed. Time and effort was spent coming to the conclusion that it was simply economically and/or logistically infeasible. The same can be said about a number of the proposed projects which have very high implementation costs and very little water-savings benefit, resulting in very high unit costs. I recommend that a separate table showing just: • P/MA # • Project Name • Quantity of water that will be saved from being pumped • Implementation and O&M costs • Unit Cost

Page	Section	Comment
		• A priority ranking column (which would be filled in by the GSP Committee based on the data in the other columns of this table)
9-12	Table 9-1	The Pumping Allocation and Control Management Action will almost certainly be an action/project that will have to be implemented to achieve Corral de Tierra subbasin sustainability. This Management Action will have to achieve the greatest amount of pumping reduction, since all of the other Projects and Management Actions combined, especially after those that are financially infeasible are eliminated, will fall far short of achieving the necessary pumping reduction. Therefore, instead of saying "Decreased extraction; range of potential benefits" in the "Project Benefits/ Quantification of Benefits" column, an amount of pumping reduction should be shown for this Management Action, so the reader can see clearly the magnitude of pumping allocation and control that will be needed.
9-18	9.3.4	In the last para of this Section it mentions that capital costs were annualized over 25 years. The interest rate for this calculation should be stated, and for what revenue source(s) that rate pertains.
9-27	9.4.2.2	The first sentence of this Section states that 15,000 AFY of desalinated water could be produced for the "Salinas Valley," and the Section goes on to say that a portion of this would go to the Monterey Subbasin. Since the Seaside Subbasin is also part of the Salinas Valley Groundwater Basin, and since this Section is discussing a "Regional Municipal Supply Project," language should be added saying that a portion of the water supply might also go to the Seaside Subbasin which is also in need of a supplemental water source to achieve sustainability.
9-51 through 9-54	9.4.6	This Section discusses the use of recycled water. Thought needs to be given to the limitation on the volume of recycled water that M1W's Salinas Valley Reclamation Plant or its Pure Water Monterey AWT Plant can produce. The feedwater source for both of those plants is M1W's Regional Treatment Plant, and its flow is currently only about 19 MGD. Water conservation and other factors have nearly eliminated increases in wastewater flows to that plant in recent years. With the CSIP being proposed for expansion in the 180/400-foot Aquifer Subbasin's GSP, with a Pure Water Monterey Expansion Project being proposed for the Seaside Subbasin, and now with the Monterey Subbasin GSP proposing obtaining recycled water from M1W, there appears to be a real risk that the amount of recycled water that can be produced may be over-subscribed.
9-52	9.4.6	The PWM Project currently is only sized to deliver 3,500 AFY to the Seaside Subbasin, not 3,700 AFY as stated in the 4th para on this page. Also on this page it states that the AWPF <u>will</u> be expanded. The word "may" should be used in lieu of the word "will" as there are still obstacles to the proposed expansion project.
9-53, 9-54	9.4.6	On these pages it mentions "a MCWD expansion of the AWPF." That should read "a M1W expansion of the AWPF."
9-54	9.4.6	The last para in this Section on this page starts out with "The current operation frequency of MCWD's productions generally ranges from 10% to 40%." Please clarify what this statement means.

Page	Section	Comment
9-60	Figure 9-7	The RUWAP pipeline is shown extending down General Jim Moore Boulevard clear through Del Rey Oaks and then easterly into Ryan Ranch. Please verify that this pipeline has already been constructed that far. I was of the understanding that it only went part of the way down General Jim Moore and not even as far as South Boundary Road.
9-65	9.4.8	The para in the middle of this page states in part "…if pumping needs to be reduced to meet sustainable yield…". It is not "if" but simply "will" need to be reduced. Calculations in earlier GSP chapters identify the estimated sustainable yield, and the amount of overpumping that will have to be eliminated to achieve sustainable yield. In addition, sustainability will also necessitate raising groundwater levels in this Subbasin, not just having extractions equal natural replenishment. The reader should clearly be informed that pumping reductions will be necessary, and not misled into thinking that somehow the other Management Actions and Projects will achieve sustainability. In this Section (or elsewhere in this Chapter) there should be a discussion of how users will be able to achieve the necessary level of pumping reduction and still meet the water demands of their customers. This is a problem already being faced in the Seaside Subbasin, specifically with the City of Seaside's Municipal Water System. That System's only source of water is groundwater from the Seaside Subbasin. If further pumping reductions affecting that Water System were to be imposed, it would be unable to supply its customers water needs.
9-65	9.4.8	In the bottom para on this page it states in part "If the sustainable yield is lower than current extraction…". Earlier chapters in this GSP have clearly shown that current extractions exceed the estimated sustainable yield. So it is not "if" the sustainable yield is lower than current extraction. This sentence should be rewritten to correct this misstatement, and to not leave the reader with the impression that pumping reductions may not be necessary.
9-66	9.4.8.2	The second para in this Section states that the network of monitoring wells is monitored by MCWRA. The Seaside Basin also monitors wells which my earlier comments (on Chapter 8) recommended be included in the monitoring well network for the Corral de Tierra Subbasin. Language should be added here to point this out.
9-67	9.4.8.8	The word "Subbasin" is missing after the word "Monterey" in the first sentence of the para at the bottom of this page.
9-68	9.4.9	I commented at one of the earlier GSP Committee meetings that any reduction in flows in any of the creeks in the Corral de Tierra Subbasin that flow westward toward the Seaside Subbasin might reduce the natural replenishment of the Seaside Subbasin. This needs to be pointed out in this Section, and that a hydrogeological evaluation of the impacts of any such projects be prepared to determine if such reductions would adversely impact the Seaside Subbasin.
9-78	9.4.11	The second sentence in this Section on this page states in part "This water will be disinfected tertiary levels…". It would be clearer and more correctly stated that "This water will be treated to a tertiary level…".

Page	Section	Comment
9-102	9.5.6	The last sentence in the first para on this page mentions effects on groundwater levels in the Monterey Subbasin. Wording should be added to this sentence that effects on groundwater levels in the adjacent Seaside Subbasin should also be evaluated using this model.
9-103	9.5.7	This Section includes a statement that "SGMA does not allow metering of de minimis well users…". SGMA Section 5202 states that the requirement to file an annual report of groundwater extraction does not apply to de minimis extractors. It says nothing about "not allowing metering", nor does it say anything that would prevent a jurisdiction, such as Monterey County or the Monterey County Water Resources Agency, from imposing such a reporting requirement separate from the requirements of SGMA. This language should be corrected to more accurately state what SGMA says. Section 10730(a) of SGMA states in part "A groundwater sustainability agency shall not impose a fee…on a de minimis extractor unless the agency has regulated the users pursuant to this part." It is not clear to me what "regulated the users pursuant to this part" means. It would be good to have a legal review made of the issue of imposing a requirement for de minimis extractors to file annual extraction reports to see if such reporting could be required and not be in conflict with SGMA. This could be very helpful in managing the Subbasin, since there are so many de minimis extractors.

Draft Chapter 6 – Comments from Seaside Basin Watermaster 9-6-21

Page	Section	Comment
6-5	6	Just above the bullet list on this page it states there are Three budget time periods, however the chart below the bullet list shows Four time periods. I did not see the value of showing the "Historical Model" bar in the chart since it seemed like only the 15-Year Historical bar was used. Also, I did not understand footnote number 2 on this page – please clarify what is meant by a "five-year equilibration period".
6-10	6.1	The last bullet on this page discusses pumping from various wells. Wouldn't pumping from wells in the Seaside Basin affect ground water levels, and therefore need to be included in the MBGWFM due to the hydrogeologic interconnection between the Seaside Basin and both subareas of the Monterey Subbasin?
6-11	6.1.1	Same comment as on page 6-10 pertaining to Pumping Records.
6-14	6.2.2	Same comment as on page 6-10 pertaining to Groundwater Pumping.
6-18	6.3.3	Don't understand why there are three bullets shown on this page with each bullet saying the same thing..
6-20	Table 6-1	Footnote (a) would be good to add to each of the tables in the Appendix in which water budgets are shown, to clarify what a positive or negative value means.
6-21 6-32 6-33 6-44 6-46 6-47	Figure 6-4 Figure 6-6 Section 6.4.3.1.3 Table 6-4 Table 6-6 Table 6-7	Under future anticipated pumping conditions, the outflow from the Corral de Tierra subarea into the Laguna Seca Subarea of the Seaside Subbasin shown in these Figures and discussed in these Sections is projected to start reversing in the future as groundwater levels in the Corral de Tierra continue to fall. The reversal would result in water starting to flow out of the Laguna Seca Subarea and into the Corral de Tierra subarea. This was the finding of Watermaster modeling performed by HydroMetrics in 2016 in their Technical Memorandum dated January 27, 2016 titled "Groundwater Flow Divides within and East of the Laguna Seca Subarea." That report is contained in Attachment 12 of the Watermaster's 2016 Annual Report which can be viewed and downloaded at this URL: http://www.seasidebasinwatermaster.org/Other/2016%20Final%20Annual%20Report%2012-8-16a.pdf. This should be discussed and addressed in Chapter 6 of the GSP.
6-22	6.4.1.1.2	In the 2nd para of this Section the typo "and" should be corrected to read "an."
6-23	6.4.1.1.3	In the upper bullet of the group of bullets in the center of this page it mentions an inflow from the Seaside Subbasin into the Monterey Subbasin, the majority of which is between the Seaside Subbasin and the Marina-Ord subarea of the Monterey Subbasin. There is a flow divide between that subarea and the Seaside Subbasin which I understood would prevent this. That should be discussed in this Section. This comment also pertains to Table 6-2, Also in this same para the typo "and" should be corrected to read "an."

Page	Section	Comment
6-33	6.4.3.1.2	In this Section there are typos in the 3rd sentence which does not make sense. The statement in this Section regarding a significant amount of pumping data being missing because de minimis pumpers do not have to report pumping data provides support to my comment made on the Comment website and at the August 25th GSP Committee meeting that a legal look should be made into whether/how de minis pumping reporting could be required.
6-41	6.5.2.2	An explanation is warranted regarding the statement in this Section that "No project scenarios were run for the Corral de Tierra area at this time."
6-42	6.5.3	The top para on this page discusses the potential for expansion of the seawater intrusion front in the Monterey Subbasin. This should be considered a significant concern and should be discussed in the Plan Implementation Chapter 10.
6-55	6.5.5	In the 1st sentence of the 2nd para of this Section the word "scenario" should be inserted after the word "project."
6-60	6.6.1	I concur with the discussion on this page that "…simply reducing pumping to within sustainable yield is not proof of sustainability under SGMA, which must be demonstrated by avoiding undesirable results for all 6 sustainability indicators." I also agree with the statement at the bottom of this page that "…confirmation that these quantities could be extracted without inducing seawater intrusion has to be verified." To augment this discussion it would be good to add some language explaining that in order to prevent inducing seawater intrusion, ground water levels near the coast need to be at or above protective elevations. This may necessitate replenishing a basin in order to raise its groundwater levels, not just pumping at the estimated sustainable yield level to stabilize groundwater levels if they would still be below sea level.
6-61	6.6.2	I concur with the discussion on this page that "…simply reducing pumping to within sustainable yield is not proof of sustainability under SGMA, which must be demonstrated by avoiding undesirable results for all 6 sustainability indicators." I also agree with the statement at the bottom of this page that "Further analysis is necessary to refine estimates of where pumping should be reduced to address all sustainability indicators." To augment this discussion it would be good to add some language explaining that in order to enable the adjacent Seaside Subbasin (specifically the Laguna Seca subarea thereof) to achieve sustainability it will be necessary for ground water levels in the Corral de Tierra subarea to be raised, not just stabilized at 2008 levels. This would necessitate replenishing that subarea of the Monterey Subbasin in order to raise its groundwater levels, not just pumping at the estimated sustainable yield level to stabilize groundwater levels.
6-64	6.7	My comment on page 6-33 also pertains to the discussion in the top bulleted para on this page.
6-64	6.7	With regard to the language in the 2nd bulleted para on this page, my understanding is that the Deep Aquifer is not present in the Seaside Subbasin.
6-65	6.7	In the next-to-last bulleted para on this page there is mention of monitoring network expansion in the Corral de Tierra subarea. In previous comments I have asked that the monitoring network be expanded to include some of the near-boundary monitoring wells in the Laguna Seca subarea of the Seaside Subbasin. Including those wells should be mentioned in this para.

Draft Chapter 10 – Comments from Seaside Basin Watermaster 9-6--21

Page	Section	Comment
10-5	10.2	In the 3rd sentence of the top para on page 10-5 the wording "as well" is repeated. In the 3rd para there is discussion of data collection by other agencies. The Seaside Basin Watermaster should also be listed as it collects monitoring well data that will be useful.
10-6	10.2.2	In the 2nd para of this Section there is discussion of data collection by other agencies. MPWMD and the Seaside Basin Watermaster should also be listed as they collect monitoring well data that will be useful.
10-9	10.2.4.5	There is the statement in this Section that "…monitoring wells outside the Monterey Subbasin cannot be included in the Subbasin's monitoring well network…" I believe this is an incorrect statement. I could find no such prohibition anywhere in SGMA. Also in this Section there is discussion regarding monitoring well FO-9 shallow. That language should be edited to read as follows: *Within the Seaside Subbasin, ~~the Watermaster is proposing to replace~~ monitoring well FO-09 Shallow where casing leakage has been identified is likely to be replaced. The monitoring well is located near the coastline just south of the Seaside-Monterey Subbasin boundary. It is used to (a) monitor groundwater levels relative to seawater intrusion protective groundwater elevations and (b) monitor ~~chloride concentrations~~ water quality in groundwater to detect occurrences of seawater intrusion into both Subbasins*
10-10	10.2.5	In the next-to-last bullet on this page the word "the" should be inserted before the word "boundary."
10-11	10.3	In the first para of this Section "the Seaside Basin Watermaster" should be inserted just before the word "other."
10-12	10.5	At the end of the 3rd para in this Section the words "and the Seaside Basin Watermaster's Seaside Basin Model" should be added. In the 4th para in this Section please clarify what is meant by the words "standing up" as it pertains to the Dry Well Notification System.
10-17	Table 10-1	My comment on page 10-9 about including monitoring wells outside of the Monterey Subbasin seems to be addressed in the line-item titled "Voluntary monitoring of non-RMS wells." Please clarify in the text if that is correct.
10-18	Table 10-1	In the line-item titled "Improving Monitoring Networks" the same language that is contained in Table 10-2 on page 10-21 "Add Seaside Subbasin wells to monitoring GWL network" should be added.
10-25	Figure 10-1	Is there a statutory allowance of 2 years for DWR to review GSPs? This seems inordinately long and could cause problems for the GSAs if DWR took that look to provide its feedback.

Farm Bureau
Monterey

1140 Abbott St., Ste. C, Salinas CA 93901
P.O. Box 1449, Salinas CA 93902-1449
831-751-3100 www.montereycfb.com

October 8, 2021

Salinas Valley Basin Groundwater Sustainability Agency
Att: Emily Gardner, Deputy General Manager
P.O. Box 1385
Carmel Valley, CA 93924

VIA: E-Mail

RE: Groundwater Sustainability Plans

Dear Ms. Gardner:

On behalf of the Board of Directors of Monterey County Farm Bureau, we express our appreciation for the dedication and diligence of both the SVBGSA's staff and the consultants of Montgomery & Associates for the progress made on the draft groundwater sustainability plans for all sub-basins, due in January 2022. This has been a tremendous lift of a workload, and the transparency provided at all the sub-basin committee meetings has greatly aided in the drafting of these plan documents.

We are encouraged that the draft sustainability plans, in their present form with minor revisions for clarification to be considered as the comments submitted are processed and reviewed, represent a pathway forward for sustainability. While we are not expressing specific language or policy suggestions in this letter, our Board and Committee members have participated in numerous meetings and expressed their comments during those specific chapter reviews.

As the drafts move forward to the SVBGSA Board of final approval, and then submission the Department of Water Resources in January 2022, it is important to keep in mind that the integration of all the collective plan provisions, practices, and projects does not propel harm on neighboring or adjacent sub-basins of the Salinas Valley during long-term implementation. The plans should all work as a cohesive whole, working towards sustainability for the entire groundwater basin regardless of the individual characteristics or status of any individual sub-basin.

In other words, the entire Salinas Valley basin needs to work together through congruent integration of all sub-basin plans to achieve the full groundwater sustainability objectives. Only through this integrated approach can all water users of the basin achieve the success that the individual plans detail.

Indeed, the collective management practices and proposed projects of all the sub-basin plans are a comprehensive and cohesive program that serves to achieve the sustainability of the entire Salinas Valley Groundwater Basin.

Sincerely,

Norman C. Groot
Executive Director

m|r|wolfe
& associates, p.c.
attorneys-at-law

October 14, 2021

Colby Pereira, Chairperson
Members of the Board of Directors
Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Via email board@svbgsa.org

Subject: Draft Groundwater Sustainability Plans for the Upper Valley Aquifer Subbasin, Forebay Aquifer Subbasin, Eastside Aquifer Subbasin, Langley Aquifer Subbasin, and Monterey Subbasin

Dear Chair Pereira and Members of the Board of Directors:

LandWatch Monterey County offers the following comments on the draft Groundwater Sustainability Plans (GSPs) for the above referenced subbasins.

A. Selection and funding of proposed projects are not coordinated among subbasins, which is contrary to the 180/400 GSP and DWR's findings approving it. And the five new GSP's fail to provide the evidence SGMA requires that their proposed projects are financially feasible.

1. The GSA represented to DWR in the 180/400 GSP that it will identify a suite of Basin-wide projects needed to attain sustainability, which will be funded through the Basin-wide water charges framework based on pumping allowances, and that this system will be set up by June 30, 2023.

The 180/400-Foot Aquifer Subbasin GSP (180/400 GSP) that was approved by DWR identifies 13 projects that purport to "constitute an integrated management program for the entire Valley," 9 of which are identified as "priority projects." (180/400 GSP, p. 9-25.) The 180/400 GSP states that "[s]ome subset of these priority projects will be implemented as part of the six Salinas Valley Groundwater Subbasin GSPs," although some additional projects may be needed in some basins. (*Id.*) The 180/400 GSP found that the "projects and management actions identified in Chapter 9 are sufficient for attaining sustainability in the 180/400-Foot Aquifer Subbasin as well as the other five subbasins in the Salinas Valley Groundwater Basin." (*Id.* at 10-9.)

The 180/400-Foot Aquifer Subbasin GSP (180/400 GSP) provides that a "water charges framework" (WCF) will be implemented basin-wide in order to fund these projects and to deter pumping in excess of groundwater allowances. (180/400 GSP pp. 9-2 to 9-4.) The WCF is to be based on tiered charges for different levels of groundwater pumping. Tier one charges would be based on a "Sustainable Pumping Allowance," and its revenues would cover just the GSA administration. Tier 2 and 3 charges would be assessed for amounts in excess of a "Transitional Pumping Allowance" and, after the Transitional Pumping Allowances are phased out, for amounts in excess of the Sustainable Pumping Allowance. Tier two and three revenues would be used to fund the new water supply projects. The pumping allowances and fee structures were to be separately determined for each subbasin, so they would not be uniform for each subbasin; but each subbasins tiered charges would be included "in the final water charges framework agreement." (*Id.* at 9-4.)

In approving the 180/400 GSP, DWR relied on the feasibility and likelihood of the integrated set of Basin-wide projects funded by a Basin-wide WCF:

> The projects and management actions designed to eliminate overdraft and prevent seawater intrusion are reasonable and commensurate with the level of understanding of the basin setting, as described in the Plan. The water charges framework, at this time, appears feasible and reasonably likely to mitigate overdraft, which is an important management action to help prevent undesirable results and ensure that the 180/400 Foot Aquifer Subbasin is operated within its sustainable yield.

(DWR, Statement of Findings Regarding The Approval Of The 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan, June 3, 2021, p. 2.) DWR found:

> To achieve sustainability, the Plan proposes to assess fees for groundwater extraction and use these funds to implement other projects or management actions, as needed. The proposal to charge fees for extraction is called the water charges framework and involves a three-tiered system where groundwater users will be charged a series of fees based on the volume of annual groundwater extraction. The proposal includes exemptions for some groundwater pumpers, including de minimis users that will not be included in the fee program. The foundation of the water charges framework is a sustainable pumping allowance that each parcel will be allocated based on the calculated sustainable yield. Groundwater users will be allowed to pump more than their sustainable allocation; however, this additional pumping (supplemental pumping) will be subject to higher extraction fees. The proposed water charges framework is also proposed to be instituted in the other five groundwater subbasins overseen by the SVBGSA, representing a Salinas Valley Basin-wide management action.

(*Id.*, p. 5.) DWR concluded that the "fundamental structure of groundwater management in the Subbasin is a management action called the water charges framework." (*Id.* at 31, emphasis added; see also *id.* at 33.) DWR found that "implementation of projects will depend, fully or partially, on revenue generated by the proposed water charges framework." (*Id.* at 13; see also *id.* at 33, 6.)

The 180/400 GSP requires development of the WCF by January 31, 2023 for all six subbasins:

> Details of the water charges framework for all six subbasins will be developed during the first three years of this GSP's implementation through a facilitated, Valley-wide process. This process will be similar to the successful facilitated process that resulted in the SVBGSA serving as the GSA for some or all parts of all six subbasins. The result of this facilitated process will be an agreement on the financing method approved by the SVBGSA. The facilitation will be complete by January 31, 2023, and the financing method will be implemented in all six subbasins immediately following.

(180/400 GSP at 10-4.) The 180/400 GSP also requires refining the list of projects intended to support the integrated management of the entire Basin on the same schedule:

> An additional benefit of refining the projects during the first three years of implementation is that this approach complements the approach for refining the water charges framework, as outlined in Section 10.2. Refinement of the projects and actions will occur simultaneously with refinement of the funding mechanism that supports the projects and actions. By refining all of these plans simultaneously, the funding mechanism and the projects will all be in place by June 30, 2023. Projects and management actions will then be immediately implemented in a coordinated fashion
> across the entire Salinas Valley Groundwater Basin.

(*Id.* at 10-10.)

Since the WCF is based on pumping allowances, these allowances must be determined on the same schedule:

> This GSP proposes a water charges framework that provides incentives to constrain groundwater pumping to the sustainable yield while generating funds for project implementation. The framework creates sustainable pumping allowances, charging a Tier 1 Sustainable Pumping Charge for pro-rata shares of sustainable yield, Tier 2 Transitional Pumping Charge to help users transition to pumping allowances, and higher Tier 3 Supplementary Pumping Charge for using more water. Pumping allowances are not water rights, but would be established to incentivize pumping reductions.

(*Id.* at ES-14.) The Sustainable Pumping Allowance is the "base amount of groundwater pumping assigned to each non-exempt groundwater pumper. The sum of all sustainable pumping allowances and exempt groundwater pumping is the sustainable yield of the Subbasin." (*Id.* at 9-3.) Pumping allowances "are not water rights. Instead, they are pumping amounts that form the basis of a financial fee structure to both implement the regulatory functions of the SVBGSA and fund new water supply projects." (*Id.*)

In short, determining pumping allowances, setting the tiered rates for the WCF, and selecting the basin-wide projects to be financed is supposed to accomplished simultaneously by January 2023 for all six subbasins.

2. **The five draft GSPs are inconsistent with the 180/400 GSP because they do not rely on, assume, or identify a common set of Basin-wide projects and do not include participation in a Basin-wide Water Charges Framework.**

Each of the five GSPs identify a different set of projects than each other and different than the projects identified in the 180/400 GSP. (See Tables 9-1 in each GSP.) There is little overlap among the projects, and there are no projects that are common to all of the GSPs.

Furthermore, both the UVA and Forebay GSPs expressly reject the Water Charges Framework. (Forebay GSP at 10-15 to 10-16; UVA GSP at 10-15 to 10-16.) The Eastside, Monterey, and Langley GSP's do not mention the water charges framework in their discussions of funding options. (Eastside GSP at 10-15; Monterey GSP at 10-23; Langley GSP at 10-15.)

At this point, the "fundamental structure" on which DWR relied to approve the 180/400 GSP has been set aside because the five new draft GSP no longer propose a Basin-wide Water Charges Framework or a common set of Basin-wide projects to attain sustainability.

If the GSA approves the five new GSPs as written, it must fundamentally revise the 180/400 GSP, which no longer appears viable if other subbasins will not fund a common set of projects. The problem that the GSA must address squarely is that pumping reductions, not just capital projects, are needed to attain sustainability in the 180/400-Foot Aquifer Subbasin. For example, instead of investing in a permanent $100 million+ pumping barrier to hold back seawater intrusion, the GSA should consider investing in a finite period of pumping reductions that would be sufficient to restore groundwater levels to protective elevations. A finite period of pumping reductions that restores protective elevations would obviate and may be less expensive than financing and operating a permanent pumping barrier. Once the protective elevations are restored, the 180/400 could resume pumping the full sustainable yield of the subbasin, which is all that SGMA allows. (The pumping barrier would not allow any <u>more</u> pumping than the sustainable yield.) In any event, pumping reductions are at least feasible, and as discussed below, there is no evidence that a pumping barrier is financially feasible.

3. **The UVA and Forebay GSPs do not require, and presumably will not fund, common Basin-wide projects.**

The only project listed by the UVA GSP and Forebay GSP that is common to some of the other GSPs is the Multi-benefit Stream Channel Improvements, which is included in the

Eastside and Monterey GSPs and which contains as one component the Invasive Species Eradication project described by the 180/400 GSP. But the Multi-benefit Stream Channel Improvements projects are expected to benefit primarily the GSP's along the Salinas River, rather than the Langley or Eastside subbasins, and it is not even included in the Langley GSP. Indeed, the GSPs do not estimate any benefits to the Monterey, Eastside, and Langley Subbasins from this project.

Furthermore, neither the UVA GSP nor the Forebay GSP actually purport to require any projects to attain sustainability. (UVA GSP at 9-1 [projects not necessary to maintain sustainability]; Forebay GSP at 9-1 to 9-2 [subbasin sustainable; only management actions to be pursued].) Both GSPs anticipate ongoing maintenance of sustainability through management actions, not projects. They list projects only in case they might be needed in the future.

At this point, no GSP should assume that the Forebay and UVA water users would agree to provide funding for any large Basin-wide capital projects, either through a water charges framework or a Proposition 218 vote. To the extent that the Eastside, Langley, and Monterey GSPs assume funding contributions or project-participation from the Forebay and UVA subbasins, the five draft GSPs are inconsistent on their faces and cannot be approved. The project discussions in the Eastside, Langley, and Monterey GSPs should be revised to make clear that the proposed projects do not rely on funding contributions or project-participation from the Forebay and UVA subbasins.

4. **The Eastside, Langley, and Monterey GSPs do not propose a commons set of Basin-wide projects and do not provide the evidence required by SGMA that any large capital projects that benefit multiple subbasins are financially feasible.**

Contrary to the expectation set up by the 180/400 GSP, there is no common set of Basin-wide projects proposed by the GSPs. Although there are several large capital projects that are listed by more than one of the GSPs, the GSPs fail to provide evidence that these projects are financially feasible. This failure is because the GSPs do not address the critical question of the willingness to pay for the water these projects might deliver.

For agricultural uses, irrigation water is an input to production, so the maximum value of water is constrained by expected returns. There must be some price beyond which agricultural users will not pay for water projects. Is it $500 AF? $750 AF? $1,000 AF? $1,500 AF? And how much water would be demanded at each of these prices? What does the demand curve for agricultural water supply look line in the Valley? The GSP's simply fail to address these critical questions.

Water markets provide some evidence of willingness to pay. Although some farmers have reportedly paid as much as $2,200 per AF for some amounts of water for high value crops (e.g., on a short term basis to protect investments in permanent crops), the average NASDAQ Veles California Water Index water futures price is now only $686 AF, an extraordinarily high price attained only as a result of a long drought period[1] Agricultural water has reached market prices in the $500 to $1000 range only in times of water stress.[2] Salinas Valley farmers may be willing to pay more for water due to their higher productivity than the average California farmer, but obviously there is a limit.

The analysis of fallowing options in the Eastside GSP provides some indirect evidence of willingness to pay; and since it is based on local land prices, it should reflect the range of agricultural productivities in the Salinas Valley. The Eastside GSP concludes that land could be fallowed to make its water available to other users by paying farmers rent and cover crop expenses. (Eastside GSP, p. 9-67.) Based on these land rents and cover crop expenses, farmers would be willing to forego farming for payments that represent water values of from $590 to $1,730 per AF. If agricultural users would find it more profitable not to use water at all when it is worth more than these values to others, it is not reasonable to suppose that they would vote to assess themselves for a capital project that produces water at higher costs per acre foot.

Despite this, the GSPs propose large capital water projects with unit costs well in excess of $1,000 per AF.[3] For example, the Eastside GSP identifies the Chualar and Soledad diversion projects using the 11043 water rights as costing $55 million and $104 million respectively. The 6,000 AFY provided by these diversion projects would cost $1,280 and $2,110 per AF respectively. The projects would benefit Eastside and 180/400 water users, but there is no analysis in either the Eastside GSP or the 180/400 GSP that would support the assumption that agricultural users would be willing to pay that much for water.

Similarly, both the Monterey and Eastside GSP's identify winter reservoir releases with ASR as a potential project, costing $172 million to provide 12,900 AFY at a unit cost of $1,450 per AF. Both the Monterey and Eastside GSPs say that the distribution of benefits would be determined through a benefits assessment. But there is simply no analysis that supports the assumption that there is a willingness to pay $1,450 per AF for agricultural water, much less to do so through a long term commitment in a Proposition 218 vote or through adoption of a Water Charges Framework.

The Eastside and Monterey GSPs both identify a Regional Municipal Supply project that is based on desalinating brackish water pumped from a seawater intrusion barrier. The unit cost for desalinating this water would come to $2,900 per AF, to which must be

---

[1] Aquaoso, California Agricultural Water Prices by Water District, June 17, 2021, available at https://aquaoso.com/blog/california-agricultural-water-prices/.

[2] *Id.*

[3] By contrast, many of the projects that are proposed to benefit only one subbasin are more modest in scale and in price per AF.

added the $1,200 per AF to pump the source water from the seawater intrusion barrier. While municipal users are willing to pay more than agricultural users for water, there is no analysis in the Eastside and Monterey GSPs of how the costs would be allocated between agricultural and urban beneficiaries or whether either group would be willing to pay as much as $4,100 per AF for this water, which they now enjoy for the cost to pump it..

Some proposed large capital projects may make sense financially. The 3,500 acre CSIP expansion, identified in the Langley and Eastside GSPs, and already proposed in the 180/400 GSP, could proceed based on the existing CSIP model if the expanded benefit assessment district is willing to assess itself $630 per AF for this water. Similarly, the direct delivery (as opposed to the aquifer storage and recovery or ASR) of winter release water for MCWD's winter urban demand at $1,100 per AF may make sense given the likely willingness of new urban customers to pay higher rates.

Each of the GSPs should be revised to include a discussion of likely willingness to pay for the proposed capital projects and the likely financial feasibility of proposed projects. The discussion should reflect whether the large capital projects are scalable and whether sufficient numbers of water users would be willing to pay the average cost per AF to actually cover the minimum scale project's entire cost. The willingness of one water user to pay the average cost per AF is not evidence that the entire project can be funded.

Without an analysis of the willingness to pay for large capital projects, especially those projects for which the cost per AF is in excess of $500, the GSP's cannot be approved by DWR. SGMA requires that a GSP include both the estimated cost for each project and "a description of how the Agency plans to meet those costs." (23 CCR § 354.44(b)(8).) DWR must have substantial evidence to support a finding that the projects are "feasible" and that the GSA "has the financial resources necessary to implement the Plan." (23 CCR § 355.4(b)(5),(9).) The GSP's do not provide evidence that funding is actually feasible. Their discussions of project funding merely list the kinds of funding arrangements that are commonly used for large capital projects. (Eastside GSP at 10-15; Monterey GSP at 10-23; Langley GSP at 10-15; UVA GSP at 10-15; Forebay GSP at 10-15.) As noted, the UVA and Forebay GSPs do not propose to provide <u>any</u> project funding because they determine that no projects are actually needed, and they specifically reject participation in the Water Charges Framework. (Forebay GSP at 10-15 to 10-16; UVA GSP at 10-15 to 10-16.) Merely listing the kinds of arrangements that can <u>conceptually</u> be used to fund projects does not explain how the GSA could <u>actually</u> meet their costs, especially where there is substantial uncertainty about willingness to participate in these funding arrangements.

The findings that projects are financially feasible are particularly critical for the Eastside and Monterey Subbasins because they depend on the success of high capital, multi-subbasin projects to address overdraft conditions. (Eastside GSP at 9-103 to 9-104; Monterey GSP at 9-105.)

B. For the Monterey Subbasin GSP, the groundwater level sustainable management criteria and interim milestones fail to support the seawater intrusion criteria.

1. SGMA requires coordination of sustainable management criteria: groundwater level minimum thresholds must support the seawater intrusion minimum threshold.

SGMA requires that each minimum threshold must avoid *each* undesirable result because SGMA requires that "basin conditions at each minimum threshold will avoid undesirable results for *each of* the sustainability indicators." (23 CCR § 354.28(b)(2), emphasis added.) For example, the groundwater level minimum threshold must be "supported by" the "[p]otential effects on *other* sustainability indicators." (23 CCR 354.28(c)(1)(B), emphasis added.) This means that each minimum threshold, especially the groundwater level minimum threshold, must be coordinated to ensure that *all* undesirable results are avoided. Furthermore, a GSP must not "adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of its sustainability goal." (23 CCR § 355.4(b)(7).)

2. The Monterey Subbasin GSP's proposed seawater intrusion SMCs do not permit any additional intrusion.

The Monterey Subbasin GSP sets the MT and MO for seawater intrusion for the lower 180-Foot Aquifer and the 400-Foot Aquifer at the line of advancement as of 2015. (Monterey GSP, p. 8-51.) The Monterey GSP sets the MT and MO for seawater intrusion to the Deep Aquifers at Highway 1, based on the observation that there is limited intrusion in these aquifers. (*Id.*, pp. 8-51 to 8-52.) In effect, the Monterey GSP commits the GSA not to permit any additional seawater intrusion in these aquifers. This is a proper goal in light of the clear impacts to beneficial users.

3. The Monterey Subbasin GSP's groundwater level SMCs and groundwater level interim milestones are set based on their effects on seawater intrusion.

The Monterey GSP acknowledges that the MT and MO for groundwater levels must support attainment of the seawater intrusion MT and MO because it identifies the primary consideration in setting the groundwater level MT and MO as the effect on seawater intrusion:

> As discussed in Section 3.1.6, groundwater use within the Marina-Ord Area is almost exclusively limited to generation of municipal supplies by MCWD. Groundwater elevations are significantly higher than municipal production well screen elevations in all aquifers in the Marina-Ord Area, and there is limited concern regarding the potential dewatering of groundwater production wells. Therefore, *groundwater levels that could cause undesirable results associated with other locally relevant sustainability indicators, such as the lateral or vertical*

> *expansion of the existing seawater intrusion extent and/or eventual migration of saline water into Deep Aquifer wells, have been used to define groundwater level minimum thresholds in the Marina-Ord Area*.

(Monterey GSP, p. 8-16, emphasis added.) The Monterey GSP also provides that

> . . . undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion and other locally relevant sustainability indicators. *These sustainability indicators have been considered when defining groundwater level minimum thresholds in the Marina-Ord Area*.

(Monterey GSP, p. 8-19, emphasis added.)

4. Setting the Monterey Subbasin GSP's groundwater level SMCs at historic 1995-2015 conditions is purportedly justified by the stability of the lateral extent of seawater intrusion in the Monterey Subbasin during that historic period.

The Monterey GSP contends that setting the groundwater level MT and MO for the 180- and 400-Foot Aquifers on the basis of the 1995 to 2015 groundwater levels is justified because the lateral extent of seawater intrusion in the Monterey Subbasin has been "generally stable" in that period:

> As discussed in the preceding sections, the potential effects of undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion. *The observed lateral extent of seawater intrusion within the Subbasin appears to have been generally stable within the 180- and 400-Foot Aquifers between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers*. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient.

(Monterey GSP, p. 8-30.) There are several problems with this contention, discussed below.

5. The "stability" rationale for setting the Monterey Subbasin GSP's groundwater level SMC's based on historic conditions is undercut by the Monterey GSP's projections that historic conditions will not continue: groundwater levels will actually continue to decline and remain below historic conditions and the interim milestones permit such declines.

First, the contention that groundwater level SMCs are justified by historic conditions ignores the GSP's own projection that groundwater levels will continue to decline until at least 2033 and will not attain the MO until 2042. The Monterey GSP documents and projects in its "Example Trajectory for Groundwater Elevation Interim Milestones" that groundwater levels for a Marina-Ord well fell below the MT in 2019, will continue to fall until 2033, will not rise above the MT until 2039, and will not attain the MO until 2042. (Monterey GSP, pp. 8-42, Figure 8-12.) The interim milestones for wells in the 400-Foot Aquifer and the Deep Aquifers assume and permit that groundwater levels will remain below historic levels and the MT for most of the next 20 years:

> Within the Monterey Subbasin, for wells in the 400-Foot Aquifer, Deep, and El Toro Primary Aquifer System Aquifers where groundwater levels have been declining, groundwater elevation interim milestones are defined based on a trajectory informed by current (fourth quarter of 2020) groundwater levels, historical groundwater elevation trends [footnote], and measurable objectives. This trajectory allows for and assumes a continuation of historical groundwater elevation trends during the first 5-year period of GSP implementation, a deviation from that trend over the second 5-year period, and a recovery towards the measurable objectives in the third and fourth (last) 5- year period.

(Monterey GSP, p. 8-41.) The proposed interim milestones for wells in the 180-Foot and Deep Aquifers permit substantial declines in groundwater levels from 2020 conditions in the years 2027 and 2032. (*Id.*, p. 8-43 to 8-44, Table 8-3.) For some wells, the interim milestones would not require that the minimum threshold be met until 2037 or later. In short, the Monterey GSP does not expect that groundwater levels will actually remain within historic levels.

Allowing groundwater levels to fall below historic levels is purportedly justified because "there are large volumes of freshwater in the Subbasin that provide additional time and flexibility to reach identified SMCs while projects and management actions are implemented." (*Id.,* p. 8-41.) However, the draft GSP provides no evidence to suggest that groundwater levels that fall and remain below the historic conditions for at least the next ten years in the Marina-Ord area will not induce further seawater intrusion, resulting in a failure to meet the seawater intrusion SMCs. The evidence is to the contrary: lower groundwater levels increase seawater intrusion.[4] Thus, declining groundwater levels

[4] Geoscience, Protective Elevations to Control Seawater Intrusion in the Salinas Valley, 2013, available at https://www.co.monterey.ca.us/home/showdocument?id=19642.

will make it impossible to meet the seawater intrusion minimum threshold and measurable objective, which require a halt to the advancement of seawater intrusion.

In summary, the historic "stability" rationale cannot be extrapolated to claim that groundwater levels well below the historic record will continue to result in a stable areal extent of seawater intrusion. It makes no sense to contend that setting the MT and MO on the basis of historic conditions will halt seawater intrusion when the GSP would effectively fail to maintain those historic conditions.

The historic stability rationale also ignores the fact that Deep Aquifer groundwater levels began dropping in 2014, have continued to drop, and are projected to continue to drop due to increased levels of extractions. MCWRA reported in 2020 that Deep Aquifer groundwater levels have been falling since 2014, are well below sea-level, and that induced vertical migration of contaminated water to the Deep Aquifers themselves is in fact occurring:

> As is the case with the 180-Foot and 400-Foot Aquifers, groundwater levels in the Deep Aquifers are predominantly below sea level. Beginning around 2014, groundwater levels in the Deep Aquifers began declining and are presently at a deeper elevation than groundwater levels in the overlying 400-Foot Aquifer based on comparisons of multiple well sets at selected locations, meaning that there is a downward hydraulic gradient between the impaired 400-Foot Aquifer and the Deep Aquifers (Figure 16 and Figure 17). This decrease in groundwater levels coincides with a noticeable increase in groundwater extractions from the Deep Aquifers (Figure 16 and Figure 17). The potential for inducing additional leakage from overlying impaired aquifers is a legitimate concern documented by previous studies and is something that would be facilitated by the downward hydraulic gradient that has been observed between the 400-Foot Aquifer and Deep Aquifers.
>
> Seawater intrusion has not been observed in the Deep Aquifers. However, the Agency has documented the case of one well, screened in the Deep Aquifers, that is enabling vertical migration of impaired groundwater into the Deep Aquifers. The Agency is working with the well owner on destruction of this well.[5]

In addition to the threat to contaminate the Deep Aquifers, the induced vertical migration of upper aquifer groundwater to the Deep Aquifers aggravates seawater intrusion in those upper aquifers. A 2003 study for MCWD concluded that increasing pumping of the Deep Aquifers from the 2002 baseline level of 2,400 AFY to just 4,000 AFY would (1) induce

---

[5] Monterey County Water Resources Agency (MCWRA), Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin: 2020 Update, May 2020, p. 31, https://www.co.monterey.ca.us/home/showdocument?id=90578

further seawater intrusion into the upper aquifers (the 180-Foot and 400-Foot Aquifers), which were vertically connected, and (2) risk contamination of the Deep Aquifers themselves.[6] Deep Aquifer pumping is now in excess of 10,000 AFY.[7]

And, in fact, the Monterey GSP admits that falling groundwater levels in the Deep Aquifer threatens to contaminate the Deep Aquifers and to induce seawater intrusion in the upper aquifers:

> Seawater intrusion has not been observed in the Deep Aquifer to date. However, groundwater elevations have been declining and are significantly below sea level. The declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPMWD#FO-10S and MPMWD#FO-11S). Although there is some uncertainty whether the Deep Aquifer is subject to seawater intrusion from the ocean, continued decline of groundwater elevations in the Deep Aquifers could increase the risk of seawater intrusion and may eventually cause vertical migration of saline water from overlying aquifers into the Deep Aquifers. As such, minimum thresholds for the Deep Aquifers are set to historically observed minimum groundwater elevations between 1995 and 2015, which is equivalent to the groundwater elevations observed in 2015 for most Deep Aquifer wells.

(Monterey GSP, p. 8-30.) Again, setting the groundwater level MT and MO to historic levels but then allowing another ten to twenty years to pass before the interim milestones actually require attainment of these historic levels cannot demonstrably ensure that there is no further advancement of seawater intrusion. However, no further advancement is precisely what is required by the seawater intrusion MT and MO.

In sum, interim milestones cannot be set at a level that permits continued declines in groundwater levels if the Monterey GSP is to find that the groundwater levels are consistent with the seawater intrusion SMCs.

---

6 WRIME, Deep Aquifer Investigative Study, May 2003, pp. 4-7, 4-11 to 4-12, pdf available upon request.

7 Monterey County Water Resources Agency (MCWRA), Well Permit Application Activities Update, prepared for May 17, 2021 MCWRA Board of Directors meeting, https://monterey.legistar.com/View.ashx?M=F&ID=9381226&GUID=34ED34CD-3A39-4851-87A3-298BE70D383C

6. The Monterey Subbasin GSP fails to assess the effects on other subbasins of setting groundwater level SMCs based on historic conditions or allowing groundwater levels to decline further through relaxed interim milestones.

As the Monterey GSP acknowledges, the interconnectivity between the 180/400-Foot Aquifer Subbasin and the Monterey Subbasin requires coordination of the sustainable management criteria for both subbasins. (Monterey GSP, p. 8-35.) Coordination is required in order to meet SGMA's requirement that the SMC's for one subbasin do not prevent another subbasin from meeting its sustainability goal. (23 CCR § 355.4(b)(7).)

Setting the groundwater level MT and MO at historic levels and then effectively ignoring these criteria through use of relaxed interim guidelines for ten to twenty years may very well impair attainment of the seawater intrusion criteria for the 180/400-Foot Aquifer GSP, which are also set at a level that permits no further advancement of the seawater intrusion front.

However the Monterey GSP provides no analysis of that possibility. Instead, the Monterey GSP proposes to defer the assessment of the impact of the Monterey Subbasin's groundwater level MTs on the Deep Aquifers in the neighboring 180/400-foot Aquifer Subbasin until after completion of the long-delayed Deep Aquifers Study and the eventual establishment of Deep Aquifer SMCs for the 180/400-foot Aquifer Subbasin.

The Deep Aquifer Study, recommended four years ago, has not commenced.

Furthermore, there is no reason that an assessment of the effects of the Monterey Subbasin's groundwater level MTs should be limited to its effects on the Deep Aquifers in the 180/400-Foot Subbasin. The assessment should also include an assessment of the effects of the Monterey Subbasin's groundwater level MTs on seawater intrusion of each of the principal aquifers in that neighboring subbasin. The Monterey Subbasin GSP argues that pumping in the 180/400-Foot Aquifer Subbasin has caused seawater intrusion in the Monterey Subbasin. In turn, the Monterey Subbasin GSP must assess the reciprocal effects of its own pumping, SMCs, and interim milestones on the 180/400-Foot Aquifer Subbasin.

SGMA's mandate to use the best available science is not an invitation to let the perfect be an enemy of the good pending completion of the Deep Aquifer study. The Monterey GSP must use the whatever science is now available to provide some discussion and assessment of the effect on the neighboring subbasins of allowing continued reductions in Monterey Subbasin groundwater levels below historic conditions through relaxed interim thresholds.

Again, it is not reasonable to extrapolate beyond the historic data to assume that lower-than-historic groundwater levels in the Monterey Subbasin will not impair adjacent basins. The purported stability of the lateral extent of seawater intrusion in the Monterey Subbasin from 1995 to 2015 was certainly not matched in the 180/400-Foot Aquifer

Subbasin, where seawater intrusion rapidly advanced during that period. The Monterey GSP provides no evidence to justify the assumption that allowing lower-than-historic groundwater levels in the Monterey Subbasin will not contribute to the continuing seawater intrusion in the neighboring subbasin.

Finally, the Monterey Subbasin GSP must also evaluate and address the effects of reduced groundwater levels in the Corral de Tierra Subarea on the Seaside Subasin. Again, there is no evidence in the record that merely maintaining historic groundwater levels is sufficient to support groundwater levels in the Seaside Subbasin. To the contrary, comments by the Seaside Basin Watermaster indicate that chronic lowering of groundwater levels in the Laguna Seca Subarea of the Seaside Subbasin can only be corrected by reducing existing pumping in the Corral de Tierra, i.e., increasing groundwater levels above historic levels. (Robert Jacques, PE, email to Sarah Hardgrave, et al., March 22, 2021.) Setting Monterey Subbasin groundwater level SMC's at historic levels violates SGMA because it will prevent attainment of groundwater level objectives in the adjacent Seaside Subbasin.

C. For the Eastside Subbasin GSP, the groundwater level sustainable management criteria and interim milestones also fail to support the seawater intrusion criteria.

As discussed above, SGMA requires that each minimum threshold must avoid *each* undesirable result because SGMA requires that "basin conditions at each minimum threshold will avoid undesirable results for *each of* the sustainability indicators." (23 CCR § 354.28(b)(2), emphasis added.) For example, the groundwater level minimum threshold must be "supported by" the "[p]otential effects on *other* sustainability indicators." (23 CCR 354.28(c)(1)(B), emphasis added.) This means that each minimum threshold, especially the groundwater level minimum threshold, must be coordinated to ensure that *all* undesirable results are avoided.

However, the groundwater level SMCs for the Eastside Subbasin fail to support the seawater intrusion SMC. Although the Eastside Subbasins is not seawater intruded itself, its GSP sets its seawater intrusion minimum threshold to prevent any seawater intrusion over the 500 mg/l threshold in any subbasin, in effect acknowledging that conditions in the Eastside Subbasin can cause seawater intrusion in adjacent subbasins. (Eastside GSP, p. 8-29.) In its discussion of its sustainability indicators for groundwater levels, the Eastside GSP acknowledges that "interference with other sustainability indicators," e.g., the sustainability indicators for seawater intrusion, would be a significant an unreasonable condition. (*Id.*, p. 8-7.) The Eastside GSP states that that the groundwater level minimum threshold is "intended not to exacerbate the rate of seawater intrusion." (*Id.*, p. 8-15.)

Overdraft conditions in the Eastside Subbasin that lower groundwater levels create a gradient causing subsurface flows from the 180/400 Subbasin to the Eastside Subbasin. These subsurface outflows from the 180/400 Subbasin contribute to seawater intrusion by negatively affecting the water budget in the 180/400 Subbbasin. The Eastside GSP acknowledges that the historic groundwater levels in the Eastside Subbasin, including the pumping trough around Salinas, have resulted in net subsurface outflows from the 180/400 Subbasin to the Eastside Subbasin. (*Id.*, p. 6-19.) Figure 6-9 demonstrates that there have been increasing net subsurface outflows from the 180/400 Subbasin to the Eastside Subbain since 1980. (*Id.*) For example, there are substantial net subsurface outflows from the 180/400 Subbasin to the Eastside Subbasin in both 2011 and 2015, and all of the other years after 1980. (*Id.*) Despite this, the Eastside GSP sets the minimum threshold for groundwater levels at the historic 2015 levels and sets the measurable objective at the 2011 level.[8] (*Id.*, pp. 8-7, 8-18.) In short, the Eastside SMC's are set at levels that will continue to induce subsurface outflows from the seawater intruded 180/400 Subbasin.

The Eastside Subbasin GSP fails to analyze the possibility that its minimum thresholds for groundwater levels and storage depletion will contribute to seawater intrusion in the 180/400 Subbasin. Instead, the Eastside GSP simply punts this issue to the future:

> Minimum thresholds for the Eastside Subbasin will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability.

(Eastside GSP, p. 8-16.) It is unclear when this review will occur, especially for the 180/400 Subbasin, for which a GSP has already been adopted. Regardless, deferral of the analysis is not sufficient. SGMA requires that the Eastside GSP squarely address whether it "will adversely affect the ability of an adjacent basin to implement its Plan or impede achievement of its sustainability goal." (23 CCR § 355.4(b)(7).) The GSP must support its conclusions with substantial evidence after applying the best science that is available <u>now</u>. (23 CCR § 354.44(c).) It is clear that the groundwater level and storage depletion sustainability indicators for the Eastside Subbasin will continue to contribute to seawater intrusion in the 180/400 GSP by inducing subsurface flows out of the 180/400 Subbasin. Since the 180/400 Subbasin minimum threshold for seawater intrusion requires halting <u>any</u> further seawater intrusion, any further inducement of seawater intrusion will prevent the attainment of sustainability by the 180/400 Subbasin.

The Eastside GSP must be revised to provide minimum thresholds and measureable objectives for groundwater levels that will not prevent attainment of sustainability by the 180/400 Subbasin, and it must provide an analysis based on the best available science to explain why.

---

[8] The Eastside GSP also sets the minimum threshold for storage reduction using the groundwater level minimum threshold as a proxy indicator. (Eastside GSP, p. 8-23.)

D. Water quality sustainable management criteria should not be limited to effects caused by "direct GSA action." The GSPs must also regulate extractions that cause undesirable results, and do so through a specific and enforceable management action.

The five new GSPs purport to limit significant and unreasonable conditions related to groundwater quality degradation to just those "[l]ocally defined significant and unreasonable changes in groundwater quality resulting from *direct GSA action*." (Monterey GSP, p. 8-56, italics added; see also, e.g., Eastside GSP, p. 8-34.) Thus, the GSPs claim that the GSA need only address water quality degradation that is a "direct result of projects or management actions conducted pursuant to GSP implementation:"

> For the Subbasin, any groundwater quality degradation that leads to an exceedance of MCLs or SMCLs in potable water supply wells or a reduction in crop production in agricultural wells <u>that is a direct result of GSP implementation</u> is unacceptable. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities they do not constitute an undesirable result. Therefore, the degradation of groundwater quality undesirable result is:
>
> > *Any exceedances of minimum thresholds during any one year <u>as a direct result of projects or management actions conducted pursuant to GSP implementation</u> is considered as an undesirable result.*

(Monterey GSP, p. 8-56, underlining added.)

This language does not define what constitutes a "direct result" of GSP implementation or "direct GSA action." However, elsewhere, the GSP's give three examples of conditions that may lead to an undesirable result and that the GSA is presumably prepared to address:

> • Required Changes to Subbasin Pumping. If the location and rates of groundwater pumping change *as a result of projects implemented under the GSP*, these changes could alter hydraulic gradients and associated flow directions, and cause movement of constituents of concern towards a supply well at concentrations that exceed relevant standards.
>
> • Groundwater Recharge. *Active recharge of imported water or captured runoff* could modify groundwater gradients and move constituents of concern towards a supply well in concentrations that exceed relevant limits.
>
> • Recharge of Poor-Quality Water. *Recharging the Subbasin* with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result.

(Monterey GSP, p. 8-58; see also Eastside GSP, p. 8-42 [same].) Significantly, none of these three conditions that might trigger GSA action include excessive pumping or changes in pumping by other parties that may cause water quality degradation; each condition includes only the secondary effects of the GSA's own projects. But the GSA's failure to take management action to regulate other parties, e.g., its failure to restrict excessive extractions or changes in pumping by other parties, may also cause water quality degradation. For example, the Community Water Center (CWC) has documented that for the San Jerardo Cooperative, Inc., increasing levels of nitrate and arsenic correspond to lower groundwater levels.[9] CWC has documented that "contaminants like arsenic, uranium, and chromium (including hexavalent chromium) are more likely to be released under certain geochemical conditions influenced by pumping rates, geological materials, and water level fluctuations."[10] It is clear that pumping levels and pumping changes can mobilize, concentrate, or move existing contaminants so as to cause water quality degradation. The GSA has a duty under SGMA to prevent this.

The Monterey GSP contends that because other agencies have authority over groundwater quality, the GSA's role is somehow limited:

> The powers granted to GSAs to effect sustainable groundwater management under SGMA generally revolve around managing the quantity, location, and timing of groundwater pumping. SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the SWRCB Division of Drinking Water and Monterey County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities.
>
> Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur.

(Monterey GSP, pp. 8-60 to 8-61; see also Eastside GSP, p. 8-35.) The fact that the County *and* the RWQCB also have authority and responsibility to address water quality degradation demonstrates that the statutory scheme does not rely on the regulatory

---

[9] Community Water Center, letter to SVGBGSA, April 23, 2021, re Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins, p. 1.

[10] *Id.*, pp. 1-2, citing Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/156 0371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

actions of any single agency. Nothing in SGMA's mandate that the GSP address water quality degradation permits the GSA to ignore water quality degradation that results from third party pumping or to ignore such third party degradation unless the GSA has affirmatively regulated pumping. The GSP must address the effects of its regulatory acts or omissions, including omissions that move, mobilize, or concentrate pollutants by permitting excessive extractions or changes in extractions by groundwater pumpers.

Indeed, DWR has made it clear in its imposition of corrective actions on the 180/400-Foot Aquifer Subbasin GSP that "groundwater management *and extraction*" mustg be addressed because it may result in degraded water quality:

> RECOMMENDED CORRECTIVE ACTION 5 Coordinate with the appropriate groundwater users, including drinking water, environmental, and irrigation users as identified in the Plan, and water quality regulatory agencies and programs in the Subbasin to understand and develop a process for determining if groundwater management *and extraction* is resulting in degraded water quality in the Subbasin.[11]

Accordingly, the GSP cannot limit its concern to the effects of its own projects without taking responsibility for the effects of unregulated, excessive, or changed extractions on water quality degradation.

For example, if there is evidence that arsenic contaminations are mobilized or concentrations increased by new or excessive extractions, then the GSP must manage extractions to avoid undesirable results from mobilized, moved, or concentrated arsenic. The GSP cannot simply state that there "is no clear correlation that can be established between groundwater levels and groundwater quality at this time" as if that disposes of the matter for the GSP planning horizon. (Monterey GSP, p. 8-58.) The GSA must adopt an effective program to investigate, apply the best available science, and manage the resource to prevent undesirable contaminant concentrations caused by excessive or changed extractions, whether those are due to changes the GSA requires in subbaasin pumping or due to the failure of the GSA to regulate existing pumping in the first instance.

In sum, the GSPs fail to propose a coordinated system of meaningful sustainable management criteria and a management action to address water quality degradation. The minimum threshold and measureable objectives should be based on zero exceedances of water quality standards, as in the Eastside GSP so that each and every instance of water quality degradation can be determined and action can be prompted. (Eastside GSP, pp. 8-34, 8-41.) The GSP's should provide for a more robust monitoring program and a self-reporting program so that any exceedance will actually be determined. It is not sufficient to monitor only a small sampling of domestic wells.

---

[11] Department of Water Resources, GSP Assessment Staff Report Salinas Valley – 180/400 Foot Aquifer (Basin No. 3-004.01), June 3, 2021, p. 37, emphasis added available at https://sgma.water.ca.gov/portal/gsp/assessments/29.

Most importantly, the proposed "Water Quality Partnership" implementation action needs to be revised so that it is an effective, enforceable commitment to action by the agency with the most direct oversight of the cause of any exceedance. (See, e.g., Eastside GSP, pp. 9-100 to 9-101.) The proposed Water Quality Partnership contains only the flowing proposals for action:

> SVBGSA will coordinate with the appropriate water quality regulatory programs and agencies in the Subbasin to understand and develop a process for determining when groundwater management and extraction are resulting in degraded water quality in the Subbasin. . . . Under this implementation action, SVBGSA will play a convening role by developing and coordinating a water quality partnership (Partnership). . . . The Partnership will review water quality data, identify data gaps, and coordinate agency communication. The Partnership will include the Regional Water Quality Control Board, local agencies and organizations, water providers, domestic well owners, technical experts, and other stakeholders. The Partnership will convene at least annually. The goal of the Partnership will include documenting agency actions to address water quality concerns. An annual update to the SVBGSA Board of Directors will be provided regarding Partnership efforts and convenings.

(Eastside GSP, p. 9-101.) In effect, the Water Quality Partnership calls for holding an annual meeting and writing a report. This is not a sufficient basis to find that the GSA has met its statutory obligation to adopt a plan that will actually address water quality degradation.

At minimum, a management action that addresses water quality degradation should include the following specific steps, which should be negotiated and memorialized in an MOU with the CCRWQCB and the Monterey County Department of Environmental Health:

- The agencies should arrange to monitor a sufficiently representative sampling of domestic wells to reliably determine any instance of a domestic well's failure to meet water quality standards.
- The agencies should accept and verify self-reporting of instances of failures to meet water quality standards.
- For each instance of failure to meet water quality standards, the agencies should ascertain whether the cause includes (1) discharge of pollutants, as determined by the CCRWQCB or the County DEH, and/or (2) pumping activity that has concentrated, mobilized, or moved pollutants, as determined by SVBGSA or the County DEH.
- Where the cause includes pumping activity, the SVBGSA should take action to abate the pumping that is causing the failure to meet water quality standards.

Absent such a program, the GSPs do not meet the statutory obligation to adopt a plan that will actually address water quality degradation.

Yours sincerely,

M. R. WOLFE & ASSOCIATES, P.C.

John Farrow

JHF:hs

Cc: Donna Meyers, meyersd@svbgsa.org
Emily Gardner, gardnere@svbgsa.org
Gary Petersen, peterseng@svbgsa.org
Les Girard, GirardLJ@co.monterey.ca.us

October 15, 2021

Via Electronic Mail

Colby Pereira, Chairperson
Members of the Board of Directors
Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Email: board@svbgsa.org

Subject: Comments on Draft Groundwater Sustainability Plans for the Upper Valley Aquifer, Forebay Aquifer Subbasin, Eastside Aquifer Subbasin, Langley Aquifer Subbasin, and Monterey Subbasin

Dear Chair Pereira and Members of the Board of Directors:

Thank you for the opportunity to submit comments. The following comments are offered on behalf of the members of California Coastkeeper Alliance and Monterey Waterkeeper.

Our comments are offered for all subbasin groundwater sustainability plans, including for the Upper Valley Aquifer, Forebay Aquifer Subbasin, Eastside Aquifer Subbasin, Langley Aquifer Subbasin, and Monterey Subbasin (collectively "GSPs"). Given the interdependence of the planning for all subbasins, comments are relevant to all the GSPs and the approach of the Salinas Valley Basin Groundwater Sustainability Agency ("SVBGSA") as applied to every subbasin. There is urgency to begin implementing meaningful projects and management actions which are protective of all beneficial uses of water, and we voice our agreement with the comments Community Water Center and LandWatch Monterey County have provided on plans developed by the SVBGSA and incorporate them here by reference.[1]

1. **Overview of Requirements for Groundwater Sustainability Plans Under the Sustainable Groundwater Management Act.**

The Sustainable Groundwater Management Act ("SGMA") requires the SVBGSA to include findings in the GSPs demonstrating the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and

[1] All comments on the GSPs and the 180/400 Foot Subbasin Plan through October 15, 2021, including comments to the Department of Water Resources.

implementation horizon.[2] Projects and management actions must be sufficient to support a determination that the GSPs will achieve the sustainability goal,[3] including descriptions of "circumstances under which projects or management actions shall be implemented, the criteria that would trigger implementation . . . and the process by which the Agency shall determine that conditions requiring the implementation of particular projects or management actions have occurred."[4] Time-tables for initiation and completion must be included,[5] along with an explanation of how the project or management action will be accomplished. Sustainability Plans must identify and *cause* the implementation of projects and management actions.[6] Providing concrete triggers and timetables for implementation is a critical and required component for demonstrating the GSPs are likely to meet the sustainability goal.

The GSPs are also required to support decisions with the best available science,[7] while Sustainable Management Criteria ("SMCs") and projects and management actions must be commensurate with the level of understanding of the basin setting.[8]

2. The Disparity Between the Basin-Wide Integrated Management Approach of the 180/400 Aquifer Subbasin GSP, and The Remaining GSPs Must Be Resolved.

The GSPs do not satisfy the SVBGSA's duty under SGMA because of conflicts between the approaches across the numerous GSPs and the 180/400 Foot Aquifer Plan. Plans for adjacent basins must not adversely affect the ability of one another to maintain their sustainability goals over the planning and implementation horizon.[9] We voice our agreement with comments LandWatch Monterey County has provided to the SVBGSA outlining concerns with consistency across the SVBGSA's GSPs, namely that inconsistency undermines the likelihood that any of the SVBGSA's subbasin plans will achieve their sustainability goals.

The groundwater sustainability plan for the 180/400 Ft Aquifer that was approved by the Department of Water Resources ("DWR") identifies 13 projects that "constitute an integrated management program for the entire Valley."[10] However, this basin-wide integrated management program has not been carried forward into the GSPs being drafted now. The GSPs each identify different sets of projects, which are also different from the projects identified in the 180/400 GSP. There is little overlap among the projects, and there are no projects that are common to all of the GSPs. Perhaps the most problematic example relates to the water charges framework. DWR relied on the feasibility and likelihood of the integrated set of basin-wide projects funded by the basin-wide water charges framework:

[2] 23 CCR § 354.24 (requiring discussion of measures that will be implemented to ensure likely achievement of sustainability goal).
[3] 23 CCR § 354.44(a).
[4] 23 CCR §§ 354.44(b)(1)(A).
[5] 23 CCR §354.44(b)(4).
[6] 10721(u) (emphasis added).
[7] *See* Cal. Water Code § 113; 23 CCR § 355.4.
[8] 23 CCR § 350.4.
[9] 23 CCR §350.4(f),
[10] 180/400 Aquifer plan, p. 9-25.

> The water charges framework, at this time, appears feasible and reasonably likely to mitigate overdraft, which is an important management action to help prevent undesirable results and ensure that the 180/400 Foot Aquifer Subbasin is operated within its sustainable yield.[11]

DWR considers the water charges framework to be the "fundamental structure of groundwater management" for the 180/400 Foot Subbasin.[12] The framework was intended to be implemented across all the SVBGSA basins.[13] However, the Upper Valley and Forebay Plans reject the Water Charges Framework,[14] meanwhile the Eastside, Monterey, and Langley plans do not mention the water charges framework in their discussions of funding options.[15]

The disparity between the basin-wide integrated management approach of the 180/400 Aquifer Subbasin GSP and the lack of integrated approach of the remaining GSPs must be resolved. After undertaking the process of developing and approving plans, a GSP must be implemented.[16] The conflict between the GSPs and the 180/400 Foot Aquifer Plan undermines the likelihood the approved 180/400 Foot Subbasin Plan will achieve its sustainability goal.

3. **Timelines for Implementation of Plans Must Be Concrete and Conservative to Ensure the Sustainability Goal Is Fulfilled.**

The GSPs do not satisfy the SVBGSA's duty to demonstrate a likelihood of achieving the sustainability goal by describing how projects and management actions are sufficiently concrete to be relied upon. The GSPs also fail to adequately address evidence of changing water supplies.

As a result of the passage of time, the SVBGSA forecloses its options to manage the basin sustainably. The SVBGSA is responsible for managing the basin sustainably, including being responsible for its choices *not* to initiate projects in a timely manner. Said differently, the choice to allow the status quo to persist is a management decision, the consequences of which the SVBGSA is responsible for under SGMA.

The urgency to begin implementation and commit to a *viable* strategy cannot be overstated. An increasing body of climate change research shows that drought will continue to intensify. For example, NOAA summarized the updated consensus on drought last month:

> The warm temperatures that have helped make this drought so intense and widespread will continue (and increase) until stringent climate mitigation is pursued and regional warming trends are reversed. As such, continued greenhouse gas warming of the U.S.

---

[11] DWR, Statement of Findings, 180/400 Foot Aquifer Subbasin, p. 2.
[12] DWR, GSP Assessment Staff Report, 180/400 Foot Aquifer Subbasin (June 3, 2021), p. 31.
[13] DWR, GSP Assessment Staff Report, 180/400 Foot Aquifer Subbasin (June 3, 2021), p. 5 ("Groundwater users will be allowed to pump more than their sustainable allocation; however, this additional pumping (supplemental pumping) will be subject to higher extraction fees. The proposed water charges framework is also proposed to be instituted in the other five groundwater subbasins overseen by the SVBGSA, representing a Salinas Valley Basin-wide management action")
[14] Forebay GSP at 10-15 to 10-16; UVA GSP at 10-15 to 10-16.
[15] Eastside GSP at 10-15; Monterey GSP at 10-23; Langley GSP at 10-15.
[16] Cal. Water Code § 10727(a)

> Southwest will make even randomly-occurring seasons of average- to below-average precipitation a potential drought trigger, and intensify droughts beyond what would be expected from rainfall or snowpack deficits alone.[17]

We concur with Community Water Center's objections to the GSPs relying on the "Central Tendency" scenario in DWR's guidance.[18] Besides the fact that expectations of future drought scenarios have changed since DWR's guidance was published in 2018, the guidance itself encourages groundwater sustainability agencies to analyze the more extreme Dry-Extreme Warming and Wet-Moderate Warming scenarios. There is no reasonable basis for not following DWR guidance and analyzing these scenarios, and choosing not to consider these scenarios constitutes a failure to consider the best available science and information as required by SGMA.

Conservative estimates and plans for water budgeting will protect front line communities from the immediate impacts of groundwater overdraft. The GSPs are expressly required to consider these impacts by SGMA[19] and to ensure consistency with California's Human Right to Water Law[20] which holds up each person's right to have safe, clean, affordable, and accessible water. Overestimating the sustainable yield will undermine the likelihood of maintaining the sustainability goal through the planning and implementation horizon as required under SGMA.[21] Unfortunately, underrepresented communities and ecological and recreational beneficial uses will be the most impacted by the GSPs' failures in the short and long-term.

The SVBGSA's reliance on projects and management actions (such as large infrastructure projects) with uncertain viability due to issues including lack of funding and unpredictable political and permitting regimes that are outside its control does satisfy its legal duties. The SVBGSA must provide concrete triggers and timelines for projects within its control, including pumping restrictions, to demonstrate a likelihood of avoiding undesirable results and meeting the sustainability goal as required under SGMA. Indeed, the State Water Resources Control Board has emphasized to the SVBGSA the importance of establishing specific and reasonable timelines with respect to projects that may be reliant on water rights, including pumping restrictions.[22] Failure to avoid undesirable results, including sea water intrusion impacts, will be devastating, and will create irreversible and expensive impacts for the entire region to deal with once they occur. Management actions that will have an immediate, quantifiable impact, including limiting new wells and taking the necessary steps to initiate pumping restrictions must be included in the GSPs because they provide certainty and therefore are reasonably likely to help meet sustainability goals for the region as SGMA requires.

---

[17] NOAA Drought Task Force Report on the 2020–2021 Southwestern U.S. Drought, September 21, 2021. Available at https://www.drought.gov/documents/noaa-drought-task-force-report-2020-2021-southwestern-us-drought

[18] Community Water Center Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins, April 23, 2021, p. 11-14

[19] Cal. Water Code §10723.2.

[20] Cal. Water Code § 106.3.

[21] *See* 23 Cal Code of Reg ("CCR") § 354.24.

[22] State Water Resources Board letter to Craig Altare, Supervising Geologist, SGMA Office, Department of Water Resources, 180/400 Foot Aquifer Groundwater Sustainability Plan (December 8, 2020).

4. The Sustainable Management Criteria and Management Actions for Depletion of Interconnected Surface Waters are Deficient and Violate SGMA and Public Trust and Reasonable Use Doctrines.

Ecological and recreational surface water beneficial uses are not adequately protected under the GSPs.

A. Legal Background and SVBGSA's Duties Related to Depletion of Interconnected Surface Waters.

Plans are required to define sustainable groundwater management by first characterizing undesirable results.[23] Undesirable result number six is defined as "depletions of interconnected surface water that have significant and unreasonable adverse on beneficial uses of the surface water."[24] Plans must include sustainable management criteria ("SMCs") for undesirable results along with sufficiently concrete timelines and commitments for projects and management actions to demonstrate the sustainability goal is likely to be achieved and maintained throughout the planning and implementation horizon.[25] The GSPs' decisions must be supported by the best available science,[26] and SMCs and projects and management actions must be commensurate with the level of understanding of the basin setting.[27]

California's Reasonable Use Doctrine requires the SVBGSA to protect water resources and balance competing beneficial uses consistent with public interest. This doctrine is enshrined in SGMA.[28] Article X, section 2 requires "water resources of the State be put to beneficial use to the fullest extent of which they are capable, and the water or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare." The Reasonable Use Doctrine is the principle governing all uses of water resources in California.[29] Section 100 of the Water Code further mandates "that the conservation of such water is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare."[30]

The SVBGSA also has an affirmative duty to take the public trust into account in the planning and allocation of water resources, and to protect public trust uses whenever feasible.[31] The SVBGSA must consider public trust resources as they relate to groundwater pumping impacts to surface water beneficial uses.

To summarize, the GSPs must first establish criteria, set out measures in sufficient detail to ensure sustainability according to the criteria, and then implement the plan. The SVBGSA

---

[23] *See* 23 CCR 354.22; Cal. Water Code § 10721(u).
[24] *See* Cal. Water Code § 10721(x)(6).
[25] *See* 23 CFR 354.22 et seq.
[26] *See* Cal. Water Code § 100; 23 CCR § 355.4.
[27] 23 CCR § 350.4.
[28] Cal. Water Code § 10720.1.
[29] *Joslin v. Mann Municipal Water Dist.,* (1967) 67 Cal.2d. 132, 137-38.
[30] Cal. Water Code § 100.
[31] *National Audubon Society v. Superior Court* (1983) 33 Cal.3d. 419, 446 (1983).

must be guided by the Public Trust and Reasonable Use doctrines, especially given the significant interaction between surface water and groundwater in the Salinas Valley. These doctrines are guideposts for developing the SMCs.[32] The GSPs must undertake an analysis of the impacts to public trust resources and ensure the reasonable use of water. Any consideration of reasonableness must include analysis of the costs to public trust resources and the reasonableness of the loss of fish populations, for example. Ecological beneficial uses of the Salinas River are essential to meeting the success and viability of the South Central Southern California Steelhead.[33]

B. The Sustainable Management Criteria for Depletion of Interconnected Surface Waters Fail to Adequately Consider Impacts to Ecological Beneficial Uses Including Habitat for Steelhead Trout.

Prevention of Undesirable Result Number Six requires the SVBGSA to develop SMCs considering all impacts beneficial uses of surface water including Steelhead habitat. The overarching legal doctrine of reasonable use and public trust provide boundaries governing beneficial uses of surface water, and inform the analysis of what constitute "significant and unreasonable adverse impacts" on beneficial uses of the surface water as a result of these depletions under SGMA.

Groundwater pumping will impact surface waters and have an adverse impact on fish and wildlife. Yet the GSPs fail to provide any analysis of the impacts to public trust resources, the first step in the process to satisfy the public trust doctrine.[34] The SVBGSA has not acknowledged, let alone provided any analysis of the damage to Steelhead Trout habitat that will be caused under the proposed SMCs. This failure also violates the Reasonable Use Doctrine.

I. Reliance on the 2007 Biological Opinion Does Not Fulfill the SVBGSA's duties under SGMA, the Public Trust Doctrine, or the Reasonable Use Doctrine.

The SVBGSA has been repeatedly alerted to the damage being caused under the Biological Opinion and Incidental Take Statement for the Salinas Valley Water Project ("2007 Biological Opinion"),[35] and it should not be used to develop SMCs for the preventing of undesirable results related to the depletion of interconnected surface water. The GSPs fail to consider the impacts on Steelhead populations in particular. Steelhead are of particular importance because of their protected status, and their value as an indicator species for the health and sustainability of Salinas River management. Stakeholders, The National Marine Fisheries Service ("NMFS") in particular, have pressed the SVBGSA for changes due to concerns about

[32] Belin, A., Guide to Compliance With California's Sustainable Groundwater Management Act: How to avoid the "undesirable result" of "significant and unreasonable adverse impacts on beneficial uses of surface waters" (2018) (available at https://stacks.stanford.edu/file/druid:kx058kk6484/Woods%20Groundwater%20Mgmt%20Act%20Report%20v06%20WEB.pdf).

[33] *See* NMFS Comment on UVA (May 7, 2021) Appendix A (Role of Salinas River in Meeting NMFS' South-Central California Coast Steelhead Viability/Recovery Criteria.**)**

[34] *National Audubon Society v. Superior Court* (1983) 33 Cal.3d. 419, 426.

[35] June 21, 2007.

the failure of the SMCs to undertake a meaningful analysis of impacts to ecological beneficial uses, including for Steelhead Trout habitat. The status quo management strategy under the withdrawn 2007 Biological Opinion does not adequately support ecological beneficial uses and constitutes an unauthorized take of steelhead trout under federal law.[36] This amounts to a violation of both the Reasonable Use Doctrine and Public Trust Doctrine. The GSPs, including projects and management actions that depend on the establishment of valid SMCs, must be revised accordingly.

The GSA has not interrogated the question of how recreational and ecological uses, including flows for Steelhead, are impacted under recent activities managing groundwater. NMFS has commented extensively throughout proceedings on the 180/400 and the proceedings on the remaining GSPs, explaining that the current regime does not protect ecological beneficial uses. Importantly, NMFS has explained that implementation of the withdrawn 2007 Biological Opinion should not be relied on by the GSA as evidence that the current regime supports ecological beneficial uses.

The 2007 Biological Opinion was withdrawn because it did not adequately protect Steelhead and was not protective of public trust resources. For example, the Biological Opinion assumed precipitation would follow historical wet and dry year patterns,[37] and the Salinas Valley Water Project would operate as planned. Neither assumption has proved correct, however. California has experienced severe, multi-year droughts that began after NMFS issued the Biological Opinion in 2007. The Flow Prescription only contemplated water releases from the Nacimiento and San Antonio Reservoirs for steelhead flows in the Salinas River when combined water storage is above 150,000 acre-feet for smolt outmigration or 220,000 acre-feet for adult upstream migration and juvenile passage to the lagoon. The Flow Prescription does allow for 2 cfs of flow to the lagoon during dry years where flows for migration are not triggered. Due to the droughts, reservoir storage capacity has not exceeded the migration-flow trigger levels, relieving Monterey County Water Resources Agency from any obligation to provide conservation releases. Due to declining reservoir storage and low rainfall, fish passage has been impossible, effectively precluding steelhead reproduction. As a result, steelhead trout receive essentially no conservation flow benefit from the Biological Opinion that was crafted with the object of protecting the species.

Since the Biological Opinion was withdrawn, federal and state agencies have made clear that the flow regime it proposed was inadequate and must be updated.[38] The SVBGSA has not explained how it can rely on a withdrawn Biological Opinion and comply with SGMA's mandate to use the best available science and information. The SVBGSA maintains that it can wait for a revised flow regime in a yet-to-be developed Habitat Conservation Plan. Meanwhile The

---

[36] "Unauthorized take" is defined as "to harass, harm pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532(19).
[37] *See, e.g.*, 2007 Biological Opinion, p. 12-13.
[38] *See* South-Central California Coast Steelhead Recovery Plan, National Marine Fisheries Service, West Coast Region, California Coastal Area Office, Long Beach, California (2013) (explaining the failures).

California Department of Fish and Game advise conservatism in such situations, where impacts of groundwater-surface water dynamics are either unknown or in the process of being analyzed.[39]

The Biological Opinion does not support ecological beneficial uses, and the SVBGSA has not explained how reliance on it to establish SMCs will protect ecological beneficial uses, protect public trust resources, and reasonably balance beneficial uses of water. NMFS has commented that the using the proposed SMCs are "likely a take," explaining:

> Given that 2015 pumping levels, and the corresponding impact of surface water depletion on beneficial uses, were likely some of the highest on record due to California's historic drought, preventing those impacts from worsening in the future is hardly a "benefit" to ecological users of surface water, and akin to ensuring a dry river channel doesn't get any drier.[40]

The fact that implementation of the proposed SMCs will cause a take to occurr, in and of itself, constitutes a "red light" scenario under Undesirable Result Number Six, and requires remedial steps by the SVBGSA.[41] The SVBGSA has responded to NMFS concerns, not by changing the substance of the GSPs to better protect ecological uses with meaningful action, but merely by explaining the intent to wait for a new Habitat Conservation Plan to establish a new flow regime that will be protective. This strategy does not analyze, much less incorporate the best information or science as required under SGMA. Neither has the SVBGSA provided any discussion or support for how waiting for a new Habitat Conservation Plan, a process completely outside the control of the SVBGSA, satisfies its duties to safeguard public trust resources and ensure the reasonable use of water.

The fact that the current flow regime is inadequate to support ecological beneficial uses has consequences for the GSPs' water budgets as well. The GSPs must consider the best available information and science in establishing the water budget.[42] The GSPs use of the withdrawn Biological Opinion does not satisfy the SVBGSA's duty to use the best available information and science for the purpose of water budgeting.

II. The Use of Groundwater Levels as a Proxy for Interconnected Surface Water Sustainable Management Criteria is Not Adequately Supported.

Under SGMA, the use of groundwater levels as a proxy in the depletion of interconnected surface water SMCs requires that a "significant correlation exists between groundwater elevations" and undesirable surface water depletion impacts they are designed to measure.[43] However, the GSPs do not establish a significant correlation, ignoring significant and

---

[39] Fish & Wildlife Groundwater Planning Considerations. California Department of Fish and Wildlife, Groundwater Program. California Department of Fish and Wildlife (2019) p. 14 (available at https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=170185&inline)

[40] NMFS Comment to Upper Valley Aquifer GSA, May 7, 2021.

[41] Belin, A., Guide to Compliance With California's Sustainable Groundwater Management Act: How to avoid the "undesirable result" of "significant and unreasonable adverse impacts on beneficial uses of surface waters" (2018).

[42] 23 CCR § 354.18(e).

[43] 23 CCR § 354.36(b).

unreasonable impacts to Steelhead, and by proxy, to the ecological health of the Salinas Basin, that are accruing under the current and projected future levels of groundwater pumping. These local circumstances, including the most relevant and current facts and impacts on recreational and ecological resources must be analyzed to establish any significant correlation. Simply citing to a 2018 Environmental Defense Fund guidance, as the SVBGSA has done, is not adequate to establish the proxy relationship. In fact, that guidance makes clear that local conditions and circumstances must be analyzed, and does not suggest that groundwater levels should be used as a proxy without such analyses.[44]

The SMCs must be reevaluated in light of the body of evidence that ecological and recreational beneficial uses are not adequately being protected. SGMA requires this information be included in the analysis of significant and unreasonable adverse impacts on beneficial uses of surface water. Despite the requirements of the Public Trust and Reasonable Use doctrines, the GSPs fail to use reasonable means available under its authority to analyze, much less limit unreasonable impacts to surface water beneficial uses and public trust resources. The SVBGSA must, as a starting point, acknowledge what those impacts are. Then the SVBGSA must determine the implications for sustainable groundwater management in the Salinas Valley.

C. Projects and Management Actions for Preventing Undesirable Result Number Six Are Not Supported by the Best Available Science.

Projects and management actions to address depletion of interconnected surface waters must consider the best available science.[45] The GSA must support its conclusions with substantial evidence after applying the best science that is available now. As explained above, the proposed SMCs, which are supposedly designed to protect against undesirable result number six, depletion of interconnected surface waters, rely on outdated findings from the 2007 Biological Opinion that has been retracted, and ignore more recent data and information. The GSP ignores ample evidence that has been submitted to the SVBGSA demonstrating the need for increased flows to support ecological beneficial uses. Relying on the Biological Opinion's flow regime while ignoring the reasons it was withdrawn and supplemental information violates SGMA regulations requiring the best available science and information support decisions in plans.

D. The GSPs Do Not Include Reasonable Steps to Develop Protective Sustainable Management Criteria, Projects, and Management Actions.

As with other SMCs, SGMA's mandate that the GSPs address depletion of interconnected surface waters requires that management actions the GSPs proposes are reasonable and supported by the best available science. In addition, the Public Trust places an affirmative duty on the SVBGSA to consider public trust resources and protect them "whenever

[44] *See* Hall, M., Babbitt, C., Environmental Defense Fund, Addressing Regional Surface Water Depletions in California, A proposed approach for compliance with SGMA (2018) p. 7 (available at https://www.edf.org/sites/default/files/documents/edf_california_sgma_surface_water.pdf).
[45] 23 CCR § 354.44(c).

feasible,"[46] and the Reasonable Use Doctrine requires that GSPs provide for "the greatest number of beneficial uses which the supply can yield."[47]

The SVBGSA's plan to "continue to coordinate with NMFS on the effect of pumping on interconnected surface water and steelhead trout" falls well short of these standards. The GSPs must set forth concrete steps that will be taken to establish legally sufficient SMCs, including impacts to Public Trust resources. SGMA requires corresponding projects and management actions, sufficient to support the determination by the SVBGSA that the sustainability goal will be met, be included in the GSP, and then implemented. The SVBGSA must separately demonstrate that it has fulfilled its duties under the Reasonable Use and Public Trust doctrines. Indeed, an attempt to avoid or minimize the harm to public trust uses is the second step required by the Public Trust Doctrine.[48]

5. Sustainable Management Criteria and Management Actions Related to Water Quality Violate SGMA.

The GSPs must analyze how groundwater conditions impact and degrade water quality. While the SVBGSA may not be the only agency with some responsibility over groundwater quality, the fact that other agencies including the County and the Regional Water Quality Board have authority and responsibility to address water quality degradation does not relieve the SVBGSA from its duty to ensure groundwater conditions in the basin do not create undesirable results. DWR rejected the SVBGSA's narrow interpretation of its responsibility to protect against water degradation.[49] The fact that multiple other agencies share responsibility demonstrates that the statutory scheme does not intend to rely on the regulatory actions of any single agency.

SGMA requires the GSPs to address degradation of water quality that accrues after January 1, 2015.[50] SGMA states that a plan "may, but is not required to, address undesirable results that occurred before, and have not been corrected by, January 1, 2015." Thus, the GSPs must address all worsening water quality that results from groundwater use, including instances where water quality may have already violated maximum contaminant levels in 2015.

Nothing in SGMA's mandate that the GSPs address water quality degradation permits the SVBGSA to ignore water quality degradation that results from third party pumping. The GSPs must address the effects of its regulatory acts, and its failures to act.[51]

The State Water Resources Board identified the importance of the SVBGSA sorting out its responsibilities vis-à-vis other agencies in 2020:

---

[46] *National Audubon Society v. Superior Court* (1983) 33 Cal.3d. 419, 446.
[47] *Peabody v. City of Vallejo*, 2 Cal. 3d 351, 368 (1935).
[48] *National Audubon Society v. Superior Court* (1983) 33 Cal.3d. 419, 426.
[49] DWR GSP Assessment Staff Report, Salinas Valley – 180/400 Foot Aquifer (June 3, 2021) p. 27.
[50] Cal. Water Code §§10727.2(b)(4); 10721(x)(4).
[51] *See, e.g.,* Cal. Water Code § 10721(u) (explaining that the plans must achieve the sustainability goal by identifying and causing the implementation of projects and management actions).

> The GSP states that only water quality impacts caused by GSP implementation are unacceptable but does not explain how SGMA-related water quality changes will be distinguished from other water quality changes. The GSP should outline the process the GSAs would use to decide whether or not an exceedance of an MT for water quality degradation was caused by GSP implementation; otherwise, it is difficult to judge how adequately the GSP addresses undesirable results related to water quality degradation. Staff recommends that the GSAs consult with the Central Coast Water Board in developing this process.[52]

Not only does the SVBGSA have responsibility to consider water quality impacts, but the GSPs must also put in place concrete plans for determining which agency will take responsibility under which circumstances, to ensure that water quality issues are dealt with. The State Water Board and DWR have identified the importance of consulting with the Central Coast Water Board to ensure responsibilities are understood and water quality is adequately protected.[53]

The proposed "Water Quality Partnership" project and/or management action in the GSPs[54] does not satisfy SGMA's requirement that he SVBGSA provide findings determining the project and management actions will achieve the sustainability goal,[55] nor do the GSPs include required descriptions of circumstances under which the partnership will be implemented, criteria triggering implementation,[56] time-tables for initiation and completion,[57] or an explanation of how the project or management action will be accomplished. The GSPs must identify and *cause* the implementation of the Water Quality Partnership actions.[58] Providing these details is a critical and required component for demonstrating the GSPs are likely to meet the sustainability goal, as the SVBGSA is required to do.

The Water Quality Partnership needs to be revised to be an effective, enforceable commitment to action by the agencies with the most direct oversight of the cause of any exceedance. At minimum, a management action that addresses water quality degradation should include the following specific details, which should be negotiated and memorialized in a memorandum of understanding ("MOU") to include the SVBGSA, the Regional Water Quality Board, and the Monterey County Department of Environmental Health:

- The agencies must monitor a sufficiently representative sampling of domestic wells to reliably determine any instance of a domestic well's failure to meet water quality standards;

- An approach to reach agreement between the agencies, for each instance of failure to meet the measurable threshold for water quality, about whether the cause includes (1)

---

[52] State Water Resources Board letter to Craig Altare, Supervising Geologist, SGMA Office, Department of Water Resources, 180/400 Foot Aquifer Groundwater Sustainability Plan, Groundwater Subbasin No. 3-004.01(December 8, 2020), p. 3.
[53] *Id*; DWR GSP Assessment Staff Report, Salinas Valley – 180/400 Foot Aquifer (June 3, 2021), p. 27.
[54] *See, e.g.*, Eastside Aquifer Plan, pp. 9-100 - 9-101.
[55] 23 CCR § 354.44(a).
[56] 23 CCR § 354.44(b)(1)(A).
[57] 23 CCR §354.44(b)(4).
[58] Cal. Water Code § 10721(u) (emphasis added).

discharge of pollutants and/or (2) pumping activity that has concentrated, mobilized, or moved pollutants. Each instance, there must be public oversight and clear system of accountability for the agency/agencies that are assigned responsibility;

- Where the cause includes pumping activity, the SVBGSA should take action to abate the pumping that is causing the failure to meet water quality standards;
- Adequate funding for all aspects of the project, including financial support for outreach to underrepresented communities;
- Unless and until the Water Quality Partnership approach results in an improvement in the water quality for the impacted well immediately after reporting, the minimum threshold should be set at 75% of the relevant maximum contaminant level to adequately protect public health.

In addition, the MOU for the Water Quality Partnership should be finalized in a timely manner. Further, the agencies should report out to the public on those meetings regularly and the GSPs should establish a concrete timeline for when the respective requirements of the MOU will be complete, and consequences if the timelines are not met.

Lastly, we voice our agreement with the voluminous comments Community Water Center has provided to the SVBGSA on water quality impacts for disadvantaged communities in particular. We implore the SVBGSA to give attention to the robust and detailed contribution of Community Water Center staff on the GSPs.

6. The SVBGSA Should Take Meaningful Steps to Improve Representation of Underrepresented Communities

The SVBGSA must take meaningful steps to remedy the disparity of representation with the SVBGSA and its board, as required by SGMA[59] and to ensure consistency with California's Human Right to Water Law.[60]

The GSPs' discussion of Underrepresented Communities acknowledges that they "have little or no representation in water management and have often been disproportionately less represented in public policy decision making."[61] However, the SVBGSA makes no meaningful commitment to remedy this issue. The GSPs should identify funding for these projects, and provide specifics as to exactly how these plans will be executed. The GSPs should explain what metrics they will use to evaluate and demonstrate the increased "representation" for underrepresented communities. The GSPs should attach specific timelines to these metrics, and also describe binding consequences that will be triggered if the SVBGSA fails to meet its goals.

In addition, to increase the representation of underrepresented communities, we implore the SVBGSA to incorporate the suggestions and direction of organizations such as Community Water Center, an organization that has dedicated significant resources to the ongoing creation of

---

[59] Cal. Water Code § 10723.2 (expressly requiring SVBGSA to consider interests of all beneficial users).
[60] Cal. Water Code § 106.3.
[61] *E.g.,* Upper Valley Aquifer Subbasin plan, p. 10-8.

SVBGSA GSPs and which has an express mission to represent underrepresented communities on the Central Coast.

Lastly, there is a systemic flaw that underlies the SVBGSA creation of its plans and will surely plague the implementation until it is resolved: the structural over-representation of agricultural interests in decision making for the SVBGSA. In addition to strong agricultural interests intrinsic to seats appointed by municipalities and the County of Monterey, four seats of the eleven-seat board are allocated to "agricultural interests." A super majority of three of those four agricultural votes are required for the most consequential decisions including to impose certain fees and impose pumping limits. To increase "representation" of underrepresented communities who often bear the burdens of unsustainable groundwater use, the SVBGSA should increase the representation of non-agricultural beneficial users, especially underrepresented communities, on the SVBGSA board to allow interests of these other beneficial users to meaningfully participate in decision making. Funding should be set aside for seats designated for underrepresented communities to ensure the seats are accessible for those with limited resources.

Thank you for your consideration, and we look forward to ongoing work with the SVBGSA to ensure our shared groundwater resources are managed sustainably.

Sincerely,

Tyler Sullivan, Staff Attorney
Drevet Hunt, Legal Director
California Coastkeeper Alliance

Sean Bothwell, Board Member
Monterey Waterkeeper

Copy via email to:
Donna Meyers, General Manager, meyersd@svbgsa.org
Emily Gardner, Deputy General Manager, gardnere@svbgsa.org

COMMUNITY WATER CENTER
EL CENTRO COMUNITARIO POR EL AGUA

San Jerardo Cooperative, Inc.

October 15, 2021

Salinas Valley Basin Groundwater Sustainability Agency
Submitted electronically to:
Emily Gardner, Deputy General Manager
Donna Meyers, General Manager

Subject: Comments on the Draft Salinas Valley Subbasin GSPs for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins

Dear Salinas Valley Basin Groundwater Sustainability Agency:

The Community Water Center (CWC) and the San Jerardo Cooperative offer comments and recommendations in response to the draft Groundwater Sustainability Plans (GSPs) for the Langley, East Side, Forebay, and Upper Valley Subbasins as released in the Fall of 2021 by the Salinas Valley Basin Groundwater Sustainability Agency (SVB GSA). Previously, we submitted comments on April 23, 2021 regarding Chapters 1-8, on April 28, 2021 on a preliminary draft of Chapter 9, and on June 17, 2021 regarding Chapters 2, 9, and 10.

Because the Subbasin GSP drafts are now to be reviewed and voted upon by the SVB GSA Board, we take this opportunity to synthesize many of our comments into one document and provide relevant updates based on SVB GSA Staff responses and our answers in turn. Responses included here from SVB GSA, unless otherwise cited, were published in the Comment Letter Comment Tables responding to public comments made mid-2021 when drafts were prepared for the Subbasin Committees.[1] Additionally, unless otherwise noted, GSP Section numbers refer to the Eastside Subbasin GSP and the comments apply to all SVB GSA subbasins. As always, these comments are intended to add to the public record and are submitted in addition to previous written and spoken comments.

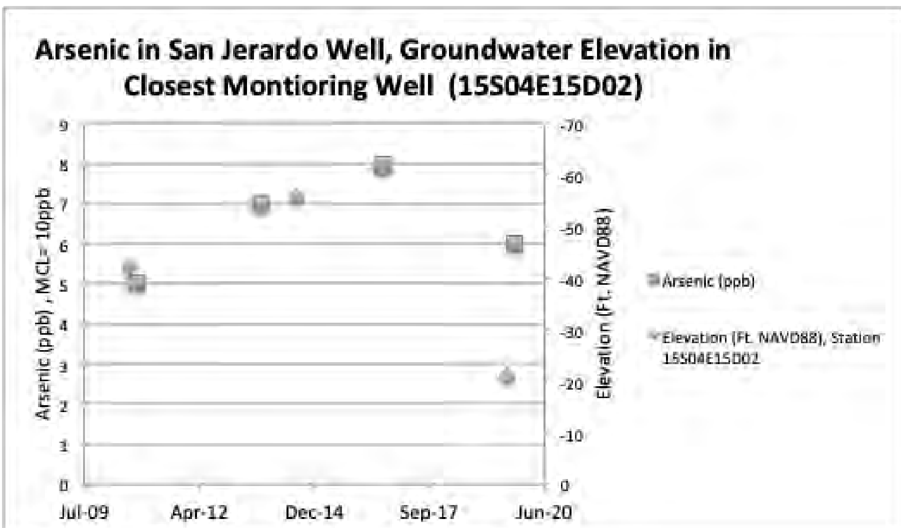
We reiterate the following context for this comment letter and the San Jerardo Cooperative's participation in particular. The challenges facing San Jerardo and similar communities throughout all the Subbasins in the Salinas Valley are the foundation of our comments in this letter. The San Jerardo Cooperative's well is highly vulnerable to changes in groundwater levels and groundwater quality. Over decades of living and working at San Jerardo Cooperative, Advisory Committee Member Horacio Amezquita has observed firsthand how the irrigation practices on properties surrounding the cooperative impact the water quality in their current and former wells. The San Jerardo Cooperative receives drinking water from a small public water system (CA2701904) and is very concerned that

---

[1] SVB GSA. (2021). *Subbasin GSP Comment Letter Comment Tables*. On file with SVB GSA and available at: svbgsa.org. *See e.g.*, https://svbgsa.org/wp-content/uploads/2021/08/Eastside-Comment-Letters-Responses-081021.pdf.

pumping, irrigation practices, and groundwater management in the East Side Subbasin will cause their drinking water well, which currently meets all drinking water standards, to exceed the maximum contaminant levels for arsenic and/or nitrate. Unfortunately, data from the State Water Board indicates increasing levels of nitrate and arsenic in their well with a high arsenic level of 8 ppb on 8/22/2016 that also corresponds to a low groundwater elevation of -61.5 in Station 15S04E15D02, the closest monitoring well to the San Jerardo Cooperative's well (See CWC Figures 1 and 2).[2] While there are too few monitoring data points to draw significant conclusions, CWC Figure 1 does suggest that arsenic levels are higher when groundwater levels are lower. Scientific studies confirm that contaminants like arsenic, uranium, and chromium (including hexavalent chromium) are more likely to be released under certain geochemical conditions influenced by pumping rates, geological materials, and water level fluctuations.[3]

CWC Figure 1: Arsenic in San Jerardo Well, Groundwater Elevation in Closest Monitoring Well
(Note: The groundwater elevation y-axis is reversed to illustrate that lower groundwater elevations are associated with higher arsenic levels.)

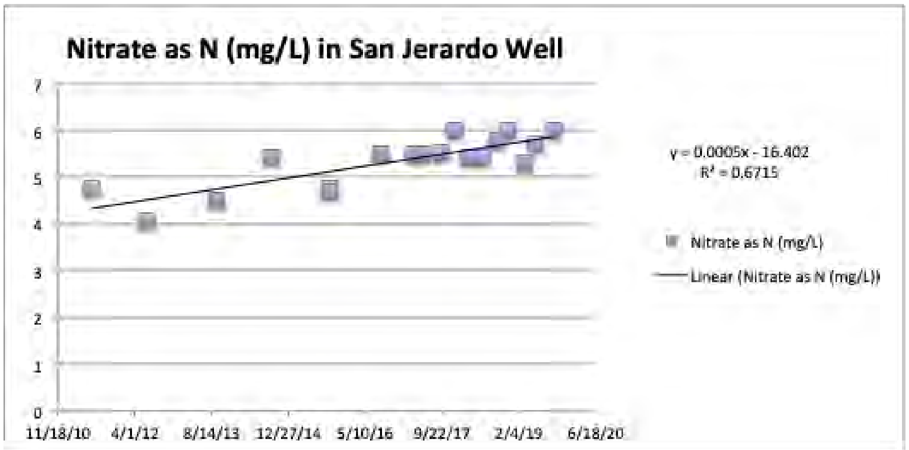


---

[2] CWC Figure 1 contains all available arsenic data from the State Water Board's Drinking Water Watch online database (https://sdwis.waterboards.ca.gov/PDWW/) which was collected in October 2010, 9/11/13, 8/22/16, and 9/23/19. We then added the monitoring data for Station 15S04E15D02 for the dates most close to the arsenic sampling dates (August 2010, August 2014, August 2016, and August 2019). CWC Figure 2 data was also downloaded from the same online database.

[3] Community Water Center and Stanford University (2019). *Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium*. Available at: https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

CWC Figure 2: Nitrate in San Jerardo Well.



We provide more specific chapter-by-chapter comments below. We emphasize that the GSP must be revised throughout to further incorporate the best available science[4] showing that groundwater pumping and groundwater level changes can influence water quality, and the GSA has obligations to prevent the significant and unreasonable exacerbation of degraded water quality. We also note that a management decision to *not* regulate pumping and to therefore permit current pumping rates is still a management decision. This recommendation is supported by DWR's 180/400 ft Aquifer GSP Determination on June 3, 2021:

> "**[S]taff find that the approach to focus only on water quality impacts associated with GSP implementation, i.e., GSP-related projects, is inappropriately narrow.** Department staff recognize that GSAs are not responsible for improving existing degraded water quality conditions. **GSAs are required; however, to manage future groundwater extraction to ensure that groundwater use subject to its jurisdiction does not significantly and unreasonably exacerbate existing degraded water quality conditions.**
> Where natural and other human factors are contributing to water quality degradation, the GSAs may have to confront complex technical and scientific issues regarding the causal role of groundwater extraction and other groundwater management activities, as opposed to other factors, in any continued degradation; but **the analysis should be on whether groundwater extraction is causing the**

---

[4] 23 CCR § 355.4(b)(1). "When evaluating whether a Plan is likely to achieve the sustainability goal for the basin, the Department shall consider the following:
(1) Whether the assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are reasonable and supported by the best available information and best available science."

> **degradation in contrast to only looking at whether a specific project or management activity results in water quality degradation**.
> Department staff recommend that the SVBGSA coordinate with the appropriate water quality regulatory programs and agencies in the Subbasin to understand and **develop a process for determining when groundwater management and extraction is resulting in degraded water quality in the Subbasin** (see Recommended Corrective Action 5)."[5]

We strongly recommend that the GSPs incorporate a more robust and representative monitoring network and minimum thresholds to protect vulnerable communities like San Jerardo and those dependent on shallow domestic drinking water wells. This network should include state and local small water systems. In tandem, we recommend the incorporation of a Well Impact Mitigation Program, as discussed below.

Thank you for reviewing this letter and for the consideration of our comments on the draft GSP chapters. We look forward to working with the SVB GSA to ensure that the GSPs are protective of the drinking water sources of vulnerable, and often underrepresented, groundwater stakeholders. Please do not hesitate to contact us with any questions or concerns. We also look forward to meeting with you in the future to further discuss issues raised in these and past comments.

Sincerely,

Heather Lukacs
Community Water Center

Horacio Amezquita
General Manager, San Jerardo Cooperative, Inc.

Justine Massey
Community Water Center

Mayra Hernandez
Community Water Center

---

[5] Department of Water Resources. (2021). *Statement of Findings Regarding the Approval of the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan.* Pp. 26-27. (Internal citations omitted; emphasis and paragraph breaks added). Available for download at: https://sgma.water.ca.gov/portal/gsp/status.

GSP Chapter 2: Communications and Public Engagement

SGMA requires GSAs to consider all beneficial users in groundwater management decisions and specifically names domestic well users and disadvantaged communities (DACs) as beneficial users.[6] SGMA also requires GSAs to "encourage the active involvement of diverse social, cultural, and economic elements of the population within the groundwater basin *prior to and during the development and implementation of the groundwater sustainability plan.*"[7] The regulations similarly require that a GSP summarize and identify, "opportunities for public engagement and a discussion of how public input and response will be used."[8] The GSA thus must engage, "diverse social, cultural, and economic elements of the population within the basin."[9] SGMA Regulations recognize that failure to engage adequately with a diverse cross-section of the public undermines the likelihood that a GSP will avoid undesirable results and meet its sustainability goal.[10]

Community Water Center appreciates the statement found in Chapter 2 of the Langley, Eastside, Forebay, and Upper Valley subbasins: "[T]he success of the... Subbasin GSP will be determined by the collective action of every groundwater user."[11] Public engagement invites citizens to get involved in deliberation and to take action on public issues that are important to them. More importantly, it helps leaders and decision-makers have a better understanding of the perspectives, opinions, and concerns of citizens and stakeholders, especially those who are traditionally underrepresented. DWR's Guidance for Stakeholder Communication and Engagement acknowledges that public engagement, when done well, goes far beyond the usual participants to include those members of the community whose voices have traditionally been left out of political and policy debates.[12] Additionally, as part of a Strategic Planning Review, SVB GSA has recently recognized an overrepresentation of agricultural interests in its GSP formation process and voiced interest in balancing its representation, however has not yet taken action to do so. In this light, we offer the following recommendations:

- **Fast-track stakeholder outreach efforts in order to meaningfully engage beneficial users throughout the basin in the GSP development process currently underway.**
  - Based on our review of the language in Chapter 2 of the Subbasin GSPs, it appears that the outreach and engagement strategies outlined in Section 2.7, which are specific to the underrepresented communities and disadvantaged communities in the Basin, are to be put in place only after the GSP is submitted in 2022.

---

[6] Cal. Water Code § 10723.2.

[7] Water Code § 10727.8. (Emphasis added).

[8] 23 CCR § 354.10(d)(2).

[9] DWR (2018). *Guidance Document for Groundwater Sustainability Plan: Stakeholder Communication and Engagement.* P. 1. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf.

[10] 23 CCR §355.4(b)(4).

[11] SVB GSA (2021). *Subbasin GSPs Draft - Chapter 2: Goals for Communication and Public Engagement.* P. 10 (in all drafts). Available at: https://svbgsa.org/subbasins/.

[12] DWR (2018). *Guidance Document for Groundwater Sustainability Plan: Stakeholder Communication and Engagement.* Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Assistance-and-Engagement/Files/Guidance-Doc-for-GSP---Stakeholder-Communication-and-Engagement.pdf.

    - This delay results in little to no participation or input from these communities during the GSP development process currently underway.
- Update: While SVB GSA held workshops with DAC representatives to develop a plan for outreach to DACs, **the resulting plan to solicit DAC input regarding the core management decisions in the GSP—including the setting of SMCs and the representative monitoring network—was *not* implemented during GSP development.** Consulting DAC stakeholders solely in regards to outreach strategies is not sufficient engagement. It is likely that due to SVB GSA's lack of implementation of their outreach strategy plan[13] many DAC voices and opinions have been left out of this current GSP because DAC residents have not been made aware of this process. Even if they are aware of the GSP process, many still lack the information and tools they need to participate. It is critical to have DAC stakeholders engaged in the development of the GSP as well as on a continuing basis.
    - Section 2.4 asserts that SVB GSA "deployed… [an] inclusive outreach and education process conducted that best supports the success of a well- prepared GSP that meets SGMA requirements." However, acknowledging that initial steps were taken, the GSA has not provided evidence of carrying out this outreach and fulfilling SGMA requirements.
- **Specify which outreach strategies will be used to reach underrepresented communities and disadvantaged communities.** The proposed goals for communication and engagement actions and strategies in this chapter lack important details to ensure that all beneficial users, especially underrepresented communities and disadvantaged communities, will have access to the resources that are being proposed. It must be noted that underrepresented communities and disadvantaged communities may not have access to the internet, therefore they may not have access to the online resources on either the SVB GSA website or through social media. Additionally, in the case that they do have access to the internet, they may lack knowledge or familiarity regarding how to access the online resources.
- **Provide a strategy for how to reach stakeholders with limited or no SGMA knowledge.** In Subbasin GSPs' Section 2.6.3, SVB GSA acknowledges that there is a "variety of audiences targeted within the Basin whose SGMA knowledge varies from high to little or none." However, no strategy is provided for how those with no knowledge will be reached. This chapter should be modified to include more details on how and what additional strategies will be implemented to ensure that SVB GSA is reaching all beneficial users. We recommend the following approaches:
    - **Include more grassroots-based approaches to request and incorporate DAC and drinking water user feedback in the GSP, which are critical to actually reaching stakeholders and fulfilling the GSA's goal.** One of the goals of the Communications and Public Engagement (CPE) Actions which we strongly support is to "invite input from the public at every step in the decision-making process and provide transparency in outcomes and recommendations." However, based on the communication/ outreach strategies mentioned in the chapter, efforts fall short of inclusivity. The general public

[13] As outlined in February 2021 SVB GSA Staff Report, Available at: https://legistarweb-production.s3.amazonaws.com/uploads/attachment/pdf/820418/Item_5a_-_Staff_Report.pdf.

does not always have access to certain resources like the internet, and even if they do have access they may not know how to use social media, use email, or browse the web.

- **Document and continue the policy of providing translation services at public meetings and of providing bilingual (English and Spanish) information and materials on the website, via email, and paper mail.** The Dymally-Alatorre Bilingual Services Act requires that public agencies serving over 10% of non-English speaking constituents provide appropriate translation services.[14] At a minimum, translated information should be provided during Plan updates and prior to critical decisions. In particular, the submitted GSP released during the formal comment period should include bilingual materials highlighting key summaries of the GSP. Critical decision points also include the adoption of groundwater fees, the approval of new groundwater projects or management actions, and decisions around pumping restrictions.
- **Consider inserting short notices in water bills and/or community newsletters on a monthly basis (notices should include key messages, visuals and information that is relevant to the average water user).** These notices must be translated as described above.
- **Specify how and when the accessible and culturally responsive GSA materials mentioned in Section 2.7 will be developed to communicate impacts of groundwater management on local water conditions and how they will be delivered or made available to URCs and DACs that do not have internet access.** Accessibility includes appropriate visual content and translation.
- **Consider using USPS every door direct mail (EDDM) to send out educational materials and updates to all stakeholders.** This tool can be used to map ZIP Code(s) and neighborhoods, it also has a filter feature that lets you filter by age, income, or household size using U.S. Census data. This tool can be helpful to reach stakeholders that do not have internet access.
- **Clearly identify and utilize existing community venues (on a monthly basis if possible) for community meetings, workshops, and events to provide information**. For example, the GSA could hold educational workshops during water board and school district board meetings, or after church services. Venues should be carefully selected in order to meet the needs of the targeted audience.
- **Clearly identify radio channels, social media avenues, websites, and other media outlets readily accessible to the community**. The submitted GSP should be revised with a policy requiring a broader outreach effort in the near future, with bilingual outlets.
- **Specify a timeline to work with key community leaders or trusted messengers on at least a monthly basis to distribute information and encourage community participation.** Venues for such leaders to share information could include churches, civic groups, clubs, non-profit organizations, and schools.
- **Consider hosting Spanish-only outreach meetings, as they can be more effective in transferring knowledge and receiving feedback.** It can be a challenge to provide

[14] California Government Code §7290.

real-time translation of technical groundwater terms and concepts in a way that is understandable and promotes participation, so it may be appropriate to conduct a meeting entirely in Spanish so that participants can be fully immersed in the discussion.

- **Consider hiring a bilingual Stakeholder and Outreach Communication specialist as part of the SVB GSA staff.** Expanding the GSA's reach to different audiences and maintaining a robust stakeholder list of interested individuals, groups and/or organizations is a good step to ensure that the general public is informed about the GSA's activities. However, it will require substantial time and effort to develop a clear outreach methodology, obtain a representative list of stakeholders (including those who do not engage online), ensure language accessibility, and make sure stakeholders stay informed and engaged. A bilingual Stakeholder and Outreach Communication specialist could support this work.

- **We recognize and appreciate the inclusion of Appendix 2D Disadvantaged Communities in this draft of the subbasin GSPs. We recommend the following corrections / improvements to better represent DACs and their drinking water sources:**
    - **Clarify the number of domestic water systems that Monterey County Department of Environmental Health regulates under its Local Primacy Agency Authority as well as the local small water systems regulated under County Code.** See page 61 of the Eastside Volume 1 Appendices which states "There are approximately 160 such systems in the County regulated under this program."[15] This number is likely referring to the total number of public water systems serving less than 200 connections regulated by Monterey County but does not include state and local small water systems. From Monterey County's webpage on Small Water Systems "The Drinking Water Protection Services regulates Local and State Small Water Systems, which serve 2-14 connections. Many residents and visitors receive their water from these systems. Drinking Water Protection Services currently administers 969 systems, which serve about 4232 connections."[16]
    - Update the maps of **all disadvantaged communities (DACs) currently in Appendix 2D in the following ways:**
        - To reflect more recent census data from 2019 or later (the current map shows data from 2016). Continue to share the DAC/SDAC status of all census block groups, census designated places, and census tracts.
        - Include DAC or SDAC communities according to household income surveys conducted in accordance with state and federal agency guidelines to determine eligibility for state funding programs.
        - More clearly show the location of DACs, their drinking water sources, and their water quality in the subbasin including private wells. Figure 2 in Appendix 2D

---

[15] https://svbgsa.org/wp-content/uploads/2021/08/Eastside-Volume-1-Appendices.pdf

[16] https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local

should combine data from GAMA and Monterey County to show the levels of COCs, including but not limited to nitrate, in recent years in drinking water sources in DAC areas. This would also provide data for Figure 2 in the Monterey County Subbasin which currently does not show any water quality data, because the Monterey Subbasin was not part of the geographic scope of the CCGS (2015) information included in the appendix.

- Update Figure 2 to show the entire Salinas Valley and not only the subbasins in the north. The Upper Valley Subbasin Volume 1 Appendices, for example, includes Figure 2 that does not show the Upper Valley subbasin.[17]

GSP Chapter 3: Description of Plan Area

The description of the plan area can be improved by clarifying the descriptions of the drinking water users in the area. In order to develop a GSP that addresses the needs of all beneficial users, it is critical that the location and groundwater needs of Disadvantaged Communities (DACs) and all drinking water users including domestic well communities are explicitly addressed early on in the GSP. In addition to comments previously submitted to the GSA on July 10, 2020, we recommend the following updates to this chapter:

- **Clarify the number and type of public water systems in the subbasins throughout the entire plan.** In each subbasin plan, there are discrepancies between types and numbers of public water systems in different chapters. It is absolutely critical to clearly include the number of public supply wells *currently in use* in the GSPs. For example, the East Side GSP lists the following:
    - Table 3-2 Well Count Summary shows “Public Supply= **24 wells**”
    - Table 5-3 GAMA Water Quality Summary shows "Number of Existing Wells in Monitoring Network Sampled for COC to be **78** for 123-TCP, **89** for Nitrate, and **70** for TDS.
    - Section 7.5 says "**Ninety** DDW wells have been chosen to be part of the RMS network. These wells are shown on Figure 7-4 and listed in Appendix 7D.” This table includes all DDW wells that were sampled for COCs between December 1982 to December 2019, yet it is unclear whether all these wells are still active, and after consulting Appendix 7D, it is unclear whether these wells are all public water system wells, as defined in Section 7.5, or whether wells of other types are also included.
    - Table 8-4 Groundwater Quality Minimum Thresholds - **No well count shown**.

  We recognize that different data sources have different limitations and recommend using the best available data consistently throughout the plan.

- Add a clear reference to a **table of all public water systems, their names, locations, number of connections, and number of active wells** in the text that is consistent with the numbers of wells in Table 3-2, Table 5-3, Section 7.5, and other locations where mentioned in the GSPs.

[17] See page 58 of Upper Valley Subbasin Volume 1 Appendices: https://svbgsa.org/wp-content/uploads/2021/08/Upper-Valley-Volume-1-Appendices-1.pdf)

    - Appendix 7-D: DDW and ILRP Wells in the Water Quality Monitoring Network should be updated to include the number of connections served by that well and the status of the well as active or inactive according to DDW.
- **Revise Section 3.6.2 on the Agricultural Order to indicate that Agricultural Order 4.0 includes monitoring requirements including on-farm domestic well monitoring of nitrate and 123-trichloropropane (123-TCP).** 123-TCP should also be included in the monitoring network (see comments in Chapter 7).

GSP Chapter 4: Hydrogeologic Conceptual Model

The hydrogeologic conceptual model is a key component of the basin setting. The basin setting represents the baseline assumptions that the GSA relies on throughout the GSP when choosing minimum thresholds, measurable objectives, and undesirable results, as well as when planning projects and management actions. We recommend that the GSA:

- **Revise Section 4.6 on Water Quality to acknowledge that "natural groundwater quality in the Subbasin" can be influenced by pumping and the way groundwater is managed.**[18] As indicated in our cover letter, this is of particular importance for the San Jerardo Cooperative who has experienced increases in nitrate and arsenic in their well.
    - SVB GSA response (Section 5.4.3): "Text about the effect of groundwater pumping on groundwater quality was added to Chapter 5 in the "Distribution and Concentrations of Diffuse or Natural Groundwater Constituents" section. A discussion on the effect of lowering groundwater elevation on groundwater quality is included in Chapter 8 in the "Relationship between Individual Minimum Thresholds and Relationship to Other Sustainability Indicators" section for groundwater elevations under the degraded water quality bullet."
    - Our response: We appreciate the addition of a paragraph in Section 5.4.3 and recommend that this is also acknowledged in Section 4.6 since the topic of "natural groundwater quality" is being discussed. Furthermore, the release of arsenic into groundwater can be attributed to low dissolved oxygen levels, high rates of pumping, and an increase in pH. These changes can all be attributed to how groundwater is managed.

GSP Chapter 5: Groundwater Conditions

SGMA Regulations require: "Each Plan shall provide a description of current and historical groundwater conditions in the basin, including data from January 1, 2015, to current conditions, based on the best available information that includes the following: … (d) Groundwater quality issues that may affect the

[18] Community Water Center and Stanford University, 2019. Factsheet "Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium" for more information.https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

supply and beneficial uses of groundwater, including a description and map of the location of known groundwater contamination sites and plumes."[19] We do not believe the GSA is meeting this requirement and recommend that the GSA make the following changes to Chapter 5 of all subbasin GSPs (East Side, Langley, Upper Valley, Forebay, and Monterey) to clearly represent current and past water quality conditions in the subbasin in order to inform the monitoring network, sustainable management criteria, planning, management actions, and projects.

Groundwater Quality Distribution and Trends

- **Clearly state in the introduction to Section 5.4 that the amount and location of pumping can impact groundwater quality distribution and trends.** We recommend including the following language in the letter submitted by the State Water Board to DWR regarding the 180/400 foot aquifer GSP (Dec. 2020): "Not all water quality impacts to groundwater must be addressed in the GSP, but significant and unreasonable water quality degradation due to groundwater conditions occurring throughout the subbasin, and that were not present prior to January 1, 2015, must be addressed in the GSP's minimum thresholds."[20] High rates of groundwater pumping can pull in contaminant plumes towards drinking water wells, cause the release of arsenic from the strata in the ground, and when shallow wells go dry or are too contaminated to use, new wells must be drilled into deeper portions of the aquifer where they are more likely to encounter high arsenic levels.[21] As previously mentioned, this is of direct concern to the San Jerardo Cooperative, which has observed increasing arsenic levels in their relatively new drinking water well, which was drilled to replace a more shallow well contaminated with nitrate and 123-trichloropropane.
    - SVB GSA response: "The SVBGSA does not have regulatory authority over groundwater quality and is not charged with improving groundwater quality in the Salinas Valley Groundwater Basin. Projects and actions implemented by the SVBGSA are not required to improve groundwater quality; however, they must not further degrade groundwater quality."[22]
    - Our response: CWC recommendation in this section is not to extend the GSA's responsibility to improving water quality. But if extraction rates that the GSA allows to occur result in water quality degradation, then that is within the GSA's responsibility to address. The GSA has explicit statutory authority and responsibility to prevent significant and unreasonable water quality degradation.[23] In line with this responsibility, DWR has instructed GSAs to map out where water quality issues exist in the basin, and to prevent

[19] Cal. Code of Regulations § 354.16(d)
[20] DWR SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29
[21] Community Water Center and Stanford University, (2019). *Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium*. Available at: https://www.communitywatercenter.org/sgmaresources.
[22] Salinas Valley Groundwater Sustainability Agency, Langley Area Subbasin GSP, p. 5-21.
[23] Cal Water Code § 10721, subd. (x)(4).

new impacts from occurring.[24] This includes managing contaminant plumes that may migrate or increase in concentration due to extraction rates and locations.

- **Include trend data for drinking water wells in the subbasins.** In some places, nitrate and other contaminants are increasing in drinking water wells. It is important to understand current contamination values and also whether well water quality is improving, staying the same or declining as well as the relationship of water quality to other sustainability indicators. As indicated by the data provided in this section, Monterey County maintains an exceptional dataset of water quality data for over 900 state and local small water systems serving 2-14 connections that should be utilized throughout the GSPs. Monterey County has sampled many small water systems for decades. CWC Figures 3 and 4 show nitrate concentrations increasing over time in two state small water systems in the East Side sub basin with high levels in one of the systems (Middlefield Rd. Water System #4) in 2015. Figure 5 illustrates arsenic concentrations in the Metz Road Water System #4 in the Forebay Subbasin. In some cases, data shows fluctuations and peaks in concentrations during the 2015-2016 timeframe. This is similar to the San Jerardo example shared previously. Further, the Central Coast Regional Water Board has analyzed data from their Irrigated Lands Regulatory Program to show that many wells across the region are showing increasing levels of nitrate concentrations and recent studies have confirmed that there is a link between decreased water quality and declining groundwater levels observed during times of drought.[25]
    - SVB GSA staff responded: "Nitrate trends are included based on a review of existing studies. The analysis of temporal trends are not required and would entail substantial additional work that would not likely change the management approach. Water quality data for DDW wells and ILRP on-farm domestic and irrigation supply wells were used to make maps showing the spatial distribution of water quality exceedances of Title 22 or Basin Plan standards from 2013 to 2019 are now included in a new Chapter 5 Appendix."
        - Our response: : We maintain our position on the importance of including trend data as previously recommended because the way in which the GSA manages the basin impacts water quality. GSAs are responsible for monitoring water quality conditions in the basin and ensuring that they do not degrade beyond 2015 conditions.[26] The rate, timing, and location of pumping as well as fluctuations in groundwater levels overtime can result in the horizontal and

---

[24] Dept. of Water Resources, 180/400 Foot Aquifer Groundwater Sustainability Plan Determination, (June 3, 2021), pp. 26-27.
[25] Draft Ag Order, Attachment A, 141-143. Available at: https://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order4_renewal/2021april/pao4_att_a_clean.pdf; *see also* U.S. Geological Survey (USGS). (Sept 2021). *Increased Pumping in California's Central Valley During Drought Worsens Groundwater Quality.* California State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (GAMA). Available at: https://www.usgs.gov/news/increased-pumping-california-s-central-valley-during-drought-worsens-groundwater-quality.
[26] Cal. Water Code §§ 10721 subd. (x)(4) and 10722.2 subd. (b)(4).

vertical migration of contaminant plumes into drinking water sources, including vulnerable private domestic wells.

- SVB GSA Staff replied: "The relationship between declining water levels and water quality degradation was evaluated for the Eastside Subbasin as presented in the December 2020 Subbasin Planning Committee Meeting. Although there seems to be a relationship between decreasing groundwater elevations and degrading water quality, within the analysis for the Eastside, subbasin-wide data does not show a strong correlation. Thus, the data is not definitive enough to determine if the decline in groundwater quality is due to additional loading of constituents or lowering of groundwater elevations. There may be a correlation within individual wells, like is seen in San Jerardo, however, that could be due to those other factors."
    - Our response: The current best available science[27] clearly links decreasing groundwater levels, including through overpumping of groundwater, to exacerbated degradation of groundwater quality. The U. S. Geological Survey (USGS) analyzed trends of increased pumping in California's Central Valley and further degradation of water quality and concluded that they are interlinked.[28] There is no reason to assume that the Central Coast would be subject to a hydrology so distinct as to negate the applicability of this finding to SVB GSA's groundwater management. Because of this established correlation, in instances of further water quality degradation, particularly when resulting in impacts to drinking water wells, SVB GSA should have the burden of proof to show that exacerbated water quality degradation is *not* linked to pumping practices, and identify the responsible source.
        - This is another example of why a more representative monitoring system for water quality (ie including SSWS and LSWS data from the Monterey County Environmental Health Department) would benefit Salinas Valley groundwater management, so that impacts can be identified and addressed in a highly localized manner. Additionally, even if the Subbasin GSPs plan to maintain current water levels, the GSA should be prepared to respond in case basin conditions do not evolve as planned and water quality degradation is exacerbated by ongoing pumping practices, including if hotspots (highly concentrated areas of

---

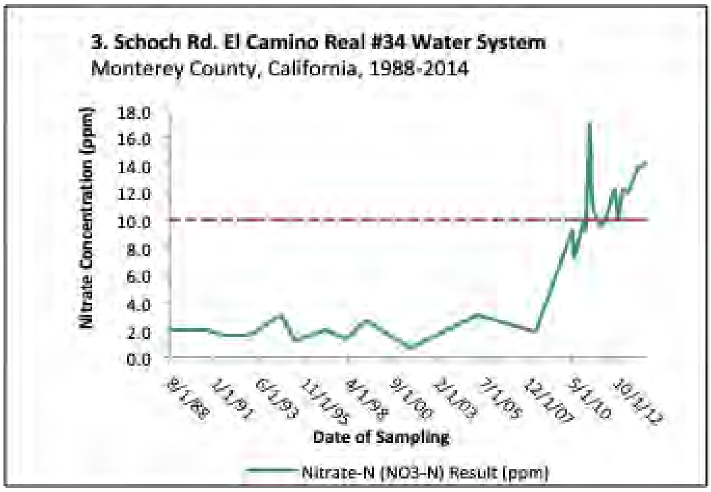
[27] 23 CCR § 355.4(b)(1). "When evaluating whether a Plan is likely to achieve the sustainability goal for the basin, the Department shall consider the following:
(1) Whether the assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are reasonable and supported by the best available information and best available science."

[28] U.S. Geological Survey (USGS). (Sept 2021). *Increased Pumping in California's Central Valley During Drought Worsens Groundwater Quality.* California State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (GAMA). Available at: https://www.usgs.gov/news/increased-pumping-california-s-central-valley-during-drought-worsens-groundwater-quality.

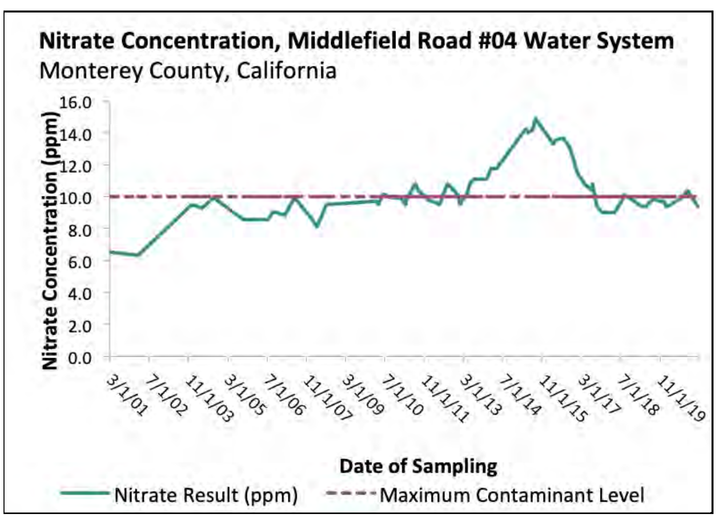
impact) of contamination form which impact drinking water beneficial users.

- We further request additional information be added to the GSP about the analysis conducted by the SVB GSA to understand the relationship between groundwater quality and groundwater levels. It is not sufficient to say this analysis was conducted without also providing the public information about the data sources, methods, and findings.

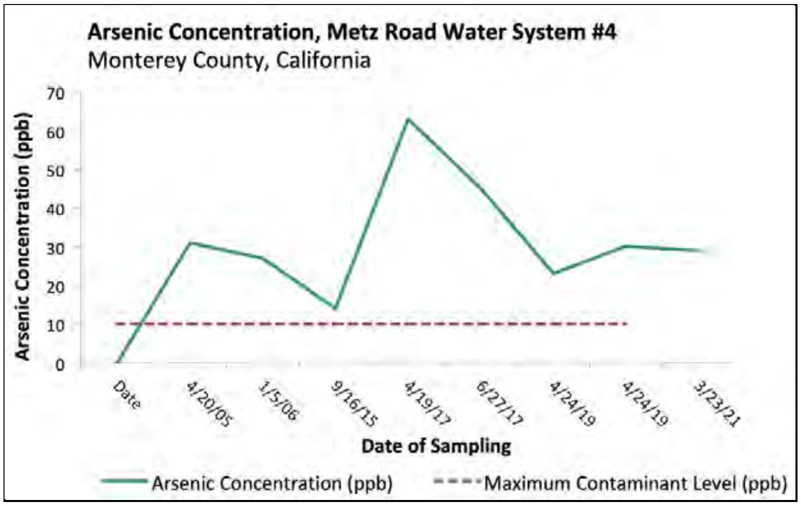
CWC Figure 3: El Camino Real WS #34 - Nitrate as N, East Side Subbasin



CWC Figure 4: Middlefield Road WS #4 - Nitrate as N, East Side Subbasin



CWC Figure 5: Metz Road Water System #4, Arsenic, Forebay Subbasin



- **Revise Section 5.4 to include a specific discussion, supported by maps and charts, of the spatial or temporal water quality trends for all constituents that have been detected in the subbasin and may affect drinking water beneficial users, as required under 23 CCR § 354.16(d).** This section should include water quality data (both in map and tabular form) for all constituents (where available) with primary drinking water standards that have been detected in the subbasin including, but not limited to, **nitrate, 123-trichloropropane, hexavalent chromium,[29] arsenic, uranium, and perchlorate for all public drinking water wells, state and local small water system wells, and private domestic wells.** It is especially important for all groundwater stakeholders to be able to understand and visualize the location of contaminant hotspots throughout each subbasin.
  - **Present maps and supporting data for all constituents of concern.** The review of water quality data in the groundwater conditions section of the draft Section 5.4 in the subbasin GSPs is focused primarily on nitrate. The GSPs identify numerous constituents that have been detected in groundwater above drinking water standards, but, with the exception of nitrate, do not present this data spatially. Even though the subbasin GSPs set water quality minimum thresholds for additional constituents (See Tables 8-4 and 8-5), the supporting data is not all presented, and limited analyses of spatial or temporal water quality trends are presented. This does not present a clear and transparent assessment of current water quality conditions in the subbasin with respect to drinking water beneficial use (23 CCR § 354.16(d)).
  - We reiterate the request made in previous comment letters and acknowledge the inclusion of Appendix 5-B, Figure 1: Water Quality Exceedances for DDW Wells which shows DDW wells that have had a COC exceedance between 1986-2019. This new appendix has significant limitations. For example, San Jerardo Cooperative's well is

---

[29] The maximum contaminant level for hexavalent chromium should be reinstated in 2021. Data is available from the State Water Resources Control Board and Monterey County Environmental Health Bureau (public water system data, state/local small water system data) as well as on GAMA from the Central Coast Regional Water Quality Control Board's private well testing program.

shown to have multiple exceedances of COCs during the time period shown (between 1986-2019). Yet, the well that had these exceedances is no longer active. Instead, San Jerardo's new well is showing increased trends of nitrate and arsenic. CWC's Figures in this comment letter illustrate the importance of presenting trend data for San Jerardo Cooperative's well and others throughout the Salinas Valley Basin. It is also important to include COC data for wells that are not yet in violation of drinking water standards. In addition, *CWC Figure 6: Arsenic Concentrations in Public Water System Wells, Monterey, Langley East Side Subbasins (Red dots = >10 ppb, Orange = 5-9.9 ppb, Yellow = 0.6-5.9 ppb, Green= non-detect)* illustrates hot spots for arsenic and also areas in orange (5-9.9 ppb arsenic), like San Jerardo, that are at risk if business-as-usual groundwater management continues.

- **Augment and clarify data presented in Table 5-3 GAMA Water Quality Data Summary and Section 5.4.1 in the following ways:**
  - **Add all state and local small water systems data.** Table 5-3 should include all state and local small water system data for nitrate, arsenic, hexavalent chromium, and any other contaminants that Monterey County monitors in the subbasin.
  - **Include additional contaminants that have been detected in the subbasin(s) to be consistent with Tables 8-5 and 8-6.** Our review of publicly available data on drinking water wells of all types (private domestic wells, state/local small water systems, and public water systems) indicate that there are additional constituents of concern beyond those currently listed. We included CWC Figure 6 (page 9) to highlight the spatial distribution of arsenic in public water system wells in the **East Side, Langley and Monterey Subbasins**, and CWC Figure 7 (page 10) to highlight the spatial distribution of hexavalent chromium in public water system wells in the **Langley Subbasin**. We recommend a more comprehensive analysis of all other constituents in the subbasins, including, but not limited to the following[30]:
    - **East Side Subbasin:** Table 5-3 presents data on two primary contaminants in drinking water: nitrate and 123-trichloropropane, but arsenic is also of particular concern to San Jerardo Cooperative and others in the subbasin. GAMA shows that four public water system wells have exceedances of the arsenic MCL in the past three years (CWC Figure 8), and state/local small water system out of compliance lists from the Monterey County Health Department (2021) show that both Old Stage Rd WS #6 and Old Stage Rd WS #7 are out of compliance for arsenic and that at least five other state or local small water systems have between 6-8 ppb of arsenic, which means they are similar to San Jerardo

[30] All Monterey County data shared in this section was collected by the small water system program.
https://www.co.monterey.ca.us/government/departments-a-h/health/environmental-health/drinking-water-protection/state-and-local
It was downloaded from the Greater Monterey County Community Water Tool on April 22, 2021:
http://www.greatermontereyirwmp.org/documents/disadvantaged-community-plan-for-drinking-water-and-wastewater/

Cooperative in terms of their vulnerability to water level fluctuations or other changes.

- **Forebay Subbasin:** While arsenic is less common in the Forebay than in the Langley, Monterey, and East Side Subbasins, our review of the Monterey County Health Department data indicates that 17 state or local smalls had arsenic at levels above 1 ppb in the 2015-2017 time period, and at least two of these had levels above the MCL. See CWC Figure 5 (page 8) which illustrates trends in one of the out-of-compliance small water systems, Metz Road Water System #4. In addition, three systems monitored by Monterey County as part of their Local Primacy Program for public water systems serving 15-199 connections had hexavalent chromium detections of 2.8 ppb, 3.4 ppb, and 2.1 ppb in the 2014-2017 timeframe.
- **Upper Valley Subbasin:** Although arsenic is not as common in the Upper Valley as other subbasins, it has been detected in levels between 3.2 and 5 ppb in six small water systems monitored by Monterey County.

○ SVB GSA Response: "The water quality analysis was redone for V2 to include both current and historic groundwater quality data, and arsenic is now a constituent of concern in the Eastside Subbasin. Section 5.4.3 and 5.4.4 text was also revised to provide more specificity about the constituents and wells sampled."

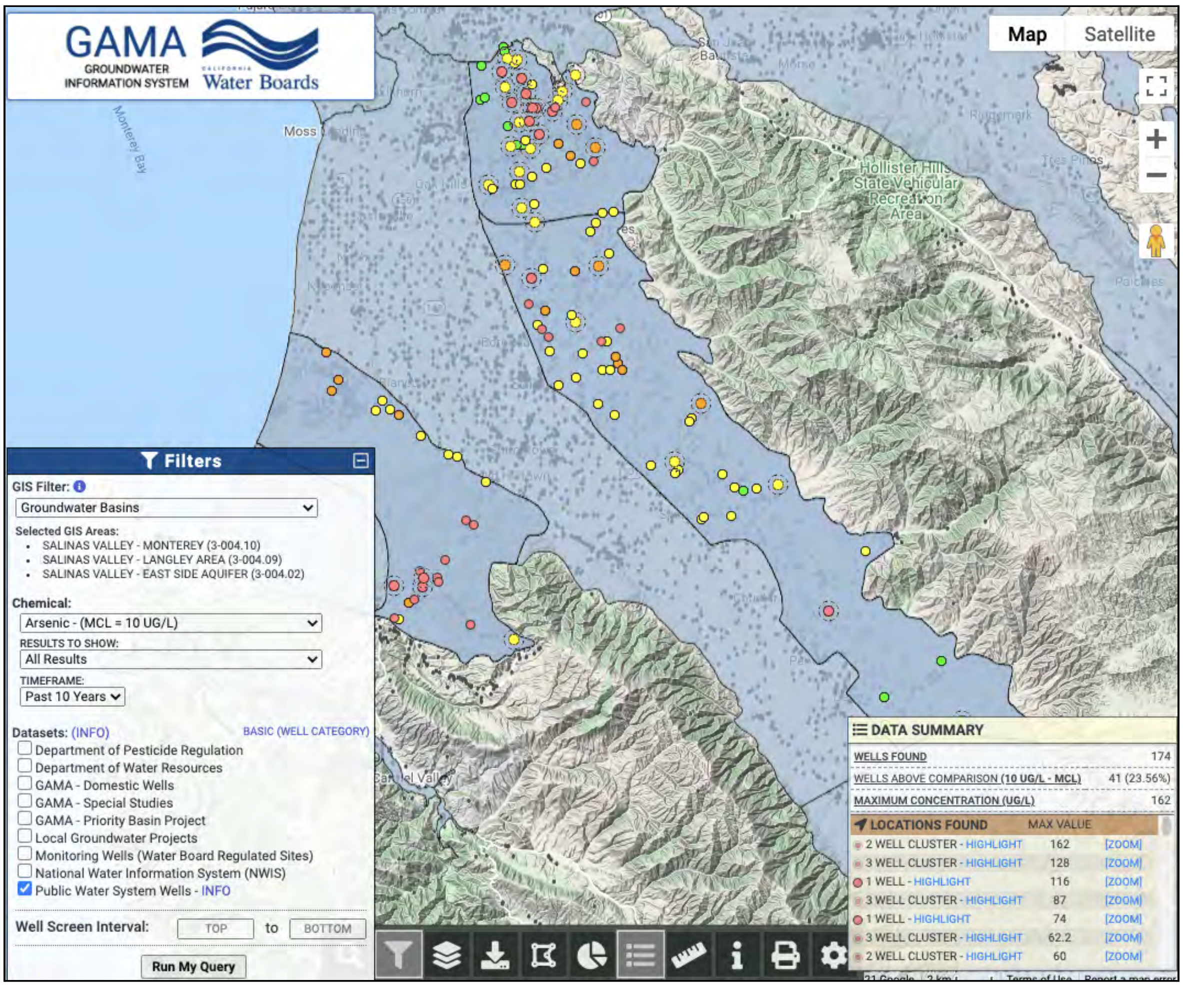
- Our Response: We acknowledge that the SVB GSA added arsenic as a constituent of concern in the Eastside Subbasin GSP. We reiterate these comments to ensure that all subbasin GSPs include all contaminants detected in the subbasins as COCs. It is important to include all contaminants detected in the subbasins as COCs and not only those greater than the MCLs because many contaminants, such as arsenic and hexavalent chromium, pose a risk to public health at levels much lower than the MCL. The Office of Environmental Health Hazard Assessment (OEHHA) sets a public health goal (PHG) for each chemical. PHGs are levels of a contaminant in drinking water that do not pose a significant risk to health. The public health goal for Arsenic is 0.004 ppb and hexavalent chromium is 0.02 ppb.[31]
- SVB GSA Staff replied: “Table 5-3 list the constituents of concern (COC) with exceedances in the latest sample for each COC in each well that has not been destroyed or abandoned, and it has been updated to be consistent with Table 8-5 that lists the minimum thresholds and measurable objectives for these constituents only. Table 8-6 list all the constituents for which data is available for the 3 types of wells in the monitoring network (DDW wells, ILRP on-farm domestic, and ILRP irrigation supply wells). Table 5-3 and Table 8-5 do not list all the constituents that have had an the exceedance in these 3 sets of wells, it only includes exceedances that occured in the latest sample, while Table 8-6 includes

[31] https://oehha.ca.gov/water/public-health-goals-phgs

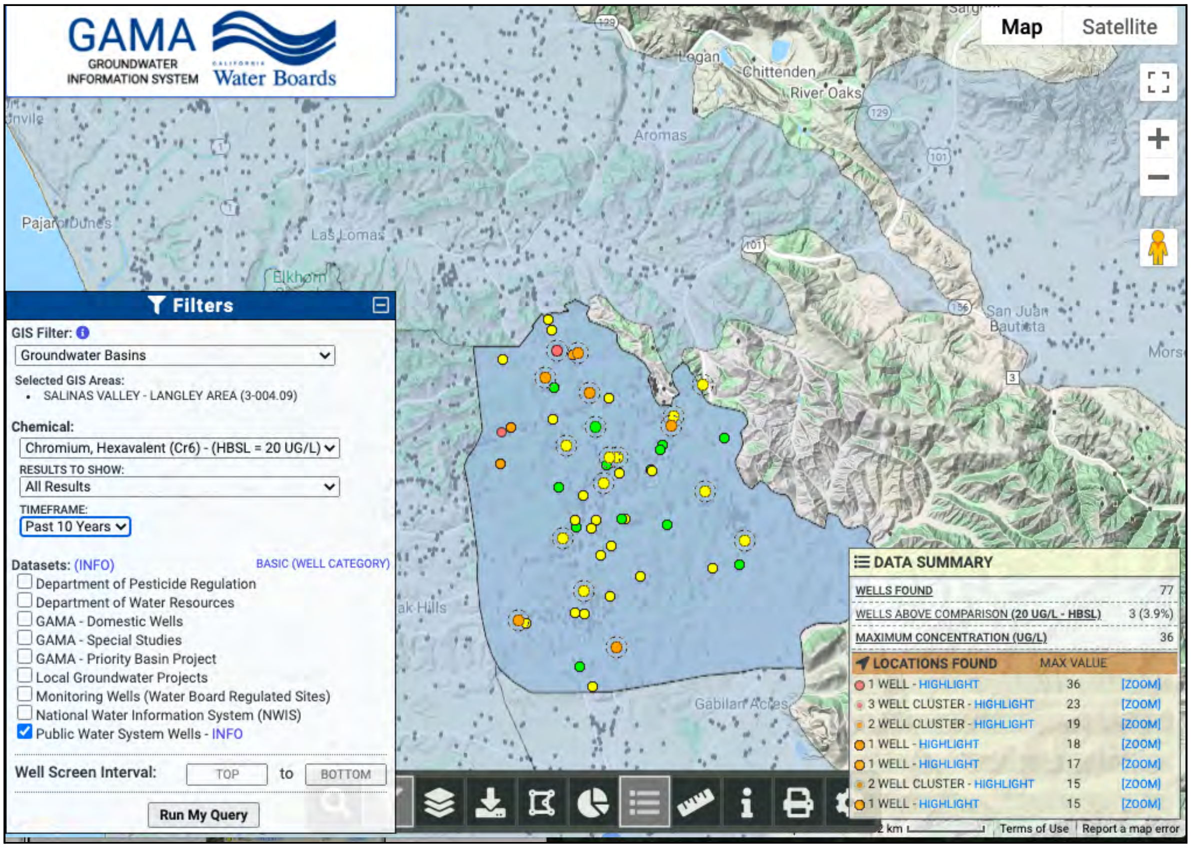
all the constituents that were included in the analysis that have been sampled for historically in each set of wells."

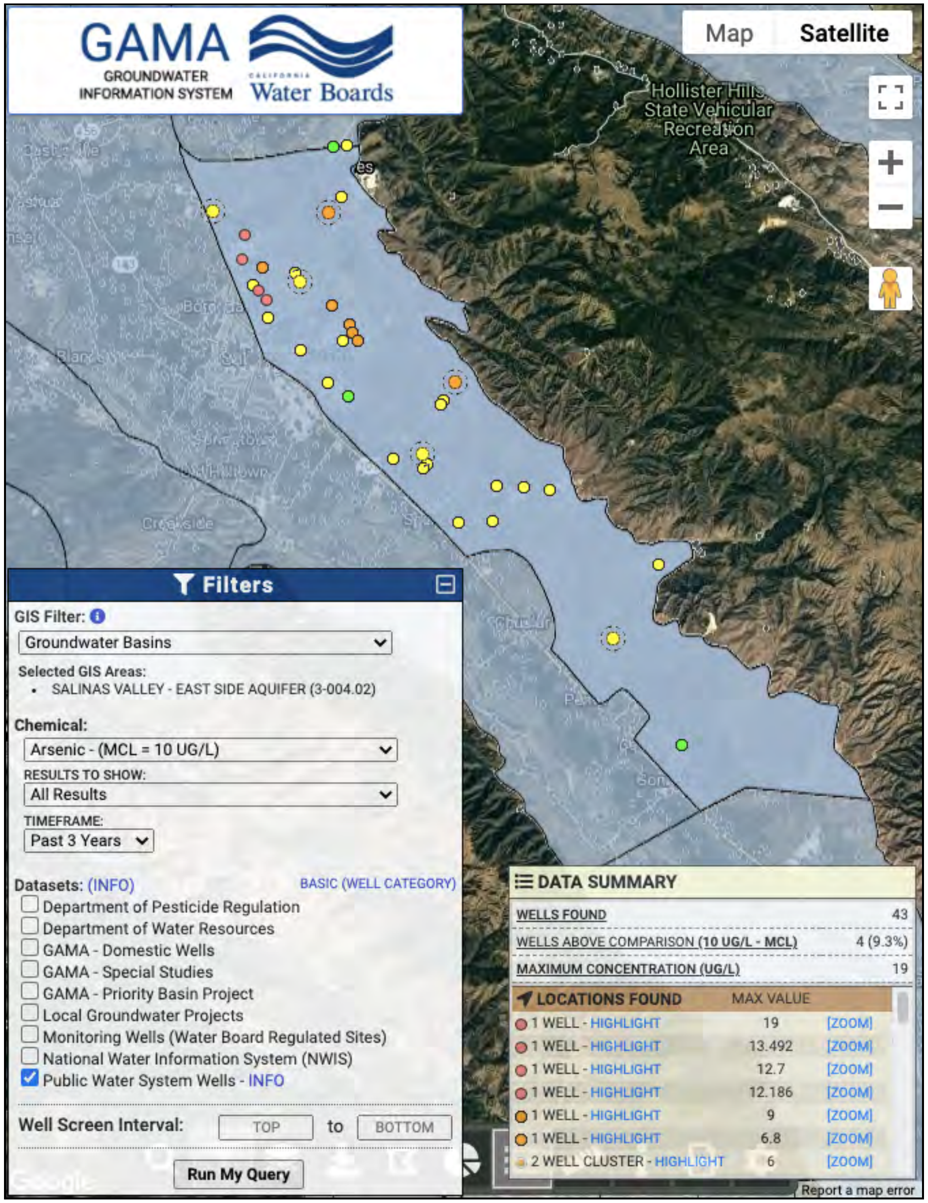
- Our response: We acknowledge the updates to Table 5-3 and request clarity on whether the DDW wells are all public water system wells, as defined in Section 7.5, or whether wells of other types are also included. Also, please add text explaining why two different time periods of data used in this table for DDW and ILRP wells. This table includes DDW wells sampled for COCs between December 1982 to December 2019, and ILRP Wells sampled from May 2013-December 2019.

CWC Figure 6: Arsenic Concentrations in Public Water System Wells, Monterey, Langley East Side Subbasins (Red dots = >10 ppb, Orange = 5-9.9 ppb, Yellow = 0.6-5.9 ppb, Green= non-detect)

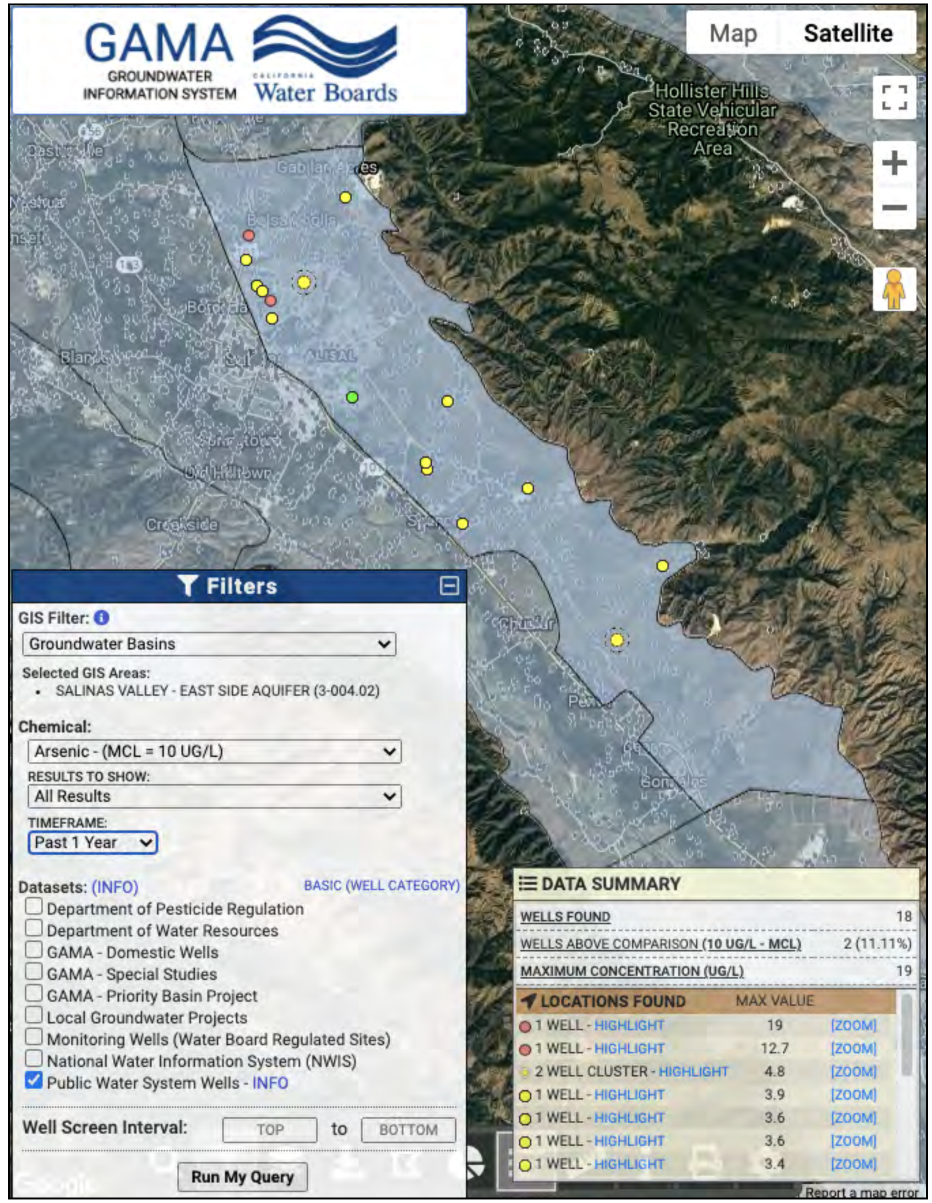


CWC FIgure 7: Hexavalent Chromium Concentrations in Public Water System Wells, Langley Subbasin





CWC Figure 8: 43 Public Water System Wells have arsenic data in the past 3 years. One well at San Jerardo Cooperative appears orange on this map.



CWC Figure 9: Only 18 Public Water Systems Wells have arsenic data in the past year. San Jerardo Cooperative's wells are not shown on this map.

GSP Chapter 6: Water Budgets

SGMA requires a GSP to quantify the water budget in sufficient detail in order to build local understanding of how historic changes have affected the six sustainability indicators in the basin.[32] Ultimately, this information is intended to be used to predict how these same variables may affect or guide future management actions.[33] GSAs must provide adequate water budget information to demonstrate that the GSP adheres to all SGMA and GSP regulation requirements, that the GSA will be able to achieve the sustainability goal within 20 years, and be able to maintain sustainability over the 50 year planning and implementation horizon.[34]

The calculations of sustainable yield and the water budget in this chapter may *overestimate the actual sustainable yield and water availability of the subbasins*. We highlight points of concern below and recommended changes.

6.4 Projected Water Budgets

The SVB GSA Subbasin GSPs explain that "[p]rojected water budgets are extracted from the SVOM, which simulates future hydrologic conditions with assumed climate change. Two projected water budgets are presented, one incorporating estimated 2030 climate change projections and one incorporating estimated 2070 climate change projections. … The climate change projections are based on data provided by DWR (2018)."[35] Including climate change scenarios in water planning is an important step for California's increased resiliency. However, which scenarios to include is a critical question.

Climate change is affecting when, where, and how the state receives precipitation.[36] Impacts to water supply, particularly drinking water supply, could be devastating if planning is inadequate or too optimistic. GSAs must adequately incorporate climate change scenarios in water budgets. As such, the DWR Climate Change Guidance[37] makes recommendations to GSAs for how to conduct their climate change analysis while preparing water budgets. DWR also provides climate data for a 2030 Central Tendency scenario and 2070 Central Tendency, 2070 Dry-Extreme Warming (DEW), and 2070 Wet-Moderate Warming (WMW) scenarios. While DWR's Guidance should be improved with more specific guidelines and requirements, the current Guidance specifically encourages GSAs to analyze the more extreme DEW and WMW projections for 2070 to plan for likely events that may have costly outcomes. Therefore, we recommend that the SVB GSA subbasin GSPs:

---

[32] 23 CCR § 354.18.

[33] California Department of Water Resources (DWR), 2016. Best Management Practices for the Sustainable Management of Groundwater, Modeling (BMP #5), December 2016.

[34] 23 CCR § 354.24.

[35] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True.

[36] Union of Concerned Scientists. Troubled Waters: Preparing for Climate Threats to California's Water System, 2020. https://www.ucsusa.org/resources/troubled-waters#top.

[37] See DWR (2018) reference above.

- **Include water budget analyses based on DWR's 2070 DEW and WMW scenarios in order to analyze the full range of likely scenarios[38] that the region faces.**
    - Currently, the SVB GSA's exclusive use of the "central tendency" climate scenario predicts an increase in surface water availability, as represented in the tables in Section 6.4.3 of the subbasin GSPs. The Projected Groundwater Budgets show increases in deep percolation of stream flow, deep percolation of precipitation, and irrigation. The subbasin GSPs are relying on this presumed increase for their water budgets. However, the 2070 DEW scenario provided by DWR could likely result in a significant decrease in precipitation and increase in evapotranspiration, which would have substantial effects on the subbasin water budgets. By analyzing only the central tendency scenario and not other likely scenarios such as the extremely dry and wet scenarios provided by DWR, the SVB GSA is ignoring the specific 2070 DEW and WMW scenarios provided by DWR as well as an increasing trend in drought frequency. In doing so, the GSP could be overestimating groundwater recharge or underestimating water demands, inadequately planning, and jeopardizing groundwater sustainability. This will waste precious time to prepare and reduce the vulnerability of the basin's agriculture and already vulnerable communities.
    - DWR's guidance (2018) states that the central tendency scenarios *might* be considered most likely future conditions -- that is not a clear endorsement of a higher statistical probability. It appears that they are calling it the central tendency merely because it falls in the middle of the other two projections, not because it is significantly more probable.
    - DWR (2018) explicitly encourages GSAs to plan for more stressful future conditions:
        - "GSAs should understand the uncertainty involved in projecting future conditions. The recommended 2030 and 2070 central tendency scenarios describe what might be considered most likely future conditions; there is an approximately equal likelihood that actual future conditions will be more stressful or less stressful than those described by the recommended scenarios. Therefore, GSAs are encouraged to plan for future conditions that are more stressful than those evaluated in the recommended scenarios by analyzing the 2070 DEW and 2070 WMW scenarios.."[39]

[38] Terminology used in the California Climate Change Assessment, 2019. (Table 3). https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf.

[39] California Department of Water Resources (DWR), 2018. Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development. Section 4.7.1. https://data.cnra.ca.gov/dataset/sgma-climate-change-resources/resource/f824eb68-1751-4f37-9a15-d9edbc854e1f?inner_span=True. (In red is a statement about the central tendency scenarios referenced in SVB GSA public meetings and email communications by the GSA's engineering consultant, and in blue is the important text accompanying it, urging GSAs to analyze the more extreme scenarios. CWC staff cited this complete paragraph in email communications with the consultant and GSA staff on April 8, 2021. CWC also raised this point at Forebay and Upper Valley Subbasin Committee meetings in March and at the April SVB GSA Board Meeting.)

  - Including the DEW and WMW climate scenarios as part of the 2070 water budget analysis is necessary to meet the statutory requirement to use the "best available information and best available science."[40] Sustainable planning must include planning for foreseeable negative and challenging scenarios. The extreme scenarios provided by DWR are certainly foreseeable, as they have been modeled and made available to the GSA for analysis.
  - It is important for the SVB GSA to include the 2070 DEW and WMW scenarios, because shallow drinking water wells in the area are particularly vulnerable to various extreme conditions, especially drought.
- **Share water budget results based on the 2070 central tendency, DEW and WMW scenarios that DWR has provided with the Subbasin committees, the Advisory Committee, and the GSA board**. This should be done at a *minimum* to see what the difference in outcomes could be, and to provide a transparent process for selecting the preferred scenario. This analysis is particularly important because of the drastic differences between the dry and wet scenarios for this region. Drought and/or intensified rainfall (more water falling over a shorter period of time) would pose severe challenges[41] to the Subbasins' plans for recharge, which is a critical component of their plans to reach sustainability.
- **Plan for potential adverse climate conditions when determining Projects and Management Actions.** The results of limited-scope planning will be detrimental to beneficial users throughout the SVB GSA. "If water planning continues to fail to account for the full range of likely climate impacts, California risks wasted water investments, unmet sustainability goals, and increased water supply shortfalls."[42] This is true not just generally across California, but also specifically on the Central Coast. "Without effective adaptations, projected future extreme droughts will challenge the management of the Central Coast region's already stressed water supplies, including existing local surface storage and groundwater recharge as well as imported surface water supplies from the State Water Project which will become less reliable, and more expensive."[43]

GSP Chapter 7: Monitoring Network

Robust monitoring networks are critical to ensuring that the GSP is on track to meet sustainability goals. GSAs undertaking recharge, significant changes in pumping volume or location, conjunctive management or other forms of active management as part of GSP implementation must consider the interests of all

---

[40] See 23 CCR § 355.4(b)(1).

[41] Union of Concerned Scientists. Inter-model agreement on projected shifts in California hydroclimate characteristics critical to water management. 2020, p. 13. https://link.springer.com/content/pdf/10.1007/s10584-020-02882-4.pdf.

[42] See Union of Concerned Scientists. Troubled Waters (2020) cited above.

[43] Regional Climate Change Assessment for the Central Coast, 2019. (Discussing drought pp. 21-23. Internal citations omitted). https://www.energy.ca.gov/sites/default/files/2019-11/Reg_Report-SUM-CCCA4-2018-006_CentralCoast_ADA.pdf.

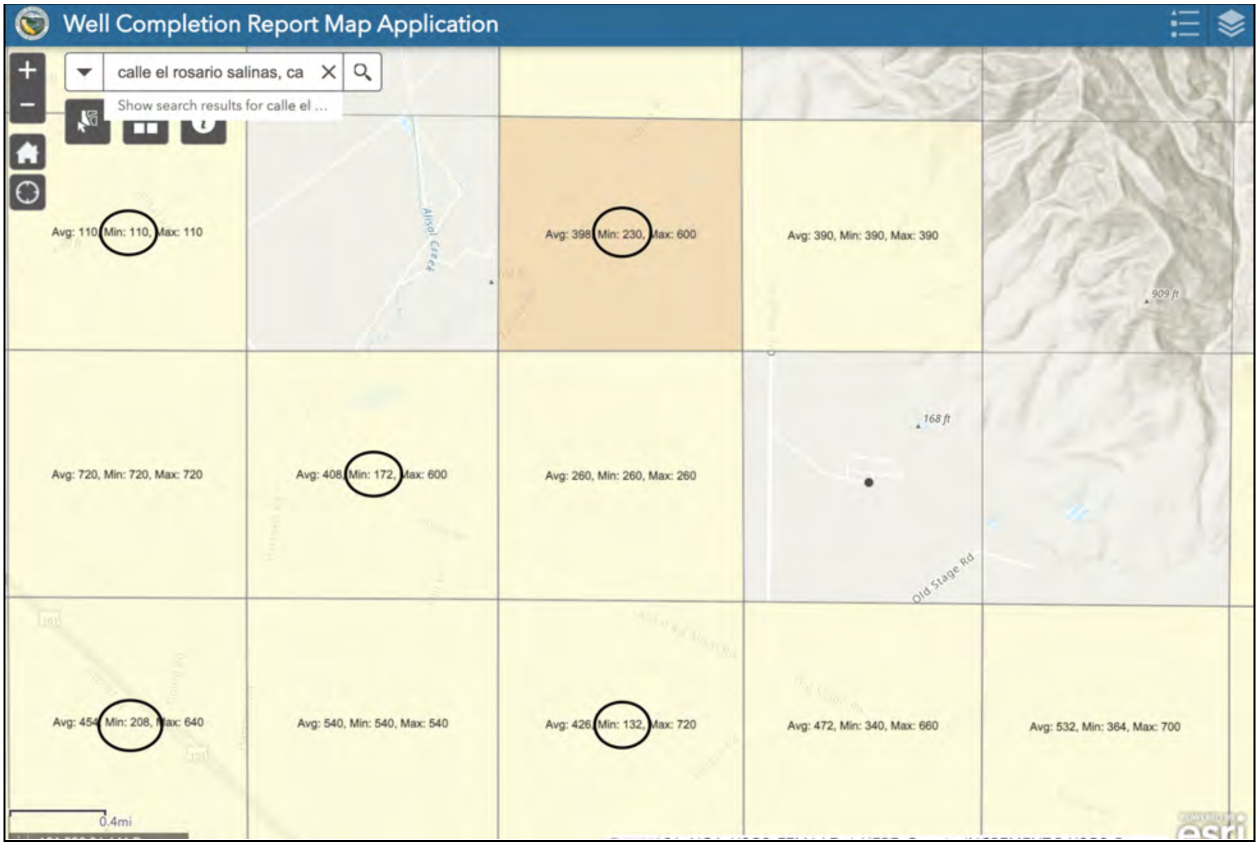
beneficial users, including domestic well owners and S/DACs. We have the following overarching recommendations for this chapter and provide more details for sub-sections below:

- **Require well registration and metering for all wells in the Salinas Valley, and begin implementation of a well registration and metering program in early 2022 with a dedicated budget.** We voice our strong support, with modifications indicated in our comments below, for proposed "Implementation Action 12: Well Registration" in Section 9.1 of Chapter 9 released in April 2021 and recommend that this action be updated and moved to Chapter 7. We agree with the SVB GSA's statement in Section 7.3.2 Groundwater Storage Monitoring Data Gaps that: "Accurate assessment of the amount of pumping requires an accurate count of the number of municipal, agricultural, and domestic wells in the GSP area. During implementation, the SVB GSA will finalize a database of existing and active groundwater wells in the Eastside Aquifer Subbasin." This is essential for the plan to achieve sustainability for all beneficial users and influences many different chapters including:
    - Monitoring networks: In order to develop a monitoring network that is representative, it will be essential to understand the number, location, well construction, and type (domestic, irrigation, other) of all wells located in the subbasins.
    - Water budget and minimum thresholds: Understanding the amount and location of pumping of all water users will be essential for creating an accurate water budget and minimum thresholds consistent with achieving sustainability.
    - Projects and management actions: Section 9.2.1 Well Registration and Metering is a key management action and component of the Water Charges Framework (in the 180/400 foot aquifer) and forthcoming subbasin GSPs. This will underpin the funding structure for many future projects.
- **Require flowmeter calibration to ensure consistent and fair monitoring among all agricultural groundwater users (Section 7.3.1).** Rather than "consider the value of developing protocols for flowmeter calibration," the GSPs should require flowmeter calibration. The water budget and sustainable yield calculation depend on reliable and fair monitoring and reporting of pumping.
- **Provide a plan and schedule for data gap resolution in Chapter 10 of the subbasin GSPs.** In the 180/400 foot aquifer GSP, there was not a clear plan or schedule for the resolution of data gaps in Chapter 7 even though it indicated that this would be included in Chapter 10.
- **Revise GSP monitoring chapters such that monitoring networks for groundwater storage (pumping), groundwater elevation, and groundwater quality adequately monitor how groundwater management actions could impact vulnerable communities including those reliant on domestic wells and shallow portions of the aquifers** (see more detail below).

7.2 Groundwater Elevation Monitoring Network

- **Include groundwater elevation monitoring sites in the network that are representative in terms of the depth and geographic distribution of private domestic wells, and that take into account areas of high agricultural pumping and wells vulnerable to groundwater decline.**
    - The draft East Side Subbasin GSP Table 7-1 of "Eastside Aquifer Groundwater Elevation Representative Monitoring Site Network" shows all irrigation and observation wells (and no domestic wells) which range in depth from 299 to 1122 feet.[44] Yet, the DWR Well Completion Report Map Application[45] shows that 1 mile by 1 mile square sections near San Jerardo Cooperative include private domestic wells with the following minimum depths: 110 ft, 210 ft, 172 ft, 208 ft, and 132 ft which are more shallow than all the wells in the current monitoring network (See CWC Figure 10).
- **Overlay the private well density map (Figure 3-7), the DWR Well Completion Report Map Application (with minimum, average, and maximum depths), the water level monitoring network (with well depths), and available pumping data to better illustrate if and how representative the proposed groundwater elevation monitoring network is of private domestic wells and which areas are vulnerable to water elevation changes.** The GSPs state: "The BMP notes that professional judgment should be used to design the monitoring network to account for high-pumping areas, proposed projects, and other subbasin-specific factors." This will also help to better visualize where there are gaps in the monitoring network which the GSAs can address.

[44] One well shows "0" depth but that must be an error or missing value.
[45] https://water.ca.gov/Programs/Groundwater-Management/Wells/Well-Completion-Reports



CWC Figure 10: Screenshot of DWR Well Completion Report Map application in the area near San Jerardo Cooperative highlighting that several 1 mi. by 1 mi. square sections include private domestic wells less than 250 feet deep.

7.5 Water Quality Monitoring Network

- **Clarify the number of public water system wells that will be included in the water quality monitoring network.** As indicated in Chapter 3 and Chapter 5 comments, the GSPs should also clearly identify the total number of public supply wells as well as the number of public supply wells that are out of compliance and at risk in each subbasin. Section 7.5 currently states that "Ninety DDW wells have been chosen to be part of the RMS network. These wells are shown on Figure 7-4 and listed in Appendix 7D." This section and appendix should be consistent with the total number of wells represented in Table 8-4 which includes groundwater quality minimum thresholds. As previously noted, we also recommend clearly presenting the number of public water system wells and state and local small water system wells located in each subbasin. A review of Appendix 7D indicates that perhaps not all wells listed are public water system wells.
- **Representative Water Quality Monitoring Wells for the shallow aquifer should be established in the GSPs based on all currently available data sources with direct agreements with landowners or public entities established.**

- **Develop long-term access agreements for Representative Monitoring Wells (RMWs) that use private wells.** It is currently difficult to reliably collect data from private wells due to access challenges, lack of well construction information, and unreliable accounting of pumping or non-pumping measurements. The GSPs should specifically identify the RMW owners and operators, include signed long-term access agreements, and identify a plan to obtain adequate monitoring data, if for any reason the well owners decide to not grant access to the wells or provide associated data to the SVB GSA. In order to maintain consistency for future sustainability analyses, the SVB GSA should also consider conducting its own water quality analysis of wells where access agreements have already been established to water quality RMWs.
- **Clarify that state and local small water systems will be added to the water quality monitoring network and that well construction information is no longer needed in order to fill this data gap.** Monterey County Environmental Health Bureau permits and monitors over 900 state and local small water systems in the County and have managed the data collected for decades. This dataset has advantages over the ILRP domestic well dataset in that it includes data on contaminants like arsenic and hexavalent chromium in addition to nitrate. Local small water systems serve 2-4 households and are much more similar to private domestic wells than public water systems in terms of depth, well construction, age, size, and maintenance - thus this data would provide a broader representation of shallow drinking water wells. State and local small water systems are located in areas of irrigated agricultural lands as well as rural residential and other land uses. This dataset should complement and not replace ILRP domestic well data.
    - **Clearly add state and local small water system data as a data gap in Section 7.5.2.** In Section 7.5 Water Quality Monitoring Network, the draft GSPs state: “These [state and local small] wells are not in the current monitoring system because well location coordinates and construction information are currently missing. SVB GSA will work with the County to fill this data gap. When location and well construction data become available, these wells will be added to the monitoring network and included in Appendix 7E and Figure 7-4." However Section 7.5.2 Groundwater Quality Monitoring Data Gaps states: "There is adequate spatial coverage to assess impacts to beneficial uses and users."
- SVB response: Small public water systems wells, regulated by Monterey County Health Department, include both state small water systems that serve 5 to 14 connections and local water systems that serve 2 to 4 service connections. SVBGSA had originally planned to work with the County to add data from small and local water systems into the monitoring network. These wells are not in the current proposed monitoring system because well location coordinates, construction information and quality data are not easily accessible. The Monterey County Health Department monitors water quality in the state small and local water systems and their data is not readily transferable. In addition, there is sufficient other available data to characterize the basin. There were no water quality data gaps identified per SGMA requirements for GSPs as there is adequate

spatial coverage to assess impacts to beneficial uses and users. As stated above, the water quality monitoring approach has been updated in V2 to include last time any well was sampled, not just the most current year.

  - Our response: We reaffirm our previous comments, requests, and arguments in support of including the SSWS and LSWS data. We would also like additional clarity on what the barriers are to including this important dataset and to explore how they can be resolved. SVB GSA has successfully incorporated the GIS data for the SSWS/LSWS boundaries into its dataviewer and now also into Chapter 3's recent updates. The water quality data was also included in the 180/400 foot aquifer GSP in Chapter 8 in a table indicating exceedances of nitrate and arsenic. CWC, San Jerardo Cooperative and the Greater Monterey County Regional WAter Management Group have also utilized this data successfully in past projects. The value of the full dataset, particularly that it more accurately represents domestic well conditions than any of the other current components of the water quality monitoring network, should outweigh any administrative burden to transfer the data.
  - **Do not rely solely on ILRP well data to represent private domestic wells (which are often more shallow than public water system wells).** Similar to CASGEM, the current groundwater quality monitoring network includes monitoring points on private property including ILRP domestic and irrigation wells, but it should not be restricted to ILRP sites only. While on-farm domestic and irrigation wells monitored through the ILRP provide a potentially useful, though limited, source of water quality information, additional representative monitoring wells in the shallow aquifer are important to include for several reasons: (1) The ILRP network only includes wells located on agricultural irrigated lands, and not all ILRP properties include domestic wells. Agricultural land use is not the primary land use in the Langley and Monterey Subbasins so this monitoring network offers very limited coverage. While agricultural land use is the primary land use in the East Side, Upper Valley, and Forebay Subbasins, there are private domestic wells in areas with different primary land uses (e.g. rural), and SGMA requires that monitoring networks are geographically representative. Monitoring network wells must also be sufficiently representative to cover all uses and users in the basin, (2) There are other, more robust networks established by USGS, GAMA, and Monterey County that could be drawn on and included to make the groundwater quality monitoring network more comprehensive and representative of conditions in the shallow aquifer, (3) Ag Order 4.0 was adopted on April 15, 2021, which means the first year of monitoring data will not be available until late 2022, (4) The GSA has no authority to determine the robustness or enforcement of monitoring in the irrigated lands network, and (5) while Ag Order 4.0 proposes to require testing for 1,2,3-TCP as well as nitrate, the current ILRP domestic well data only samples for nitrate, and neither Order tests for other contaminants found in the region. In our experience, not all growers are consistent with their water quality and other reporting, despite the regulatory requirements in place.

- SVB GSA response: "Section 7.5 text was revised to specify that the groundwater quality monitoring network is dependent on the existing samping and well density of the ILRP and DDW monitoring programs. Chapter 5 and 8 text include the constituents of concern that will be monitored in each type of well. SGMA Regulations only require "spatial and temporal coverage." Furthermore, the vertical coverage of the monitoring system cannot be further determined because ILRP well data do not include well depths or screen intervals, which would make it difficult to map vertical water quality."

- Our response: SGMA Regulations instruct GSAs to "[c]ollect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues."[46] Sufficient "spatial" data would include appropriate well depths in order to adequately capture potential groundwater quality trends, particularly those that would affect domestic well owners and DACs.

GSP Chapter 8: Sustainable Management Criteria

SGMA requires a GSA to define existing conditions within the basin and characterize undesirable results, including minimum thresholds and measurable objectives to determine a sustainability goal as sustainable management criteria.[47] We have grouped our comments in this section into general recommendations related to all sustainable management criteria (SMCs) followed by a section specific to the water quality SMCs.

General Recommendations

- **Undertake a drinking water well impact analysis that adequately quantifies and captures well impacts at the minimum thresholds, proposed undesirable results, and potential interim conditions.** Include this analysis during the annual reporting process. We disagree with the assumption included in all draft GSPs that the exact location of wells needs to be known in order to include them in a drinking water well impact analysis. In the 180/400 Foot Aquifer Subbasin GSP, the SVB GSA included a domestic well impact analysis. Although the SVB GSA did not describe the methods used in this analysis,[48] it is CWC's understanding that the analysis was based on Public Land Survey System (PLSS) section location data, demonstrating that such an analysis is feasible. Similar analyses in the Water Foundation Whitepaper (June 2020)[49] and in the Kings River East GSP[50] were completed using the same PLSS section location data for private domestic wells that is available to the SVB GSA. The current analysis is incomplete as it includes

---

[46] 23 CCR § 354.34(c)(4).
[47] 23 CCR §§ 354.22-354.30.
[48] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020.
https://sgma.water.ca.gov/portal/service/gspdocument/download/4012
[49] The Water Foundation Whitepaper, April 2020: "Estimated Numbers of Californians Reliant on Domestic Wells Impacted as a Result of the Sustainability Criteria Defined in Selected San Joaquin Valley Groundwater Sustainability Plans and Associated Costs to Mitigate Those Impacts." April 9, 2020.
http://waterfdn.org/wp-content/uploads/2020/05/Domestic-Well-Impacts_White-Paper_2020-04-09.pdf
[50] Kings River East Groundwater Sustainability Agency. Groundwater Sustainability Plan. Adopted December 13, 2019.

very few wells in all subbasins. The current analysis is also substantially inaccurate as it relies on the "average computed depth of domestic wells in the Subbasin," and groundwater elevations vary significantly across the subbasin and also on an annual basis. For example, only 8 of the 154 domestic wells in the Forebay GSP with an average depth of 292.45 feet, and only 20 of 2016 domestic wells in the East Side GSP with an average depth of 365.5 feet were included. CWC Figure 10 illustrates that the average computive depth is not representative of conditions in shallow domestic wells. Therefore, we recommend revising Section 8.6.2.2 Minimum Threshold Impact on Domestic wells following the process explained below:

- **Include a map of potentially impacted wells so the public can better assess well impacts specific to DACs, small water systems, or other beneficial users of water.**
- **Quantify impacts for all drinking water wells in the subbasin for which approximate location (PLSS section) and well depth are available.** Similar analyses based on the PLSS section location of private domestic wells have been completed by Water Foundation (June 2020)[51] and in the Kings River East GSP[52].
- **Account for well screen and pump depth when available.** When not available, well screen and pump depth should be estimated conservatively to capture potential impacts to well operability under water scarcity conditions.
- **Quantify impacts for potential unfavorable interim conditions, such as droughts and short-term lowering of groundwater levels while implementation measures are put in effect.**
- **Quantify the elevation difference (in feet) between current groundwater levels and well bottoms, screens, and pumps.** If current groundwater levels are nearing well bottoms, screens or pumps, that indicates that the wells are vulnerable to interim lowering of groundwater levels.
- **Quantify the elevation difference (in feet) between the minimum threshold groundwater levels and well bottoms, screens, and pumps.** If the minimum threshold is near the well bottom, screen or pump, that well will be impacted if groundwater levels in the vicinity drop below the minimum threshold (even if minimum thresholds are met at 90 percent of monitoring wells and an undesirable result has not technically occurred).
- **Quantify the number of potentially impacted wells of each well type (irrigation, domestic, state/local small water system, public water system) for water quality, water levels, and sea water intrusion MTs.**
- **Quantify the costs associated with impacted wells including desalinization/treatment, lowering pumps, well replacement and increased pumping costs associated with the increased lift at the projected water levels.**

[51] *Id.*
[52] *Id.*

- SVB GSA's response: Domestic well analyses were conducted for the minimum thresholds and measurable objectives. Wells that did not have accurate locations were not included, because water levels vary greatly throughout the Subbasin, thus, it is unlikely that the water level for the centroid of a PLSS section can accurately represent all wells that have the centroid of the section as their location.
- Our response: We reiterate that including the centroid of the section is a reasonable and feasible way of conducting this analysis and has been used by other GSAs and researchers. As noted, we believe that SVB GSA itself used PLSS data to conduct the well impact analysis for the 1800/400 Foot Aquifer GSP. Including such a disproportionately low number of wells in the studies is likely to produce unrepresentative results.

Groundwater Quality

We are pleased that the Salinas Valley Subbasin GSPs establish minimum thresholds based on maximum contaminant levels (MCLs) for contaminants of concern for drinking water supply systems. However, there are other areas in regards to groundwater quality sustainable management criteria that are not clear and could cause significant impacts to drinking water users if not adequately addressed. Therefore, we recommend the following revisions:

- **Add state and local small water systems to the monitoring network with the same water quality minimum thresholds and measurable objectives for reasons stated in Chapter 7 comments.** A table for state and local small water system minimum thresholds was included in the 180/400 foot aquifer GSP, but in the draft subbasin GSPs, there is no such table and Table 8-1 only mentions public supply and on-farm domestic wells.
- **If a contaminant was already above the MCL as of January 1, 2015, subbasin GSPs should set a MT to prevent further degradation or aim to improve groundwater quality conditions where possible.** Increased contamination levels can require water systems to utilize more expensive treatment methods and/or to purchase additional alternative supplies as blending may become more difficult or impossible. Communities reliant on domestic wells who are aware of contamination in their water and use point-of-use/point-of-entry (POU/POE) treatment systems may no longer be able to use their devices if contaminate levels rise too high. Higher contaminant levels can also result in higher costs of waste disposal from certain types of treatment systems. Further, residents who rely upon domestic wells, state small water systems, or local small water systems may not even know what contaminants are in their water and at what levels. Users of these drinking water sources are not required to conduct testing, and many times do not have the resources necessary to conduct regular testing. Rising contaminant levels put these users and their health at serious risk. Increased contamination levels result in unreasonable impacts to access to safe and affordable water and are, thus, inconsistent with SGMA and the Human Right to Water. This recommendation is consistent with the State Water Board's recommendations regarding this topic in their letter to DWR regarding the 180/400 foot aquifer GSP in which they state: "Increasing concentrations of nitrate, arsenic, and other constituents at monitoring wells with existing exceedances may represent worsening of existing

conditions due to groundwater pumping. Staff recommend setting concentration threshold levels for these wells in order to determine if impacts due to pumping are occurring."[53]

    - **Develop management areas to protect areas where drinking water wells have water quality that are vulnerable, including the San Jerardo area.**

- **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSPs should set MOs at 75% of the MCLs.** Subbasin GSPs should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold exceedance at a representative monitoring well. This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. If the GSA waits until the minimum threshold is exceeded, it may be too late or difficult for actions to be effective. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded. We also recommend that groundwater quality and trigger levels at 75% are added to the Water Quality Partnership plans and/or a Well Impact Mitigation Program
    - SVB GSA response: The GSA is not responsible for improving water quality and 75% of MCLs would require remediation.
    - Our response: To clarify, our recommendation is, where water quality is currently below 75% of MCLs, to maintain levels below that mark instead of allowing them to progress up to the MCL. The objective should not be to allow water quality to degrade up to just below the MCL. Many contaminants, such as 123-TCP and arsenic, have public health goals far below the MCL. The MCL is not an established safe level, but rather is a legal limit that also takes into account the economic and technical feasibility of compliance for public water systems. For those contaminants, increasing from 50% to 75% of the MCL represents an increase in health risk.
- **Clearly identify and describe past and present levels of contamination and salinity at each representative monitoring well (RMW) and attribute specific numeric values for MTs/MOs at each RMW for each contaminant of concern.** Quantitative values need to be established for MTs/MOs for each applicable sustainability indicator at each RMW as required by 23 CCR § 354.28 and 23 CCR § 354.30. The GSPs should include a map and tables that include each individual RMW along with water quality data for each RMW (this data is currently summarized in Table 8-4 and Table 8-5). This information should be presented clearly so that the public can determine how the proposed monitoring network and sustainable management criteria (SMCs) relate to their own drinking water well or water supply system.
- **Include hexavalent chromium as a contaminant of concern and plan to add contaminants of emerging concern to the monitoring network.** While there is currently not a Maximum Contaminant Level for hexavalent chromium, there is still a Public Health Goal and public health

---

[53] State Water Resources Control Board. (Dec. 2020). Comments to DWR regarding 180/400 Foot Aquifer GSP. Downloaded from SGMA GSP Portal. Available under the tab "Submitted After Public Comment Period" at: https://sgma.water.ca.gov/portal/gsp/comments/29.

threat posed by this contaminant in drinking water. The State is required to adopt an MCL for chromium-6 again and is in the process of updating the MCL. In addition to including hexavalent chromium, the GSPs must explain how the Plans will be updated to align groundwater monitoring efforts and the sustainable management criteria with any contaminants of emerging concern in the basin and any future new MCLs.

- The text in Section 8.6.2.3 now acknowledges that groundwater pumping can not only cause the movement of contaminant plumes, but can also cause the release of naturally occurring contaminants such as arsenic and chromium. It states:
    - 1. Changes in groundwater elevation could change groundwater gradients, which could cause poor quality groundwater to flow toward production and domestic wells that would not have otherwise been impacted. These groundwater gradients, however, are only dependent on differences between groundwater elevations, not on the groundwater elevations themselves. Therefore, the minimum threshold groundwater levels do not directly lead to a significant and unreasonable degradation of groundwater quality in production and domestic wells.
    - 2. Decreasing groundwater elevations can mobilize constituents of concern that are concentrated at depth, such as arsenic. The groundwater level minimum thresholds are near or above historical lows. Therefore, any depth dependent constituents have previously been mobilized by historical groundwater levels. Maintaining groundwater elevations above the minimum thresholds assures that no new depth dependent constituents of concern are mobilized, and are therefore protective of beneficial uses and users.
- **Include an analysis of the relationship between changes in groundwater levels and groundwater quality concentrations.** In order to clearly evaluate the relationship between changes in groundwater levels and groundwater quality, SVB GSA should undertake an analysis of the change in water quality constituent concentrations relative to change in water levels,[54] particularly over drought periods, to evaluate the potential relationship between water quality

[54] *See* P.A.M. Bachand et. al. Technical Report: Modeling Nitrate Leaching Risk from Specialty Crop Fields During On-Farm Managed Floodwater Recharge in the Kings Groundwater Basin and the Potential for its Management https://suscon.org/wp-content/uploads/2018/10/Nitrate_Report_FInal.pdf. *See also,* Groundwater Recharge Assessment Tool, created by Sustainable Conservation to help groundwater managers make smart decisions in recharging overdrafted basins, including modeling whether a particular recharge project would result in short or long term benefits or harms to water quality, http://www.groundwaterrecharge.org/.

and groundwater management activities.[55] It is our understanding that groundwater quality issues in the Salinas Valley Basin did, in fact, worsen and continue to do so during low groundwater elevations years.[56] Arsenic in the San Jerardo well was at its highest during the lowest groundwater elevation measurement (See CWC Figure 1).

- **Add the total number of wells in each category that will be included in the water quality monitoring network and have SMCs evaluated to Table 8-4. For each constituent of concern, add the number of wells included in the chart and the number exceeding the MT/MO based on the latest sample.** This comment has the same goal as the comment we provided in Chapter 7. SMCs should be set at every public drinking water well and a representative network of drinking water wells that rely on more shallow aquifers. It is essential to track the same wells each year in the monitoring network. If a well is no longer active, it should be removed from the network. In the current representation, it is not clear which wells are included in the monitoring network, which wells have data for each constituent, and which wells are exceeding the regulatory standard.
    - We acknowledge that new information was provided in Chapter 5 that partially addresses this comment, yet we still recommend that the GSP clarify the total number wells in the water quality monitoring network in each category (DDW and ILRP) and that this information be added to Table 8-4.
- **Engage stakeholders and scientists in a transparent discussion regarding "the process the GSAs would use to decide whether or not an exceedance of an MT for water quality degradation was caused by GSP implementation."**[57] The State Water Board recommended that the 180/400 foot aquifer GSP outline this process "otherwise, it is difficult to judge how adequately the GSP addresses undesirable results related to water quality degradation." This relates to the

---

[55] More information about groundwater quality and the relationship between changes in groundwater levels can be found in the following resources:
U.S. Geological Survey (USGS). (Sept 2021). *Increased Pumping in California's Central Valley During Drought Worsens Groundwater Quality.* California State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (GAMA). Available at: https://www.usgs.gov/news/increased-pumping-california-s-central-valley-during-drought-worsens-groundwater-quality. *See also,* Stanford, Community Water Center (2019). *Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium.* Available at: https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896. *See also,* Community Water Center. (2019). *Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act*. https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

[56] U.S. Geological Survey (USGS). (Sept 2021). *Increased Pumping in California's Central Valley During Drought Worsens Groundwater Quality.* California State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment Program (GAMA). Available at: https://www.usgs.gov/news/increased-pumping-california-s-central-valley-during-drought-worsens-groundwater-quality.

[57] State Water Board comments to DWR on 180/400 Foot Aquifer GSP (Dec. 2020). Downloaded from SGMA GSP Portal: https://sgma.water.ca.gov/portal/gsp/comments/29. .

undesirable result for water quality which currently reads: "There shall be no additional minimum threshold exceedances beyond existing groundwater quality conditions during any one year as a direct result of projects or management actions taken as part of GSP implementation."

Chapter 9 Projects and Management Actions

Projects and Management Actions should benefit the basin and all beneficial users.[58] Drinking water users and DACs, who are protected as beneficial users of water under SGMA,[59] can be adversely impacted by either groundwater levels or water quality degradation. Thus, projects and management actions outlined in the GSP, including those currently referred to as implementation actions, should address sustainability issues facing drinking water and other domestic water uses, hold those who cause impacts accountable for remedying them, and address secondary impacts of the projects in order to ensure continued drinking water availability.

While determining how such benefits will be distributed based on the nature of different projects and actions, and who should bear the associated costs, the SVB GSA should keep in mind the **"polluters pay" principle.** Drinking water users should not be put into the position of shouldering additional costs to protect their basic Human Right to Water. Domestic water use has not led to overdraft conditions, as evidenced by the statutory designation of "de minimis" use. Nor should benefits be distributed based on which interested parties can most easily fund a project, but rather towards the overall sustainability of the basin and equity of benefits among beneficial users.

The SVB GSA Subbasin GSPs should (1) clearly identify potential impacts to water quality from all projects and management actions, (2) include management actions that respond to immediate needs and (3) develop a more robust implementation schedule and funding plan for projects and management actions. We acknowledge that the implementation actions are currently in the beginning stages of design but encourage incorporating these elements as soon as possible so that the public and DWR can accurately assess their benefits and feasibility.

Further, because SVB GSA defines its sustainability criteria in a way that potentially allows for drinking water well impacts and because there is so much uncertainty regarding potential domestic well impacts, we recommend incorporating a **Robust Drinking Water Well Mitigation Program.** This program should include the Dry Well Notification System as well as (1) a plan to prevent impacts to drinking water users from dewatering, increases in contaminant levels and increases in salinity, and (2) a plan to mitigate the drinking water impacts that occur even when precautions are taken.

- This type of adaptive management implementation action is crucial to ensuring that all beneficial users within the basin are protected under the GSP. As we have highlighted in previous comments[60]:

[58] As outlined in the Eastside and Upper Valley April 7 meeting materials, soliciting feedback, "[p]rojects implement the GSP and enable the subbasin to reach sustainability by 2042, then maintain sustainability for another 30 years."
[59] Cal. Water Code § 10723.2.
[60] Community Water Center and San Jerardo Cooperative, Inc. Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan. May 15, 2020. Available at: https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

- A GSP that lacks a mitigation program to curtail the effects of projects and management actions as to the safety, quality, affordability, or availability of domestic water, violates both SGMA itself and the Human Right to Water (HR2W).[61] The California legislature has recognized that water used for domestic purposes has priority over all other uses since 1913[62] in Water Code § 106, which declares it, "established policy of this State that the use of water for domestic purposes is the highest use of water and that the next highest use is for irrigation."[63]
- The passage of the Safe and Affordable Drinking Water Fund by Governor Newsom indicates a clear State-level commitment to provide safe and affordable drinking water to California's most vulnerable residents.[64] To ensure compliance with the Legislature's long established position, the HR2W requires that state agencies, including the Department of Water Resources and the State Water Board, must consider the effects on domestic water users when reviewing and approving GSPs.[65] Therefore, GSPs that cause disparate impacts to domestic water use are in violation of the HR2W, and cannot be approved in a manner that meets DWR's requirements under SGMA, and Water Code § 106.3.
- It is important to note that SAFER should not be counted on to remedy impacts to domestic wells that result from GSA management. In order for the state to uphold the HR2W, SAFER funds need to be reserved for issues where there are currently no other responsible regulatory authorities to cover the costs. This is not the case where GSAs are managing the groundwater in their basin in a way that allows domestic wells to go dry or degrade water quality. Local prioritization of continued pumping should not be subsidized by the SAFER fund when the demand for those funds already outstrips the available funds nearly 10-fold.[66]
- The SAFER Needs Assessment Executive Summary highlights: "$10.25 billion represents the total estimated cost of implementing interim and long-term solutions for HR2W list systems, At-Risk water systems and well owners."[67]

- In order to effectively protect drinking water users during GSP implementation, we recommend that the GSA's **Drinking Water Well Impact Mitigation Program Implementation Action,** in line with and expanding upon the currently proposed Dry Well Notification System and potentially incorporated into actions carried out under the Water Quality Partnership, should include the following components:

---

[61] WAT § 106.3 (a).
[62] Senate Floor Analysis, AB 685, 08/23/2012.
[63] This policy is also noted in the Legislative Counsel's Digest for AB 685.
[64] SB 200 (Monning, 2019).
[65] WAT § 106.3 (b).
[66] SWB. *SAFER Needs Assessment*. Available at: https://www.waterboards.ca.gov/drinking_water/programs/safer_drinking_water/docs/draft_white_paper_indicators_for_risk_assessment_07_15_2020_final.pdf.
[67] SWB. *SAFER Needs Assessment: Executive Summary.* P. 23 Available at: https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/needs/executive_summary.pdf

- **Include a vulnerability analysis of Disadvantaged Communities (DACs) and drinking water supplies in order to protect drinking water for these vulnerable beneficial uses and users.** Although rural domestic and small water system demand does not contribute substantially to the overdraft conditions, drinking water users could face significant impacts, particularly if the region faces another drought. Without a clear commitment and timeline for actions regarding establishing groundwater allocations or reductions in groundwater pumping, the SVB GSA may create disparate impacts on already vulnerable communities. See comments submitted by CWC and San Jerardo Cooperative on April 23, 2021 regarding Chapter 8 of SVB GSA Subbasin GSPs for further recommendations for conducting well impact analyses.
- **Develop a trigger system for both groundwater levels and quality in collaboration with stakeholders, in particular groups that are more susceptible to groundwater elevation and quality changes. Stakeholder recommendations provided back to the GSA should be incorporated into quantifiable measures, such as the GSP measurable objectives, MCLs, and numbers of partially or fully dry drinking water wells.**[68]
- **Ensure that the monitoring network is representative of conditions in all aquifers in general, including the shallow aquifer upon which domestic wells rely.**
- **Routinely monitor for all contaminants that could impact public health, including those with established MCLs, such as nitrates, and contaminants of emerging concern,through the representative water quality monitoring network.** Contaminated drinking water can cause both acute and long-term health impacts and can affect the long-term viability of impacted regions.[69] Among other causes, groundwater contamination can result through the use of man-made chemicals, fertilizers, or naturally-occurring elements in soils and sediments.[70] Routinely monitoring for contaminants will allow the GSA to accurately monitor for impacts on the most vulnerable beneficial users, and protect DACs' and domestic well owners' access to safe and affordable drinking water.[71]
    - **For monitoring network wells with contamination less than 75% of the MCL for all contaminants, the GSP should set MOs at 75% of the MCLs.** The GSP should include MOs as action triggers at 75% of MCL for each constituent of concern so that groundwater can be managed in that area to prevent a minimum threshold

---

[68] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*
[69] Community Water Center. (2019). Guide to Protecting Drinking Water Quality Under the Sustainable Groundwater Management Act. https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.
[70] See previous Community Water Center (2019) reference.
[71] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

exceedance at a representative monitoring well.[72] This buffer is particularly critical with contaminants like nitrate that can cause acute health effects. As discussed in previous submitted comments, water quality impacts can intensify as water levels decrease.[73] If the GSA waits until a minimum threshold set at an MCL is exceeded, it may be too late or difficult for actions to be protective of public health and prevent undesirable results. Actions to prevent minimum threshold exceedances should also be clearly explained in this Chapter including a description of what action will be taken, what type of evaluation will be used, under what time period action will take place, and how this action will be funded.

- **Include a combination of different strategies for mitigation including: replacing impacted wells with new, deeper wells, connecting domestic well users to a nearby public water system, or providing interim bottled water.**
- **Include an implementation timeframe, budget, and funding source**.[74] As currently written, the Dry Well Notification System suggests convening "a working group to assess the groundwater situation if the number of wells that go dry in a specific area cross a specified threshold." We support emergency response if one or more wells are impacted, and also request that this section be updated to include strategies to prevent impacts from occuring in the first place. Additionally, plans to address and mitigate those impacts should be solidified beforehand so resources can be mobilized in a timely manner. Drinking water users cannot afford to wait for interim plans to be developed once their primary sources of water for drinking, cooking and hygiene are compromised.

In response to our previous comments, the SVB GSA stated:

> "Thanks for support of the program (now titled Dry Well Notification System). This program focuses on access, not quality. A robust drinking water well mitigation program falls within the responsibilities of other agencies; however, the GSA may consider supporting such a program. The text has been revised to explicitly include it as a potential program that the GSA can collaborate with other agencies on through the Water Quality Partnership. To set MOs at 75% of the MCLs for drinking water, the GSA would need to take on responsibility for cleaning up groundwater contamination present prior to 2015, which would take significant effort and is not the GSA's responsibility. The GSA does acknowledge the need for action on water quality, and will work with other agencies to determine what the GSA's role in that is."

[72] This recommendation was also made previously in a comment letter to SVB GSA from CWC and San Jerardo Cooperative regarding Chapter 8 of the 180/400 ft Aquifer GSP on November 25, 2020, as well as in our comments to the SVB GSA on April 23, 2021 regarding Chapter 8 of drafts for the SVB GSA Subbasin GSPs.

[73] Community Water Center and Stanford University. Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium. (2019). https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

[74] See previous reference for *Framework for a Drinking Water Well Impact Mitigation Program.*

Our response:

A drinking water well mitigation program deals with more than just water quality. Such a program also protects wells from becoming dewatered due to lowering groundwater levels. As both pertain to the GSA's mandate to manage pumping in the basin in a way to avoid undesirable results, a drinking water well impact mitigation programs would be appropriate and should be required in the SVB GSA Subbasins.

- In regard to water quality, the GSA has responsibilities, mandated by statute, to prevent significant and unreasonable degradation of water quality.[75] DWR has clarified that water quality is a meaningful component of GSA management and has specifically given corrective instructions to SVB GSA, as cited in our prior comments and above. As this is such a critical point of contention with the GSA, we again quote this section from DWR's 180/400 foot Aquifer Determination:
    - "[S]taff find that the approach to focus only on water quality impacts associated with GSP implementation, i.e., GSP-related projects, is **inappropriately narrow.** Department staff recognize that GSAs are not responsible for improving existing degraded water quality conditions. **<u>GSAs are required; however, to manage future groundwater extraction to ensure that groundwater use subject to its jurisdiction does not significantly and unreasonably exacerbate existing degraded water quality conditions."</u>**[76]
    - DWR clearly identifies the responsibility of the GSA to manage future groundwater extraction in order to prevent significant and unreasonable degradation of water quality conditions. DWR does not limit this duty to merely apply when the GSA regulates groundwater pumping for the purpose of maintaining sustainable groundwater levels, but rather posits an affirmative duty for the GSA to manage extraction in order to avoid exacerbating existing degraded water quality conditions. SVB GSA's jurisdiction does not hinge on whether or not a Subbasin Committee decides to instate allocations or pumping restrictions. SVB GSA does not have the power to discard this authority by opting against regulating pumping. Instead, SVB GSA is exercising its authority as an affirmative action to continue to allow pumping at current rates.
- DWR clarifies further:
    - "Where natural and other human factors are contributing to water quality degradation, the GSAs may have to confront complex technical and scientific issues regarding the **causal role of groundwater extraction and other groundwater management activities**, as opposed to other factors, in any continued degradation; but **<u>the analysis should be on whether groundwater extraction is causing the degradation</u>**

[75] Cal. Water Code § 10721(x)(4).

[76] Department of Water Resources. (2021). *Statement of Findings Regarding the Approval of the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan.* Pp. 26-27. (Internal citations omitted; emphasis added). Available for download at: https://sgma.water.ca.gov/portal/gsp/status.

in contrast to only looking at whether a specific project or management activity results in water quality degradation."[77]
    - SVB GSA must establish a viable plan to prevent the exacerbation of degraded water quality conditions in the basin. In response to previous comments, SVB GSA asserted, "Groundwater quality is included within the purview of the SMC TAC, so it can make recommendations of projects that mitigate groundwater quality degradation for drinking water users, including impacts due to pumping."

Recharge Projects (Direct or Indirect)

We offer the following overarching comments regarding Recharge Projects in the Subbasin GSPs:

- **Assess constituents in the ground before using land for recharge, to avoid further contamination.** Reference the Groundwater Recharge Assessment Tool (GRAT) developed by Sustainable Conservation.[78]
    - On-farm recharge has the potential to further spread contaminants. Soil contaminants should be measured before dedicating the land to recharge purposes. "Short-term" impacts on domestic wells due to recharge efforts, which can include increased leaching of certain contaminants such as uranium, or displacement of contaminant plumes, should be mitigated in order to minimize the harm to beneficial drinking water users, and to replace water sources if compromised.[79]
- **In order to achieve successful recharge management, the GSA must identify where groundwater contaminant plumes are currently located, in order to then assess whether recharge projects could cause problematic movement of plumes. Implement recommendations from our previous comment letters regarding Section 5.4:**
    - "**[I]nclude a specific discussion, supported by maps and charts, of the spatial or temporal water quality trends for all constituents that have been detected in the subbasin and may affect drinking water beneficial users, as required under 23 CCR § 354.16(d).** This section should include water quality data (both in map and tabular form) for all constituents (where available) with primary drinking water standards that have been detected in the subbasin including, but not limited to, nitrate, 123-trichloropropane, hexavalent chromium, arsenic, uranium, and perchlorate for all public drinking water wells, state and local small water system wells, and private domestic wells. It is especially important for all groundwater stakeholders to be able to understand and visualize the location of contaminant hotspots throughout each subbasin.

---

[77] *Id.*

[78] Sustainable Conservation. *Groundwater Recharge Assessment Tool.* Available at: https://suscon.org/wp-content/uploads/2016/08/GRAT-Summary-8-2017.pdf.

[79] Community Water Center and Stanford University (2019). *Groundwater Quality in the Sustainable Groundwater Management Act (SGMA): Scientific Factsheet on Arsenic, Uranium, and Chromium*. Available at: https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1560371896/CWC_FS_GrndwtrQual_06.03.19a.pdf?1560371896.

- **Present maps and supporting data for all constituents of emerging concern.** The review of water quality data in the groundwater conditions section of the draft Section 5.4 in the subbasin GSPs is focused primarily on nitrate. The GSPs identify numerous constituents that have been detected in groundwater above drinking water standards, but, with the exception of nitrate, do not present this data spatially. Even though the subbasin GSPs set water quality minimum thresholds for additional constituents (See Tables 8-4 and 8-5), the supporting data is not all presented, and no analyses of spatial or temporal water quality trends are presented. This does not present a clear and transparent assessment of current water quality conditions in the subbasin with respect to drinking water beneficial use (23 CCR § 354.16(d)).”[80]

- We appreciate the identification of multi-benefit improvements to streams, and agree that slowing the speed of groundwater in its course of movement is a useful way to increase recharge. Such improvements to multi-benefit streams are a cost-effective and low-harm recharge method.

Reoperation of Reservoirs

We offer the following overarching comments regarding Reoperation of Reservoirs projects:

- **Conduct holistic cost-benefit analyses for large-scale infrastructure projects such as the MCWRA Interlake Tunnel and Spillway Modification, taking into account the specific benefits that projects will or will not confer on underrepresented communities and DACs, including the San Jerardo Cooperative in the Eastside Subbasin.**
    - Benefits should be equitable and take into account how different climate projections would impact the potential benefits from such a project in the case of little to no rainfall.
    - Cost-benefit analyses should also consider alternatives that could provide affordable long-term benefits.
- **The MCWRA Drought TAC should ensure that all beneficial water users are considered, and that drinking water needs are particularly protected from harm during current and future droughts, in line with the Human Right to Water.**

Management Actions

Conservation and Agricultural BMPs

- **Best Management Practices (BMPs) should utilize the latest technologies and take advantage of opportunities to modify agricultural pumping needs in order to provide overall groundwater basin benefits for all beneficial users.**

[80] Community Water Center and San Jerardo Cooperative, Inc. *Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins.* (April 2021). P. 7. On file with SVB GSA and available at: https://drive.google.com/file/d/1wH7wvCMmQd4bu_PIri5o66_y5caW9ti7/view.

- **BMPs should also be used as a mechanism to improve or stabilize groundwater quality by using evapotranspiration (ET) data with soil moisture sensors and soil nutrient data to promote efficient irrigation practices and limit the application of synthetic fertilizers.**
- **BMPs should include best available science, including climate-smart approaches and nature-based solutions which have been recognized on state, national, and international levels.** For example, while written with the Central Valley in mind, FoodFirst's *Healthy Soils, Healthy Communities* outlines the following strategies and benefits which can also be applied to the Central Coast:
  - **Soil organic matter can reduce soil fumigant emissions** – Pesticides applied directly to soils form short-lived climate pollutants, and contribute to air and water pollution. Increased soil organic matter can reduce fumigant emissions and reduce the need for fumigants in the first place.
  - **Soil organic matter slows water contamination** – Synthetic fertilizer and pesticides have contaminated drinking water in the Central Valley over the last 70 years. Soils higher in organic matter leach fewer pollutants, including nitrates and pesticides. Soils high in organic matter also require less synthetic fertilizer to produce a crop. Using compost instead of synthetic fertilizer can reduce nitrogen loads in the area. Over time, increased soil organic matter and riparian restoration could help reduce groundwater contamination.
  - **Composted manure from dairies could be a source of soil organic matter** – Concentrated manure from industrial dairies is a major local air quality and water quality issue. If that manure were properly composted, it could become a source of valuable nutrients and soil organic matter instead of a pollutant, and help displace the use and manufacture of synthetic fertilizers.[81]
  - **Composting farm waste could prevent black carbon emissions** – Instead of burning orchard waste, another local air pollutant, mulches and composted farm waste could be a source of soil organic matter for farms and rangelands.
  - **BMPs are an opportunity for rural workforce development and wildfire management** – From the Conservation Corps, to ecological restoration, nursery stock production, wetland management and fire prevention, there is a lot of work to do to conserve and increase terrestrial carbon on public and private lands. This is an opportunity to both train and employ young people with low-to-moderate incomes and in communities of color in natural resource and agricultural management.
  - **Carbon-friendly practices can support small-scale and immigrant farmers** – Public support for carbon-friendly practices could help make small to mid-scale and immigrant farmers more resilient and boost their bottom line through a combination of financial support for carbon-friendly practices and more stable land access. These programs will

[81] USDA. *Manure in Organic Production Systems.* Available at: https://www.ams.usda.gov/sites/default/files/media/Manure%20in%20Organic%20Production%20Systems_FINAL.pdf. (Citation added).

have to be accessible to small-scale farmers and take into account chronic issues around access to land, credit and technical assistance.

Fallowing, Fallow Bank, and Agricultural Land Retirement

- **Dewatered drinking water wells or migration of contamination plumes should be considered as factors when deciding where to incentivize targeted agricultural fallowing or land retirement, and should trigger pumping restrictions in affected areas as necessary.**
  - This approach is further elaborated in the Drinking Water Well Impact Mitigation Framework.[82]

SMC Technical Advisory Committee (TAC)

- **Ensure that this TAC functions as a public decision-making space and not a consultative committee.** Discussions regarding SMCs and how or whether to intervene when conditions approach MTs should be fully public and held under Brown Act rules. These discussions are core to the management of the basin and necessarily must be informed by stakeholder input.
  - Additionally, plans to prevent and/or mitigate potential undesirable results should be finalized *prior* to the emergence of such conditions. We note that the formerly proposed Forebay Drought/Pumping TAC has been adapted to mirror the Upper Valley's SMC TAC and emphasize that planning for drought conditions must be done before those conditions arise, not as an improvised reaction in the moment. Such a delay in planning would be counter to the spirit and letter of SGMA.
- **Create management zones with pumping restrictions in areas with vulnerable drinking water wells.**
- **The SMC TAC should consider and recommend projects and management actions that mitigate groundwater quality degradation for drinking water users due to GSA actions, including impacts resulting from over-extraction under GSA management, as was clarified in DWR's 180/400ft Aquifer Determination Letter on pages 26 and 27.**

Pumping Allocations and Control

- **Quantify the demand reductions (pumping restrictions) necessary to meet all minimum thresholds in the short and long term, including in dry conditions.** Designing a feasible and effective allocation structure requires thorough groundwater elevation data as well as a comprehensive, ongoing assessment of the interrelated effects of SMCs on one another. Pumping allocations must be responsive to groundwater conditions throughout the basin and avoid undesirable results.
- **Parameters for pumping restrictions in times of widespread water shortages should be decided ahead of time as part of a publicly-informed, adaptive management approach.** Decisions around pumping regulation should be made as part of GSP development and not relegated to a later decision-making body which will be inherently less accountable to the public than SVB GSA's current Committees and Board. It will not be sufficient to solely bring pumping

---

[82] Self-Help Enterprises, Leadership Counsel for Justice and Accountability, Community Water Center. (2020). *Framework for a Drinking Water Well Impact Mitigation Program*. Available at: https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ca9389712b732279e5296/1597811008129/Well_Mitigation_English.pdf.

decisions to the public after actions have already been designed and are at the point of being approved. Lack of public input for such a critical component of the GSA's management is especially troubling in the negative—if action is not being taken.

- **As part of an adaptive management approach, pumping restrictions should be implemented by the GSA in a timely way so as to prevent harm to beneficial users, particularly vulnerable drinking water users and DACs.**
- **Consider hybrid allocation systems which account for de minimis users, regardless of homeownership status, to ensure sustainable yields for all beneficial users.** Langley GSP proposes such a hybrid allocation system in which de minimis users are included within the estimated sustainable yield. This approach will provide a more complete picture of groundwater use within the basin, to inform groundwater management decisions.

Implementation Projects

CWC and San Jerardo see value in the projects listed in this section, though we point out insufficiencies below and offer recommendations for how these proposed projects should be adjusted so that they will support SVB GSA in coming into compliance with SGMA. We also note that "Implementation Projects" is a separate category of GSA management activities that SGMA does not specify, and believe these projects should be integrated into either the Projects or the Management Actions sections.[83] GSA activities that are necessary to meet SGMA requirements, such as those intended to prevent a water quality UR, should fit within either Projects or Management Actions.

Groundwater Elevation Management System (GEMS) Expansion

- **Include data from more drinking water wells, including small water system wells and domestic wells, in order to have a sufficiently representative monitoring program.**

Water Quality Partnership (formerly Domestic Water Partnership)

CWC would like to voice conditional support for the Water Quality Partnership, as a step towards coordinating local and regional responses to water quality issues. However, the GSA remains directly responsible for recognizing and resolving water quality degradation that results from its policies and projects.

- The GSA must clarify the role that it will play in this partnership in dealing with water quality issues. Water quality is an integral part of SGMA, one of the six Undesirable Results that GSAs are tasked with preventing while achieving sustainability.[84] Impacts from extraction, including due to overdraft and projects and management actions undertaken by the GSA, fall under the purview of the GSA and should be tracked and remedied according to the GSP. Thus, the GSP must include plans to respond to problems should they arise. If, for example, a contaminant plume were to begin migrating based on pumping patterns or a project/MA, the GSA is not permitted to allow that problem to progress unchecked. If the GSA wishes to collaborate with

[83] 23 CCR § 354.44

[84] Cal. Water Code § 10721, subd. (x)(4). "Undesirable result" means one or more of the following effects caused by groundwater conditions occurring throughout the basin: ...(4) Significant and unreasonable degraded water quality, including the migration of contaminant plumes that impair water supplies.

other regulatory agencies who also deal with water quality issues as a way to fulfill its obligations, the GSA should enter into a Joint Powers Agreement (JPA) or a formal Memorandum of Understanding (MOU) in order to formalize the roles and responsibilities. Otherwise, DWR cannot determine whether the plan is sustainable.[85]

- As currently drafted, the Water Quality Partnership only guarantees one meeting per year, and a review of water quality conditions resulting in a report. These proposed actions are not sufficient to ensure that the GSA is equipped to prevent or react to exacerbated water quality should those impacts occur.
- **The GSA should work with local and regional water agencies or the county to implement groundwater quality remediation projects to prevent degradation and potentially improve both groundwater quality as well as groundwater levels to ensure groundwater management does not cause further degradation of groundwater quality.[86]** The strategic governance structure of GSAs can uniquely leverage resources, provide local empowerment, centralize information, and help define a regional approach to groundwater quality management, unlike any other regional organization. When implemented effectively, GSPs have the potential to be instrumental in reducing levels of contaminants in their regions, thus reducing the cost of providing safe drinking water to residents. GSAs are the regional agency that can best comprehensively monitor and minimize negative impacts of declining groundwater levels and degraded groundwater quality that would directly impact rural domestic well users and DACs within their jurisdictions. When potential projects are proposed, SVB GSA should consider how projects could potentially both positively and negatively impact groundwater quality conditions and should take leadership in coordinating regional solutions.
- **Include - without delay - Monterey County water quality data for state and local small water systems.** This data is readily available and would add significantly to the proposed water quality monitoring network in draft subbasin Chapters 7. We do not want this potential partnership implementation/management action to delay the incorporation of this important data source. This action can and should, however, integrate this County data into current draft subbasin plans in order to identify potentially vulnerable populations and create management actions to protect them.
- **Integrate key components of a Drinking Water Well Mitigation Program Framework in order to protect drinking water users from losing access to their drinking water during GSP implementation.** CWC was informed by SVB GSA Staff that concepts from the Mitigation Framework were being incorporated into the Water Quality Partnership language in the GSP, but we do not see evidence of this in the current draft. CWC would like to coordinate with SVB GSA Staff to incorporate this item into the agenda of one or more of the remaining 2021 Advisory and Board meetings in order to present on the Framework to the Committees and Board.

[85] Cal. Water Code §§ 10721, subd.(x)(4) and 10723.6.
[86] Community Water Center and San Jerardo Cooperative, Inc. *Comments on the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan.* May 15, 2020. On file with SVB GSA and available at: https://sgma.water.ca.gov/portal/service/gspdocument/download/4012.

- **Integrate water quality considerations across planning and implementation.** As now acknowledged in the GSPs, groundwater quality in the Subbasins can be influenced by pumping and the way groundwater is managed. This is of particular importance for the San Jerardo Cooperative which has experienced increases in nitrate and arsenic in their well, as highlighted in our cover letter and previous comments.[87] This relationship between groundwater levels and groundwater quality should be reflected throughout planning and implementation so that the GSA can manage the basin in a way that does not exacerbate water quality degradation.
  - Support for this recommendation is evidenced by Recommendation #5 of DWR's 180/400 GSP Determination.
- **Fill previously identified water quality data gaps in baseline information and the monitoring network.**
  - DWR assessed water quality monitoring in the 180/400 Foot Aquifer as follows: "The monitoring network to evaluate degradation of groundwater water quality is based on three existing water quality regulatory programs operating in the Subbasin: Monterey County's small community water system wells program, the State Water Resources Control Board's public supply well program, and the Central Coast Water Board's Irrigated Lands Regulatory Program. The Plan proposes to use four sets of wells that are routinely sampled under these programs. Within each set of wells, a specific set of constituents of concern will be monitored. In total, the monitoring network consists of 136 small community water system wells, 51 public supply wells, and a currently unknown number of domestic and agricultural wells from the Irrigated Lands Regulatory Program. The specific number of Irrigated Lands Regulatory Program wells will be finalized when the Central Coast Water Board adopts Agricultural Order 4.0 (anticipated in 2020). The Plan identifies the lack of well construction information (e.g., the depth of well screens or the total depth of the well) for many groundwater quality monitoring wells as a data gap. The implementation chapter of the Plan simply states that "[d]uring implementation, the SVBGSA will obtain any missing well information, select wells to include in monitoring network, and finalize the water quality network." Department staff recommend the SVBGSA provide updates on the progress toward filling this data gap in its annual reports and that more details be provided in the first five-year assessment of the Plan."[88] The remaining SVB GSA Subbasins should match a similar standard for their monitoring systems, and anticipate the need to show progress on filling data gaps in annual reports and at the five year update.

---

[87] Community Water Center and San Jerardo Cooperative, Inc. *Comments on the Draft Salinas Valley GSP Chapters 1-8 for the Langley, East Side, Forebay, Upper Valley and Monterey Subbasins.* (April 2020). Pp. 4-5. On file with SVB GSA and available at: https://drive.google.com/file/d/1wH7wvCMmQd4bu_PIri5o66_y5caW9ti7/view.

[88] Department of Water Resources. (2021). *Statement of Findings Regarding the Approval of the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan.* Pp. 30-31. (Internal citations omitted). Available for download at: https://sgma.water.ca.gov/portal/gsp/status.

Dry Well Notification System (Previously Localized Groundwater Elevation Triggers)

The Dry Well Notification System, which is designed to "assist well owners (domestic or state small and local small water systems) whose wells go dry due to declining groundwater elevations" is an important potential component of the Subbasin GSPs, for tracking and responding to impacts due to droughts and overdraft. We support the inclusion of a "notification system whereby well owners can notify the GSA or relevant partner agency if their well goes dry," particularly linking them to DWR's reporting website. We also support the proposal that the GSA "could set up a trigger system whereby it would convene a working group to assess the groundwater situation if the number of wells that go dry in a specific area cross a specified threshold. A smaller area trigger system would initiate action independent of monitoring related to the groundwater level SMC." We encourage SVB GSA to commit to incorporating this project into implementation. Implementation of the Dry Well Notification System would significantly increase the GSA's ability to track and address impacts to domestic wells. To further improve upon the program's efficacy, we recommend:

- **Integrate technical assistance into this program, facilitate access to resources through a collaboration with state agencies and/or directly administer impact mitigation funding.**
    - Tracking instances of dry or depleted wells and linking impacted beneficial users to information about potential available resources is a positive step, however services such as directing DACs and other impacted drinking water users to apply for funding would only be minimally helpful while those households are experiencing a water shortage crisis. The GSA's efforts to respond to impacts due to low groundwater elevations should go further in order to be effective. Such services should include reducing pumping in areas where groundwater supply shortages are being exacerbated by over extraction, actively facilitating coordination between residents and assistance programs, and potentially providing a conduit to state funds directed towards water resiliency—a multi-billion dollar drought & water resiliency package was recently passed by the State Legislature.

Well Registration

- **We recommend that SVB GSA require all wells that pump over two acre-feet per year to be metered and charge fees based on the amount of water pumped, to pay for future projects and incentivize voluntary reductions.**

Support Protection of Areas of High Recharge

- **Develop criteria for recharge projects that prevent unintended impacts to drinking water.**
- **As with all recharge projects, evaluate whether recharge could have any unintended consequences such as moving contaminant plumes toward wells, thus degrading the water quality, and closely monitor water quality in all areas affected by recharge.** The GSP states that "[t]hese areas are typically identified using soils and soil classification maps but would need additional investigation and data to confirm." Accurate mapping of water quality issues in the basin is also crucial in order to prevent unintended water quality impacts.
- **Where applicable, encourage use of low-impact cover crops where water is captured at the site of precipitation or flooding.** Roots in the soil help to capture more water, clean the water source, and maintain healthy soils so that less fertilizer/pesticide is used, as evidenced in organic

and regenerative agricultural practices. Cover crops and compost cycles, as well as chicken manures or natural organic-matter fertilizers can also keep nitrogen in the soil longer, providing benefits to crops and keeping nitrate out of groundwater.

Deep Aquifers Study

- We support the Deep Aquifers Study due to the influence that hydrogeologic interconnections between aquifers in the Salinas Valley Basin would necessarily have on influencing better sustainable management of the basins.

New Water Supply Projects

- **Quantify which combinations of projects could address projected overdraft and what the costs of those combinations would be.** With high costs, permitting and other challenges, there is a high degree of uncertainty whether each project can be implemented. As written, it is difficult to evaluate how feasible it is to address overdraft via the options provided.
    - For example, in the Eastside GSP draft, Table 6-15 in Chapter 6 projects 20,400 AF/yr overdraft in 2030 and 20,500 AF/yr overdraft in 2070. Table 9-8 in Chapter 9 lists projects that could mitigate overdraft. However, Table 9-8 only quantifies benefits for some of the projects, and often for the Salinas Valley basin as a whole as opposed to the Eastside Subbasin. The table also omits costs. This information will be critical for planning and implementing projects to address overdraft.
- **Factor in known uncertainties when determining which projects to prioritize in implementation.** At the top of pg 9-24 for 11043 Diversion at Chualar, and also for 11043 Diversion of Soledad, the GSP states that the groundwater model used to estimate Salinas River flows "does not account for the uncertainty surrounding greater variations in precipitation, timing, intensities and subsequent flows." The model should provide a sensitivity analysis for potential conditions, particularly in light of large variations between climate change predictions in the region.
    - This recommendation is also in line with DWR's 180/400 Determination which instructs SVB GSA to determine how they will define "average hydrogeological conditions," in Section 4.3.3.2 and the overarching statutory requirement to continually update the GSP to meet the statutory requirement to use the "best available information and best available science."[89]
- **Where projects overlap between subbasins, clarify what effects the project will have across subbasins.** For example, provide clarity around what effects the Eastside Irrigation Water Supply Project (or Somavia Road Project) will have on the 180/400 Foot Aquifer Subbasin where water will be pumped from. Account for any effects in the 180/400-Foot GSP in ongoing updates, including pertinent sections of Annual Reports.

[89] 23 CCR § 355.4(b)(1). "When evaluating whether a Plan is likely to achieve the sustainability goal for the basin, the Department shall consider the following:
(1) Whether the assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are reasonable and supported by the best available information and best available science."

- **Quantify what the sustainable yield is for the entire basin.** This calculation should be done to ensure that the water budgets balance across all the Subbasin Plans.

GSP Chapter 10: Groundwater Sustainability Plan Implementation

Our overarching recommendations for GSP Implementation and Updates are as follows:

- **Take interim actions while working toward long-term sustainability.**
- **Address missing data for domestic wells as recommended by DWR:**
    - "[T]he GSA should inventory and better define the location of active wells in the Basin and document known impacts to drinking water users caused by groundwater management … in subsequent annual reports and periodic updates."[90]
- **Continue to include the small water system data from the County as a data gap in the subbasin GSPs, as it was in the 180/400 foot Aquifer GSP.** As Tom Berg, a DWR representative, indicated at the SVB GSA Advisory Committee meeting on June 17, 2021, the specific decisions made during the formation of the 180/400 foot Aquifer GSP allowed for it to receive DWR's approval. Mr. Berg recommended that the SVB GSA review the three other letters that DWR released on June 3, 2021, to better understand the parameters of what is required for a GSP to receive approval.
- **Engage underrepresented communities immediately.** As this section acknowledges, underrepresented communities have little or no representation in water management and have often been disproportionately less represented in public policy decision making. It is important to note that their engagement and input around their main concerns must be noted and considered during routine GSA proceedings. Their input should be (or rather should have been) solicited and received while the GSP formation process is/was still active.
- **Continually update the GSP and Implementation strategy as best available science[91] evolves.** Meaningful updates to data sources and interpretation should occur at a minimum on a yearly basis, timed with the Annual Reports.

[90] Department of Water Resources. (2021). *Statement of Findings Regarding the Approval of the 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan.* P. 24. Available for download at: https://sgma.water.ca.gov/portal/gsp/status.

[91] 23 CCR § 355.4(b)(1).

Friday, October 15, 2021

Salinas Valley Basin Groundwater Sustainability Agency SVBGSA Public Comments Form

Name Douglas Deitch

Organization Monterey Bay Conservancy (MBC)

Email Address siddhartha1002@gmail.com

Subbasin Langley Eastside Forebay Upper Valley Monterey Whole Basin 180/400

Chapter Salinas Valley Basin GSA (entire)

Comments

https://twitter.com/DouglasDeitch/status/1375814806364594178/photo/1

Part I-General comments on balkanized/"sub basined" and too many Monterey Bay GSAs, our ground water commons, our Water Berry (and other similar) Ponzi Schemes (MBC @ CCC 2009 @ http://www.begentlewiththeearth.org , http://ourinconvenienttruth.net http://ourinconvenienttruth.org http://ourinconvenienttruth.com & 2011 @ http://douglasdeitch.com http://douglasdeitch.net & MBC @ http://dougforassembly.com @ SWRCB requesting SWRCB Monterey Bay Regional "Intervention" for the first time in 2016 @ 11:21 @ http://thebestthatmoneycantbuy.org), and their ongoing and worsening (terminal?) tragedy ... and our Alternatives

1. "Those who cannot remember the past are condemned to repeat it." :
"Toolittle/toolatefortheCentralValley (and Monterey Bay's $5 billion+ annual production) &it'sAG?
Those who cannot remember the past are condemned to repeat it, like we have forgotten in the Monterey Bay w/ berries&Driscolls/Reiter (et al) instead of cotton&Boswells@ http://youtube.com/watch?v=I5uloOJ5m1o&feature=youtu.be
http://santacruzfoods.com

https://twitter.com/DouglasDeitch/status/1448627629557354500

Alternative#1 @ Living within our means @ http://dougdeitch.info , 1995 Zmudowsky Beach 43 acre Pilot Project @ http://dougdeitch.com & @ MBC @ CCC in 2011 @ https://www.youtube.com/watch?v=ija6HUdP-eY

2. "VAST majority of the water/food/RE resources of World's 5th biggest economy/Community are inextricably tied to SFBay/Delta/Sierra-Snowpak&CentralValleyag. CCC predicts 3.5ftSLR in 30 years@ http://documents.coastal.ca.gov/assets/slr/CCCendorsement_SLRPrinciples.pdf .
5:42@ http://pebblebeachrealestate.com Dr.Mount sez what 1 foot will do!"
https://twitter.com/DouglasDeitch/status/1374672809163550720

Question #1: If one foot of SLR will "salt up" the Delta, as Dr. Mount tells us in 2015, how, for example will this same one foot SLR affect our already overuse/critically overstressed local ground water commons? How is this above referenced projected CCC 3.5 feet SLR in next 30 years accounted for, if at all, in any current Monterey Bay GSA, particularly the only and first two and already approved ones in this or your, my, and GM/Santa Cruz Mayor Meyer's neighbor's and partner's "Mid County Ground Water Agency" and the sustainability of each's respective ground water basins and "sub basins"? Here's my recent comment to the CCC on this exact issue:

"Good Afternoon Dear Chair and Commissioners,

Please find my four (4) comments (in reverse order) I tendered last Friday, as described in the "Subject" of this email, and various attached images/articles/etc. w/ some repetition? (please excuse)

I hope you will have the opportunity to review them and watch the 12 minute VICE video @ I suggested you please review @ www.sandiegorealestate.com (and elsewhere) at the last real public in person meeting you had in March 12 of 2020, so long ago,

... @ minute/second 12:12 @ https://cal-span.org/unipage/?site=cal-span&owner=CCC&date=2020-03-12&mode=large&fbclid=IwAR1Fh5WDXG7kaFHIj0NvpnIe58Ry8zsMXnsOAd3cgJZ9poK5LjQjXQPqW-E

Best/health/tikkun olam,

Respectfully,

Douglas Deitch

MBC

831.476.7662

http://sipodemos.democrat

http://lomejorqueeldineronopuedecomprar.com

www.dougdeitch.info

-------- Forwarded Message --------
Subject: Fwd: Please add Additional Comment 4. + attached image (Fwd: Comments on "public review draft of Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone")
Date: Fri, 24 Sep 2021 15:17:27 -0700
From: ddeitch@pogonip.org
To: StatewidePlanning@coastal.ca.gov, Ddeitch

4. continued: Here is the MC Weekly 2018 article mentioned below @ https://www.montereycountyweekly.com/news/local_news/as-seawater-intrusion-advances-new-farmland-puts-marina-s-water-supply-in-peril/article_b35ca7e0-f66e-11e7-b541-57771b472126.html

"As seawater intrusion advances, new farmland puts Marina's water
supply in peril.

* David Schmalz

* Jan 11, 2018
* Along Highway 1 just north of Marina, what has been grassland for
decades is turning into row crops. A look at satellite images on
Google, stretching back to 1984, shows that farming on the property,
known as Armstrong Ranch, started in 2014 just south of the Marina
landfill.

Expect that trend to continue: On Nov. 21, 2017, Valle Del Sol Properties LLC bought 1,784 acres of Armstrong Ranch for $81.5 million. (Monterey County Assessor Steve Vagnini says the price per-acre, just over $45,000, is in keeping with local agricultural land values.)

Three new ag wells have been drilled on the property since 2015, and an application for another is currently being processed by the county. But here's the rub: The wells are pumping from an ancient, finite water source. It's the same water source that residents of Marina and the former Fort aquifers, named for their respective depths – is impaired by seawater intrusion, a process that occurs when excessive pumping creates a pressure differential that draws seawater into the aquifers, fouling their water with salt.

The only groundwater available to irrigate the property is in the so-called deep aquifer, an ancient groundwater supply 900-plus-feet underground that is not recharging through natural mechanisms. Scientists believe the water is probably more than 20,000 years old.

The only recharge to the deep aquifer, hydrologists say, comes from leakage from overlying aquifers. In the coastal area around Marina, those aquifers are already compromised by seawater intrusion, making them unusable as municipal or irrigation water supplies.

Pumping from the deep aquifer is considered "water mining," and has long been viewed as a last-ditch water supply that is both expensive to tap – it costs upwards of $1 million to drill a well into it – and risky to rely on because its quantity is unknown. Yet Marina Coast Water District, which supplies the city of Marina and the former Fort Ord, pumps roughly 50 percent of its water from the deep aquifer. (In 2017, that came out to 1,587 acre-feet of 3,239-acre feet.)

In October, Howard Franklin, senior hydrologist with the Monterey County Water Resources Agency, presented six recommendations to the County Board of Supervisors to help combat worsening seawater intrusion.

Among those recommendations was a moratorium on new wells in the deep aquifer until a study determines its viability as a water supply..."

"All wells in the deep aquifer are of concern with respect to the recommendations," Franklin says. "This is an urgent situation. This is imminent."

According to Michael Cahn, an irrigation water resources adviser with UC Cooperative Extension in Salinas, an acre of strawberries requires about 2.5 to 3 acre-feet of water annually.

That means if the entire 1,784 acres were converted to strawberries, it would require in excess of 4,000 acre-feet of water annually – more than Marina Coast's current annual production.

Franklin, when articulating the urgency of the situation for Marina Coast, and others that rely on the deep aquifer, says the human-caused mechanism of recharge for the deep aquifer – leakage from overlying aquifers – does not happen easily, or quickly, but that it will happen in a matter of years.

"The damage is being done now, and the impact of that damage could be 10 years from now, but if you [pump the deep aquifer] today, the damage will occur," Franklin says.

Marina Coast does not have jurisdiction over new agricultural wells on Armstrong Ranch.

“It’s on our radar, and we’re concerned about it, but we’re not necessarily in the loop,” Marina Coast General Manager Keith Van Der Maaten says. “Unfortunately, I don’t think we’re as involved as we should be. We should have a more active role.”

The county’s Environmental Health Bureau processes applications for new wells, but while projects for residential water supplies face a gauntlet of bureaucratic hurdles, wells for agriculture are typically approved without any pushback.

That may change in the coming years with the formation of the Salinas Valley Groundwater Sustainability Agency, but ag wells in the region have so far have faced minimal regulation.

Marina Coast is currently exploring new potential water supplies, other than desalination. The agency is vying for up to $1 million in state grant funds – the grants will be awarded in February – to study water storage options in the aquifers around Armstrong Ranch.

The project would potentially seek to store excess winter flows in the Salinas River, which would make it similar to the Monterey Peninsula’s aquifer storage and recovery project in the Seaside Basin, where winter flows are pumped from Carmel River and injected underground.

Theoretically, Van Der Maaten says, Marina Coast could produce between 2,000-8,000 acre-feet of water annually with the project, and even send some of the water north to Castroville.

But he says there are still many unknowns, including whether it is technically feasible, whether Marina Coast could secure the water rights to those flows, and whether it would be economically feasible for Marina Coast to supply Armstrong Ranch farmland with water so that they stop pumping from the deep.

Van Der Maaten knows it won’t be easy, but the mission is clear: “We absolutely need to get into this deeper, and get people off the deep aquifer.”

---------- Forwarded Message --------

Subject: Please add Additional Comment 4. + attached images (Fwd: Comments on "public review draft of Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone")
Date: Fri, 24 Sep 2021 14:48:18 -0700
From: ddeitch@pogonip.org
To: Ddeitch , StatewidePlanning@coastal.ca.gov

4. The recent September 20, 2021 presentation by USGS and CCC staff (see attached images) on ground water and Sea Level Rise underlines and emphasizes the unadvisability and inherent risks and unknowns involved with our too many recent non DPR recycled water supply projects like Pure Water Monterey, Soquel, San Diego caused by sea level rise invading our ground waters despite our best efforts and intentions to prevent this.

At minute/second 5:41 @ the 12 minute VICE video at http://www.sanfranciscorealesatate.com , Dr. Jeff Mount in 2015 explains what just one foot of SLR will do to the Delta and the CCC plans for 3.5 feet SLR by 2050 (@ https://documents.coastal.ca.gov/assets/slr/CCCendorsement_SLRPrinciples.pdf) . So, just imagine what that same 1 foot of SLR will do to our coastal ground water, particularly in our already critically overdrafted coastal ground water basins and related new water supply infrastructure.

Now add to this uncontrolled and unplanned for increased ag coastal well pumping for new ag, such as is presEnt in the Pure Water Monterey area described in this Monterey Weekly article from a couple of years ago which will, at 5400 acre feet per year, completely offset the cleaned injected recycled water in the Monterey Pure Water expanded project.

-------- Forwarded Message --------
Subject: Comments on "public review draft of Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone"
Date: Fri, 24 Sep 2021 06:33:31 -0700
From: Douglas Deitch
To: StatewidePlanning@coastal.ca.gov, Ddeitch

"Thosewhocannotrememberthepast https://youtu.be/I5uIoOJ5m1o can't adapt to 3.5' in30yrSLR? @ https://twitter.com/DouglasDeitch/status/1374672809163550720 toprotectvastmajoritywater/food/re assets w/o 1. http://sipodemos.democrat 2. http://dougdeitch.info : https://t.co/2L1RYOqKrI http://dougforassembly.com ?" (https://twitter.com/DouglasDeitch/status/1426946751336914944)

Comments on "public review draft of Critical Infrastructure at Risk: Sea Level Rise Planning Guidance for California's Coastal Zone : "This Guidance focuses on adaptation of transportation infrastructure (Chapter 5) and water infrastructure (Chapter 6), including highways, roads, railroads, wastewater, stormwater, and water supply infrastructure."

1. "VAST majority of the water/food/RE resources of World's 5th biggest economy/Community are inextricably tied to

nt_SLRPrinciples.pdf . 5:42@ http://sandiegorealestate.com
Dr.Mount sez what 1 foot will do!" @
https://twitter.com/DouglasDeitch/status/1374672809163550720 :

Analysis & Conclusions: Due to this 2020 3.5 ft. SLR by 2050 "planning guideline/projection" (and other reasons like possible COVID19 and other possible contamination of our waste waters which cannot be cleaned (@
https://twitter.com/DouglasDeitch/status/1426593026571313152)

Additionally, this is why we must immediately begin investigation of feasibility and advisability of damming the Golden Gate run down @ http://sipodemos.democrat @ Linkedin:

CA - DWR

You Retweeted

Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRAT
@DouglasDeitch

Replying to
@CA_DWR
#CaWaterBoards
https://twitter.com/DouglasDeitch/status/1401916742541013000

DPRisbest! like @ my "NAUTURAL SOLUTION" @
http://dougdeitch.info and 21000 acre Monterey Bay Estuarine Nat'l Monument in the Monterey Bay, which will include up to 31k/a/f/yr from Castroville Reclamation Plant repurposed to urban, recharge, and conservation uses from ag use in perpetuity, to wit:

https://twitter.com/DouglasDeitch/status/1411648137878380551

*"Douglas Deitch, Balanced Law and Order Liberal Democrat for State
Senator*

September 14, 2019 ·
WELCOME TO www.DOUGDEITCH.info !!! ... Best SUSTAINABLE Monterey Bay region "SLR" (Sea Level Rise) water solution?
lomejorqueeldineroNOpuedecomprar.com /
lawandorderliberal.org
My 21,000 acre "Monterey Bay Estuarine National Monument" , etc. 'Water Fix" ..., of course.
The Castroville reclamation plant/project, run down @

1998 for around $75 million in Castroville.
This 31,000 acre feet/yr of water will be repurposed to urban use, further cleaned, processed, and distributed regionally and will easily supply and service all current and future Montrey Bay regionally urban water needs.
This will be accomplished by using the 12000 acres of land associated with this 31000 a/f/yr of water to it's highest and best use.
At present, this water is dedicated to exclusively ag use on 12,000 coastal ag acres at the mouth of the Salinas Valley to use instead of well water pumped at this location to protect the Salinas Valley from further salt water intrusion.
As farmland, this land is FMV worth around $50,000 per acre as farmland (https://www.santacruzsentinel.com/.../retired-federal.../). However, this 12,000 acres highest and best use is not as farmland but instead as a ground water conservation/aquifer recharge/ and estuarine habitat conservation/rehabilitation project, which actually doubles the FMV of this land to $100,000 per acre or $1.2 billion.
This land comprises roughly something under 5% (?) of irrigated farmland in the "Salinas Valley"
If this 12000 acres was publicly acquired and fallowed/or all well pumping ceased, along with another tract of 9000 acres of irrigated farmland at the mouth of the Pajaro Valley running from approximately Elkhorn Slough to Manresa Beach on the ocean side of Highway One in Santa Cruz County for 21000 acres in total to protect the Pajaro Valley from salt water intrusion in the same way, ag well pumping would stop on this 21000 acres and, @ 3 a/f/yr per acre for ag water, 63,000 a/f/yr of ground water, would be CONSERVED annually per year in perpetuity. Additionally, wouldn't this 63,000 a/f/yr be also de facto RECHARGED at these two most hydrologically critically important locations with the highest quality recharge water possibly available with the lowest cost and best "GREEN tech" water available possible anywhere, in perpetuity as well, ... the recharge water produced and recharged naturally by our best water purveyor named Ms. Mother Nature?
Correct.
This is what I call the "Monterey Bay Estuarine National Monument", and it is truly a national monument with the highest concentration of critically threatened critical estuarine resources and habitat of ANY LOCATION ANYWHERE IN THIS COUNTRY !!! Here's my already successful 25 year old "Pilot Project" @ "Willoughby Ranch" @ Zmudowski Beach @ to check out @ www.dougdeitch.com & www.dougdeitch.info (this page)... "Farmlands back to wetlands"
Query: Where's the $2.1 billion?
Response: Reallocated rail bond money billions to "water/habitat/environmental projects" aka "OPM" (...other people's money) and INFRASTRUCTURE FUNDING.

2. "I wonder what the latest SCIENCE is today re:"Removing the novel coronavirus from the water cycle"& our ground water injection of "cleaned"? recycled/injection water projects like "Pure Water Soquel"? Monterey San Diego etc? @
https://twitter.com/DouglasDeitch/status/142659302657131

3152/photo/1 ?

3. SWRCB must intervene in Monterey Bay immediately to achieve sustainability and proper, legal, and responsible water management in the entire Monterey Bay @ https://twitter.com/DouglasDeitch/status/1375814806364594178/photo/1

Respectfully submitted,
Douglas Deitch

ED/Monterey Bay Conservancy

540 Hudson Lane, Aptos, Ca., 95003

831.476.7662"

Question #2:This 2018 Monterey County Weekly article @ https://www.montereycountyweekly.com/news/local_news/as-seawater-intrusion-advances-new-farmland-puts-marina-s-water-supply-in-peril/article_b35ca7e0-f66e-11e7-b541-57771b472126.html#comments cites around 1800+/- new acres of ag & new well pumping @ 5400 a/f/yr which seems to approximately cancel/use up all the new Monterey One ASR water? ... Any unanticipated problems, present or future conflicts/miscalculations, etc in this regard here or not?

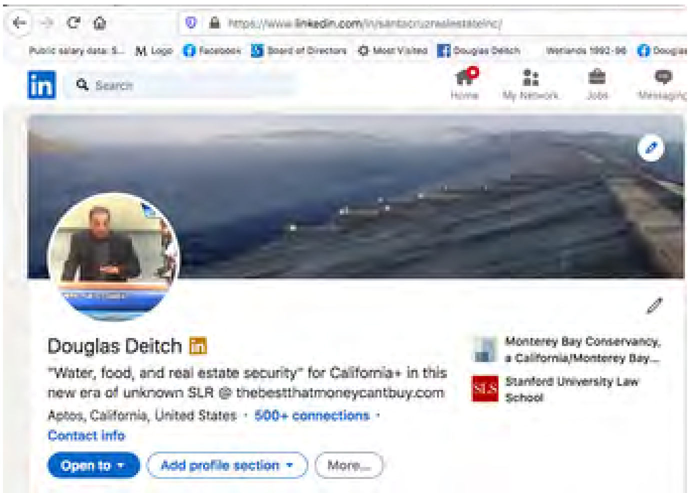
Please watch my most recent and 5th request for SWRCB INTERVENTION IN THE ENTIRE MONTEREY BAY water management and "control" just on August 3, 2021 @ 9:48 @ https://www.youtube.com/watch?v=A9KTIa0RDu8&t=919s and @ https://twitter.com/DouglasDeitch/status/1422889479061196803, my first request @ 11:21 @ www.thebestthatmoneycantbuy.org pictured below from April/2015, over SIX years ago, and please REVIEW the documents I am holding in my hand I presented and went through w/ SWRCB 4/16/15 during my presentation and first request for SWRCB INTERVENTION then @ http://www.dougforassembly.com , which only ONE current SWRCB board MEMBER then, Ms. Doreen D'Adamo, was present for?

... to be continued.
Respectfully,
Douglas Deitch/MBC
siddhartha1002@gmail.com

File Upload


Douglas Deitch 8-10-2011...California Coastal Commission Public Comment Ground Water
CAL SPAN.ORG
08-10-2011
3 GENERAL PUBLIC COMMENT
CALIFORNIA COASTAL COMMISSION


Douglas Deitch: Damming the Golden Gate??? ... (PLEASE SHARE THIS WITH 5 PEOPLE and request they do the same?...)


https://www.linkedin.com/in/santacruzrealestateinc/
Search
Home
My Network
Jobs
Douglas Deitch
"Water, food, and real estate security" for California+ in this new era of unknown SLR @ thebestthatmoneycantbuy.com
Aptos, California, United States · 500+ connections ·
Contact info
Open to
Add profile section
More...
Monterey Bay Conservancy, a California/Monterey Bay...
Stanford University Law School

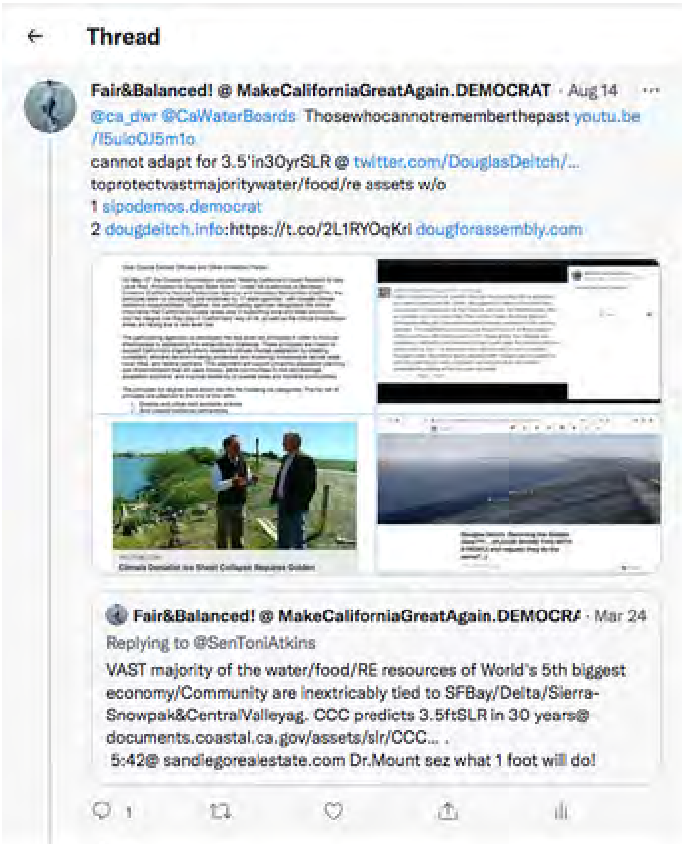

You Retweeted
Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRAT
@DouglasDeitch
Replying to @DouglasDeitch
Perourlocal1987signed"WellOrdinance"@ pogonip.org/ord.htm &lateJudge/SupeAlmquist@ pogonip.org/alm.htm SantaCruzCounty @sccounty hasbeenina requiredlegalbutnegligentlyuninforced WATER EMERGENCY since1998@ begentlewiththeearth.com @RyanCoonerty @manukoenig @supervisoraskew
LOCAL
A9
Water activist sues county board
Panel seeks school
"Tikkun Olam..."?
Sentinel
County water supplies dwindle
COUNTY OF SANTA CRUZ
8:39 AM · Aug 8, 2021 · Twitter Web App


ITEM 6F:
INFORMATIONAL BRIEFING:
UNDERSTANDING SLR RELATED GROUNDWATER CHANGE
CALIFORNIA COASTAL COMMISSION

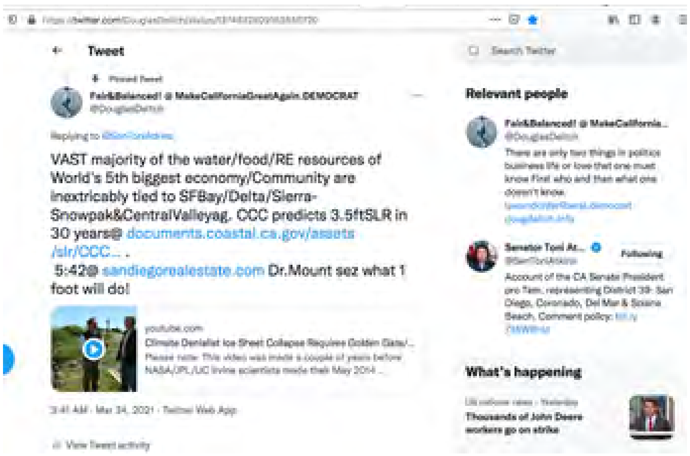

The Relevance of Sea Level Rise
Over 1 billion people are expected to live in the coastal zone by 2050
SLR will likely cause 'once-in-a-lifetime' coastal flooding events to occur annually by 2050, and every day by 2100
When including storms and coastal change, ~3 times more people would be at risk
In California
26 million residents in coastal counties
Over 600,000 people and $200 billion in property at risk by 2100 (6% of GDP!)
These potential impacts are ~ 10 times greater than the worst wildfires and earthquakes in California history
USGS


Coastal Groundwater Response to SLR
USGS

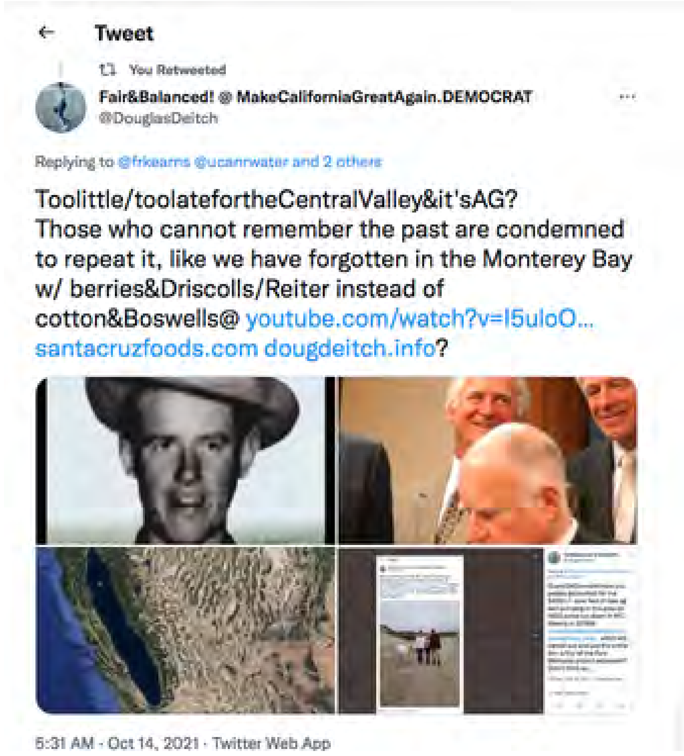

Tweet
You Retweeted
MakeCaliforniaGreatAgain.DEMOCRAT @DougDeitch.info
@DouglasDeitch
#covid19 contamination risks still! MakeCaliforniaGreatAgain.Democrat @SenToniAtkins @GavinNewsom @vp @SenFeinstein @SenAlexPadilla @Rendon63rd @SupervisorAlejo @RyanCoonerty @swrcb thebestthatmoneyCANTbuy.org @11:21 dougdeitch.info /.com pebblebeachrealestate.com sipodemos.democrat
MakeCaliforniaGreatAgain.DEMOCRAT @DougDeitch.info · Jun 2, 2020
#covid19 Despite our SWRCB in Cali assuring us, it's in our treated sewage and recycled water now being injected into our ground water commons for their next tragedy run down "Removing the novel coronavirus from the water cycle" @ sciencedaily.com/releases/2020/... youtube.com/watch?v=2W_zby...
Show this thread
that maybe helpful.
YOUTUBE.COM
SWRCB Board Meeting May 19, 2020
7:59 AM · Jun 7, 2021 · Twitter Web App

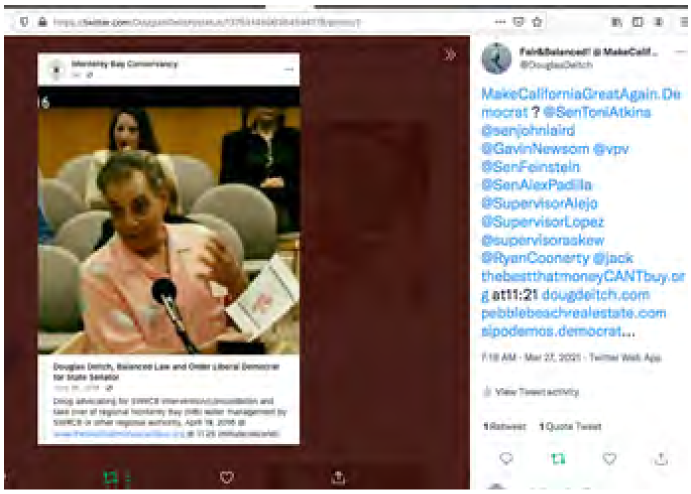

Thread
Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRAT · Aug 14
@ca_dwr @CaWaterBoards Thosewhocannotrememberthepast youtu.be/I5uloOJ5m1o
cannot adapt for 3.5'in30yrSLR @ twitter.com/DouglasDeitch/...
toprotectvastmajoritywater/food/re assets w/o
1 sipodemos.democrat
2 dougdeitch.info:https://t.co/2L1RYOqKri dougforassembly.com
Climate Denialist Ice Sheet Collapse Requires Golden
Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRA · Mar 24
Replying to @SenToniAtkins
VAST majority of the water/food/RE resources of World's 5th biggest economy/Community are inextricably tied to SFBay/Delta/Sierra-Snowpak&CentralValleyag. CCC predicts 3.5ftSLR in 30 years@ documents.coastal.ca.gov/assets/slr/CCC... .
5:42@ sandiegorealestate.com Dr.Mount sez what 1 foot will do!
1


Fair&Balanced! @ MakeCalif...
@DouglasDeitch
QueryGMDonnaM:Have you people accounted for the 5400+/- acre feet of new ag well pumping in this area on 1800 acres run down in MC Weekly in 2018@ montereycountyweekly.com/news/local_new... which will cancel out and use the entire 5k+ a/f/yr of the Pure Monterey project expansion? Didn't think so..
7:31 AM · Sep 30, 2021 · Twitter Web App
View Tweet activity


Tweet
Pinned Tweet
Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRAT
@DouglasDeitch
Replying to @SenToniAtkins
VAST majority of the water/food/RE resources of World's 5th biggest economy/Community are inextricably tied to SFBay/Delta/Sierra-Snowpak&CentralValleyag. CCC predicts 3.5ftSLR in 30 years@ documents.coastal.ca.gov/assets/slr/CCC... .
5:42@ sandiegorealestate.com Dr.Mount sez what 1 foot will do!
youtube.com
Climate Denialist Ice Sheet Collapse Requires Golden Gate/...
3:41 AM · Mar 24, 2021 · Twitter Web App
View Tweet activity
Search Twitter
Relevant people
Fair&Balanced! @ MakeCalifornia...
Senator Toni At...
Following
What's happening
Thousands of John Deere workers go on strike


NOW
Deep Threat
As seawater intrusion advances, new farmland puts Marina's water supply in peril.


Tweet
You Retweeted
Fair&Balanced! @ MakeCaliforniaGreatAgain.DEMOCRAT
@DouglasDeitch
Replying to @frkearns @ucanrwater and 2 others
Toolittle/toolatefortheCentralValley&it'sAG?
Those who cannot remember the past are condemned to repeat it, like we have forgotten in the Monterey Bay w/ berries&Driscolls/Reiter instead of cotton&Boswells@ youtube.com/watch?v=I5uloO... santacruzfoods.com dougdeitch.info?
5:31 AM · Oct 14, 2021 · Twitter Web App


Monterey Bay Conservancy
Douglas Deitch, Balanced Law and Order Liberal Democrat for State Senator
Fair&Balanced! @ MakeCalif...
@DouglasDeitch
MakeCaliforniaGreatAgain.Democrat ? @SenToniAtkins @senjohnlaird @GavinNewsom @vpv @SenFeinstein @SenAlexPadilla @SupervisorAlejo @SupervisorLopez @supervisoraskew @RyanCoonerty @jack thebestthatmoneyCANTbuy.org at11:21 dougdeitch.com pebblebeachrealestate.com sipodemos.democrat...
7:18 AM · Mar 27, 2021 · Twitter Web App
View Tweet activity
1 Retweet 1 Quote Tweet

PINNED POST

Monterey Bay Conservancy
August 6 ·

Please watch my most recent and 5th request for SWRCB INTERVENTION IN THE ENTIRE MONTEREY BAY water management and "control" just on August 3, 2021 @ 9:48 @ https://www.youtube.com/watch?v=A9KTIa0RDu8&t=919s and @ https://twitter.com/DouglasDeitch/status/1422889479061196803, my first request @ 11:21 @ www.thebestthatmoneycantbuy.org pictured below from April/2015, over SIX years ago, and please REVIEW the documents I am holding in my hand I presented and went through w/ SWRCB 4/16/15 during my presentation and first request for SWRCB INTERVENTION then @ www.dougforassembly.com , which only ONE current SWRCB board MEMBER then, Ms. Doreen D'Adamo, was present for?

Monterey Bay Conservancy
August 27, 2018 ·

"It's past time for the State Water Resources Control Board to take control of our now predominantly below sea level Monterey Bay ground water commons..." https://www.linkedin.com/.../its-
nFRwxZIzGSPuoFx5b6R_jsixz-IB5meE6-tz-ScLicdi_RupVKolXxw-cqFX2DyZFouT

STATE OF CALIFORNIA - NATURAL RESOURCES AGENCY — GAVIN NEWSOM, Governor

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE (415) 904-5200
FAX (415) 904-5400

May 22, 2020

Dear Coastal Elected Officials and Other Interested Parties,

On May 13th the Coastal Commission adopted "Making California's Coast Resilient to Sea Level Rise: Principles for Aligned State Action." Under the leadership of Secretary Crowfoot (California Natural Resources Agency) and Secretary Blumenfeld (CalEPA), the principles were co-developed and endorsed by 17 state agencies[1] with coastal climate resilience responsibilities. Together, the participating agencies recognized the critical importance that California's coastal areas play in supporting local and state economies and the integral role they play in Californians' way of life, as well as the critical threat these areas are facing due to sea level rise.

The participating agencies co-developed the sea level rise principles in order to improve effectiveness in addressing this extraordinary challenge. These principles are meant to support California's ongoing efforts related to climate change adaptation by creating consistent, efficient decision-making processes and improving collaboration across state, local, tribal, and federal partners. This alignment will support proactive adaptation planning and implementation that will save money, allow communities to test and leverage adaptation solutions, and improve resiliency of coastal areas and frontline communities.

The principles for aligned state action fall into the following six categories. The full set of principles are attached to the end of this letter.

1. Develop and utilize best available science
2. Build coastal resilience partnerships
3. Improve coastal resilience communications
4. Support local leadership and address local conditions
5. Strengthen alignment around coastal resilience
6. Implement and learn from coastal resilience projects

Among other important goals, the Principles include an ambitious target for the year 2050 of preparing for 3.5 feet of sea level rise. Although this is not a new sea level rise projection, this planning target will help encourage state agencies and others to begin now to proactively prepare for the sea level rise that is anticipated to occur over short-, medium-, and long-term time horizons.

MONTEREY COUNTY

WATER RESOURCES AGENCY

PO BOX 930
SALINAS, CA 93902
(P): 831-755-4860
(F): 831-424-7935

BRENT BUCHE
GENERAL MANAGER

STREET ADDRESS
1441 SCHILLING PLACE, NORTH BUILDING
SALINAS, CA 93901

October 15, 2021

Donna Meyers, General Manager
Salinas Valley Basin Groundwater Sustainability Agency
1441 Schilling Place
Salinas, CA 93901

Re: Draft Monterey Subbasin Aquifer Groundwater Sustainability Plan

Dear Ms. Meyers:

Monterey County Water Resources Agency (Agency) appreciates the opportunity to comment on the draft Monterey Aquifer Subbasin Groundwater Sustainability Plan (GSP). As you know, Agency staff has been involved in reviewing this GSP in a technical role to assure that the data collected and curated by the Agency is utilized and described in an accurate manner.

What the Agency has been unable to do is to review most of management actions and projects in this document for feasibility and to verify the claims of benefits to groundwater sustainability. The management actions and projects that involve modifying many of the Agency's operations, projects, programs and/or permits have not been vetted by the Agency to ensure that Agency's goals and objectives will continue to be met if implemented. This document does not contain enough detail for an in-depth review which would be required before the Agency could provide support for these activities. Therefore, the Agency considers most of these management actions and projects as conceptual ideas that provide the Salinas Valley Groundwater Basin Sustainability Agency (SVGBSA) with a menu of options to move forward in this planning phase. What moves forward to implementation has yet to be decided. The Agency understands that feasibility studies will be conducted by the SVBGSA before any considerations for implementation of management actions or projects that utilize Agency facilities, operations or permits will proceed. Coordination and discussions between the Agency and SVBGSA are pertinent to this being successful.

SVGBSA staff has characterized this GSP as a starter document that will be revised in an iterative process and does not commit the Agency to any specific actions. The Agency looks forward to those revisions and updates that contain feasibility studies for the management actions and programs that include a complete project description that outlines specific tasks, identifies the benefits to the entire Salinas Valley Groundwater Basin and determines costs along with a sustainable funding mechanism for implementation.

MCWRA staff has reviewed the draft GSP, except for Chapter 9 – Projects & Management Actions, released by the SVGBSA on August 18, 2021 and provide the following comments for consideration:

Comments on Chapter 1 – Introduction

- **Section 1.3.3, page 9** – Still lists Keith Van Der Matten as a plan manager
- **Section 1.3.4.2, page 11** –First bullet point: Correct 180/400-Foot Aquifer Subbasin to Monterey Subbasin

Comments on Chapter 3 – Plan Area

- **Section 3.2.2.4, page 55** – Clarify date of Marina Coast Water District Urban Water Management Plan. Both 2020 and 2021 are used in this section.
- **Section 3.2.2.8, page 59** – Last bullet point: Clearly note that this ordinance has expired and is no longer in effect.
- **Section 3.5.4.3, page 74** – Correct expiration date of ordinance from March 2021 to May 2021. Consider adding text describing current CEQA role in ministerial vs. discretionary well permit application process.

Comments on Chapter 4 – Hydrogeologic Conceptual Model

- **Section 4.2.2, page 31** – Consider changing text to "The following set of principal aquifers [and aquitards] are defined…", as all the layers listed are not only aquifers.
- **Section 4.2.5.1, page 40** – Consider updating information of the "Study of the Deep Aquifers Underlying the 180/400-Foot Aquifer Subbasin in the Salinas Valley" as a RFQ has been released for bid and SVBGSA is now taking point on this study.

Comments on Chapter 5 – Groundwater Conditions

- **Section 5.1.3.1, page 21** – Information in the subsection **400-Foot Aquifer** seems to contain information on both the 400-Foot Aquifer and the Deep Aquifers. Consider clearly organizing this information into two subsections labeled **400-Foot Aquifer** and the **Deep Aquifers.**

MCWRA appreciates the opportunity to comment on the draft GSP for the Monterey Subbasin. If you have any questions regarding the enclosed comments, please contact MCWRA at 831-755-4860.

Sincerely,

Elizabeth Krafft
Deputy General Manager

Friday, October 15, 2021

Salinas Valley Basin Groundwater Sustainability Agency

SVBGSA Public Comments Form

Name Stephanie Hastings

Organization Brownstein Hyatt Farber Schreck, LLP

Email Address SHastings@bhfs.com

Subbasin Langley Eastside Forebay Upper Valley Monterey Whole Basin

Comments Please see the attached correspondence submitted on behalf of the Salinas Basin Water Alliance. The exhibits are available on our sharefile at:

https://bhfs.sharefile.com/d-scb50238ba04e4b4294bdf73ac89d25ee

File Upload pdf 2021.10.15 Comment Letter to SVBGSA re Dr...

Brownstein Hyatt
Farber Schreck

Stephanie O. Hastings
Attorney at Law
805.882.1415 tel
shastings@bhfs.com

October 15, 2021

VIA E-MAIL – MEYERSD@SVBGSA.ORG; BOARD@SVBGSA.ORG; PRISO@MCWD.ORG; CITYCLERK@CI.GREENFIELD.CA.US

Donna Meyers
General Manager
Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924

Remleh Scherzinger
General Manager
c/o Paula Riso
Executive Assistant/Clerk to the Board
Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road
Marina, CA 93933-2099

Curtis Weeks
General Manager
c/o City Clerk
Arroyo Seco Groundwater Sustainability Agency
599 El Camino Real
Greenfield, CA 93927

RE: Draft Groundwater Sustainability Plans for the Upper Valley, Forebay, Eastside, Langley, and Monterey Subbasins of the Salinas Valley Groundwater Basin

Dear Ms. Meyers, Mr. Scherzinger, and Mr. Weeks:

This office represents the Salinas Basin Water Alliance (*Alliance*), a California nonprofit mutual benefit corporation formed to preserve the viability of agriculture and the agricultural community in the greater Salinas Valley. *Alliance* members include agricultural businesses and families that own and farm more than 80,000 acres within the Salinas Valley. Many *Alliance* members have been farming in the Salinas Valley for generations. As such, the *Alliance* has a significant interest in the long-term sustainability of the water supplies in the Salinas Valley. As mentioned in our preliminary comment letter on the draft Groundwater Sustainability Plans (GSP) for the Upper Valley, Forebay, Eastside, Langley, and Monterey Subbasins dated August 12, 2021, the *Alliance* greatly appreciates the Salinas Valley Basin Groundwater Sustainability

Agency (SVBGSA) staff and consultant team's efforts to implement the Sustainable Groundwater Management Act (SGMA) in the Salinas Valley Groundwater Basin (Basin) and in each of the six subbasins within the jurisdiction of the SVBGSA. The *Alliance* likewise appreciates the efforts undertaken by the Marina Coast Water District Groundwater Sustainability Agency (MCWDGSA) and the Arroyo Seco Groundwater Sustainability Agency (ASGSA) to implement SGMA in the Monterey and Forebay Subbasins, respectively.

The *Alliance* offers these comments, as well as the comments of aquilogic, Inc. attached hereto as **Exhibit A**, on the draft GSPs for the Upper Valley, Forebay, Eastside, Langley, and Monterey Subbasins.[1] These comments are submitted to the SVBGSA as the exclusive groundwater sustainability agency for the Upper, Eastside, and Langley Subbasins, and one of the groundwater sustainability agencies that will adopt the GSPs for the Forebay and Monterey Subbasins. These comments are also submitted to the MCWDGSA and the ASGSA as groundwater sustainability agencies that will adopt the GSPs for the Monterey Subbasin and Forebay Subbasin, respectively. Please include this letter, the aquilogic, Inc. memorandum ("aquilogic Memo"), and the other attachments hereto in the record of proceedings for the GSP of each of these subbasins.

I. <u>THE DRAFT GSPS MUST BE INTEGRATED TO SATISFY SGMA</u>

SGMA's goal is to provide for the sustainable management of priority groundwater basins throughout the State.[2] "Sustainable management" is defined as the "management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results"—e.g., chronic lowering of groundwater levels, significant and unreasonable reduction of groundwater storage, significant and unreasonable seawater intrusion, and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.[3] In order to achieve this goal, groundwater sustainability agencies must coordinate groundwater management within each basin[4] and with each adjacent basin.[5]

Coordination requires GSPs to maintain consistency or analyze inconsistencies in the data and modeling used to develop the GSPs, the minimum thresholds and measurable objectives set in the GSPs, and the

[1] The *Alliance* notes that several of the draft GSPs are being revised by the GSA during the public review process. An additional public comment period must be provided once the draft GSPs have been finalized for adoption. Informed public input cannot be provided on documents that are still subject to change.
[2] Wat. Code, § 10720.1.
[3] Wat. Code, § 10721(v), (x).
[4] SGMA defines "basin" as "a groundwater basin or subbasin identified and defined in Bulletin 118." (Wat. Code, § 10721(b); see also 23 Code Regs. ("GSP Regs."), § 341(g) ["The term 'basin' shall refer to an area specifically defined as a basin or 'groundwater basin' in Bulletin 118, and shall refer generally to an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom, as further defined or characterized in Bulletin 118"; "The term 'subbasin' shall refer to an area specifically defined as a subbasin or 'groundwater subbasin' in Bulletin 118, and shall refer generally to any subdivision of a basin based on geologic and hydrologic barriers or institutional boundaries, as further described or defined in Bulletin 118."].)
[5] Wat. Code, §§ 10727, 10727.6.

projects and management actions proposed in the GSPs.[6] DWR will review each GSP to ensure it satisfies this requirement—i.e., that the GSP does not adversely affect the "ability of an adjacent basin to implement their groundwater sustainability plan or impedes achievement of sustainability goals in an adjacent basin."[7] Any GSP that cannot meet this standard will not satisfy SGMA.[8]

The consultant that prepared the draft GSPs for the Upper, Forebay, Eastside, and Langley Subbasins has acknowledged the importance of integrated management of surface water and groundwater throughout the Basin:

> It has long been acknowledged that the water resources of the Salinas Valley consist of an integrated surface water and groundwater system . . . This acknowledged surface water/groundwater integration underpins the approach the SVBGSA is taking to achieving groundwater sustainability throughout the Valley; the Salinas River is an integral part of groundwater management and managing groundwater cannot be divorced from the Salinas River's operations. Similarly, groundwater management plays an important role in maintaining Salinas River flows. Larger areas of low groundwater levels in the Salinas Valley will induce more leakage from the Salinas River – reducing Salinas River flows. Maintaining adequately high groundwater levels will help maintain Salinas River flows. These higher groundwater levels that help maintain Salinas River flows is one of the desired outcomes of our groundwater management and is a benefit to surface water users. Groundwater sustainability can lead to long-term reliability in surface water supplies . . .
>
> The Salinas River operations, Salinas River flows, and ability to use water from the River will be clearly influenced by the decisions made during GSP development and implementation. Balanced groundwater management that

---

[6] See e.g., Wat. Code, § 10727.6; GSP Regs., § 354.28(b) ("The description of minimum thresholds shall include the following: . . . (3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals."); see also *id.* at §§ 350.4(b), 354.28(b), 354.34(i), 354.38(e), 354.44(b)(6)-(7), 357.2; Department of Water Resources (DWR) Sustainable Management Criteria BMP, pp. 12-17 (Considerations when establishing minimum thresholds for each sustainability indicator includes the adjacent basin's minimum thresholds); DWR Modeling BMP, pp. 21-22; DWR Water Budget BMP, pp. 12, 16, 17, 36.
[7] Wat. Code, § 10733(c).
[8] *Ibid.*; GSP Regs., §§ 350.4, 354.8(d), 354.14, 354.18, 354.28(b)(3), 354.44(b)(6), 354.44(c), 355.4(b), 356.4(j), 357.2(b)(3); DWR Monitoring Networks and Identification of Data Gaps BMP, pp. 6, 8, 27; DWR Water Budget BMP, pp. 7, 12, 16, 17, 36; DWR Modeling BMP, pp. 21-22; DWR Sustainable Management Criteria BMP, pp. 9, 31.

> maintains consistent groundwater levels will provide surface water reliability for the Valley's surface water users.[9]

A Senior Hydrologist with the Monterey County Water Resources Agency (MCWRA) similarly commented:

> Additionally, as was experienced and monitored throughout the Basin during the most recent drought period, lowering of the groundwater table has a significant impact on the Agency's ability to operate the reservoirs to a controlled range of flows at the Salinas River Diversion Facility. As such, overdraft of the groundwater basin, resulting in a reduction in groundwater levels significantly impacted surface water flows, depleting the availability of surface water to riparian water uses.[10]

Close coordination of the draft GSPs for the subbasins is critical as each of the GSPs acknowledge a significant hydrologic and hydraulic connection with adjacent subbasins.[11] In other words, groundwater management in the Upper Valley impacts groundwater management in the Forebay Subbasin, which impacts groundwater management in the 180/400-Foot Aquifer, Eastside, Langley, and Monterey Subbasins, and there is a direct link between groundwater in the Basin and surface water in the Salinas River.

Given the integration of the Basin's surface and groundwater supplies (e.g., that pumping in one subbasin impacts surface and subsurface flows to an adjacent subbasin), SGMA mandates the coordination and integration of the GSPs for the subbasins within SVBGSA's jurisdiction—the GSPs must be integrated in their planning, development, and implementation to ensure the objectives of SGMA are satisfied, the interests of all beneficial users throughout the Basin are considered, and the burden of sustainability is equitably allocated across the Basin.[12] Indeed, the SVBGSA has acknowledged this obligation in its Joint Exercise of Powers Agreement[13] and, as the groundwater sustainability agency for the 180/400-Foot Aquifer, Monterey,

---

[9] Feb. 26, 2019 Letter from Derrik Williams to Leslie Girard, attached hereto as **Exhibit B**.

[10] March 4, 2019 Memorandum from Howard Franklin to Leslie Girard and Gary Petersen, attached hereto as **Exhibit C**.

[11] Draft Upper Valley Subbasin GSP, § 4.3.1.1; Draft Forebay Subbasin GSP, § 4.3.1.1; Draft Eastside Subbasin GSP, § 4.3.1.1; Draft Langley Subbasin GSP, § 4.3.1.1; Draft Monterey Subbasin GSP, § 4.2.3; aquilogic Memo, pp. 2-3, attached hereto as **Exhibit A**.

[12] Wat. Code, § 10723.2; see also DWR Water Budget BMP, pp. 16-17 ("For many basins within the . . . Salinas Valley . . . not all lateral boundaries for contiguous basins serve as a barrier to groundwater or surface water flow . . . In situations where a basin is adjacent or contiguous to one or more additional basins, or when a stream or river serves as the lateral boundary between two basins, it is necessary to coordinate and share water budget data and assumptions. This is to ensure compatible sustainability goals and accounting of groundwater flows across basins, as described in § 357.2 (Interbasin Agreements) of the GSP Regulations."

[13] See Joint Exercise of Powers Agreement Establishing the Salinas Valley Basin GSA, § 2.2 ("The purpose of Agency is to . . . develop[], adopt[], and implement[] a GSP that achieves groundwater sustainability in the Basin."); § 4.1(c) (The JPA has the power to "develop, adopt and implement a GSP for the Basin."); *id.* at § 4.1(l) (The JPA has the power to "establish and administer projects and programs for the benefit of the Basin."); *id.* at § 4.3 ("As set forth in Water Code section 10723.3, the GSA shall consider the interests of all beneficial uses and users of groundwater in the Basin, as well as those responsible for implementing the

Eastside, Langley, Forebay, and Upper Subbasins, the SVBGSA is uniquely qualified to ensure coordination and integration among these subbasins. The SVBGSA previously proposed an integrated GSP that would incorporate the GSPs for each of the six subbasins, but appears to have abandoned or significantly delayed that commitment. As a result, the draft GSPs do not adequately coordinate and integrate their data, minimum thresholds and measurable objectives, and projects and management actions and do not analyze potential impacts on the adjacent subbasins. The draft GSPs must analyze and address these issues before they can be adopted, or delineate a plan for adding this information to the GSPs as soon as possible.

II. THE DRAFT GSPs DO NOT SUFFICIENTLY ANALYZE AND ADDRESS SUSTAINABLE GROUNDWATER MANAGEMENT THROUGHOUT THE BASIN

The *Alliance* supports integrated groundwater management throughout the Basin—such management is critical to the sustainable and equitable management of the integrated water resources throughout the Basin. In accordance with SGMA, this management should utilize consistent data and modeling, analyze impacts of groundwater production on adjacent subbasins, estimate sustainable yields and set minimum thresholds in consideration of impacts to adjacent subbasins, and coordinate projects and management actions throughout the Basin. As described further below, the draft GSPs as currently presented do not meet these thresholds dictated by SGMA.

A. Each Draft GSP Fails to Analyze Inconsistencies in the Data and Modeling Utilized By the Draft GSPs for Adjacent Subbasins

As an initial matter, the draft GSPs for the subbasins utilize differing modeling/estimation techniques that produce inconsistent data throughout the Basin and prevent integration of groundwater management absent additional analysis.

For example, the 180/400-Foot Aquifer Subbasin GSP's historical and current water budgets were created "by aggregating data and analyses from previous reports and publicly available sources" while the future

---

GSP. Additionally, as set forth in Water Code section 10720.5(a) any GSP adopted pursuant to this Agreement shall be consistent with Section 2 of Article X of the California Constitution and nothing in this Agreement modifies the rights or priorities to use or store groundwater consistent with Section 2 of Article X of the California Constitution . . . Likewise, as set forth in Water Code section 10720.5(b) nothing in this Agreement or any GSP adopted pursuant to this Agreement determines or alters surface water rights or groundwater rights under common law or ay provision of law that determines or grants surface water rights."); 180/400-Foot Aquifer Subbasin GSP, p. 9-10 ("This GSP is part of an integrated plan for managing groundwater in all six subbasins of the Salinas Valley Groundwater Basin that are managed by the SVBGSA. The projects and management actions described in this GSP constitute an integrated management program for the entire Valley."); *id.* at 10-14 ("The SVBGSA oversees all or part of six subbasins in the Salinas Valley Groundwater Basin. Implementing the 180/400-Foot Aquifer Subbasin GSP must be integrated with the implementation of the five other GSPs in the Salinas Valley Groundwater Basin . . . The implementation schedule reflects the significant integration and coordination needed to implement all six GSPs in a unified manner."); see also Draft Upper Valley GSP, p. 10-16; Draft Eastside Subbasin GSP, pp. 9-1, 10-7, 10-8, 10-16; Draft Forebay Subbasin GSP, pp. 2-4, 9-2, 9-4, 10-7, 10-9, 10-17; Draft Langley Subbasin GSP, pp. 2-4, 9-1, 9-4, 10-8, 10-9, 10-16.

water budget was created using the Salinas Valley Integrated Hydrologic Model (SVIHM).[14] The draft GSPs for the Eastside, Langley, Forebay, and Upper Valley Subbasins take a different approach—the historical and current water budgets were developed using a "provisional version" of the SVIHM, while future water budgets were developed using "an evaluation version" of the Salinas Valley Operational Model (SVOM).[15] And the draft Monterey Subbasin GSP utilizes a third approach—employing the Monterey Subbasin Groundwater Flow Model for the historic, current, and projected water budgets.[16]

What is more, each of these approaches uses different time periods: (1) the 180/400-Foot Aquifer Subbasin GSP analyzes a historical period of 1995 to 2014 and a current period of 2015 to 2017[17]; (2) the draft GSPs for the Langley, Eastside, Forebay, and Upper Valley Subbasins analyze a historical period of 1980 through 2016 and a current period of 2016[18]; and, (3) the draft Monterey Subbasin GSP analyzes a historical period of 2004 to 2018 and a current period of 2015 to 2018.[19]

The inconsistency in the water-budget approaches for each subbasin must be addressed in the draft GSPs. Absent such an analysis, the draft GSPs cannot adequately analyze a subbasin's potential to impact an adjacent subbasin or foster integrated groundwater management throughout the Basin.[20] Further, this absence of analysis prevents informed input on the draft GSPs by interested parties.[21]

This issue is best exemplified in the inconsistencies between the 180/400-Foot Aquifer Subbasin GSP and the draft Forebay Subbasin GSP. The 180/400-Foot Aquifer Subbasin GSP estimates that the 180/400-Foot Aquifer Subbasin receives (historically and currently) 17,000 acre-feet per year (AFY) of subsurface flow from the Forebay Subbasin.[22] However, the draft Forebay Subbasin GSP estimates that this amount was 3,100 AFY historically and 2,900 AFY currently. These numbers in the draft Forebay GSP are likely

[14] 180/400-Foot Aquifer Subbasin GSP, p. 6-1.
[15] See each referenced draft GSP, pp. 6-1-2. The GSA's use of the SVIHM and SVOM models for the draft GSPs does not satisfy the modeling requirements in the GSP Regulations. Section 352.4(f) of the GSP Regulations state that the models used to develop GSPs must "include publicly available supporting documentation" and "consist of public domain open-source software." The GSPs acknowledge that these requirements are not satisfied, and the draft GSPs state that "[d]etails regarding source data, model construction and calibration, and results for future budgets will be summarized in more detail once the model and associated documentation are available." (See, e.g., Draft Upper Valley Aquifer Subbasin GSP, pp. 6-1-2.) Interested parties cannot provide informed comments and input on the draft GSPs until the GSAs incorporate use of models that satisfy the GSP Regulations.
[16] Draft Monterey Subbasin GSP, p. 6-7.
[17] 180/400-Foot Aquifer Subbasin GSP, p. 6-1.
[18] See each referenced draft GSP, pp. 6-7-8.
[19] Draft Monterey Subbasin GSP, p. 6-5.
[20] See DWR, Water Budget BMP, p. 9 ("Building a coordinated understanding of the interrelationship between changing water budget components and aquifer response will allow local water resource managers to effectively identify future management actions and projects most likely to achieve and maintain the sustainability goal for the basin.").
[21] The draft GSPs also do not explain why different years are used to set minimum thresholds and measurable objectives in each subbasin, or how those inconsistencies impact sustainable groundwater management. (See aguilogic, Inc. Memo, p. 3, attached hereto as **Exhibit A**.)
[22] 180/400-Foot Aquifer Subbasin GSP, p. 6-16.

overestimates (i.e., the 180/400-Foot Aquifer is estimated to receive less subsurface flow from the Forebay Subbasin than the stated numbers) as the SVIHM utilized to provide the estimates in the draft Forebay Subbasin GSP only accounted for approximately 65% of the groundwater pumping in the Forebay Subbasin.[23] The discrepancy in interbasin flow needs to be addressed in the draft Forebay Subbasin GSP, or identified as a data gap that will be addressed through additional modeling as soon as possible. Without such information, the draft GSP cannot analyze how its implementation will impact the implementation of the 180/400-Foot Aquifer Subbasin GSP.

In sum, the draft GSPs must identify and analyze the inconsistencies in the modeling simulations and the time periods used for the water budgets in each of the GSPs in order to satisfy SGMA.[24] The *Alliance* identified a potential solution to this issue in its correspondence to the SVBGSA dated August 12, 2021, wherein the *Alliance* requested that the GSA conduct additional simulations with the SVIHM that are specifically focused on the issue of interbasin groundwater flows in order to understand the amount of Basin-wide groundwater discharge that is and has been captured by pumping. After adjusting the modelling simulations with GEMS data, the SVBGSA could integrate the data into the draft GSPs and provide an informed analysis of how each draft GSP will impact adjacent subbasins. Based upon the text of the draft GSPs, it appears that this modelling has already been completed in some capacity. In each of the draft GSPs for the Langley, Eastside, Forebay, and Upper Valley Subbasins, the GSPs state a “model simulation without any groundwater pumping in the model . . . was compared to the model simulation with groundwater pumping” to understand depletion of interconnected surface water.[25] However, the draft GSPs do not extrapolate this data to analyze impacts on surface or subsurface interbasin flows or adjacent subbasins. The *Alliance* understands that the SVBGSA is undertaking additional modeling for an update to the draft GSPs and strongly recommends that the SVBGSA incorporate the *Alliance’s* requested modeling simulations into the update. If not, the *Alliance* urges the SVBGSA to commit to adding this information prior to adoption of the draft GSPs or committing to a timeline in which it will be added shortly thereafter. Without this information, the GSPs cannot not analyze each of the issues required to be addressed by SGMA.

B. The Draft GSPs Do Not Adequately Analyze Impacts to Adjacent Subbasins

As discussed above, a GSP must not adversely affect “the ability of an adjacent basin to implement their [GSP] or impede[] achievement of sustainability goals in an adjacent basin.”[26] The GSP Regulations specify that minimum thresholds should be selected to “avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals.”[27] And the GSP Regulations require DWR to evaluate a GSP to ensure it satisfies these objectives.[28] The draft GSPs as currently presented do not satisfy these requirements.

---

[23] Draft Forebay Subbasin GSP, pp. 6-19, 21.
[24] See, e.g., DWR Water Budget BMP, pp. 16-17.
[25] See, e.g., Draft Forebay Subbasin GSP, p. 5-30.
[26] Wat. Code, § 10733.
[27] GSP Regs., § 354.28(b)(3).
[28] GSP Regs., § 355.4(b)(7).

1. The Draft Eastside Subbasin and Langley Subbasin GSPs

The Eastside Subbasin and Langley Subbasin GSPs largely require similar analysis and information to satisfy SGMA. The GSPs do not account for impacts to adjacent subbasins in defining sustainable yields or setting minimum thresholds and measurable objectives. Each of these issues is addressed in detail below.

a. *The GSPs do not account for impacts to adjacent subbasins in defining sustainable yields*

SGMA defines "sustainable yield" as "the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result."[29] Further, the sustainable yield must be defined in a manner that will not result in undesirable results in adjacent subbasins.[30] Here, the sustainable yields in the draft GSPs for both the Eastside and Langley Subbasins do not account for impacts on interbasin flow to the 180/400-Foot Aquifer Subbasin.

For example, the draft Eastside Subbasin GSP states that a pumping depression east of the City of Salinas creates a hydraulic gradient towards the depression, with groundwater flowing towards the pumping depression and away from the boundary with the 180/400-Foot Aquifer Subbasin.[31] This depression has reversed the natural downgradient groundwater flow from the Eastside Subbasin to the 180/400-Foot Aquifer Subbasin, drawing 3,600 AFY historically and 5,400 AFY currently of groundwater from the 180/400-Foot Aquifer Subbasin.[32] This amount is likely substantially underestimated as the SVIHM only accounts for 81% of groundwater pumping in the Subbasin.[33] Despite this unnatural hydraulic gradient and the pull of groundwater from the 180/400-Foot Aquifer Subbasin, the draft Eastside Subbasin GSP includes this interbasin flow in its calculation of sustainable yield,[34] but the draft GSP does not analyze how estimated sustainable yield will impact groundwater management in the 180/400-Foot Aquifer Subbasin.

Similarly, the draft Langley Subbasin GSP states that a pumping depression has formed in the center of the Langley Subbasin as a result of a pumping trough.[35] Groundwater is drawn towards the pumping depression and away from the 180/400-Foot Aquifer Subbasin despite the natural downward gradient flow towards the 180/400-Foot Aquifer and Eastside Subbasins.[36] The draft Langley Subbasin GSP then estimates that,

---

[29] Wat. Code, § 10721(w).
[30] See Wat. Code, § 10733.
[31] Draft Eastside Subbasin GSP, p. 5-11.
[32] *Id.* at pp. 6-19-20 ("Groundwater pumping near the [C]ity of Salinas has created a cone of depression . . . that draws in groundwater into the Eastside Aquifer Subbasin from the 180/400-Foot Aquifer Subbasin, which is naturally slightly downgradient in the Salinas area. Estimated groundwater inflows from the 180/400-Foot Aquifer Subbasin have slightly increased since 1980.").
[33] *Id.* at p. 6-17. The 180/400-Foot Aquifer Subbasin GSP estimates the outflow to the Eastside and Langley Subbasins amounts to 8,000 AFY. (*Id.* at p. 6-19.)
[34] *Id.* at pp. 6-22-24, Table 6-10.
[35] Draft Langley Subbasin GSP, p. 5-7.
[36] *Id.* at p. 5-18, Figure 5-11.

despite this reversal in groundwater elevations, the 180/400-Foot Aquifer Subbasin has historically received 3,700 AFY and currently receives 2,900 AFY in interbasin flow from the Langley Subbasin, while the Eastside Subbasin has historically received 1,100 AFY and currently receives 1,700 AFY in interbasin flow from the Langley Subbasin.[37] However, the draft Langley Subbasin GSP fails to analyze how the pumping depression in the Langley Subbasin has impacted and will continue to impact these interbasin flows—e.g., what are the outflows to the 180/400-Foot Aquifer and Eastside Subbasins if the pumping depression were ameliorated? Again, the draft GSP includes these unnatural interbasin flows in its calculation of the sustainable yield without analyzing the impacts on adjacent subbasins.[38]

Without understanding how groundwater production impacts interbasin flows, the draft GSPs cannot accurately estimate the sustainable yield of the subbasins and their impact on adjacent subbasins.[39] As discussed above, this issue can be addressed by undertaking the additional modeling simulations requested by the *Alliance* and revising the draft GSPs accordingly. This additional information should be added prior to the adoption of the draft GSPs, or the draft GSPs should commit to a timeline under which this information will be added as soon as possible after adoption of the draft GSPs.

b. *The GSPs do not analyze how their minimum thresholds and measurable objectives will impact adjacent subbasins*

The draft GSPs also do not consider impacts to adjacent subbasins in their setting of minimum thresholds and measurable objectives, as required by SGMA.[40]

For example, the draft Eastside Subbasin GSP sets the minimum threshold for groundwater elevations at 2015 levels.[41] As shown in Figure 8-1, these levels are only nominally above historic lows (approximately 6 feet higher) and barely above the lowest elevation since the introduction of the CSIP and Salinas Valley Water Project.[42] Consequently, these groundwater elevations will still produce a significant pumping

---

[37] *Id.* at p. 6-19.
[38] *Id.* at pp. 6-21-23.
[39] See DWR Water Budget BMP, p. 17 (To evaluate the impact on adjacent basin, "this will necessitate GSA coordination and sharing of water budget data, methodologies, and assumptions between contiguous basins including: • Accurate accounting and forecasting of surface water and groundwater flows across the basin boundaries.").
[40] GSP Regs., § 354.28(b)(3) ("The description of minimum thresholds shall include the following: . . . (3) How minimum thresholds have been selected to avoid causing undesirable results in adjacent basins or affecting the ability of adjacent basins to achieve sustainability goals."); see also GSP Regs., § 355.4(b)(7); DWR Sustainable Management Criteria BMP, p. 9; DWR Sustainable Management Criteria BMP, p. 10 ("The purpose of the specific requirements is to ensure consistency within groundwater basins and between adjacent groundwater basins.").
[41] Draft Eastside Subbasin GSP, p. 8-7.
[42] *Id.* at p. 8-13.

depression east of the City of Salinas that will draw water away from the boundary with the 180/400-Foot Aquifer Subbasin.[43]

Similarly, the draft Langley Subbasin GSP sets the minimum threshold for groundwater elevations at 2019 levels—the lowest elevations since the introduction of the CSIP and Salinas Valley Water Project and only nominally above the historic lows in the Subbasin.[44] These levels will continue to produce a significant pumping depression east of the City of Salinas that will draw water away from the boundary with the 180/400-Foot Aquifer Subbasin.[45] Despite the maintenance of these unnatural gradients, neither draft GSP analyzes how these minimum thresholds will impact adjacent subbasins (e.g., the 180/400-Foot Aquifer Subbasin).

The draft GSPs for the Eastside and Langley Subbasins merely include the statement that: "Minimum thresholds for the [subbasins] will be reviewed relative to information developed for the neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasins from achieving sustainability."[46] This statement is not evidence and it does not ensure the management of the subbasins will avoid impacts to adjacent subbasins.[47] As discussed above, this issue can be addressed by undertaking the additional modeling simulations requested by the *Alliance* and revising the draft GSPs accordingly.

The lack of analysis is concerning as both draft GSPs acknowledge that low groundwater elevations within the Langley and Eastside Subbasins may exacerbate seawater intrusion in the 180/400-Foot Aquifer Subbasin.[48] But the draft GSPs only mention this issue in concluding: "The chronic lowering of groundwater

---

[43] *Id.* at p. 8-10, Figure 8-3. The same issue applies to the draft Eastside Subbasin GSP's measurable objective for groundwater elevations—it maintains a pumping depression that reverses the natural hydraulic gradient towards the 180/400-Foot Aquifer Subbasin but fails to explain how the measurable objective will not impact the 180/400-Foot Aquifer Subbasin. (See e.g., Draft Eastside Subbasin GSP, p. 8-19.)
[44] Draft Langley Subbasin GSP, pp. 8-8, 8-13.
[45] *Id.* at p. 8-10. Again, the same issue applies to the draft Langley Subbasin GSP's measurable objective for groundwater elevations—it maintains a pumping depression that reverses the natural hydraulic gradient towards the 180/400-Foot Aquifer Subbasin but fails to explain how the measurable objective will not impact the 180/400-Foot Aquifer Subbasin. (See e.g., Draft Langley Subbasin GSP, p. 8-19.)
[46] *Id.* at p. 8-6; Draft Eastside Subbasin GSP, p. 8-16.
[47] See Joint Exercise of Powers Agreement Establishing the SVBGSA, § 4.3 ("As set forth in Water Code section 10723.3, the GSA shall consider the interests of all beneficial uses and users of groundwater in the Basin, as well as those responsible for implementing the GSP. Additionally, as set forth in Water Code section 10720.5(a) any GSP adopted pursuant to this Agreement shall be consistent with Section 2 of Article X of the California Constitution and nothing in this Agreement modifies the rights or priorities to use or store groundwater consistent with Section 2 of Article X of the California Constitution . . . Likewise, as set forth in Water Code section 10720.5(b) nothing in this Agreement or any GSP adopted pursuant to this Agreement determines or alters surface water rights or groundwater rights under common law or ay provision of law that determines or grants surface water rights.").
[48] See Draft Langley Subbasin GSP, pp. 3-18, 4-32, 5-18 (Figure 5-11 "shows the groundwater elevations that are persistently below sea levels that, when paired with a pathway, enable seawater intrusion. The groundwater elevation contours show that groundwater is drawn toward the depression at the northern end of the Eastside Aquifer Subbasin. If the magnitude of this depression increases, it could potentially draw seawater intrusion into the Langley Subbasin."), 5-20 (Figure 5-11); Draft Eastside Subbasin GSP, pp. 3-17,

level minimum thresholds are set above historic lows. Therefore, the groundwater elevation minimum thresholds are intended to not exacerbate, and may help control, the rate of seawater intrusion."[49] That statement must be revised to acknowledge that the pumping depressions in the Langley and Eastside Subbasins will remain even if the groundwater elevation minimum thresholds and measurable objectives are achieved, and the seawater minimum thresholds set by the draft Langley and Eastside Subbasin GSPs only protect against seawater intrusion in their respective subbasins, not against seawater intrusion in adjacent subbasins like the 18/400-Foot Aquifer Subbasin.[50]

In sum, the draft Langley and Eastside Subbasin GSPs in their current form do not account for potential impacts to adjacent subbasins in setting their minimum thresholds and measurable objectives. As a result, the draft GSPs cannot provide any evidence that their implementation will not impair implementation of a GSP in an adjacent subbasin—e.g., the 180/400-Foot Aquifer Subbasin GSP's seawater intrusion minimum threshold, which requires seawater intrusion to be maintained at 2017 levels, and measurable objective, which requires the seawater intrusion isocontour to be pushed back to Highway 1.[51] This analysis should be added to the draft GSPs prior to adoption by the SVBGSA, or the draft GSPs should provide a commitment to incorporating this information within a time certain.[52]

c. *There is no support for using groundwater elevations as a proxy for groundwater storage minimum thresholds*

As mentioned above, the sustainable yield of the basin is the amount of water that can be withdrawn annually without causing an undesirable result, such as the "significant and unreasonable reduction of groundwater storage."[53] The GSP Regulations permit a minimum threshold for groundwater elevations to be used as the minimum threshold for other sustainability indicators, "where the Agency can demonstrate that the representative value is a reasonably proxy . . . as supported by adequate evidence."[54] Here, both the draft Eastside Subbasin GSP and the Langley Subbasin GSP utilize groundwater elevation minimum thresholds

---

4-35 ("the groundwater elevations in the northwestern portion of the Eastside Subbasin (near the City of Salinas) are below sea level, creating a groundwater gradient away from the coast and towards the Eastside Subbasin"), 5-26-29 .

[49] Draft Langley Subbasin GSP, p. 8-15; Draft Eastside Subbasin GSP, p. 8-15.

[50] Draft Langley Subbasin GSP, p. 8-28; Draft Eastside Subbasin GSP, p. 8-29.

[51] See 180/400-Foot Aquifer Subbasin GSP, pp. 8-32-37.

[52] A report prepared for MCWRA has highlighted the significant impact pumping in the Eastside and Langley Subbasins has on seawater intrusion in the 180/400-Foot Aquifer Subbasin. (See November 19, 2013, Technical Memorandum, Protective Elevations to Control Sea Water Intrusion in the Salinas Valley, attached hereto as **Exhibit D**.) The report states: "At one time (before excessive pumping), the East Side Subarea was one of the natural sources of recharge to the adjacent Pressure Subarea with ground water flowing from the northeast to the southwest. However, historical groundwater level declines have resulted in a reversal of the gradient." (*Id.* at p. 3.) The report then states that: "Artificial recharge in the East Side Subarea would reduce subsurface inflow from the Pressure Subarea and eventually restore the historical northeast to southwest recharge. Both northwest underflow from the Forebay Subarea as well as southwest recharge from the East Side Subarea would help control seawater intrusion." (*Id.* at pp. 6-7.) See also aquilogic Memo, pp. 8-12, attached hereto as **Exhibit A**.

[53] Wat. Code, § 10721(w), (x).

[54] GSP Regs., § 354.28(d); DWR Sustainable Management Criteria BMP, pp. 17-18.

as proxies for groundwater storage minimum thresholds.[55] However, there is insufficient evidence to support that approach.

In particular, each of the draft GSPs sets groundwater elevations at near historic lows, and show a substantial trend in declining groundwater storage over the historic period.[56] The minimum threshold groundwater elevations, in other words, have resulted in overdraft of the subbasins.[57] And by setting the minimum thresholds at historic low groundwater elevations, the draft GSPs will facilitate continued decline in groundwater storage.[58] In fact, because there is no commitment to pump at the sustainable yield of the subbasins, it is possible that production in the subbasins could increase over historic and current amounts so long as the subbasins do not experience another significant drought and still comply with the groundwater elevation minimum thresholds. The SVBGSA's prior actions seem to imply that utilizing groundwater elevations as a proxy in this scenario is improper—the 180/400-Foot Aquifer Subbasin GSP set the groundwater storage minimum threshold to production at the projected sustainable yield.[59] The draft GSP must explain why this different approach will suffice now.

2. The Draft Forebay and Upper Valley Subbasin GSPs

The draft Forebay and Upper Valley Subbasin GSPs lack the same analysis as the draft GSPs for the Eastside and Langley Subbasins—they do not adequately consider impacts to adjacent subbasins. These issues begin with the draft GSPs' water budget and estimate of sustainable yield, and cascade through the minimum thresholds, measurable objectives, and projects and management actions.

As discussed above, SGMA requires GSPs to define a sustainable yield for each basin that will avoid undesirable results and impacts to adjacent basins. The sustainable yields defined in the draft GSPs for the Forebay and Upper Valley Subbasins do not meet this threshold. Both draft GSPs conclude that the subbasins have not been in overdraft historically, but they do not analyze how groundwater pumping within the subbasins (151,100 to 174,500 AFY in the Forebay Subbasin and 108,500 to 129,600 AFY in the Upper Valley) impacts surface and subsurface flows to adjacent subbasins.[60]

---

[55] Draft Eastside Subbasin GSP, p. 8-23; Draft Langley Subbasin GSP, p. 8-22.
[56] See discussion *supra;* Draft Eastside Subbasin GSP, p. 5-21; Draft Langley Subbasin GSP, p. 5-16.
[57] *Ibid*.
[58] See, e.g., Wat. Code, § 10721(x)(1) ("Overdraft during a period of drought is not sufficient to establish a chronic lowering of groundwater levels if extractions and groundwater recharge are managed as necessary to ensure that reductions in groundwater levels or storage during a period of drought are offset by increases in groundwater levels or storage during other periods.").
[59] 180/400-Foot Aquifer Subbasin GSP, p. 8-25 ("The total volume of groundwater that can be annually withdrawn from the Subbasin without leading to a long-term reduction in groundwater storage or interfering with other sustainability indicators is the calculated sustainable yield of the Subbasin."); see also DWR GSP Assessment Staff Report, p. 25 ("The Plan describes how setting the minimum threshold as the long-term sustainable yield for the Subbasin is a reasonable, protective approach against overdraft and the long-term reduction of groundwater storage.").
[60] Draft Forebay Subbasin GSP, pp. 6-45-46; Draft Upper Valley Subbasin GSP, pp. 6-22-23.

For example, the draft Forebay Subbasin GSP states that the SVIHM, which undercounts groundwater pumping by 35%, estimates the Forebay Subbasin received 90,300 AFY historically through stream exchange, currently receives 77,800 AFY, and 31,800 AFY of that stream exchange on average is caused by groundwater pumping.[61] Similarly, the draft Upper Valley Subbasin GSP states that the SVIHM, which under counts groundwater pumping by 24%, estimates the Upper Valley Subbasin received 89,100 AFY historically through stream exchange, currently receives 65,500 AFY, and 1,100 AFY of that stream exchange on average is caused by groundwater pumping.[62] This recharge is substantially induced by the operation of the Nacimiento and San Antonio Reservoirs; prior to that time groundwater storage was significantly decreasing in the subbasins.[63] However, neither draft GSP analyzes: (a) how streamflow recharges the subbasins during drought years, offering instead averages over the historical period, and (b) how groundwater pumping impacts natural surface or subsurface flows to adjacent subbasins—i.e., without pumping, how much groundwater would flow to the downgradient subbasin? Instead, the draft GSPs use the average stream exchange amounts to facilitate a "finding" that the subbasins are presently managed within their sustainable yield. Without understanding how pumping impacts streamflow during drought years and interbasin surface and subsurface flow, the draft GSPs cannot reasonably estimate sustainable yield in the subbasins or analyze how implementation of the draft GSPs will impact adjacent subbasins' GSPs.

The failure to analyze impacts to adjacent subbasins becomes more apparent in the draft GSPs' discussion of minimum thresholds. The draft Forebay Subbasin GSP sets the minimum threshold for groundwater elevations at 2015 groundwater levels, only a few feet above the historic low, while the draft Upper Valley Subbasin GSP sets the minimum threshold for groundwater elevations at "5 feet <u>below</u> the lowest ground elevation between 2012 and 2016," significantly below the historic low.[64] These minimum thresholds are not reasonable—set at levels experienced at the bottom of a historic drought, or even lower—and cannot be qualified as sustainable groundwater management.[65] The draft Upper Valley GSP admits as much, stating: "The groundwater elevations during the 2012 to 2016 drought in the Upper Valley Aquifer Subbasin are the lowest groundwater elevations seen in the Subbasin and are considered <u>significant and unreasonable</u>."[66]

---

[61] Draft Forebay Subbasin GSP, pp. 5-30, 6-23. Note that the draft GSPs may also underestimate streamflow depletion by only analyzing stream cells that are connected to groundwater more than 50% of the time. (See aquilogic Memo, p. 5, attached hereto as **Exhibit A**.)
[62] Draft Upper Valley Subbasin GSP, pp. 5-31, 6-22.
[63] Draft Upper Valley Subbasin GSP, p. 5-18; Draft Forebay Subbasin GSP, p. 5-17; see also Hydrogeology and Water Supply of Salinas Valley, pp. 15-16, attached hereto as **Exhibit D**.
[64] Draft Forebay Subbasin GSP, pp. 8-8, 8-14; Draft Upper Valley Subbasin GSP, pp. 8-7, 8-12 (emphasis added).
[65] Wat. Code, § 10720.1 ("In enacting this part, it is the intent of the Legislature to do all of the following: (a) To provide for the sustainable management of groundwater basins. . . . (c) To establish minimum standards for sustainable groundwater management."]; GSP Regs., § 355.4(b) ("When evaluating whether a Plan is likely to achieve the sustainability goal for the basin, the Department shall consider the following: (1) Whether the assumptions, criteria, findings, and objectives, including the sustainability goal, undesirable results, minimum thresholds, measurable objectives, and interim milestones are reasonable and supported by the best available information and best available science. . . .").
[66] Draft Upper Valley Subbasin GSP, p. 8-10 (emphasis added).

Moreover, the draft GSPs do not analyze how the minimum thresholds will impact flows in the Salinas River or adjacent subbasins. Rather, this analysis appears to be deferred to the future. The draft GSPs state that: "Minimum thresholds . . . will be reviewed relative to information developed for neighboring subbasins' GSPs to ensure that these minimum thresholds will not prevent the neighboring subbasin from achieving sustainability."[67] As discussed above, this issue can be addressed by undertaking the additional modeling simulations requested by the *Alliance* and revising the draft GSPs accordingly. This additional information should be added prior to the adoption of the draft GSPs, or the draft GSPs should commit to a timeline under which this information will be added as soon as possible after adoption of the draft GSPs.

These same concerns are raised with respect to the groundwater storage minimum thresholds. The draft Upper Valley Subbasin GSP uses the groundwater elevation minimum threshold as a proxy, which is permitted, as discussed above, as long as it is supported by adequate evidence.[68] However, there is no evidence supporting that approach as the groundwater elevation minimum threshold suffers the flaws discussed above, and evidence in the draft GSP relating groundwater elevations to groundwater storage shows groundwater storage at historic lows by a wide margin when groundwater levels were 5 feet above the groundwater elevation minimum threshold in 2016.[69] Similarly, the draft Forebay Subbasin GSP sets the minimum threshold for groundwater storage based upon the groundwater elevation minimum threshold: "The minimum threshold groundwater elevation contours . . . were used to estimate the amount of groundwater in storage when groundwater elevations are held at the minimum threshold levels."[70] Again, there is no evidence supporting that approach as the groundwater elevation minimum threshold is flawed as discussed above, and evidence in the draft GSP shows the groundwater elevation minimum threshold results in historic lows in groundwater storage.[71] In fact, the groundwater elevation minimum thresholds allow for additional production in the subbasins over historic and current amounts so long as the subbasins do not experience another significant drought. There is no commitment in the draft GSPs that the production in the subbasins will be restricted to the estimated sustainable yield in the subbasins, and there is no model simulation showing the minimum threshold for groundwater elevations will prevent continued decline in groundwater storage.

Finally, the draft GSPs also utilize groundwater elevations as proxies to set the minimum thresholds for depletion of interconnected surface water.[72] But again, there is no evidence supporting this approach. These groundwater elevation proxies are at or near historic lows, and there is no evidence proving these elevations will prevent the depletion of interconnected surface water that would have a significant and unreasonable impact on beneficial uses. Rather, the draft GSPs merely state that these levels will not impact beneficial uses because there is not currently any litigation over surface water uses, and due to the operation of the Nacimiento Reservoir.[73] However, this statement does not acknowledge that decreased groundwater

---

[67] Draft Upper Valley Subbasin GSP, p. 8-14; Draft Forebay Subbasin GSP, p. 8-17.
[68] Draft Upper Valley Subbasin GSP, p. 8-20.
[69] Draft Upper Valley Subbasin GSP, pp. 5-13, 5-18.
[70] Draft Forebay Subbasin GSP, p. 8-24.
[71] Draft Forebay Subbasin GSP, p. 5-17.
[72] See Draft Upper Valley Subbasin GSP, p. 8-39; Draft Forebay Subbasin GSP 8-42.
[73] Draft Forebay Subbasin GSP, pp. 8-44-45; Draft Upper Valley Subbasin GSP, pp. 8-41-42.

elevations will increase depletion of the Salinas River, and reduce flow to downstream uses, including those uses in adjacent subbasins.[74] Lastly, the draft GSPs do not analyze how these minimum thresholds for depletion of interconnected surface water will impact adjacent subbasins.

In sum, the draft Forebay and Upper Valley GSPs require additional data and analysis to satisfy SGMA. These issues must be addressed before the GSPs are adopted, or the draft GSPs must be provide for their provision by a date certain.[75]

3. The Inadequacies in the Draft GSPs Addressed Above Threaten to Impinge Upon Water Rights

As stated previously, each of the groundwater sustainability agencies has an obligation to consider the interests of all beneficial users of the Basin[76] when implementing SGMA. Moreover, SGMA does not "determine[] or alter[] surface water rights or groundwater rights under common law or any provision of law that determines or grants surface water rights."[77]

By not analyzing potential impacts to adjacent subbasins in each draft GSP, the groundwater sustainability agencies disproportionately allocate the burden of sustainability across the Basin and threaten to impair groundwater users' rights in and to the Basin. This approach violates SGMA and must be addressed before the groundwater sustainability agencies adopt the draft GSPs or, as discussed above, through a commitment in the draft GSPs to modify or update their contents within a time certain.

III. THE DRAFT GSPS MUST INCORPORATE PROJECTS AND MANAGEMENT ACTIONS TO ACHIEVE SUSTAINABILITY

The GSP Regulations require each GSP to "include a description of the projects and management actions the Agency has determined will achieve the sustainability goal for the basin, including projects and management actions to respond to changing conditions in the basin."[78] Because the draft GSPs are lacking the data and analysis described in Section II above, the draft GSPs cannot meet this requirement (e.g., the draft GSPs' lack of analysis of impacts to adjacent basins prevents an adequate proposal of projects and management actions to achieve sustainability). Further, without understanding impacts on interbasin surface and subsurface flow and how implementation of the draft GSPs will impact adjacent subbasins, the groundwater sustainability agencies will be unable to properly assess the benefits associated with any future projects or management actions—e.g., if they propose projects involving dam operations, how can the groundwater sustainability agencies assess the benefits of those projects to the Lower Valley? Accordingly,

[74] aquilogic Memo, pp. 3-8, attached hereto as **Exhibit A**; DWR Water Budget BMP, pp. 4-5.
[75] See also aquilogic Memo, pp. 3-8, attached hereto as **Exhibit A**.
[76] Wat. Code, § 10723.2
[77] Wat. Code, § 10720.5(b); see also Wat. Code, § 10720.1(a) and (b).
[78] GSP Regs., § 354.44(a).

the *Alliance* reserves the right to comment on the draft GSPs' proposed projects and management actions once the issues described above have been addressed.

However, as a preliminary note, the draft GSPs as currently presented do not include sufficient projects or management actions to achieve sustainable groundwater management Basin-wide. Rather, the draft GSPs appear to foist the burden of sustainable groundwater management on the Eastside, Langley, 180/400-Foot Aquifer, and Monterey Subbasins, while avoiding consequential projects and management actions in the Forebay and Upper Valley Subbasins. Indeed, the draft GSPs for the Eastside, Langley, and Monterey Subbasins each include a management action for pumping allocations and controls, but no such management action is included in the draft Forebay Subbasin or Upper Valley Subbasin GSPs.[79] Instead, the draft Forebay Subbasin and Upper Valley Subbasin GSPs include management actions that only superficially impact the subbasins—e.g., the proposed Subbasin "Sustainable Management Criteria Technical Advisory Committees," which require the formation of a "TAC for each Subbasin" that will "develop recommendations to correct negative trends in groundwater conditions and continue to meet the measurable objectives."[80] This issue must be addressed in the next draft of the GSPs.

The *Alliance* also notes that the draft GSPs do not mention the project proposed in the Hydrogeology and Water Supply of Salinas Valley White Paper prepared by the Salinas Valley Groundwater Basin Hydrology Conference for MCWRA in 1995 ("Salinas Valley White Paper"), which is attached hereto as **Exhibit E**. The "Conference" was a "panel of 10 geologists, hydrogeologists, and engineers familiar with Salinas Valley ground water basin" that was convened to "reach agreement on the basic physical characteristics of the basin, and the surface and ground water flow within the basin."[81] The Conference had a "remarkable unanimity of opinion" on the understanding of the "physical characteristics of the basin, the hydrologic system, the interaction between surface water and ground water, and definition of the specific ground water problems in the basin."[82] The Conference agreed that this understanding pointed "compellingly toward an already identified *regional* solution to the Valley's groundwater water resources problem" and recommended pursuing that solution.[83]

> The need for conjunctive operation of surface water and ground water storage was recognized as early as 1946. In 1946, the California Department of Water Resources published a report on Salinas Valley that described the occurrence of seawater intrusion and declining ground water levels. The report recommended a project to eliminate these problems that included development of surface water and ground water storage. Surface water storage was to be accomplished by the construction of dams on tributaries to Salinas River, and ground water storage was to be accomplished by ground water transfers from the Forebay Area to the Pressure Area and East [S]ide Area. The Department

[79] See Draft Eastside Subbasin GSP, § 9.4.12; Draft Langley Subbasin GSP, § 9.4.5; Draft Monterey Subbasin GSP, § 9.4.8; see also 180/400-Foot Aquifer Subbasin GSP, § 9.2 [water charges framework].
[80] Draft Upper Valley Subbasin GSP, § 9.4.1; Draft Forebay Subbasin GSP, § 9.4.1.
[81] *Id.* at p. 5.
[82] *Ibid.*
[83] *Ibid.*

> recommended transfer facilities that include wells in the Forebay Area, conveyance facilities from the Forebay Area to the Pressure and East Side Areas, and distribution facilities within the Pressure and East Side Areas. In such a conjunctive operation, the increased extraction in the Forebay Area and conveyance of water to the Pressure and East Side Areas would vacate ground water storage in the Forebay Area. This empty storage space would be refilled by additional infiltration from Salinas River . . . Part of the recommended facilities for surface water and ground water storage have been completed by the construction of the dams for San Antonio and Nacimiento reservoirs, but the facilities for the effective use of groundwater storage have not been completed. The operation of San Antonio and Nacimiento reservoirs has produced benefits to [S]alinas Valley, but the ultimate benefits that would result from the construction and operation of transfer facilities have not been realized. **The panel concluded that the facilities recommended in 1946 by the California Department of Water Resources should be completed immediately** . . . The result of partially completing the project has been an uneven distribution of benefits throughout the Valley. The Forebay Area and Upper Valley Areas have enjoyed relatively large benefits from San Antonio and Nacimiento reservoirs that would have been shared equally with the Pressure and East Side Areas if the intended transfer facilities had been built. In the absence of the transfer facilities, seawater intrusion into the Pressure Area and water-level declines within the East Side Area have not been mitigated.[84]

The Conference noted that this solution is practical as the "water resources problem in Salinas Valley is not a water supply problem. It is a water distribution problem. The basin has enough surface and ground water to meet existing and projected future average annual agricultural, and municipal and industrial water demand through the year 2030. The problem lies in managing those supplies to meet water demands at all locations in the Valley at all times."[85] This project is an example of integrated groundwater management for the Basin as a whole and should be included in the list of projects and management actions in each of the draft GSPs.[86]

IV. <u>CONCLUSION</u>

The *Alliance* appreciates the opportunity to provide these comments on the draft GSPs, as well as the groundwater sustainability agencies' consideration of the *Alliance*'s input. At present, the draft GSPs do not provide a sufficient basis for integrated management of the Basin given their inconsistent analytical approaches and inadequate analysis of impacts on adjacent subbasins. The *Alliance* makes these comments with the hope that these issues can be addressed through additional engagement prior to the adoption of the GSPs. It is critical that the groundwater sustainability agencies lay the foundation now for the integrated sustainable management of the Basin; without such a foundation, the agencies will not be able to satisfy their obligations under SGMA.

---

[84] Salinas Valley White Paper, pp. 15-16, attached hereto as **Exhibit E (**emphasis added).
[85] *Id.* at p. 7.
[86] See aquilogic Memo, pp. 12-13, attached hereto as **Exhibit A**.

Respectfully submitted,

Stephanie Osler Hastings
Christopher R. Guillen

Exhibits:

A. October 15, 2021 aquilogic, inc. memorandum
B. February 26, 2019 Letter from Derrik Williams to Les Girard
C. March 4, 2019 Memorandum from Howard Franklin to Gary Petersen & Les Girard
D. November 19, 2013 Technical Memorandum re Protective Elevations to Control Sea Water Intrusion in the Salinas Valley
E. June 1995 Salinas Valley Ground Water Basin Hydrology Conference White Paper re Hydrogeology and Water Supply of Salinas Valley

cc: Emily Gardner, Senior Advisor / Deputy General Manager (gardnere@svbgsa.org)
Derrik Williams, Montgomery & Assoc. (dwilliams@elmontgomery.com)
Leslie Girard, Monterey County Counsel (GirardLJ@co.monterey.ca.us)

23184613

aquilogic, Inc.
environment • water • strategy

245 Fischer Avenue, Suite D-2
Costa Mesa, CA 92626
Tel. +1.714.770.8040
Web: www.aquilogic.com

October 15, 2021

MEMORANDUM

To: Donna Meyers, Salinas Valley Basin Groundwater Sustainability Agency
Remleh Scherzinger, Marina Coast Water District Groundwater Sustainability Agency
Curtis Weeks, Arroyo Seco Groundwater Sustainability Agency

From: Robert H. Abrams, PhD, PG, CHg, Principal Hydrogeologist, aquilogic, Inc.
Anthony Brown, CEO & Principal Hydrologist, aquilogic, Inc.

Subject: Comments on Draft Groundwater Sustainability Plans for the Eastside Aquifer, Forebay Aquifer, Upper Valley Aquifer, Langley Area, and Monterey Subbasins of the Salinas Valley Groundwater Basin

Project No.: 018-09

Aquilogic, Inc. (**aquilogic**) is pleased to provide this memorandum on behalf of the Salinas Basin Water Alliance (SBWA). The curricula vitae for Mr. Brown and Dr. Abrams are provided in **Attachment A**. The memorandum provides our comments on the following draft Groundwater Sustainability Plans (GSPs) prepared by the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA):

- Upper Valley Aquifer Subbasin (Upper Valley)
- Forebay Aquifer Subbasin (Forebay)
- Eastside Aquifer Subbasin (Eastside)
- Langley Area Subbasin (Langley), and
- Monterey Subbasin (Monterey)

The draft GSP for the Monterey was prepared jointly with the Marina Coast Water District (MCWD) GSA.

Aquilogic's analysis of the five draft GSPs found a significant deficiency with four of the five plans: The impact of the draft GSPs on adjacent subbasins is not sufficiently evaluated in the draft GSPs for the Upper Valley, Forebay, Eastside, and Langley. These impacts may hinder or prevent adjacent subbasins from achieving sustainability. The impacts on adjacent subbasins occur because all subbasins in the Salinas Valley Groundwater Basin (SVGB) are hydrologically and hydraulically connected. The impacts are caused by two factors: (1) unreasonably low minimum thresholds (MTs) for the chronic lowering of groundwater levels and (2) groundwater extractions that reduce flows to adjacent subbasins or reverse natural hydraulic gradients.

These two factors are linked because the unreasonably low MTs allow groundwater extractions to continue at or above their current magnitude.

The draft GSPs relied on the Salinas Valley Integrated Hydrologic Model (SVIHM) and the Salinas Valley Operational Model (SVOM) for much of their content. The SVIHM and the SVOM are not publicly available at this time. Thus, stakeholder review of the GSPs, especially the content that relies heavily on the models, is hampered by an inability to access, evaluate, and run these models. **Aquilogic** reserves the right to supplement our comments at a later date as the models, model data, assumptions, and results become available.

Connected Subbasins

It has long been recognized and accepted that the subbasins comprising the SVGB are hydraulically connected, with groundwater flowing between adjacent subbasins (Division of Water Resources [DWR], 1946; Salinas Valley Ground Water Basin Hydrology Conference [SVGWBHC], 1995; Monterey County Water Resources Agency [MCWRA], 2001; Kennedy/Jenks, 2004). For example, MCWRA (2001) states that the Salinas Valley hydrologic subareas, which are generally coincident with the six subbasins under the purview of the SVBGSA, are "*…hydrologically and hydraulically connected…*" and that "*[l]andowners and other water users pumping groundwater* [from the Valley] *are drawing water from the same groundwater basin*." In other words, what happens in one subbasin can affect the other subbasins. There are numerous sections within the GSPs (see **Attachment B**) that state "the GSP needs to consider potential for groundwater flow between these adjacent subbasins." However, the GSPs generally do not consider these flows in terms of impacts on adjacent subbasins, nor do the GSPs assess the impact on adjacent subbasins of reaching or exceeding the MTs and measurable objectives (MOs) in one or more subbasins.

Other statements in the GSPs regarding subbasin boundaries are incorrect or contradictory. For example, page 4-10 of the draft Eastside GSP states: "*The southeastern boundary* [of the Eastside] *with the adjacent Forebay Subbasin is near the town of Gonzales (DWR, 2004). It is extended from the approximate southern limit of the regional clay layers that are the defining characteristic of the southern extent of the 180/400-Foot Aquifer Subbasin. There may be reasonable hydraulic connectivity with the Forebay Subbasin, although the principal aquifers change from relatively unconfined to confined near this boundary*." The last sentence of this passage conflicts with the statement on page 4-18 of the draft Eastside GSP, where it is stated: "*In addition to the fact that aquifer material cannot be correlated between boreholes, no evidence exists for a discrete confining layer in the Subbasin (Brown and Caldwell, 2015)*."

Another example of a contradictory statement regarding subbasin boundaries occurs on page 4-10 of the draft Eastside GSP, as well as on page 4-9 of the 180/400 GSP, where it is stated: "*Previous studies of groundwater flow across this boundary* [i.e., between the Eastside and

180/400] *indicate that there is restricted hydraulic connectivity between the subbasins*." The references for these previous studies should be provided, because this statement is an apparent contradiction with other statements in the draft Eastside GSP (e.g., p. 4-21 of the draft GSP, "*Subsurface recharge is primarily from inflow from the adjacent Forebay and 180/400-Foot Aquifer Subbasins to the south and west, respectively (DWR, 2004)*." The apparent uncertainty regarding the nature of the boundary between the Eastside and 180/400 should be listed as an identified data gap on page 4-35 of the draft Eastside GSP.

A detailed list of additional statements from the GSPs that establish and describe the subbasin interconnections is provided as **Attachment B**.

Minimum Thresholds and Groundwater Extractions

As described below, the evidence presented in the draft GSPs indicates that groundwater extractions in the Upper Valley deplete inter-subbasin groundwater flows to the Forebay. Groundwater extractions in the Forebay deplete inter-subbasin groundwater flows to the 180/400 and Eastside and streamflow to the 180/400. Groundwater extractions in the Eastside and Langley reduce groundwater levels in those subbasins to the point where they cause, or have the potential to cause, groundwater flow from the 180/400 to the Eastside and Langley, which is the reverse of the natural groundwater flow direction (i.e., the natural flow direction is from higher topographic elevation to lower topographic elevation). These conditions are likely exacerbating seawater intrusion (SWI) in the 180/400 and hinder or may even prevent that subbasin from achieving sustainability. Additionally, extractions in the 180/400, combined with inter-subbasin flow from the 180/400 to the Eastside, and potentially from the 180/400 to the Langley, has lowered groundwater levels to the point where groundwater is induced to flow from the Monterey to the 180/400.

These conditions are likely to persist indefinitely because the draft GSPs set unreasonably low MTs for the chronic lowering of groundwater levels, and projects and management actions, in general, appear to be insufficient to overcome these problems. Moreover, the unreasonably low MTs facilitate groundwater extractions at current or increased rates in the Upper Valley, Forebay, Eastside, and potentially the Langley, despite the issues described in the previous paragraph.

MTs and MOs have been set to differing levels in adjacent basins. The GSPs do not explain why such differences are appropriate and why or how they would lead to achieving sustainability throughout the SVGB. **Aquilogic** finds no significant analysis or discussion in the draft GSPs for the Upper Valley, Forebay, Eastside, or Langley on the impact of differing MTs and MOs or on the potential impacts of alternative MTs and MOs.

Upper Valley

The draft GSP for the Upper Valley states that locally defined significant and unreasonable groundwater elevations in the subbasin include groundwater levels that "*[a]re at or below the observed groundwater elevations during the 2012 to 2016 drought*."[1] However, the MT for the chronic lowering of groundwater levels is set five feet *lower* than the lowest level recorded between the drought years of 2012 and 2016.[2] In terms of the cumulative change in average groundwater levels, the MT is five feet *lower* than the 2016 level, which was the lowest average groundwater level ever recorded.[3] The 2016 level has never been exceeded since record keeping began in 1944, and that level occurred only because of the 2012-2016 drought. The next lowest level occurred in 1990, also during a severe drought, and was 8.5 feet higher than the 2016 level.[3] Nevertheless, groundwater levels have in general been stable over time in the Upper Valley due to the operation of Nacimiento and San Antonio reservoirs (SVGWBHC, 1995).[3]

Aquilogic finds that the history of groundwater levels in the Upper Valley[3] indicates the MT for chronic lowering of groundwater levels will only be exceeded if: (1) there is an unprecedented increase in groundwater extractions, and/or (2) an unprecedented, severe drought occurs. Importantly, the very low MT for groundwater levels facilitates increased groundwater extractions in the Upper Valley (perhaps significantly increased extractions), without triggering the "undesirable result" defined in the draft GSP.[4] By setting the MT for chronic lowering of groundwater levels at five feet lower than the historic low, undesirable results may occur. Further, the potential impact of increased pumping in the Upper Valley is ignored. Increased pumping could lower groundwater levels down to the MT, which would have impacts on the remainder of the SVGB.

SVBGSA acknowledges that groundwater extractions estimated by the SVIHM are only 76% of reported extractions in the Upper Valley.[5] The extractions estimated for the historical water budget were consequently updated to reflect this discrepancy, but the other groundwater budget components, some of which are linked to groundwater extractions, were not updated, although they should have been prior to completing the draft GSP.[6] Because of this, the following discussion relies on the SVIHM-calculated groundwater-budget components, for comparison purposes. It should be noted that the impacts described below could be determined to be even more significant, if and when pumping in the model is fixed.

---

[1] Page 8-7 of the draft Upper Valley GSP.
[2] Table 8-1, page 8-6 of the draft Upper Valley GSP
[3] Figure 8-2, page 8-12 of the draft Upper Valley GSP
[4] Increased extractions might be limited by the MT for depletion of interconnected surface water (ISW), which is set to 2016 groundwater levels in shallow wells near ISW. However, it follows that 2016 shallow-well groundwater levels are also likely to be the lowest levels in recorded history.
[5] Page 6-17 of the draft Upper Valley GSP
[6] Our understanding is that the USGS is working on resolving SVIHM issues such as these.

Prior to construction of Nacimiento and San Antonio reservoirs, groundwater levels in the Upper Valley were declining substantially.[7] In response to conservation releases from these two reservoirs, which flow to the Salinas River, groundwater levels in the Upper Valley began recovering in 1957 and have since stabilized. During the draft GSP's historical period (i.e., 1980-2016, post operation of the reservoirs), groundwater extractions (-91,600 acre-feet per year [AFY]) in the Upper Valley were supported by net stream exchange (89,100 AFY).[8]

On average, the draft GSP states that pumping in the Upper Valley does not substantially increase stream depletion. Although the draft GSP concludes that only an average of 1,100 AFY of stream depletion is caused by pumping (mostly limited to the Salinas River),[9,10] it should be noted that **aquilogic** believes the depletion value may be higher, because the method employed by SVBGSA to estimate stream depletion with the SVIHM does not account for stream cells that are connected to groundwater for less than 50% of the model period and, as noted above, the SVIHM underestimates pumping by 24%. It is expected that stream cells connected to groundwater for less than 50% of the model period (e.g., 48%) would also contribute to stream depletion. Furthermore, limiting the stream-depletion discussion in the draft GSP to the historical average obscures the higher stream depletions that would occur during drought years. Without understanding drought year depletion, the impact on adjacent basins during droughts cannot be assessed. Despite these limitations in the model results, **aquilogic** opines that *decreases* in current groundwater extractions in the Upper Valley would result in proportional *increases* in subsurface flow from the Upper Valley to the Forebay, as illustrated by the following discussion.[11]

The draft GSP's estimated stream depletion (due to pumping) is only 1% of the net stream exchange, which implies that streamflow infiltration along the Salinas River in the Upper Valley would be of the same order with or without pumping. The infiltration occurs due to the relatively high streambed conductivity and hydraulic conductivity of the surrounding aquifer, in conjunction with a hydraulic gradient that is directed away from the streambed and into the Upper Valley aquifer. Because of these conditions, and the fact that 99% of the net stream exchange occurs without the influence of groundwater extractions, **aquilogic** finds that the absence of pumping would not result in significant groundwater discharge into the Salinas River in the Upper Valley. Therefore, on average, Upper Valley pumping captures groundwater that would otherwise flow to the adjacent Forebay. On average, for the historical period, the Forebay receives only 7,700 AFY of subsurface flow from the Upper Valley.[12] This amount would

---

[7] Figure 5-8, page 5-13 of the draft Upper Valley GSP
[8] Table 6-10, page 6-22 of the draft Upper Valley GSP
[9] Table 5-4, page 5-31 of the draft Upper Valley GSP
[10] Figure 4-11, page 4-26 of the draft Upper Valley GSP
[11] The SBWA has previously asked the SVBGSA to conduct simulations with the SVIHM that would address this issue (see Attachment C).
[12] Table 6-6, p. 6-17 of the draft Forebay GSP

be higher if groundwater extractions in the Upper Valley were lower, which constitutes an impact on the adjacent Forebay. This impact cascades through the Forebay and into the 180/400 and the Eastside, and potentially the Monterey, and should be analyzed in the draft GSP.[11]

It should not be ignored that if groundwater extractions were to increase enough in the Upper Valley (relative to the historical average), groundwater levels could be lowered to the point where they are at or near the MT for the chronic lowering of groundwater levels (and the MT for depletion of ISW), which would result in substantially more stream depletion due to pumping than is revealed by limiting the analysis to historical averages. The draft Upper Valley GSP does not, but should, analyze this.

In summary, the draft Upper Valley GSP does not consider the undesirable results that would occur if the MTs were reached or exceeded, both within the Upper Valley and within downstream subbasins. This issue should be addressed before the Upper Valley GSP is finalized.

Forebay

In the draft GSP for the Forebay, the MT for the chronic lowering of groundwater levels is set to 2015 levels.[13] In terms of the cumulative change in average groundwater levels, this is the second lowest level on record.[14] The 2015 level has been exceeded once in recorded history, in 2016, when the average groundwater level was four feet lower. These low levels occurred only due to the 2012-2016 drought. The next lowest level occurred in 1991, also during a severe drought, and was 14.5 feet higher than the 2016 level.[14] Nevertheless, average groundwater levels have generally been stable over time in the Forebay due to the operation of Nacimiento and San Antonio reservoirs (SVGWBHC, 1995).[14]

Aquilogic finds that the history of groundwater levels in the Forebay[14] indicates the MT for chronic lowering of groundwater levels will only be exceed if: (1) there is an unprecedented increase in groundwater extractions, and/or (2) a severe drought occurs. Importantly, the very low MT for groundwater levels facilitates increased groundwater extractions in the Forebay under average conditions (perhaps significantly increased extractions), without triggering the "undesirable result" defined in the draft GSP.[15] By setting the MTs at 2015 levels, four feet above the historic low, undesirable results may occur. Further, the potential impact of increased pumping in the Forebay is ignored. Increased pumping could lower groundwater levels down to the MT, which would have impacts on the remainder of the SVGB.

[13] Table 8-1, page 8-6 of the draft Forebay GSP
[14] Figure 8-2, page 8-14 of the draft Forebay GSP
[15] Increased extractions might be limited by the MT for depletion of ISW. The MT for depletion of ISW is set by proxy to 2015 groundwater levels, for shallow groundwater near locations of ISW, which are also likely at or near historic lows.

SVBGSA acknowledges that groundwater extractions estimated by the SVIHM are only 65% of reported extractions in the Forebay.[16] The extractions estimated for the historical water budget were consequently updated to reflect this discrepancy, but the other groundwater budget components, some of which are linked to groundwater extractions, were not updated, although they should have been prior to completing the draft GSP. Because of this, the following discussion relies on the SVIHM-calculated groundwater-budget components, for comparison purposes. It should be noted that the impacts described below could be determined to be even more significant, if and when pumping in the model is fixed.

Prior to construction of Nacimiento and San Antonio reservoirs, groundwater levels in the Forebay were declining substantially.[17] In response to conservation releases from these two reservoirs, which flow to the Salinas River, groundwater levels in the Forebay began recovering in 1957 and have since stabilized. During the draft GSP's historical period (i.e., 1980-2016, post operation of the reservoirs), groundwater extractions (-108,700 AFY) in the Forebay were supported by net stream exchange (90,300 AFY).[18]

On average, pumping in the Forebay substantially increases stream depletion. According to the draft Forebay GSP, an average of 29,700 AFY of stream depletion along the Salinas River is caused by Forebay pumping.[19] It should be noted that **aquilogic** believes the depletion value may be higher, because the method employed by SVBGSA to estimate stream depletion with the SVIHM does not account for stream cells that are connected to groundwater for less than 50% of the model period, and as noted above, the SVIHM underestimates pumping by 35%. It is expected that stream cells connected to groundwater less than 50% of the model period (e.g., 48%) would also contribute to stream depletion. Furthermore, limiting the stream depletion discussion in the draft GSP to the historical average obscures the higher stream depletions that would occur during drought years. Without understanding drought year depletion, the impact on adjacent basins during droughts cannot be assessed. Despite these limitations in the model results, **aquilogic** opines that *decreases* in groundwater extractions in the Forebay would cause *increases* in subsurface flow from the Forebay to the Eastside and 180/400 and *increases* in surface flow from the Forebay to the 180/400, as illustrated by the following discussion.[11]

The reported stream depletion (due to pumping) value is 33% of the net stream exchange, which implies that substantial streamflow is captured by groundwater pumping in the Forebay. The draft Forebay GSP states that 31% of the stream depletion along the Salinas River occurs during the principal conservation period for reservoir releases,[19] and therefore is a desired outcome.[20] However, the draft GSP should also acknowledge that streamflow not depleted in

---

[16] Page 6-19 of the draft Forebay GSP
[17] Figure 5-7, page 5-11 of the draft Forebay GSP
[18] Table 6-12, page 6-23 of the draft Forebay GSP
[19] Table 5-4, page 5-30 of the draft Forebay GSP
[20] Page 8-42 of the draft Forebay GSP

the Forebay would flow to the 180/400, where streamflow infiltration of reservoir releases is also a desired outcome. **Aquilogic** finds that it is possible, but unlikely, that the absence of pumping would result in significant groundwater discharge into the Salinas River in the Forebay. Therefore, on average, Forebay pumping captures groundwater that would otherwise flow to the adjacent 180/400 and Eastside and captures streamflow that would otherwise flow to the 180/400. These inter-subbasin flows would be higher if Forebay pumping were lower, which constitutes an impact on the adjacent 180/400 and Eastside. The proportion of unpumped groundwater that would become subsurface flow to adjacent subbasins, relative to surface flow to the adjacent 180/400, is currently unknown but could be estimated with the SVIHM. The SBWA has repeatedly asked the SVBGSA to conduct simulations that would address this issue (see **Attachment C**). Regardless, the impacts on adjacent subbasins should be analyzed in the draft GSP.

It should not be ignored that if groundwater extractions were to increase enough in the Forebay (relative to the historical average), groundwater levels could be lowered to the point where they are at or near the MT for the chronic lowering of groundwater levels (and the MT for depletion of ISW), which would result in substantially more stream depletion due to pumping than is revealed by limiting the analysis to historical averages. The draft Forebay GSP does not, but should, analyze this.

In summary, the draft Forebay GSP does not consider the undesirable results that would occur within downstream subbasins if the MTs were reached or exceeded. This issue should be addressed before the Forebay GSP is finalized.

Eastside

In the draft GSP for the Eastside, the MT for the chronic lowering of groundwater levels is set to 2015 levels.[21] In terms of the cumulative change in average groundwater levels, this level has only been exceeded during the drought years of 1990-1993 and 2016.[22] That is, these low levels occurred only due to severe droughts. The MTs for reductions in groundwater storage and depletion of ISW in the Eastside are also set to 2015 groundwater levels, by proxy.[21,23]

Declining groundwater storage is documented in the Eastside,[24,25] although the magnitude is uncertain. The average storage decline initially estimated in the draft Eastside GSP is 3,400 AFY

[21] Table 8-1, page 8-6 of the draft Eastside GSP
[22] Figure 8-3, page 8-13 of the draft Eastside GSP
[23] However, the SVIHM-simulated cumulative change in storage does not correlate well with the average change in groundwater elevation (Figure 8-6, page 8-25 of the draft Eastside GSP). This is particularly true for the 1991-1998 period, during which groundwater levels were increasing, but the model shows ongoing storage declines.
[24] Figure 5-14, page 5-21 of the draft Eastside GSP
[25] Figure 6-10, page 6-21 of the draft Eastside GSP

for the years 1944-2019, based on groundwater elevation changes and an assumed storage coefficient.[26] Brown and Caldwell (2015) reported an average decline in groundwater storage in the Eastside of 5,000 AFY between 1944 and 2013.[27] On the other hand, the SVIHM calculates an average groundwater storage decline of 21,700 AFY from 1980 to 2016.[28] The draft Eastside GSP states that the SVIHM storage-decline estimate is "…*more consistent with drought year estimates than the long-term historical average estimates*," because it is similar in magnitude to the 25,000 AFY to 35,000 AFY storage decline estimated by Brown and Caldwell (2015) for the drought years of 1984-1991.[27] Because of these uncertainties, the draft Eastside GSP adopts an average of available estimates and states that the historical loss of groundwater storage is 10,000 AFY.[29] However, SVBGSA acknowledges that SVIHM-estimated groundwater pumping in the Eastside is only 81% of reported extractions,[30] which **aquilogic** interprets to mean that the SVIHM estimate of storage decline is also likely underestimated. Improving the estimated change in groundwater storage should be a priority for the SVBGSA, so that potential future changes in storage can be more readily assessed.

As noted, the draft Eastside GSP indicates that "undesirable results" for the chronic lowering of groundwater levels can be avoided in the Eastside by maintaining average groundwater levels at or above 2015 levels. Despite not triggering an "undesirable result,", **aquilogic** finds that groundwater elevation maps for 2015 show persistent and widespread groundwater flow from the 180/400 to Eastside in the Salinas area (i.e., southwest to northeast, at and near the subbasin boundary).[31,32] Importantly, the natural groundwater flow direction in this area is northeast to southwest (i.e., from higher topographic elevation to lower topographic elevation). The 2015 groundwater elevations show a reversal of the natural flow direction which, as stated, induces groundwater flow from the 180/400 to the Eastside. This flow direction is likely exacerbating SWI in the 180/400 and will likely continue to do so into the future. By setting the MTs at 2015 levels, which are near historic lows, undesirable results may occur. Further, the potential impact of increased pumping in the Eastside is ignored. Increased pumping could lower groundwater levels down to the MT, which would have impacts on the remainder of the SVGB.

Because the MTs for chronic lowering of groundwater levels, reduction of groundwater storage, and depletion of ISW are set to 2015 groundwater levels, **aquilogic** finds that sustainability, in terms of these three sustainability indicators (SIs), may come at the expense of the 180/400's ability to achieve sustainability for its SIs, particularly for SWI. The MT for SWI in the 180/400 is

[26] Pages 5-19 to 5-20 of the draft Eastside GSP
[27] Page 6-22 of the draft Eastside GSP
[28] Table 6-10, page 6-22 of the draft Eastside GSP
[29] Page 6-23 of the draft Eastside GSP
[30] Page 6-17 of the draft Eastside GSP
[31] https://www.co.monterey.ca.us/home/showpublisheddocument/31286/636355521174600000
[32] https://www.co.monterey.ca.us/home/showpublisheddocument/31284/636355520821470000

the 2017 extent of the 500 mg/L chloride isocontour.[33] This MT has already been exceeded,[34] which constitutes an undesirable result.[33] If average groundwater levels in the Eastside persist at the MT (i.e., 2015 groundwater levels), it may not be possible for the 180/400 to avoid undesirable results in terms of SWI. Note that the most promising project in the 180/400 for limiting SWI, a proposed SWI extraction barrier, will not address existing inland SWI.[35] Furthermore, the MT for SWI in the Eastside is the 500 mg/L chloride isocontour at the Subbasin boundary which, based on the current locations of that isocontour in the 180-Foot Aquifer and the 400-Foot Aquifer,[34] will not discourage Eastside pumping for many years, a scenario that may prevent the 180/400 from achieving sustainability.

Aquilogic finds that the measurable objective (MO) for chronic lowering of groundwater levels in the Eastside, which is set to 1999 groundwater levels, also allows continued groundwater flow from the 180/400 to the Eastside.[36] The sole groundwater contour map prepared for 1999 by the MCWRA shows that, similar to 2015, there was also persistent and widespread groundwater flow from the 180/400 to the Eastside,[37] as do maps from other sources,[38] particularly in and around the City of Salinas. Such southwest-to-northeast groundwater flow in 1999, which as noted is the reverse of the natural groundwater flow direction, likely exacerbated seawater intrusion in the 180/400, and would likely continue to do so even if the MOs for the chronic lowering of groundwater levels in the Eastside are achieved. To illustrate, there were substantial increases in SWI between 1997 and 1999, and between 1999 and 2001, in both the 180-Foot Aquifer[39] and the 400-Foot Aquifer.[40] Pumping in the 180/400 plays a role in ongoing SWI in the 180/400; however, northeastward groundwater flow to the Eastside in and around Salinas also plays a role. It should be noted that these increases in SWI in the 180/400 occurred during a time when groundwater levels were *increasing* in the Eastside (i.e., 1995-1999).[22] These issues—the potential for the Eastside MTs and MOs to exacerbate SWI in the 180/400—should be addressed in the draft GSP before the SVBGSA considers the document for adoption.

Aquilogic opines that, under the MTs set by the draft GSP, groundwater extractions in the Eastside could likely continue at their current magnitude, or perhaps even at a greater magnitude, despite the ongoing concerns described above. This opinion is supported by recent data. The draft Eastside GSP states that, "*[a]n undesirable result for chronic lowering of groundwater levels does not currently exist*…"[41] due to all representative monitoring sites being

---

[33] Table 8-1, page 8-6 of the 180/400 GSP
[34] Figures 11 and 12, pages 27 and 28 of the 180/400-Foot Aquifer Subbasin WY 2020 Annual Report
[35] Page 9-52 of the 180/400 GSP
[36] 1999 groundwater levels are also used for the reduction in groundwater storage and depletion of ISW MOs, by proxy.
[37] https://www.co.monterey.ca.us/home/showpublisheddocument/19504/636232633785900000
[38] Figures 8-4 and 8-5, pages 8-19 and 8-20 of the draft Eastside GSP
[39] https://www.co.monterey.ca.us/home/showpublisheddocument/100287/637514182745270000
[40] https://www.co.monterey.ca.us/home/showpublisheddocument/100289/637514807577300000
[41] Page 8-22 of the draft Eastside GSP

above their MTs in 2019. Because two other SIs use groundwater levels as proxies,[21] and due to other conditions related to the remaining SIs, the Eastside is currently sustainable, despite a history of chronic loss of groundwater storage and reversed groundwater flow that threatens to make sustainability in the 180/400 unachievable. It appears that the draft GSP could facilitate increased pumping, further impacting the 180/400, as groundwater contour maps for 2019 show the same persistent reversed groundwater flow from the 180/400 to the Eastside in and around Salinas that was observed in 1999 and 2015.[42] As previously noted, the draft Eastside GSP ignores the potential impact that increased pumping in the Eastside, which could lower groundwater levels down to the MT, may have on the remainder of the SVGB.

In summary, the Eastside GSP does not consider the undesirable results that would occur if the MTs and MOs were reached or exceeded, both within the Eastside and within the 180/400. This issue should be addressed before the Eastside GSP is finalized.

Langley

The MT for the chronic lowering of groundwater levels in the Langley is difficult to evaluate in a historical context, due to a lack of data. It is set at 2019 groundwater levels,[43] but in terms of the cumulative change in average groundwater levels,[44] there are no values for 2015 or for the drought years 1989-1991. The 2019 levels are among the lowest on record, and the lowest levels since 1994, but values on the order of 1-2 feet lower have been recorded.

Simulations with the SVIHM indicate net subsurface flow out of the Langley to the 180/400.[45] However, **aquilogic** finds that groundwater in the southwestern portion of the Langley flows from the 180/400 to the Langley,[46] which risks exacerbating SWI in the 180/400 and possibly preventing 180/400 from achieving sustainability in terms of SWI. Furthermore, the SWI MO and MT for the Langley state that the 500 mg/L chloride isocontour must not cross the Langley boundary from the 180/400.[43] If the 500 mg/L isocontour were to approach or cross the subbasin boundary, the SWI MT in the 180/400 would have been exceeded long before SWI MT in the Langley would be exceeded, a scenario that may prevent the 180/400 from achieving sustainability and could facilitate increased pumping in the Langley. Again, these issues should be analyzed before the GSP is finalized.

Monterey

The MT for the chronic lowering of groundwater levels in the Monterey is also difficult to evaluate, in part because changes to MTs and MOs occurred after the draft GSP was issued and

---

[42] https://www.co.monterey.ca.us/home/showpublisheddocument/87229/637177055290800000
[43] Table 8-1, page 8-6 of the draft Langley GSP
[44] Figure 8-2 of the draft Langley GSP
[45] Table 6-8, page 6-19 of the draft Langley GSP
[46] Figure 5-11, page 5-20 of the draft Langley GSP

the matter is still unresolved. In the Marina-Ord management area, the MT is set to the lowest groundwater level between 1995 and 2015.[47] It is our understanding that this MT will not change. In the Corral de Tierra management area, the draft GSP states that the MT for the chronic lowering of groundwater levels is set to 2015 groundwater levels.[47] However, it is our understanding, gleaned from public meetings, that that this level was changed to 2008 levels at a recent subbasin meeting and that the matter will be discussed in an upcoming subbasin meeting.

Descriptions of the Deep Aquifers in the draft Monterey GSP suggest that "*[t]here is a strong likelihood of flow through these confining layers (MCWRA, 2018).*"[48] **Aquilogic** believes this statement is speculative and not supported by water quality data. A detailed study of the Deep Aquifers by the SVBGSA will commence in the near future, which will likely provide additional insight into the nature of the confining layers in the Deep Aquifers. Until that study is completed, the draft GSP should avoid speculation.

The draft GSP for the Monterey used the Monterey Subbasin Groundwater Flow Model (MBGWFM) to determine historical, current, and projected water budgets, rather than the SVIHM. Under historical groundwater conditions, there is a net flow of groundwater out of the Monterey and into the 180/400.[49] For the projected water budget, multiple simulations were conducted with the MBGWFM to assess, among other things, the impact of possible future conditions in the 180/400. Under all reasonably foreseeable groundwater conditions in the 180/400, groundwater outflow from Monterey to 180/400 continues to occur.[50] These conditions could hinder or prevent the Monterey from achieving sustainability, and the draft GSP should address this more thoroughly.

Projects and Management Actions

Potential projects and management actions are listed and described in each of the draft GSPs and the 180/400 GSP for the SVGB in Monterey County. While lengthy, the list is not exhaustive. Furthermore, there has not been a comprehensive effort to simulate project benefits with the available models; thus, the potential effectiveness of many of the proposed projects and management actions is unknown.

Missing from the analysis of potential projects is perhaps the one project that could balance all or most of the water demands in the Monterey County portion of the SVGB. That project is the surface conveyance of groundwater extracted from the Forebay to be delivered to the Eastside and 180/400. This project was first proposed in DWR Bulletin 52 in 1946 as the second

[47] Table 8-1, page 8-11 of the draft Monterey GSP
[48] Page 36 of Chapter 4 of the draft Monterey GSP
[49] Table 6-1, page 6-20 of the draft Monterey GSP
[50] Table 6-4, page 6-44 of the draft Monterey GSP.

component of a larger project that included impoundment of surface water to provide conservation releases to the Salinas River. The surface impoundments were built: Nacimiento and San Antonio reservoirs. The groundwater extraction facilities and surface conveyance were never constructed. SVGWBHC (1995) found the 1946 solution, "…*so compelling we could not refrain from recommending it*." SVGWBHC (1995) also stated that, "*More recent studies conducted by MCWRA since 1946 have reaffirmed and endorsed the original concepts*." In addition, SVGWBHC stated:[51]

> "*We urge the MCWRA to focus its attention on the completion of the original plan by the construction and operation of water transfer facilities. The MCWRA should avoid diverting its attention to suggested alternatives that are less viable economically or less effective technically. These less viable and less effective alternatives would not provide the same benefits as the original plan, would be more expensive, and the projected price of water would be significantly higher for all parties.*
>
> *The panel believes strongly that Salinas Valley is fortunate that an in-Valley solution is available. We urge the Salinas Valley community to support the MCWRA in this effort to distribute the available water supplies for more efficient water management and lasting benefits for all residents of the Valley*."

In the era of the Sustainable Groundwater Management Act (SGMA), one need only replace "MCWRA" with "SVBGSA" in the above quote.

Delivery of Forebay groundwater extractions from such a project to the 180/400 for SWI mitigation and to the Eastside for overdraft mitigation has the potential to restore the natural groundwater flow direction in the Eastside by providing in-lieu recharge. Significantly, delivery of this water to the 180/400 may have the potential to restore SWI protective elevations, as described in Geoscience (2013), also via in-lieu recharge, and may also be able to provide water to a SWI injection barrier in the 180/400.

Aquilogic strongly encourages the SVBGSA to consider including this project in all of the GSPs.

[51] Page 18 of SVGWHC (1995)

References Cited

Brown and Caldwell (2015). State of the Salinas River Groundwater Basin. Prepared by Brown and Caldwell for the Monterey County Water Resources Agency. January. https://www.co.monterey.ca.us/home/showpublisheddocument/19586/636232667593230000, accessed September 30, 2021.

DWR (1946). Salinas basin investigation. Department of Public Works, Division of Water Resources. Bulletin 52. (Note, a subset of Bulletin 52 that contains the relevant information, Bulletin 52-B, can be found here: https://www.co.monterey.ca.us/home/showpublisheddocument/19576/636232667537000000, accessed September 30, 2021.)

Geoscience (2013). Protective elevations to control sea water intrusion in the Salinas Valley. Prepared by Geoscience for the Monterey County Water Resources Agency. November. https://www.co.monterey.ca.us/home/showpublisheddocument/19642/636232715345100000, accessed October 4, 2021.

Kennedy/Jenks (2004). Final report: Hydrostratigraphic analysis of the northern Salinas Valley. Prepared by Kennedy/Jenks Consultants for the Monterey County Water Resources Agency. May. https://www.co.monterey.ca.us/home/showpublisheddocument/19582/636232667568400000, accessed September 30, 2021.

SVGWBHC (1995). Hydrogeology and water supply of Salinas Valley: A white paper prepared by Salinas Valley Ground Water Basin Hydrology Conference for the Monterey County Water Resources Agency. June. https://www.co.monterey.ca.us/home/showpublisheddocument/19584/636232667576070000, accessed September 29, 2021.

MCWRA (2001). Draft environmental impact report / environmental impact statement for the Salinas Valley Water Project. Prepared by the Monterey County Water Resources Agency and the U.S. Army Corps of Engineers. June. https://www.co.monterey.ca.us/home/showpublisheddocument/24180/636281210678370000, accessed September 30, 2021.

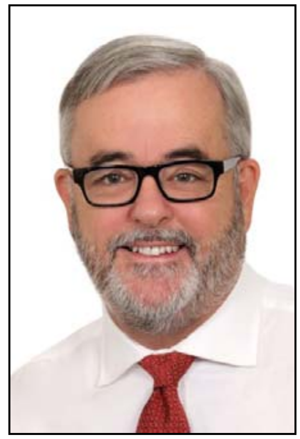
Attachment A

aquilogic, Inc.
environment • water • strategy

185 San Leandro Way
San Francisco, CA 94127, USA
Mobile Tel. +1.949.939.7160
Web: www.aquilogic.com

CURRICULUM VITAE

September 2021



Anthony Brown

Principal Hydrologist

mobile: +1.949.939.7160
email: anthony.brown@aquilogic.com

Disciplines

Hydrology, Hydrogeology, Water Resources, Water Quality, Water Supply, Drinking Water Treatment, Contaminant Source Identification, Contaminant Fate and Transport, Soil and Groundwater Remediation, Environmental Liability Management, Legal and Regulatory Strategy.

Education

M.Sc. Engineering Hydrology, Imperial College London, 1989
D.I.C. Postgraduate diploma in Civil Engineering, Imperial College London, 1988
B.A. Geography, King's College London, 1985

Professional Experience

Anthony is a versatile and proficient professional with over 30 years of experience in hydrology, hydrogeology, water resources, water quality, fate and transport of contaminants, groundwater remediation, regulatory strategy, water resources evaluation, and water supply engineering.

Anthony has conducted and managed numerous groundwater resources projects, including:

- resource evaluation, development and management
- water balance, storage capacity and safe yield analysis
- water rights disputes and adjudication
- marginal groundwater development (e.g., brackish water)
- aquifer storage and recovery (ASR)
- indirect potable reuse (IPR).

He has also implemented hundreds of hazardous waste site investigations, including sites with multiple potentially responsible parties (PRPs), complex hydrogeology and fate and transport, fractured rock, multiple contaminants, and co-mingled plumes. This work has included detailed Remedial Investigation (RI) or Phase II characterization studies, groundwater flow and solute transport modeling, Preliminary Endangerment Assessments, Human Health Risk Assessments, and remedial feasibility studies (FS), remedial system design and implementation. Anthony has been involved in the design, testing, and permitting of drinking water treatment systems for impaired (contaminated) water sources.

Anthony has provided expert services to many prominent water and environmental law firms, the Attorneys General of California, New Jersey, Pennsylvania, Maryland, Ohio, North Carolina, and Puerto Rico, several County District Attorneys, and numerous City Attorneys' Offices.

Through his work for water utilities impacted by gasoline constituents (e.g. MTBE), chlorinated solvents (e.g. PCE, TCE), solvent stabilizers (e.g. 1,4-dioxane), soil fumigants (e.g. 1,2,3-TCP), chlorofluorocarbons (e.g. Freon 11, 12 and 113), perfluorinated compounds (i.e., PFAS), the rocket propellants perchlorate and NDMA, and hexavalent chromium, arsenic and other metals, Anthony has become a recognized expert in the fate, transport, and remediation of these compounds, and the protection of source waters from contamination by such recalcitrant chemicals.

Amongst other technical areas of expertise, he has also provided expert advice related to:
- groundwater resource development
- groundwater basin management
- California Sustainable Groundwater Management Act (SGMA)
- water rights and the development of physical solutions
- groundwater discharges and the Clean Water Act
- compliance with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and National Contingency Plan (NCP)
- cleanup under the Resource Conservation and Recovery Act (RCRA)
- the environmental impact of oil field contaminants and their mitigation
- source identification and mitigation of bacteria and fecal contamination in coastal waters
- source identification and persistence of microplastics in coastal waters.

Through his extensive experience on "high-profile" projects, Anthony has developed an excellent working relationship with private and public sector clients, Federal, State, and local elected officials and government agency staff, the legal community, professional organizations, non-profit environmental organizations, and his colleagues in the environmental and water resources professions.

Anthony has also testified before the U.S. Senate and briefed White House staff, federal, State, and local elected officials and regulators, independent commissions, professional groups, academic institutions, and the news media (including CBS 60 Minutes, National Public Radio [NPR] and local newspapers) on groundwater issues.

Beyond his US experience, Anthony has worked on projects in the United Kingdom, Ireland, Canada, Mexico, Costa Rica, Columbia, Ecuador, Yemen, Egypt, and Nepal.

U.S. Senate Testimony and Briefings for Elected Officials

- Testimony before the U.S. Senate Committee on Environment and Public Works on "the Appropriate Role of States and the Federal Government in Protecting Groundwater", on April 18, 2018.
- Briefing for White House Officials and the Council on Environmental Quality on "the Impact of MTBE on Water Resources of the United States", in October 1997.
- Briefing for U.S. Senators Feinstein and Boxer on "MTBE Contamination of the City of Santa Monica Water Supply", in October 1997.
- Briefing for Assistant Administrators and other leadership at the US Environmental Protection Agency (EPA) on "the Impact of MTBE on Water Resources of the United States", in October 1997.
- Briefing of State Senator Sheila Kuehl, several Assembly members, leadership at the California Environmental Protection Agency (CalEPA) and State Water Resources Control Board (SWRCB) on "MTBE Contamination of the City of Santa Monica Water Supply", in 1997-1998

Anthony has also briefed the following on the impact of fuel oxygenates, chlorinated solvents, rocket propellants, metals, oil field activities, and bacteria on water quality:

- USEPA staff (Region IX)
- State Senators and Assembly Members
- State regulators
- Local officials (Mayors, council and board members, City attorneys, etc.)
- Independent Commissions
- Professional bodies (ABA, ACS, ACWA, AEHS, AGWA, NGWA, GRA, etc.)
- Academic institutions and many other organizations
- Media outlets (NPR, CBS 60 Minutes, local TV stations)

Expert Consulting and Witness Services

Anthony is a respected, credible, and highly effective expert witness. He has testified at trial on 11 occasions, including three times in Federal court. Anthony is currently scheduled to testify in another seven trials during the next 18 months. Overall, he has been retained as an expert in over 60 matters related to water rights, water resources management, and water pollution. Anthony has provided deposition testimony in 27 of these matters and these depositions have lasted from one to 32 days in length.

Active:

- Retained (but not disclosed) in numerous cases (>200) related to the impact on water supplies by a group of emerging contaminants (consolidated in multi-district litigation [MDL])
- Lanier Parkway Associates vs. Hercules Chemical (Ashland) (the impact of benzene and chlorobenzene contamination from a chemical facility on an adjacent commercial property) – Superior Court of Glynn County, Georgia (expert affidavit)
- Retained (but not disclosed) by a confidential investor-owned water utility client addressing the impact of Per and polyfluorinated substances (PFAS) on water supplies in two northeastern states
- College Park East vs. Midway City Sanitary District et al (groundwater contamination by chlorinated solvents at a former dry cleaner) - US District Court, Central District of California (discovery)
- TC Rich et al vs. Shaikh et al (chlorinated solvent contamination at a former small batch chemical distributor in Los Angeles) - US District Court, Central District of California (expert report)
- Mojave Pistachios et al vs. Indian Wells Valley Groundwater Authority (IWVGA) (challenge to the Groundwater Sustainability Plan [GSP] and associated pumping fees in a groundwater basin in eastern Kern County) – California Superior Court, Kern County (discovery)
- James J. Kim vs. L. Tarnol et al (chlorinated solvent contamination at a former dry cleaner in Glendale) – California Superior Court, Los Angeles County (discovery)
- City of Oxnard v. Fox Canyon Groundwater Management Agency (water rights dispute) – California Superior Court, Los Angeles County (discovery)
- City of Arcadia vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – US District Court, Central District of California (expert report)
- Friends of Riverside Airport vs. Department of the Army et al (poly-chlorinated biphenyl [PCB] contamination of soil at a former wastewater treatment plant in Riverside, California) US District Court, Central District of California (expert report, deposition)
- Stoll vs. Ewing et al (chlorinated solvent contamination at a former dry cleaner in Pleasanton) - US District Court, Northern District of California (discovery)
- San Luis Obispo Coastkeeper et al vs. Santa Maria Valley Water Conservation District et al (dispute over surface water flows to enhance steelhead habitat in the Santa Maria River watershed, Santa Barbara County) – US District Court, Central District of California (discovery)
- Mojave Pistachios vs. Indian Wells Valley Water District (IWVWD) et al (water rights dispute in eastern Kern County between agricultural interests and public water purveyors) – California Superior Court, Kern County (discovery)
- Goleta Water District vs. Slippery Rock Ranch (water rights dispute in central California between an avocado ranch adjacent to an adjudicated groundwater basin) – California Superior Court, Santa Barbara (expert report, deposition, trial scheduled for May 2021)

- Santa Barbara Channel-keeper et al vs. City of San Buenaventura et al (adjudication of surface water and groundwater rights in the Ventura River watershed, Ventura County) – California Superior Court, Los Angeles (expert report)
- Las Posas Valley Water Rights Coalition et al vs. Fox Canyon Groundwater Management Agency et al (adjudication of groundwater rights in the Las Posas Groundwater Basin, Ventura County) – California Superior Court, Santa Barbara (expert report, deposition pending, trial scheduled for 2022)
- Black Warrior Riverkeeper et al vs. Drummond Coal (acid mine drainage from a former coal mine impacting a tributary of the Black Warrior River, Alabama) – US Federal Court, Middle District of Alabama, Birmingham (expert report, deposition, trial scheduled for October 2021)
- City of Riverside vs. Goodrich et al (perchlorate contamination of groundwater resources and water supply wells) - California Superior Court (expert declaration, deposition, further deposition pending)
- Commonwealth of Pennsylvania vs. ExxonMobil, et al (State-wide assessment of impact and damages associated with MTBE and TBA releases) – US Federal Court, Southern District of New York (expert reports)
- State of Maryland vs. ExxonMobil et al (State-wide assessment of impact and damages associated with MTBE and TBA releases in Maryland) – US Federal Court, Southern District of New York (discovery)
- Steinbeck Winery et al vs. City of Paso Robles et al (Quiet title action brought by a group of wineries against the public water agencies to adjudicate water rights) - California Superior Court, San Jose (deposition, Phase 2 and Phase 3 trial testimony, Phase 4 pending)
- Various individuals vs. San Luis Obispo County et al (Trichloroethene [TCE] contamination in groundwater and water supply wells in a community adjacent to a County-operated airport) – California Superior Court, San Luis Obispo (litigation stayed)
- Commonwealth of Puerto Rico vs. Shell Oil Co., et al (Island-wide assessment of impact and damages associated with MTBE and TBA releases in Puerto Rico) – US Federal Court, Southern District of New York (expert report, deposition, trial pending)
- City of Fresno vs. Shell Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – California Superior Court (discovery)
- New Jersey Department of Environmental Protection (NJDEP) vs. Sunoco et al (State-wide assessment of impact and damages associated with MTBE and TBA releases in New Jersey) – US Federal Court, Southern District of New York (expert report, deposition, hearing testimony, trial pending)
- Orange County Water District (OCWD) vs. Sabic Innovative Plastics et al (Chlorinated solvent, 1,4-dioxane and perchlorate contamination of groundwater resources from various sites in Orange County, California) – California Superior Court, Orange County (expert report, deposition [32 days], trial testimony)

- City of Modesto vs. Vulcan Chemical et al (perchloroethylene [PCE] releases from numerous dry cleaners contaminating drinking water wells and groundwater resources) – California Superior Court, San Francisco (expert reports, deposition [25 days], trial testimony, returned by Appeals Court)

Past:

- City of Upland vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – US District Court, Central District of California (expert report, settled)
- Borrego Water District (water rights dispute and physical solution) – California Superior Court, San Diego (stipulated adjudication)
- Charleston Waterkeeper and South Carolina Coastal Conservation League vs. Frontier Logistics (lawsuit over polyethylene nurdle pollution in and around Charleston Harbor) - US District Court, Charleston District of South Carolina (expert report, settled)
- San Miguel Electric Cooperative vs. Peeler Ranch (contamination of soil, surface water and groundwater beneath a ranch from a lignite mine and coal-fired power plant) – Texas Superior Court, 218th District (expert report, deposition, hearing testimony, settled)
- City of Hemet vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – US Federal Court, Southern District of California (expert report, settled)
- Sierra Club et al vs. Dominion Energy (contamination of groundwater and surface water resources by coal combustion residuals [CCRs] from ash ponds) – US Federal Court, Eastern District of Virginia (deposition, trial testimony)
- Sunny Slope Water Company vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – California Superior Court, Los Angeles County (settled)
- Greenfield et al vs. Ametek Aerospace et al (solvent contamination in groundwater beneath three mobile home parks) – US Federal Court, Southern District of California, San Diego (expert report, deposition, settled)
- Golden State Water Company vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells in Nipomo and Claremont) – US Federal Court, Southern District of California (expert report, settled)
- National Association for the Advancement of Colored People (NAACP) vs. Duke Energy (coal ash contamination of groundwater, sediments, and surface waters at the Belews Creek coal-fired power plant) – US Federal Court, Middle District of North Carolina (expert report, settled)
- City of Atwater vs. Shell Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – California Superior Court (expert report, deposition, trial testimony)
- State of Vermont vs. ExxonMobil et al (State-wide assessment of impact and damages associated with MTBE and TBA releases in Vermont) – US Federal Court, Southern District of New York (settled)

- Trujillo et al vs. Ametek Aerospace et al (solvent contamination in groundwater beneath an elementary school) – US Federal Court, Southern District of California, San Diego (expert report, deposition, settled)
- Roanoke River Basin Association vs. Duke Energy (coal ash contamination of groundwater, sediments, and surface waters at two coal-fired power plants: Mayo and Roxboro) – US Federal Court, Middle District of North Carolina (expert report, deposition, settled)
- OCWD vs. Unocal et al (MTBE and TBA contamination of groundwater resources from service station sites in Orange County, California) – US Federal Court, Southern District of New York (expert report, deposition, settled)
- State of North Carolina vs. Duke Energy (administrative hearing related to coal ash contamination at six power plants) – North Carolina Superior Court (settled)
- City of Clovis vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – California Superior Court (expert report, deposition, trial testimony)
- San Juan Hills Golf Course vs. City of San Juan Capistrano et al (suit filed over groundwater pumping in the San Juan Basin) – California Superior Court, Orange County (settled)
- City of Tulare vs. Dow Chemical et al (1,2,3-TCP contamination of groundwater resources and water supply wells) – California Superior Court (settled)
- State of California vs. Columbia Casualty Company et al (perchlorate and solvent contamination at the Stringfellow Acid Waste disposal pits in Glen Avon) – California Superior Court (expert report, settled)
- City of Delano vs. Crop Production Services (CPS) et al (Nitrate contamination of water supply wells) - California Superior Court (settled)
- Laborers' International Union of North America Local Union No. 783 v. Santa Margarita Water District et al. (Review of the groundwater hydrology of the Cadiz project, San Bernardino County) - California Superior Court, Orange County (independent expert report, settled)
- Southern California Water Company vs. Aerojet General Corp. (TCE, perchlorate and NDMA contamination of drinking water supplies in Rancho Cordova, California) – California Superior Court, Sacramento District (expert report, deposition, settled)
- The City of Stockton Redevelopment Agency (RDA) vs. Conoco-Phillips et al (petroleum hydrocarbon contamination at former oil terminals) – California Superior Court (deposition, settled)
- PK Investments vs. Barry Avenue Plating (hexavalent chromium and solvent contamination of soil and groundwater) - California Superior Court, Los Angeles District (deposition, settled)
- City of Santa Monica, California vs. Shell et al (MTBE contamination of drinking water supplies) – California Superior Court, Orange County District (expert report, deposition, settled)
- State of California vs. Joint Underwriters (perchlorate and solvent contamination at the Stringfellow Acid Waste disposal pits in Glen Avon) – California Superior Court (expert report, deposition, settled)

- Community of Broad Creek, North Carolina vs. BP Amoco et al (MTBE, benzene and 1,2-DCA contamination of private water supply wells) – North Carolina Superior Court (deposition, settled)
- South Tahoe Public Utility District, California vs. ARCO et al (MTBE contamination of drinking water supplies) - California Superior Court, San Francisco (expert report, deposition, trial testimony)
- Private well owners in 18 reformulated gasoline (RFG) states vs. various oil companies (class action related to MTBE) - US Federal Court, New York District (deposition, class certification hearing)
- Individual plaintiffs vs. Lockheed Corporation (TCE and perchlorate contamination of drinking water supplies in Redlands, California) – California Superior Court, Los Angeles District (deposition, settled)
- City of Norwalk vs. Five Point U-Serve et al (1.2-DCA contamination of a municipal drinking water well) – California Superior Court (deposition, case dismissed)
- Forest City Corp. vs. Prudential Real Estate (PCE contamination of soil and groundwater) – California Superior Court, Los Angeles District (deposition, trial testimony)
- Huhtamaki vs. Ameripride (chlorinated solvent contamination at a commercial dry cleaner/ laundry facility) – California Superior Court, Sacramento District (expert report, deposition, settled)
- Consolidated Electrical Distributors (CED) vs. Hebdon Electronics et al (chlorinated solvent contamination in fractured granite) - California Superior Court, North San Diego District (expert report, deposition, trial testimony)
- Southern California Water Company vs. various parties (water rights petition and adjudication for the American River, Sacramento, California) – State Water Resources Control Board, Sacramento
- The City of Santa Monica, California vs. ExxonMobil Corporation (MTBE contamination of drinking water supplies) – California Superior Court (designated, settled, retained as consultant to both parties for remedy implementation)
- The town of Glenville, California vs. various parties (MTBE contamination of drinking water supplies in Kern County, California) - California Superior Court (designated, settled)
- Great Oaks Water Company vs. Chevron and Tosco (MTBE contamination of drinking water supplies in San Jose, California) - California Superior Court (designated, settled)
- Orange County District Attorney's Office vs. ARCO et al (Underground Storage Tank [UST] violations, and MTBE contamination of soil and groundwater) - California Superior Court (designated, settled)
- Cambria Community Services District (CCSD) vs. Chevron et al (MTBE impact to drinking water supplies) in San Luis Obispo County, California - California Superior Court (designated, settled)
- Los Osos Community Services District (CCSD) vs. Chevron et al (MTBE impact to drinking water supplies) in San Luis Obispo County, California - California Superior Court (designated, settled)

- The town of East Alton, Illinois vs. various parties (MTBE contamination of drinking water supplies) – Illinois Superior Court, Jefferson County (designated, settled)
- The City of Dinuba vs. Tosco et al (MTBE contamination of groundwater resources) - California Superior Court (expert report, settled during deposition)
- Stella Stephens vs. Bazz-Houston et al (chlorinated solvent contamination at an active metal finishing facility in Garden Grove, California) - California Superior Court (designated, settled)
- Communities for a Better Environment (CBE) vs. Chrome Crankshaft (hexavalent chromium and TCE contamination beneath a chrome plating facility and adjacent school) - California Superior Court (designated, settled)
- California Attorney General's Office vs. Unocal (Natural Resource Damage Assessment [NRDA] at a former oil field in the central coast of California) - California Superior Court (designated, settled)
- Phillips Petroleum Corporation vs. private property owner (contamination from a former oil well in Signal Hill, California) - California Superior Court (designated, settled)
- Mobil Oil Corporation vs. private property owner (contamination from a former bulk fuel plant in the Bay Delta area) – California Superior Court (designated, settled)
- Mobil Oil Corporation vs. terminal operator (contamination from a former bulk fuel plant in Monterey area) – California Superior Court (designated, settled)

General Project Experience

Anthony has acted as the Principal in Charge, Project Manager (PM), Quality Assurance (QA) Manager and/or Principal Review for the following ongoing or recently completed projects:

Current Water Resources Projects

- Review of the Effect of Releases from a Reservoir on Surface Water Flows Intended to Enhance California Steelhead Habitat, and the Potential Impact on Groundwater Recharge – City of Santa Maria, Golden State Water Company
- An Investigation of the Hydrology of Perennial Spring in the Mojave Desert, as it Relates to Potential Impact from a Groundwater Resource Development Project - Three Valleys Municipal Water District
- Consulting Support Related to the Implementation of SGMA in the Pleasant Valley and Oxnard Plain Groundwater Basins, Pleasant Valley County Water District, Guadalasca Mutual Water Company.
- Consulting Support for a Surface Water and Groundwater Rights Dispute in the Ventura River Watershed – Group of Confidential Landowners
- Support Related to a New Car Manufacturing Plant in Huntsville, Alabama, and potential impact on habitat for an endangered species of fish – Center for Biological Diversity
- Review of the Groundwater Monitoring, Management, and Mitigation Plan (GMMMP) for the Cadiz Water Conservation Project – Three Valleys Municipal Water District

- Groundwater Consulting Support to an Agricultural Business in southeast Kern County Located within a Partially Adjudicated Basin – SunSelect
- Strategic Groundwater Consulting Support to a Large Golf Resort Located in a Desert Groundwater Basin Subject to Critical Overdraft under SGMA – Rams Hill GC
- Assessment of Water Resources at Oil Fields Throughout California and the Development of Produced Waters as an Alternate Water Supply – California Resources Corporation (CRC)
- Support Related to SGMA, Possible Adjudication, and Overall Groundwater Management Strategy for a Municipality in Southern California – Confidential Municipal Client
- Consulting Support for a Groundwater Rights Adjudication in the Las Posas Groundwater Basin, Ventura County – Group of Large Landowners
- Support Related to SGMA, Salinity Management, Alternate Water Sources, and Overall Groundwater Management Strategy for a Grower in the Bay-Delta – Wonderful Orchards
- Evaluation of the Feasibility of Using Brackish Groundwater and Oilfield Produced Water as an Alternate Water Supply for a Basin in Critical Overdraft – Northwest Kern Brackish and Oilfield (BOF) Water Study Group
- Support Related to SGMA, Possible Adjudication, and Overall Groundwater Management Strategy for a Large Water District in the Central Valley – Confidential Water District Client
- Water Rights Dispute Between a Water District and an Avocado Ranch in Central California – Slippery Rock Ranch
- Evaluation of the Feasibility of Using Brackish Groundwater as an Alternate Water Supply for a Closed Desert Basin in Critical Overdraft – Indian Wells Valley Brackish Water Study Group
- Development of a Plan for an Adjudication of Water Rights in a Desert Basin and the Principles of a Groundwater Management Plan (i.e., Physical Solution) – Confidential Water District Client
- Support Related to SGMA for Water Districts on the West Side of Kern County, Including the Creation of Defined Groundwater Management Areas – Westside District Water Authority
- Support to Agricultural Interests in the "White Areas" in Madera County with Respect to the Implementation of the California Sustainable Groundwater Management ACT (SGMA) – Madera County Farm Bureau
- Evaluation of Water Supply Options, Including New Water Supply Wells, for a Major Oilfield in West Fresno County – CRC
- Development of a Water Budget for a Baseline Period, and Evaluation of Native Safe Yield, Annual Operating Safe Yield, Historical Pumping, and Conditions of Overdraft as Part of a Water Rights Dispute in the Central Coast of California – City of Paso Robles
- Design and Permitting of an Aquifer Storage and Recovery (ASR) Project for Indirect Potable Reuse (IPR) of Tertiary Treated Municipal and Industrial Wastewater – City of Fresno
- Assessment of Increased Pumping at a Data Center and the Impact on Nearby Municipal Water Supply Wells in Charleston, South Carolina – Southern Environmental Law Center (SELC)

- Litigation Support and Development of Groundwater Management Approaches as an Alternative to Compliance with the Sustainable Groundwater Management Act – Confidential Water District Client, Southern California
- Groundwater Management Support to a Very Large Agribusiness with Over 170,000 Acres of Almonds, Pistachios, Mandarins, Pomegranates, and Grapes in the San Joaquin Valley - Wonderful Orchards
- Evaluation of Groundwater Conditions and Quality, and The Degree of Hydraulic Connection Between Groundwater Basins, as Part of a Water Rights Dispute in the Central Coast of California – City of Paso Robles
- Development of a Water Supply Well Drilling Ordinance and Valuation of Water Rights for a Confidential Municipality in Southern California
- Support for a Major Agricultural Interest with Holdings in Four Separate Groundwater Basins in Relation to the Implementation of SGMA – RTS Agribusiness
- Development of a New Water Supply Well Field, Including Compliance with California Division of Drinking Water (DDW) Policy 97-005 (Impaired Source Policy), and Evaluation of Groundwater Contamination at a Nearby Aerospace Facility – City of Torrance
- Evaluation of Aquifer Characteristics and Groundwater Conditions Related to the Reinjection of Oil Field Produced Water and Development of a Strategy to Obtain an Aquifer Exemption – Confidential Oil Company
- Development of a recycled water program (including possible aquifer storage and recovery [ASR]/salt-water intrusion program) using advanced treatment of a blend of brackish groundwater and urban storm-water – City of Santa Monica
- Membership of the Technical Advisory Committee (TAC) of a Cooperative Groundwater Group that will Become a Groundwater Sustainability Agency (GSA) – Indian Wells Valley
- Evaluation of Basin Hydrogeology, Groundwater Conditions, Water Quality, and Well Production in a Riparian Coastal Basin in Southern California – City of San Juan Capistrano
- Investigation and Development of Alternate Groundwater Supplies for an Agricultural Interest with Land Holdings in an Arid California Valley – Mojave Pistachios
- Development of a 50,000 acre-foot per year (AFY) ASR Project in the Eastern Portion of a Large Agricultural Valley in Southeast California – Confidential Client
- Review of the Groundwater Hydrology of the Cadiz Project – an independent expert report prepared for Orange County Superior Court in re: Laborers' International Union of North America Local Union No. 783 v. Santa Margarita Water District et al.

Petroleum Hydrocarbons

- Assessment of the Impact of MTBE/TBA Contamination of Water Resources in the State of Vermont, Including Contamination at Release Sites, Public Water Supply Wells, and Private Domestic Wells – State of Vermont

- Evaluation of Produced Water Management Options for Two Active Oil Fields in Southern California, including Treatment and Beneficial Use - CRC
- Assessment of the Impact of MTBE/TBA Contamination of Groundwater Resources in the State of Maryland, and Development of Costs to Address the Contamination at Release Sites, Public Water Supply Wells, and Private Domestic Wells – State of Maryland
- Investigation of Petroleum Hydrocarbon Contamination Related to Releases at a Pipeline that Crosses a Large Ranch in the Central Coast of California – Twin Oaks Ranch
- Assessment of Petroleum Contamination from a Large Pipeline Release that is Discharging to Two Streams and a Wetland in Belton, South Carolina – Southern Environmental Law Center (SELC)
- Evaluation of Contamination by Petroleum Hydrocarbons from a Pipeline Release at a Large Ranch/Winery in the Central Coast of California, and Development of a Conceptual Remedial Program and Costs to Implement – Santa Margarita Ranch, California
- Assessment of the Impact of MTBE/TBA Contamination of Groundwater Resources in the State of Pennsylvania, and Development of Costs to Address the Contamination at Release Sites, Public Water Supply Wells, and Private Domestic Wells – Commonwealth of Pennsylvania
- Investigation and Remediation of MTBE/TBA and Petroleum Hydrocarbon Contamination (using surfactant enhanced product recovery) at a Maintenance Facility in Hawthorne, California – Golden State Water Company
- Assessment of the Effectiveness of Site Investigation and Remediation Activities, Investigation of Off-Site Groundwater Contamination by MTBE/TBA, and Development of Remedial Programs (and Costs) at "Bellwether" Trial Sites - Orange County Water District
- Evaluation of Contaminant Conditions and Prior Site Investigation and Remediation Activity, Implementation of Off-site Investigations, and Development of Remedial Programs and Associated Costs to Address MTBE/TBA Contamination at Trial Sites in Puerto Rico – Commonwealth of Puerto Rico
- Assessment of Site Investigation and Remediation Activities, Investigation of Off-Site Groundwater MTBE/TBA Contamination, and Development of Remedial Programs (and Costs) at Trial Sites – New Jersey Department of Environmental Protection (NJDEP)
- Environmental Impact Report (EIR) and Baseline Environmental Assessment at a Proposed Oil Field Redevelopment Project, Southern Iraq - Confidential Client
- Development of a Remediation Approach and Costs for Soil and Groundwater Contamination at Two Former Petroleum Terminals – Stockton Redevelopment Agency
- Assessment of the Nature of Contamination and the Costs to Address this Contamination at a Former Municipal Landfill in San Diego County – Confidential Client
- Evaluation of Contaminant Sources, and the Fate and Transport of MTBE, 1,2-DCA and Benzene to Numerous Private Water Supply Wells in the Community of Broad Creek, North Carolina

- Assessment of the Effectiveness of Site Investigation and Remediation Activities to Address MTBE/TBA/Benzene Contamination at ARCO and Thrifty Service Stations Throughout Orange County, California - Orange County District Attorney's Office
- Evaluation of Contaminant Sources, Fate, Transport, and Impact of MTBE and TBA to Public Water Supplies, and the Costs to Treat these Contaminants, in the town of East Alton, Illinois
- Court Appointed Consultant to Develop Site Investigation Programs for MTBE/TBA/Benzene Contamination at 35 Thrifty Service Stations in Orange County
- Impact and Mitigation of Oil Field Contaminants at the Belmont Learning Center – Los Angeles Unified School District (LAUSD) - Belmont Commission
- Investigation, PRP Identification, Remediation and Restoration of Municipal Well Fields Impacted by MTBE Contamination – City of Santa Monica (Charnock Well Field), South Lake Tahoe Public Utility District (STPUD), Santa Clara Valley Water District (SCVWD), Great Oaks Water Company
- Oversight of Oil Company Investigation and Remediation Programs in Honolulu Harbor, Hawaii – US Environmental Protection Agency (USEPA)
- Assessment of Oil Field Contaminants in Relation to High Incidences of Leukemia and non-Hodgkins Lymphoma at a High School in Southern California – Confidential Client
- Evaluation of Fuel Releases and Their Impact upon Groundwater Resources at Service Stations, Bulk Plants, Fuel Terminals and Refineries Throughout California – Confidential Client
- Complete Restoration of Municipal Water Supply Wells Contaminated with MTBE – City of Santa Monica (Arcadia Well Field) and ExxonMobil Corporation
- Preliminary Environmental Assessment (PEA) at the Hull Middle School - located on a former oil field and landfill - Torrance Unified School District (TUSD), California
- Oversight of Investigation and Remediation Activities for a MTBE Release at a Service Station and the Potential Impact on a City's Water Distribution System – City of Oxnard, California
- Investigation of MTBE Contamination of Water Supply Wells and Other Petroleum Hydrocarbon Contamination at a Marine Fueling Depot on Catalina Island – Southern California Edison
- Impact of MTBE Releases at Service Stations and a Bulk Fuel Terminal on Drinking Water Wells and Groundwater Resources - City of Dinuba, California
- Oversight of a Court-ordered MTBE/TBA Plume Delineation Program at Gasoline Service Stations in Orange County, California – OCDA, California
- Oversight and Investigation of Remediation of MTBE Contamination Impacting Drinking Water Supplies in the Towns of Cambria and Los Osos/Baywood Park, California – Cambria Community Services District (CCSD), Los Osos Community Services district (LOCSD), Cal-cities Water Company
- Assessment of the Impact of an MTBE Release on Water Supply Wells, Sewers, and a Wastewater Treatment Plant – City of Morro Bay, California

- Investigation and Remediation of an MTBE Release in the Immediate Vicinity of a Drinking Water Supply Well - City of Cerritos, California
- Assessment of the Impact of Petroleum Hydrocarbon Contamination from a Wolverine Pipeline Release in Jackson, Michigan – Private Property Owner
- Investigation of Fuel Oil LNAPL and Hexavalent Chromium Contamination at a Former Clay Products Manufacturing Facility in Fremont, California – Mission Clay Products
- Assessment of the Impact of MTBE Releases on Water Supply Wells, and Oversight of Responsible Party (RP) Investigation and Remediation Activities - Soquel Creek Water District, California
- MTBE Contamination of Private Drinking Water Supplies and Development of Water Supply Treatment and Replacement Alternatives – Glenville, California
- Assessment of the Impact of MTBE on Drinking Water Supply Wells in Santa Clara County, California – Great Oaks Water Company (GOWC)
- Assessment of Data Gaps and Research Needs Regarding MTBE Impact to Water Resources – UK Environment Agency
- Investigation and Mitigation of the Impact of Oil Field Contaminants on a Large Apartment Complex in Marina del Rey, Los Angeles, California – Confidential Client
- Investigation and Remediation of Methane and Hydrogen Sulfide as Part of the Redevelopment of a Former Oil Field in Carson, California - Dominguez Energy/Carson Companies
- Assessment of Methane and Petroleum Hydrocarbon Contamination at a Former Oil Field in Santa Fe Springs, California – General Petroleum
- Natural Resource Damage Assessment (NRDA) at the Guadalupe Oil Field, California - State of California (Department of Fish and Game [DFG], Oil Spill Prevention and Response [OSPR], Attorney General and Regional Water Quality Control Board [RWQCB])
- Assessment of the Impact of Oil Field Activities on Surface Water and Groundwater Resources in the Central Coast of California – State of California
- Groundwater Investigation and Remediation at Four Petroleum Terminals in Wilmington, Carson, and San Pedro, California - GATX
- Research into Technologies for Treatment of MTBE in Water - Association of California Water Agencies (ACWA) / Western States Petroleum Association (WSPA) / Oxygenated Fuels Association (OFA)
- Characterization and Remediation of a Hydrocarbon Release (including MTBE) from a Refined Product Pipeline in Fractured Bedrock in Illinois – Shell
- Investigation and Remediation of Petroleum Hydrocarbon Contamination Beneath a City Maintenance Yard and City Bus Yard – City of Santa Monica, California
- Investigation and Remediation of a Gasoline Release (including MTBE) in Fractured Bedrock Resulting from a Catastrophic Tank Failure – Intrawest Ski Resorts, California

- Assessment of LNAPL, Aromatic Hydrocarbon, and Chlorinated Solvent Contamination Beneath a Former Waste Disposal Facility in Santa Fe Springs, California – Confidential Client
- Investigation of Soil and Groundwater Contamination at a Fueling Facility at a Municipal Airport – City of Santa Monica, California
- Pipeline Leak Investigation and Remedial Design - Mobil Pipeline, Ft. Tejon, California
- Investigation of a Petroleum Release in Fractured Bedrock - Chevron, Julian, California
- Contribution of Multiple Sources to Groundwater Contamination – Mobil Oil Corporation, La Palma, California
- Forensic Assessment of a Gasoline Release – Mobil Oil Corporation, Santa Monica, California
- Investigation of a Diesel Fuel Release – General Petroleum, Point Hueneme, California
- Service Station Investigations and Remediation (> 60 sites) - Mobil Oil Corporation, World Oil, Los Angeles County Metropolitan Transportation Authority (LACMTA), and Others
- Assessment of a Crude Release from a Former Pipeline - Mobil Oil, Gorman, California
- Remediation of 2,000,000-gallon (7,560 m^3) LNAPL Spill - Gulf Strachan Gas Plant, Alberta

Chlorinated Solvents

- Evaluation of Groundwater Contamination at an Aerospace Facility in El Cajon, the Threat to Water Supply Wells, and Vapor Intrusion Concerns at Overlying Properties – Confidential Client
- Investigation of Groundwater Contamination and Potential Sources for TCE Contamination in Groundwater and Water Supply Wells in a Community Adjacent to a County-Operated Airport – Confidential Client
- Evaluation of Poly-Chlorinated Biphenyls (PCBs) in Storm Water and the Impact on Groundwater Resources and the Use of Treated Storm Water for Aquifer Recharge and Saline Intrusion Barriers – Confidential Municipal Clients
- Assessment of the Effectiveness of Site Investigation and Remediation Activities, Investigation of Off-Site Groundwater Contamination, and Development of Remedial Programs (and Costs) at Solvent “Source Sites” in the South Basin Groundwater Protection Project (SBGPP) - Orange County Water District
- Consulting Support to a Community Adjacent to the Santa Susana Field Laboratory (SSFL), a Facility Previously Used to Test Rockets – Bell Canyon Homeowners Association
- Investigation of Groundwater Contamination by Perfluorinated Compounds (e.g., PFOA, PFOS) and its Impact on Public Water Supplies in Southeastern North Carolina – Confidential Client
- Investigation of Chlorinated Solvent and Petroleum Hydrocarbon Contamination, and Implementation of an Extended Remediation Pilot Study, at a Small-Batch Chemical Distribution Facility in Santa Fe Springs, California – Angeles Chemical Corporation

- Evaluation of Contaminant Distribution and Fate, and Development of a Remedial Approach and Costs, for Chlorinated Solvent Contamination in Groundwater at a Light Industrial Facility in Northridge, California, – Confidential Client
- Project Management Consultant (PMC) for the Hazardous Substances Account Act (HSAA) Program (i.e., State-CERCLA) as part of the SBGPP – Orange County Water District
- Assessment of Conceptual Hydrogeology and the Sources of 1,2-DCA and PCE Contamination of a Large Public Water Supply Well – Confidential Client
- Investigation and Remediation of Chlorinated Solvent Contamination in Soil and Groundwater Beneath a Metal Finishing Facility in Inglewood, California – Bodycote Hinterliter and Joseph Collins Estate.
- Investigation and Remediation of Soil and Groundwater Contamination at a Former Wood Treating Facility – Port of Los Angeles
- Assessment of the Nature of PCE Releases from Dry Cleaning Facilities, the Impact Upon Groundwater Resources, and the Cost of Remediation – City of Modesto, California
- Investigation of Chlorinated Solvent Contamination in Soil, Groundwater and Drinking Water Supplies Beneath Various Facilities in Lodi, California – Confidential Client
- Investigation of TCE and Hexavalent Chromium Contamination at the Suva School in Montebello, California – Communities for a Better Environment
- Remediation of Chlorinated Solvents, Including Vinyl Chloride, in Soil and Groundwater Beneath a Former Aerospace Facility in West Los Angeles, California – Playa Vista Capital
- Assessment of Chlorinated Solvent and Hexavalent Chromium Contamination at an Active Metal Finishing Facility in the City of Garden Grove, California – Confidential Client
- Investigation and Remediation of Hexavalent Chromium and TCE Contamination at an Active Plating Facility in West Los Angeles – confidential client
- Contamination of Drinking Water Supplies by TCE and Perchlorate from an Aerospace Manufacturing Facility in Redlands, California – Individual Plaintiffs
- Investigation and Remediation of Hexavalent Chromium, TCE, and Gasoline LNAPL Contamination at an Active Plating Facility in Santa Fe Springs, California – Confidential Client
- Investigation and Remediation of Hexavalent Chrome and TCE Contamination at the Los Angeles Academy (formerly Jefferson) Middle School, Los Angeles, California – Jefferson Site PRP Group
- Evaluation of Groundwater and Contaminant Conditions at an Active Municipal Landfill in Los Angeles County, California – Browning Ferris Industries (BFI)
- Investigation of Chlorinated Solvent Contamination in Groundwater Beneath a Municipal Airport – City of Santa Monica, California
- Resource Conservation and Recovery Act (RCRA) Facility Assessment and Closure for a Large Aerospace Facility in Hawthorne, California – Northrop Grumman Corporation

- Characterization of Complex Hydrogeology and Contaminant Fate and Transport (with Poly-chlorinated Biphenyls [PCBs] and Chlorinated Solvents) in Karstic Bedrock at a Site on the National Priority List (NPL) in Missouri – MEW PRP Steering Committee
- Design of a Groundwater Remediation Program for Chlorinated Solvent, Perchlorate and Other Contaminants Utilizing Existing Drinking Water Wells – San Gabriel Valley Water Company (SGVWC)
- Investigation of a Chlorinated Solvent Release in Fractured Bedrock – Consolidated Electrical Distributors, San Diego, California
- Contamination of Drinking Water Supplies by TCE from an Aerospace Manufacturing Facility in Redlands, California – Individual Plaintiffs
- Investigation of a Chlorinated Solvent Release at an Active Chemical Terminal - GATX, San Pedro, California
- Technical and Regulatory Assistance, and RP Oversight and Review, Chlorinated Solvent Contamination Beneath a Former Aerospace Facility – City of Burbank, California
- Investigation and Remedial Design for a Chlorinated Solvent Release at an Active Machine Shop – Mighty USA, Los Angeles, California
- Remediation of Chlorinated Solvents in Groundwater as Part of a Rail Freight Transfer Terminal Development - Port of Los Angeles, California
- Remedial Evaluation of PCE Contamination at a Former Scientific Instruments Manufacturing Facility – Forest City, Irvine, California
- Evaluation of a Chlorinated Solvent Release at a Dry Cleaners - Los Angeles City Attorney, West Los Angeles, California
- Assessment of a Chlorinated Solvent Release from Former Dry Cleaners – DeLoretto Plaza, Santa Barbara, California
- Characterization and Remediation of LNAPL at an Active Chemical Refinery - ICI, Teeside, UK

Perchlorate

- Investigation of Regional Perchlorate Contamination of Groundwater Resources in the Central Basin of Los Angeles – Water Replenishment District of Southern California (WRD)
- Investigation of regional groundwater contamination by perchlorate in the Rialto-Colton, Bunker Hill, and North Riverside Basins, and impact to water supply wells – City of Riverside
- Assessment of the Effectiveness of Site Investigation and Remediation Activities, Investigation of Off-Site Groundwater Contamination, and Development of Remedial Programs (and Costs) at Perchlorate Release Sites in the South Basin Groundwater Protection Project (SBGPP) - Orange County Water District
- Hydrogeologic Investigation, Source Identification, Water Supply Well Impact Assessment, and Drinking Water Treatment for Perchlorate – City of Morgan Hill, California
- Evaluation of the Fate and Transport of Perchlorate and NDMA Contamination and its Impact on Water Supplies in Rancho Cordova, California – Southern California Water Company

- Hydrogeologic Investigation, Water Supply Well Impact Assessment, Regulatory Assistance, and Responsible Party (RP) Oversight for Perchlorate Contamination – City of Gilroy, California
- Regulatory and Technical Assistance, RP Oversight and Review, Water Resource Impact Assessment for Perchlorate Contamination – City of Santa Clarita, California
- Design of a Groundwater Remediation Program for Chlorinated Solvent, Perchlorate and Other Contaminants Utilizing Existing Drinking Water Wells – San Gabriel Valley Water Company (SGVWC), San Gabriel Valley Superfund Site, California
- Evaluation of the Off-site Migration of Perchlorate and TCE Contamination from a Rocket Testing Facility in Simi Hills, California – City of Calabasas, County of Los Angeles
- Investigation of Potential Perchlorate Source Sites, Source Contribution, Contaminant Pathway Assessment, and Drinking Water Treatment – Fontana Water Company, West Valley Water District, Fontana, California
- Evaluation of Previous Environmental Investigations, Contaminant Transport and Remediation Options for Perchlorate and Solvent Contamination at the Stringfellow Acid Waste Disposal Pits in Glen Avon, California – Joint Underwriters

Hexavalent Chromium

- Investigation and Remediation of Hexavalent Chrome and TCE Contamination at the Los Angeles Academy (formerly Jefferson) Middle School, Los Angeles – Jefferson Site PRP Group
- Investigation and Remediation of Hexavalent Chromium and TCE Contamination at an Active Plating Facility in West Los Angeles – Confidential Client
- Hydrogeologic Investigation of Hexavalent Chromium Contamination in the Northern Area of the Central Basin in Los Angeles County – Water Replenishment (WRD)
- Investigation of TCE and Hexavalent Chrome Contamination at the Suva School in Montebello, California – Communities for a Better Environment
- Investigation of Fuel Oil LNAPL and Hexavalent Chromium Contamination at a Former Clay Products Manufacturing Facility in Fremont, California – Mission Clay Products
- Investigation and Remediation of Hexavalent Chromium, TCE, and Gasoline LNAPL Contamination at an Active Plating Facility in Santa Fe Springs California – Confidential Client

Other Projects

- Investigation of the Source, Magnitude, Extent and Fate of Polyethylene Nurdle Pollution in and Around Charleston Harbor – Charleston Waterkeeper and South Carolina Coastal Conservation League
- Review and Critique of Proposed Coal Ash Pond Closure at the Tennessee Valley Authority (TVA) Gallatin Power Plant - SELC
- Evaluation of Surface Water and Groundwater Pollution by Boron and Other Metals and Salts Associated with Coal Ash at Georgia Power's Plant Scherer Generating Station - SELC

- Assessment of the Impact of 1,2,3-TCP Contamination from Soil Fumigant Applications on Municipal Water Supplies – City of Arcadia
- Investigation of PCB Contamination at a Former Wastewater Treatment Plant at a Former US Army Camp – City of Riverside
- Investigation of the Fate, Transport, and Persistence of 1,2,3-TCP Contamination of Groundwater and Municipal Water Supply Wells – City of Upland
- Assessment of Sediment, Surface Water, and Groundwater Contamination Associated with Coal Ash at the Belews Creek Coal-Fired Power Plants in North Carolina, and an Evaluation of Closure Options for Coal Ash Basins – NAACP
- Assessment of the Impact of 1,2,3-TCP Contamination from Soil Fumigant Applications on Municipal Water Supplies – Sunny Slope Water Company
- Investigation of Sources and Fate and Transport of 1,2,3-TCP Contamination in Groundwater and its Impact on Potable Water Supply Wells in and around the City of Claremont – Golden State Water Company
- Evaluation of disposal and/or treatment options for produced waters at three active oil fields in Kern County – California Resources Corporation
- Assessment of 1,2,3-TCP Contamination of Groundwater and Potable Water Supply Wells in the Nipomo Area of Central California – Golden State Water Company
- Evaluation of potential water resources impacts from a proposed coal ash landfill located within a flood plain near Laredo Texas – confidential ranch owner
- Investigation of the Fate, Transport, and Persistence of 1,2,3-TCP Contamination of Groundwater and Municipal Water Supply Wells – City of Hemet
- Investigation of elevated concentrations total dissolved solids (TDS) and dissolved metals in surface water and groundwater related to an active lignite mine and coal-fired power plant at a large ranch in southeast Texas – Peeler Ranch
- Assessment of soil, groundwater, and surface water contamination associated with a Former Manufactured Gas Plant (MGP) in South Carolina – Southern Environmental Law Center (SELC)
- Evaluation of Contaminated Groundwater and Surface Waters by 1,4-dioxane, Perfluorinated Compounds [PFCs], and Gen-X at a Chemical Manufacturing Facility in North Carolina – Cape Fear Riverkeeper
- Investigation of 1,2,3-TCP Contamination of Groundwater and Municipal Water Supply Wells – City of Fresno
- Evaluation of Surface Water, Sediment, and Groundwater Contamination and Assessment of Remedial Actions at a Former Manufactured Gas Plant in South Carolina – Confidential Client
- Evaluation of Flow Conditions and Water Quality in Surface Water and Groundwater at an Active Coal-Fired Power Plant in North Carolina, including Three-Dimensional Groundwater Flow and Solute Transport Modeling – Sierra Club

- Assessment of 1,2,3-TCP Contamination of Groundwater Resources and Water Supply Wells in Clovis, California, and Development of Well-head Treatment Programs and Associated Costs - City of Clovis
- Investigation of Surface Water and Groundwater Impacted by Acid Mine Drainage (AMD) from a Former Coal Mine in Alabama, Including Geophysical Mapping, Piezometer Installation, and Soil, Sediment, and Surface Water Sampling – Black Warrior Riverkeeper
- Evaluation of Groundwater and Surface Water Contamination by Coal Combustion Residuals (CCRs) from Ash Ponds at Power Generation Facilities in Eastern Virginia – Sierra Club
- Investigation of 1,2,3-TCP Contamination of Groundwater and Municipal Water Supply Wells – City of Atwater
- Evaluation of Contaminant Sources and Hydrogeologic Pathways for 1,2,3-TCP Contamination of Water Supply Wells - City of Tulare
- Identification of Potential Sources of Nitrate Contamination at a Municipal Water Supply Well – Water Replenishment District of Southern California (WRD)
- Assessment of Sediment, Surface Water, and Groundwater Contamination Associated with Coal Ash at Two Coal-Fired Power Plants in North Carolina, and an Evaluation of Closure Options for Coal Ash Basins – Roanoke River Basin Association
- Assessment of the Volume and Quality of Storm Water and Shallow Groundwater (from Dewatering) at a Large Condominium Complex, as part of a City's MS-4 Storm Water Permitting – Coronado
- Investigation of Nitrate Contamination of Groundwater Resources and Water Supply Wells in Delano, California, and Development of Well-head Treatment Programs and Associated Costs - City of Delano
- Evaluation of Contaminant Conditions and Closure Plans for Coal Ash Basins at Two Coal-Fired Power Plants in Virginia – Sierra Club
- Evaluation of Groundwater and Surface Water Contamination by CCRs from Ash Ponds at a Former Power Generation Facility in Central Virginia – Sierra Club and Potomac Riverkeeper
- Negotiation of Private Agreements Between Water Utilities and RPs – City of Santa Monica, STPUD, City of Morro Bay, SGVWC, GOWC, City of Oxnard, OCDA
- Evaluation of Power Plant Intake and Outfall Structures on Fecal Coliform Plume Dynamics and Resulting Beach Closures, Huntington Beach, California – California Energy Commission
- Investigation of Bacteria and Fecal Contamination in Groundwater Beneath the Downtown Area of Huntington Beach, California – City of Huntington Beach
- Investigation of the Source(s) and Transport of Enterococcus and Fecal Bacteria to the Near Shore Waters of Huntington Beach, California – City of Huntington Beach, County of Orange, Orange County Sanitation District (OCSD)
- Characterization and Remediation, Former Town Gas Sites - British Gas Properties, U.K.
- Aquifer Characterization, Contaminant Assessment, Slurry Wall Design and Installation, Soil Excavation and Water Treatment System Design - Port of Los Angeles, California

Professional History

aquilogic, Inc., CEO and Principal Hydrologist, 2011 to present.
exp, Executive Vice-President, Chief Business Development Officer, 2010 to 2011
WorleyParsons, Senior VP, Strategy & Development, 2006 to 2010.
Komex Environmental Ltd., Chief Executive Officer, Principal Shareholder, Director, 1999 to 2005.
Komex•H2O Science•Inc., President and Principal Hydrologist, 1992 to 1999.
Remedial Action Corporation, Project Manager and Geohydrologist, 1989 to 1992.
Lanco Engineering, Project Manager, 1985 to 1987, and 1988.
Royal Geographical Society, Kosi Hills Resource Conservation Project, Nepal: Project Director, 1983 to 1985

Teaching

Anthony has recently taught the following classes:

- Environmental Aspects of Soil Engineering and Geology - a ten-week course at the University of California, Irvine
- Site Characterization and Remediation of Environmental Pollutants - two lectures as part of the course at Imperial College London
- Methyl Tertiary Butyl Ether: Implications for European Groundwater - a one day seminar for the UK Environment Agency (UKEA)
- Successful Remediation Strategies – a two-day course for the NGWA
- Understanding Environmental Contamination in Real Estate, and one day class for the International Right-of-Way Association (IRWA)
- Project Development and the Environmental Process, a one-day class for the IRWA
- Environmental Awareness, a one-day class for the IRWA
- Regional Fuels Management Workshop, a two-day workshop for the USEPA.

Publications

In addition to his teaching experience, Anthony has prepared over 1000 written project reports, and has written, presented and published many articles regarding the following:

- The implementation of the SGMA in California
- Groundwater law in California
- The development of alternate water supplies, notably brackish groundwater
- Aquifer storage and recovery and other groundwater augmentation actions
- The Clean Water Act and groundwater contamination
- Contamination of groundwater and drinking water supplies by fuel oxygenates, chlorinated solvents, rocket propellants, PFCs, and metals
- Contaminant fate and transport in fractured or heterogeneous media
- The impact of oil field activities on the environment

- Source water assessment and protection
- Public health and toxicology
- Risk analysis and assessment
- Environmental economics
- General water resources and environmental issues

The following is a list of publications and presentations:

Brown, A., 2021. Science in the Court Room: Expert Witness Testimony in Contamination Cases. American Groundwater Trust California PFAS Webinar, March 2021.

Brown, A., 2021. Sources of 1,2,3-TCP and its Persistence in California Groundwater. American Groundwater Trust 1,2,3-TCP Webinar, February 2021.

Brown, A., 2020. Groundwater and the Clean Water Act. American Groundwater Trust California Groundwater Conference, Ontario, February 2020.

Brown, A., and T. Watson, 2020. Produced Water – A New California Resource. Produced Water Society Annual Seminar, Houston, February 2020.

Brown, A., 2019. Perspectives on the Future of the Water Business. Environmental Business International, Industry Summit, San Diego, March 2019.

Brown, A., 2019. Paso Robles – The First Jury Trial over Water Rights in California. American Groundwater Trust California Groundwater Conference, Ontario, February 2019.

Brown, A., 2018. Emerging Contaminants – Where Do They Come From? American Groundwater Trust Conference on Emerging Contaminants, Chino Basin, March 2018.

Brown, A., 2017. Contaminated Groundwater as a Resource. State Bar of California Environmental Law Conference, Yosemite, October 2017.

Stone A. and A. **Brown**, 2017 (organizers). Groundwater Law – An American Groundwater Trust Conference. UC Hastings Law School, San Francisco, May 18, 2017

Brown, A. 2016. The SGMA Cookbook – Implementing the Sustainable Groundwater Management Act. Association of California Water Agencies (ACWA), Spring Conference, Monterey, CA, April 2016.

Stone A. and A. **Brown**, 2016 (organizers). Groundwater Law – An American Groundwater Trust Conference. Loyola Law School, Los Angeles, April 26, 2016

Stone A. and A. **Brown**, 2015 (organizers). Groundwater Law – An American Groundwater Trust Conference. Doubletree San Francisco Airport, May 15, 2015

Brown, A., 2015. Challenges Implementing the California Sustainable Groundwater Management Act (SGMA). Bar Association of San Diego County, May 5, 2015.

Brown, A., 2015. Technical and Other Issues Implementing the California Sustainable Groundwater Management Act (SGMA). Ventura Association of Water Agencies, March 19, 2015.

Brown, A., 2015. Outlook for Environmental Services in the Global Energy and Resources Sectors. Environmental Business Journal, Environmental Industry Summit, San Diego, March 11-13, 2015.

Brown, A., 2015. The Effect of $50 Oil on the Environmental Services Sector. Environmental Business Journal Conference, San Diego, March 11-13, 2015.

Brown, A. 2014. Hydrology and the Law: The Role of Science in the Resolution of Legal Issues for Water Quality and Damages Issues. Law Seminars International, Santa Monica, CA. October 2014

Stone A. and A. **Brown**, 2014 (organizers). Groundwater Law – An American Groundwater Trust Conference. Marriott Marina del Rey, May 20-21, 2014

Brown, A. 2014. Environmental Issues with Hydraulic Fracturing. Los Angeles County Bar Association (LACBA), Spring Symposium, Los Angeles, CA. April 2014.

Brown, A. 2014. Environmental Services in the Global Energy & Resources Sectors. Environmental Business Journal, Environmental Industry Summit, San Diego, March 2014.

Brown, A. 2013. Dealing with Emerging Groundwater Contaminants. Association of California Water Agencies (ACWA), Fall Conference, Los Angeles, November 2013.

Brown, A., 2013. Outlook for Environmental Services in the Global Energy and Resources Sectors. Environmental Business Journal, Environmental Industry Summit, San Diego, March 2013.

Brown, A., Colopy, J, and Johnson, T, 2007. Groundwater Science in the Courtroom: Observations from the Expert Witness Chair. Groundwater Resource Association of California (GRAC), Groundwater Law Conference, San Francisco, June 2007.

Brown, A. 2005. Emerging Water Contaminants. California Special Districts Association (CSDA), Annual Conference, Palm Springs, May 2005.

Brown, A. 2005. The Interplay of Science and Policy at Contaminated Sites. Los Angeles County Bar Association (LACBA), Spring Symposium, Los Angeles, CA. April 2005.

Brown, A., M. Trudell, G. Steensma, and J. Dottridge, 2005. European Experiences with Artificial Aquifer Recharge. Groundwater Resource Association of California (GRAC), Aquifer Storage Conference, Sacramento, March 2005.

Brown, A. 2004. Viagra, Estrogen, Prozac, and Other Emerging Contaminants: have you checked your groundwater lately? American Groundwater Trust (AGWT), Legal Issues Conference, Los Angeles, November 2004.

Brown, A. 2004. The Use of Groundwater Models in Complex Litigation. American Groundwater Trust (AGWT), Groundwater Models in the Courtroom Symposium, May 2004.

Brown, A. 2004. Emerging Groundwater Contaminants: MTBE as a Case Study. Association of California Water Agencies (ACWA), Spring Conference, Los Angeles, May 2004.

Rohrer, J., A. **Brown**, S. Ross, 2004. MTBE and Perchlorate, Lessons Learned from Recent Groundwater Contaminants. California Special Districts Association (CSDA), Annual Conference, Palm Springs, May 2004.

Hagemann, M., A. **Brown**, and J. Klein, 2002. An Estimate of Costs to Address MTBE Releases from Underground Storage Tanks and to Treat Drinking Water Supplies Impacted by MTBE. NGWA, Conference on MTBE: Assessment, Remediation, and Public Policy, Orange, CA. June 2002

Hagemann, M., A. **Brown**, and J. Klein, 2002. From Tank to Tap: A Chronology of MTBE in Groundwater. NGWA, Conference on Litigation Ethics, and Public Awareness, Washington, D.C., August 2002

Major, W., A. **Brown**, S. Roberts, L. Paprocki, and A. Jones, 2001. The Effects of Leaking Sanitary Sewer Infrastructure on Groundwater and Near Shore Ocean Water Quality in Huntington Beach, California. California Shore and Beach Preservation Association and California Coastal Coalition – Restoring the Beach: Science, Policy and Funding Conference. San Diego, California, November 8-10, 2001.

Ross, S.D., A. Gray, and A. **Brown,** 2001. Remediation of Ether Oxygenates at Drinking Water Supplies and Release Sites. Can-Am 6th Annual Conference of National Groundwater Association Banff, Alberta, Canada. July 2001.

Gray, A.L. and A. **Brown**, 2000. The Fate, Transport, and Remediation of Tertiary-Butyl-Alcohol (TBA) in Ground Water. Proceedings of the NGWA/API 2000 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Remediation. Anaheim, November 14-17, 2000.

Hardisty, P.E., J. Dottridge and A. **Brown**, 2000. MTBE in Ground Water in the United Kingdom and Europe. Proceedings of the NGWA/API 2000 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Remediation. Anaheim, November 14-17, 2000.

Brown, A., B. Eisen, W. Major, and A. Zawadzki, 2000. Geophysical, Hydrogeological and Sediment Investigations of Bacterial Contamination in Huntington Beach, California. California Shore and Beach Preservation Association – Preserving Coastal Environments Conference. Monterey, California, November 2-4, 2000.

Hardisty, P.E., G.M. Hall, A. **Brown** and H.S. Wheater, 2000. Natural Attenuation of MTBE in Fractured Media. 2nd National Conference on Natural Attenuation in Contaminated Land and Groundwater. Sheffield, U.K., June 2000.

Brown, A., 2000. Treatment of Drinking Water Impacted with MTBE. Mealey's MTBE Conference. Marina del Rey, California. May 11-12, 2000.

Brown, A., 2000. Other Fuel Oxygenates in Groundwater. Mealey's MTBE Conference. Marina del Rey, California. May 11-12, 2000.

Brown, A., 2000. The Fate, Transport and Remediation of TBA in Groundwater. Mealey's MTBE Conference. Marina del Rey, California. May 11-12, 2000.

Brown, A., 2000. MTBE Contamination of the City of Santa Monica Water Supply: Recap. Mealey's MTBE Conference. Marina del Rey, California. May 11-12, 2000.

Mooder, R.B., M.D. Trudell, and A. **Brown**, 2000. A Theoretical Analysis of MTBE Leaching from Reformulated Gasoline in Contact with Groundwater. American Chemical Society, Div. of Environmental Chemistry, 219th ACS National Meeting. San Francisco, March 26-30, 2000.

Trudell, M.R., K.D. Mitchell, R.B. Mooder, and A. **Brown**, 2000. Modeling MTBE Transport for Evaluation of Migration Pathways in Groundwater. American Chemical Society, Div. of Environmental Chemistry, 219th ACS National Meeting. San Francisco, March 26-30, 2000.

Brown, A., 1999. How LUST Policy Led to the Current MTBE Problem. Submitted for the Government Conference on the Environment. Anaheim, CA. August 1999.

Trudell, M.R., K.D. Mitchell, R.B. Mooder and, A. **Brown**, 1999. Modeling MTBE transport for evaluation of migration pathway scenarios. In proceedings, 6th International Petroleum Environmental Conference, Houston TX, November 16-19, 1999. Integrated Petroleum Environmental Consortium, University of Tulsa, OK.

Gray, A.L., A. **Brown**, R.A. Rodriguez, 1999. Treatment of a Groundwater Impacted with MTBE By-Products**.** In proceedings, 6th International Petroleum Environmental Conference, Houston TX, November 16-19, 1999. Integrated Petroleum Environmental Consortium, University of Tulsa, OK.

Gray, A.L., A. **Brown**, M.M. Nainan, and R.A. Rodriguez, 1999. Restoring a Public Drinking Water Supply Contaminated with MTBE. In proceedings, 6th International Petroleum Environmental Conference, Houston TX, November 16-19, 1999. Integrated Petroleum Environmental Consortium, University of Tulsa, OK.

Ausburn M.P., A. **Brown**, D. A. Reid, and S.D. Ross, 1999. Environmental Aspects of Crude Oil Releases to the Subsurface. In proceedings, 6th International Petroleum Environmental Conference, Houston TX, November 16-19, 1999. Integrated Petroleum Environmental Consortium, University of Tulsa, OK.

Hardisty, P.E., A. **Brown**, and H. Wheater, 1999. Using Economic Analysis to Support Remedial Goal Setting and Remediation Technology Selection. In proceedings, 6th International Petroleum Environmental Conference, Houston TX, November 16-19, 1999. Integrated Petroleum Environmental Consortium, University of Tulsa, OK.

Brown, A., and J.J. Clark, 1999. MTBE: Air Today, Gone Tomorrow! California Environmental Law and Remediation Reporter. Argent Communications Group. Foresthill, CA. Volume 9 (2): pp 21 - 30.

Brown, A., P.E. Hardisty, and H. Wheater, 1999. The Impact of Fuel Oxygenates on Water Resources. A one-day course for the UK Environment Agency. London, UK. June 1999

Brown, A., K.D. Mitchell, C. Mendoza and M.R. Trudell, 1999. Modeling MTBE transport and remediation strategies for contaminated municipal wells. Battelle In-Situ and On-Site Bioremediation, Fifth International Symposium, San Diego, CA. April 19-22, 1999.

Brown, A., 1999. LUST Policy and Its Part in the MTBE Problem. USEPA National Underground Storage Tank Conference. Daytona Beach, FL. March 15-17, 1999.

Brown, A., T.E. Browne, and R.A. Rodriguez, 1999. Restoration Program for MTBE Contamination of the City of Santa Monica Arcadia Well Field. Ninth Annual Conference on Soil and Groundwater Contamination, Oxnard, CA. March 1999.

Brown, A., 1999. Moderator of a Panel Session - Judging Oil Spill Response Performance: The Challenge of Competing Perspectives. International Oil Spill Conference. Seattle, WA. March 8-11, 1999.

Brown, A., 1999. MTBE: Asleep at the Wheel! Editorial in the Newsletter of the Los Angeles County Bar Association, Environmental Section. February 1999.

Brown, A., J.S. Devinny, T.E. Browne and R.A. Rodriguez, 1998. Restoration of a Public Drinking Water Supply Impacted by Methyl *tertiary* Butyl Ether (MTBE) Contamination. Proceedings of the NGWA/API 1998 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Remediation, November 11-13, 1998, Houston, TX.

Brown, A., 1998. Petroleum and the Environment: A Consultants Perspective. USEPA Regional Fuels Management Workshop, November 3-4, 1998, Shell Beach, CA.

Brown, A., 1998. How Much Does Remediation Really Cost? Presented at the Southern California Chapter of the Appraisal Institute, Summer Seminar Spectacular: Damages, Diminution and Mitigation. Anaheim, California, August 13, 1998.

Brown, A., J.S. Devinny, A.L. Gray and R.A. Rodriguez, 1998. A Review of Potential Technologies for the Remediation of Methyl *tertiary* Butyl Ether (MTBE) In Groundwater. International Petroleum and the Environment Conference, Albuquerque, NM. October 1998.

Brown, A., A.L. Gray, and T.E. Browne, 1998. Remediation of MTBE at Leaking Underground Storage Tank (LUST) Sites. The UST Clean-up Fund Conference, Austin, TX. June 22, 1998.

Brown, A., J.R.C. Farrow, R.A. Rodriguez, and B.J. Johnson, 1998. Methyl *tertiary* Butyl Ether (MTBE) Contamination of the City of Santa Monica Drinking Water Supply: An Update. Proceedings of the National Ground Water Association (NGWA) Southwest Focused Conference: MTBE and Perchlorate, June 3-5, 1998, Anaheim, California.

Patterson, G, B. Groveman, J. Lawrence, and **A. Brown**, 1998. The Legal Implications, Claims, and Courses of Action for Water Purveyors Impacted by MTBE and Perchlorate. Proceedings of the NGWA Southwest Focused Ground Water Conference: Discussing the Issue of MTBE and Perchlorate in Ground Water. June 3-4, 1998, Anaheim, California.

Clark, J.J., **A. Brown**, and R.A. Rodriguez, 1998. The Public Health Implications of MTBE and Perchlorate in Water: Risk Management Decisions for Water Purveyors. Proceedings of the NGWA Southwest Focused Ground Water Conference: Discussing the Issue of MTBE and Perchlorate in Ground Water. June 3-4, 1998, Anaheim, California.

Brown, A., J.S. Devinny, M.K. Davis, T.E. Browne, and R.A. Rodriguez, 1997. A Review of Potential Technologies for the Treatment of Methyl *tertiary* Butyl Ether (MTBE) in Drinking Water. Proceedings of the NGWA/API 1997 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Remediation, November 12-14, 1997, Houston, TX.

Brown, A., J.R.C. Farrow, R.A. Rodriguez, B.J. Johnson and A.J. Bellomo, 1997. Methyl *tertiary* Butyl Ether (MTBE) Contamination of the City of Santa Monica Drinking Water Supply.

Proceedings of the National Groundwater (NGWA) and American Petroleum Institute (API) 1997 Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Remediation, November 12-14, 1996, Houston, Texas.

Brown, A., J.S. Devinny, M.K. Davis, T.E. Browne, and R.A. Rodriguez, 1997. A Review of Treatment Technologies for Methyl *tertiary* Butyl Ether (MTBE) in Drinking Water. Proceedings of the American Chemical Society (ACS) Conference on Chemistry and Spectroscopy, October 1997, Irvine, California.

Brown, A., J.S. Devinny, T.E. Browne and D. Chitwood, 1997. A Review of Alternative Technologies for the Removal of MTBE from Drinking Water. Association of California Water Agencies (ACWA) Workshop on MTBE, March 13, 1997, Ontario Airport Hilton, California.

Brown, A., 1997. Methyl tertiary Butyl Ether (MTBE) in Groundwater and its Impact on the City of Santa Monica Drinking Water Supply. California Groundwater Resource Association (GRA), January 22, 1997, Wyndham Garden Hotel, Costa Mesa, California.

Gray, A.L., **A. Brown**, B.J. Moore, and T.E. Browne, 1996. Respiration Testing for Bioventing and Biosparging Remediation of Petroleum Contaminated Soil and Groundwater. NGWA Outdoor Action Conference, Las Vegas, NV, May 1996.

Brown, A., and P.E. Hardisty, 1996. Use of Technical and Economic Analyses for Optimizing Technology Selection and Remedial Design: Examples from Hydrocarbon Contaminated Sites. Sixth West Coast Conference on Contaminated Soils and Groundwater, AEHS, March 1996.

Farrow, J.R.C., **A. Brown**, W. Burgess, R.E. Payne, 1995. High Vacuum Soil Vapor Extraction as a Means of Enhancing Contaminant Mass Recovery from Groundwater Zones of Low Transmissivity. Accepted for Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Groundwater, API/NGWA Conference. Houston, TX. November 1995.

Ausburn, M.P., **A. Brown**, M. Brewster, and P. Caloz, 1995. Use of Borehole Terrain Conductivity Logging to Delineate Multiple Ground Water Bearing Zones and Map Alluvial Fan Facies. California Groundwater Resource Association (GRA), Annual Conference, November 1995, Costa Mesa, California.

Hardisty, P.E., S.D. Ross, F.B. Claridge and **A. Brown**, 1995. Technical and Economic Analysis of Remedial Techniques for LNAPL in Fractured Rock. International Association of Hydrogeologists (IAH), October 1995, Solutions 95 Conference, Calgary, Canada.

Croft, R.G., **A. Brown**, P. Johnson, and J. Armstrong, 1994. Tracer Gas Use in Soil Vapor Extraction and Air Sparge Pilot Tests: Case Studies. HMRCI Superfund XV Conf. Proceedings, Washington D.C, November 1994.

Bauman, P.B., M. Brewster and **A. Brown**, 1994. Borehole Logging as an Aid to Hydrogeologic Characterization of Leaking Underground Storage Tank (LUST) Sites. Proceedings from the National Groundwater Association (NGWA), 8th National Outdoor Action Conference and Exposition, Minneapolis, Minnesota. May 1994.

Bauman, P.B., **A. Brown,** M. Brewster, and M. Lockhart, 1994. The use of Borehole Geophysics in the Characterization of Both Vadose and Saturated Zone Lithologies at LUST Sites.

Proceedings from the USEPA Technology Transfer at LUST Sites Conference, Urbana, Illinois. May 1994.

Bauman, P.B., J. Sallomy, **A. Brown** and M. Brewster, 1994. Unconventional Applications of Terrain Conductivity Logging to Groundwater Investigations. Proceedings of the Symposium on the Application of Geophysics at Environmental and Engineering Projects (SAGEEP), Boston, Massachusetts, 1994.

Brown, A., R.E. Payne, and P. Perlwitz, 1993. Air Sparge Pilot Testing at a Site Contaminated with Gasoline. Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Groundwater: Prevention, Detection, and Restoration. API/NGWA Conference, Houston, Texas. November 1993.

Brown, A., 1991. Air Permeability Testing for Vapor Extraction. Conference Proceedings; Petroleum Hydrocarbon Contaminated Soil, San Diego, California. March 1991.

Wheater, H., B. Beck, **A. Brown,** and S. Langan, 1991. The Hydrological Response of the Allt a' Mharcaidh Catchment, Inferences from Experimental Plots. Journal of Hydrology, Vol. 123; pp 163-1990.

Brown, A., 1986. The Final Report of the Kosi Hills Resource Conservation Project, Nepal 1984. Royal Geographical Society Student Expedition.

aquilogic, Inc.
environment • water • strategy

245 Fischer Avenue, Suite D-2
Costa Mesa, CA 92626, USA
Tel. +1.714.770.8040
Web: www.aquilogic.com

CURRICULUM VITAE

October 2021

Robert H. Abrams, PhD, PG, CHg

Principal Hydrogeologist

mobile: +1.650.743.0594
email: bob.abrams@aquilogic.com

Disciplines

Hydrogeology, Water Resources, Geology, Geostatistics, Analytical and Numerical Modeling, Water Quality, Groundwater and Vadose Zone Fluid Flow, Contaminant Fate and Transport.

Education

Ph.D. Hydrogeology, Stanford University, 1999
M.S. Hydrogeology, Stanford University, 1996
B.S. Geology, San Francisco University, 1991

Professional Registrations

Professional Geologist, CA (No. 8703)
Certified Hydrogeologist, CA (No. 931)
Licensed Geologist, North Carolina (No. 2639)

Professional Experience

Bob has over 20 years of professional experience in groundwater resource development, groundwater sustainability, groundwater banking, groundwater quality, and model design and evaluation. He has worked for the California Geological Survey, the U.S. Geological Survey, Stanford University, San Francisco State University, consulting firms, and as an independent consultant for public and private clients. Recent projects have included vadose zone characterization and modeling, evaluation of subsidence investigations, developing and reviewing integrated groundwater/surface water hydrologic models that include simulation of current and future land-use-based water demand and the impact of climate change, and preparation of Groundwater Sustainability Plans.

Project Experience

Summary of California Central Coast Projects

- Currently serving on the Seawater Intrusion Working Group (SWIG) and SWIG Technical Advisory Committee (TAC). Theses groups are tasked with evaluating and recommending approaches for mitigating seawater intrusion in the 180/400-Foot Aquifer Subbasin – *Salinas Basin Groundwater Sustainability Agency, Carmel Valley, California, representing the Salinas Basin Water Alliance*.

- Currently serving on a Drought Technical Advisory Committee (TAC) charged with developing standards and guiding principles for determining release schedules and operations of Nacimiento and San Antonio reservoirs during multiyear droughts. The TAC is also charged with developing the release schedules during such droughts – *Monterey County Water Resources Agency, Salinas, California, representing Grower-Shipper Association of Central California.*
- Invited to participate in the Deep Aquifer Roundtable, a formal meeting attended by Salinas Valley hydrogeology experts to discuss approaches to monitoring and protecting the deepest portions of the Salinas Valley aquifer system – *Monterey County Water Resources Agency, Salinas, California*.
- Served on the Technical Advisory Committee for the development of the Salinas Valley Integrated Hydrologic Model, a new MODFLOW model constructed by Monterey County and the U.S. Geological Survey – *Monterey County Water Resources Agency, Salinas, California representing Grower-Shipper Association of Central California*.
- Well efficiency test results for multiple years and multiple wells were evaluated for a Salinas Valley grower and food processor. Quantitative and statistical analyses were used to assess well performance and make recommendations for potential well maintenance and repair activities – *Nunes Vegetables, Salinas, California*.
- The factors influencing nitrate concentrations in well-water from approximately 60 wells on 40 ranches were determined and an enhanced groundwater monitoring program was developed. Diverse and complex data sets were analyzed statistically and qualitatively to understand the geologic, hydrologic, and anthropogenic factors that variably influence well-water concentrations over short- and long-term timeframes. Specific recommendations for wellhead protection were also developed – *Costa Farms, Analysis of Observed Nitrate Concentration Trends in Irrigation Wells, Soledad, California*.
- Published reports and data from international and national seawater intrusion mitigation efforts were reviewed and analyzed. The analysis was to assess the feasibility, level of effort required, volumes of water necessary, and costs of implementation in the Salinas Valley of a seawater intrusion injection barrier using recycled water. Ongoing injection barrier projects in Orange County and L.A. County were selected for in-depth review to evaluate the feasibility of a similar project in Monterey County – *Tanimura & Antle, Salinas, California*.
- Publicly available groundwater quality data from a set of regularly sampled water-supply wells were evaluated statistically to develop an alternative to installation of new monitoring wells for a land application area that received wastewater from a food processing plant. The effort was driven by a Central Coast Regional Water Quality Control Board order requiring client to participate in the General Waste Discharge Requirements (WDRs) for Fruit and Vegetable

Processors, which has stricter monitoring requirements than the previous individual WDRs – *Dole Fresh Vegetables, Salinas, California*.

- Evaluated (with SEAWAT) the degree to which irrigation wells were drawing seawater inland and if groundwater withdrawals contributed to anoxic conditions in certain reaches of a river hydraulically connected to the aquifer – *El Sur Ranch, Seawater Intrusion and Impact of Irrigation Wells, Monterey County, California*.
- Monte Carlo hydraulic gradient analysis and stochastic 1D and 2D solute transport simulations (analytical solutions) were conducted based on regional groundwater maps and 13 years of monthly groundwater levels from dozens of production wells to determine the most likely MTBE source areas. A customized GIS framework was developed to evaluate source-area probability. Accepted by the Central Coast Regional Water Quality Control Board – *Monterey County Water Resources Agency, Salinas MTBE Investigation, Salinas, California.*
- Conducted a technical evaluation and provided detailed comments regarding the hydrologic analysis undertaken for the draft environmental impact report/environmental impact statement for the proposed Monterey Peninsula Water Supply Project (MPWSP) - *Third-Party Evaluation of Hydrologic Analysis Conducted for Monterey Peninsula Water Supply Project, City of Marina, California*.

Summary of Selected Recent Projects

- Designed and wrote custom computer programs to construct and test a facsimile of the USGS Central Valley Hydrologic Model (CVHM) that runs in Groundwater Vistas (GV), a graphical user interface. The computer programs generated input data for the facsimile model from CVHM MODFLOW packages that are not supported by GV. The facsimile model produces results that are nearly identical to CVHM – *Confidential Client*.
- Combined vadose-zone flow and transport modeling, groundwater flow modeling, and particle-tracking simulations to estimate the persistence of dissolved 1,2,3-trichloropropane in the subsurface. Multiple application areas were characterized using lithologic logs and water flux out of the root zone taken from C2VSimFG Beta. Custom computer programs were written to determine arrival time at a declining water table. MODFLOW and MODPATH were used to estimate travel time from the water table to receptor water-supply wells. Four regions in California (one in Central Valley, three in Southern California) were successfully analyzed with this methodology (settlements and jury awards). For the Central Valley region, the CVHM facsimile model (described above) was used – *Confidential Clients*.
- Co-wrote the Chapter Groundwater Sustainability Plan for the Westside Water Authority in Kern County. Extremely sparse data and modeling results from C2VSimFG-Kern were used to estimate current and future water budgets and groundwater availability – *Westside Water Authority*.

- Conducted environmental impact assessment simulations using the CVHM facsimile model described above to evaluate drawdown and subsidence caused by a proposed brackish groundwater water treatment project in Kern County – *Westside Water Authority*.
- Critically evaluated subsidence estimates along the Tule Subbasin portion of the Friant-Kern Canal (FKC) by reviewing historical USGS reports, InSAR data, geomechanical modeling, and the Tule Subbasin Groundwater Flow Model. This evaluation indicated that responsibility for FKC subsidence should be shared across the subbasin and not focused primarily on the Eastern Tule Groundwater Sustainability Agency – *Confidential Client*.
- Critically evaluated groundwater flow and solute transport models for three coal ash disposal sites in North Carolina. Primary questions included if the models simulated flow and transport properly and sufficiently to allow the sites' owner to claim no offsite groundwater quality impacts above water quality standards – *Southern Environmental Law Center*.
- Developed a new IWFM groundwater-surface water model, based on the Central-Valley-wide C2VSim model, for Stanislaus County to assess impacts in terms of foreseeable land-use changes and installation of new wells – *Stanislaus County, Regional Groundwater-Surface Water Model for PEIR, Modesto, California.*
- Assist Stanislaus County with evaluation of new major well permit applications based on a then-recently passed groundwater ordinance requiring evaluation under CEQA for potential pumping-induced impacts to the groundwater basin, such as lowered water levels in existing wells, land subsidence, and significant groundwater or surface water depletion – *Stanislaus County, Well Permit CEQA Analysis, Modesto, California*.

Summary of Other Selected Water Supply Projects

- Two local-scale groundwater flow (MODFLOW) and solute transport models (MT3DMS) were developed for two sub-regions of the USGS regional Antelope Valley MODFLOW model to evaluate the performance of a new groundwater bank. Updated geologic characterization was based on recent investigations by the USGS and sparse well logs. Groundwater bank performance was evaluated with respect to water quantity and quality for various operational strategies, including well placement and infiltration schedules – *Antelope Valley-East Kern Water Agency (AVEK), Groundwater Banking and Blending Study, Palmdale, California.*
- Developed and calibrated three-dimensional, groundwater flow (MODFLOW) and solute transport models (MT3DMS) to assess water sources for a new 20 MGD water treatment plant. A detailed geologic model was developed for this project to assess the extent of the deep target aquifer, evaluate the risk from a heavy industrial area, well locations, long-term performance, define the wellhead protection area, and optimize wellfield performance – *City of Longview, Design and Construction of a New Groundwater Source and Treatment Facility, Longview, Washington.*
- Pilot study to evaluate the feasibility of compressed air energy storage of renewable energy. Developed and implemented three-dimensional groundwater flow models (MODFLOW) to

evaluate the impact on nearby wells of compressed air injection into a depleted natural-gas reservoir – *Pacific Gas and Electric (subcontractor to Jacobson James and Associates), Compressed Air Energy Storage Pilot Project, San Joaquin County, California.*

- Developed hydrostratigraphic model of the Mesquite Lake groundwater subbasin as interpreted from existing well logs and USGS studies that had been performed to the west and north. The hydrostratigraphic model was used as input to a three-dimensional, transient groundwater flow model (MODFLOW) that assessed the volume of water available for a new municipal water treatment plant – *Twentynine Palms Water District, Groundwater Study for the Mesquite Lake Subbasin, Twentynine Palms, California.*
- Developed a calibrated two-dimensional, steady-state analytical groundwater flow model for the Rialto-Colton Basin. The calibrated model was used to delineate source areas for two impacted production wells for a CDPH 97-005 permit application – *West Valley Water District, Wellhead Treatment Project, Rialto, California.*
- Analyzed the results of aquifer tests of multiple water supply wells completed in a fractured-rock aquifer – *Lake Don Pedro Community Services District, California (subcontractor to SGI The Source Group)*.
- Analyzed the results of a complex aquifer-test dataset to determine aquifer properties and assess groundwater availability. Characterized groundwater quality and assessed regional impact of developing a new water supply – *Silver Oak Cellars (subcontractor to Taber Consultants), Aquifer Test Analysis and Groundwater Availability Study, Sonoma County, California.*
- A well and a spring were evaluated in terms of water quality, influence of surface water, source area, and zone of influence for a license application to operate a new private water supply – *Buster's on the Mountain (subcontractor to Taber Consultants), Hydrogeology Report for New Private Water Supply, Napa County, California*.
- Groundwater flow modeling, aquifer test results, and qualitative hydrogeological analyses were reviewed and critiqued for accuracy and completeness to assess the feasibility of a gravel mining operation adjacent to the upper reaches of a major river in Los Angeles and Ventura counties. The assessment formed the basis for communications with the State Water Resources Control Board regarding appropriative water rights. In the second phase of the project, a new MODFLOW model was developed to assess groundwater-surface water interactions – *Confidential Client (subcontractor to Todd Engineers), Groundwater Pumping Impacts on Streamflow, Los Angeles County, California.*
- Developed complex geologic model in the fold-thrust terrane of the Las Posas Basin in eastern Ventura County. The geologic model formed the foundation for preliminary wellfield design and estimation of available groundwater for desalter operations in a strictly managed aquifer – *Calleguas Municipal Water District, Somis Desalter Feasibility Study, Las Posas Basin, Ventura County, California*.

- Evaluated geologic, hydrologic, and hydrogeologic data to assess the suitability for establishing a groundwater banking operation. Provided recommendations on further field-based and modeling studies deemed necessary to address data and knowledge gaps – *Los Angeles Department of Water and Power, Evaluation of Proposed Water Storage/Transfer Potential in Fremont Valley Basin, Fremont Valley, California.*
- Evaluated the groundwater component of an existing water-budget model. Implemented changes to include the effects on water levels from climate and distant municipal pumping in deeper parts of the aquifer. The improvements facilitated the development and simulation of future "what-if" scenarios used to design an engineered wetland that used stormwater runoff and groundwater pumping to maintain lake levels – *San Francisco Public Utilities Commission, Lake Merced Water-Budget Model, San Francisco, California.*

Summary of Other Selected Water Quality Projects

- Developed three-dimensional, variably saturated flow and reactive transport models (MODFLOW-SURFACT) to assess the groundwater impact from arsenic and boron in recharged partially treated oilfield produced water. Transport through the unsaturated and saturated zones related to groundwater banking operations were simulated. Regulatory approval was granted by the Central Valley Regional Water Quality Control Board – *Cawelo Water District, Groundwater Banking Waste Discharge Requirements Support, Central Valley, California*.
- A calibrated transient three-dimensional model (MODFLOW and MT3DMS) of groundwater flow and solute transport was developed, calibrated, evaluated, to compare estimated timeframes to achieve RAOs for three alternatives. Site data were used to characterize the subsurface and estimate land application rates and water quality of applied water. Regulatory approval was granted by the Central Valley Regional Water Quality Control Board – *Hilmar Cheese Company, Groundwater Modeling for Cleanup and Abatement Order, Central Valley, California.*
- The results of two modeling efforts were reviewed to reassess contributions from responsible parties. A new metric, the Responsibility Factor (RF), was developed and applied to existing input data. The RFs were used to estimate relative contributions to the MEW Superfund site regional plume from several responsible parties – *Confidential Client (subcontractor to Montclair Environmental Management), Reassessment of Contributions to the MEW Superfund Site Regional Plume, Santa Clara County, California.*
- Mass flux calculations for TCE and PCE were conducted on behalf of a multi-PRP group. Calculations of mass flux through time were compared upgradient and downgradient of several sites within the Omega Superfund site regional plume to estimate the contribution from each individual site. These calculations were used as part of the basis for cost allocation among PRPs – *Confidential Client, Mass Flux Calculations for Cost Allocation, Omega Superfund Site, Santa Fe Springs, California.*
- A three-dimensional model (MODLFOW-SURFACT) of unsaturated zone and saturated zone flow and solute transport was developed and calibrated based on sparse discharge records

and well observations to assess the fate of a legacy of contaminated soil water being mobilized by increased discharge to the subsurface. The modeling was an integral part of a report of waste discharge and request for waste discharge requirements from the Central Valley Regional Water Quality Control Board – *California Dairies, Incorporated, Report of Waste Discharge, Central Valley, California.*

- A transient groundwater flow model (MODFLOW) was conceptualized, implemented, and calibrated for a major oil refinery. Linear programming was used to quantitatively minimize groundwater pumping and qualitatively optimize well placement for containment of subsurface LNAPL and BTEX-contaminated groundwater. Multiple capture zones of various sizes were analyzed for control of LNAPL hotspots and site-wide containment scenarios – *Sun Oil Company, Pumping-Rate Optimization and Capture Zone Analysis, Tulsa County, Oklahoma.*
- A groundwater flow and reactive solute transport model (MODFLOW and RT3D) was developed to evaluate remediation efforts at a chemical production facility. The efficacy of a permeable reactive barrier was evaluated by simulating sequential decay and transport of TCE and its daughter products. The model was post-verified in the field by analyzing the concentration histories of several observation wells – *Mohawk Laboratories, Analysis of Permeable Reactive Barrier, Sunnyvale, California.*
- Determined regional-scale risk to groundwater from potentially contaminating activities (PCA) in the Santa Clara Valley, Coyote, and Llagas subbasins, as part of a multifaceted effort. A regional-scale PCA-risk map was developed and combined with intrinsic aquifer sensitivity to generate a groundwater vulnerability map, which formed the basis of a web-based GIS tool for evaluating development projects and land-use changes – *Santa Clara Valley Water District, Groundwater Vulnerability Study, Santa Clara, California.*
- A Remedial Investigation (RI) Summary report was prepared under CERCLA guidelines, which included development of a conceptual model that incorporated regional and local hydrostratigraphy, source-area history, details of previous remedial investigations, and characterization of the basin-wide perchlorate and TCE groundwater contamination – *West Valley Water District, NCP Compliance Documents, Rialto, California.*
- The volume of LNAPLs beneath a refinery was estimated by modifying the analytical solutions for LNAPL recovery presented within API Publications 4682 and 4729, utilizing the van Genuchten relations for porous media. Results of the modeling work were used to design a LNAPL recovery system – *Sun Oil Company, LNAPL Spatial Distribution, Tulsa County, Oklahoma.*
- DNAPL Assessment Techniques, Klickitat County, WA. Developed internal White Paper describing techniques and thresholds for assessing DNAPL mobility at a fueling facility – *BNSF, Remediation Design Support, Park County, Montana*.
- Report of waste discharge and request for waste discharge requirements for land application of onsite waste and storm water. For submission to the Los Angeles Regional Water Quality Control Board – *Confidential Client, Report of Waste Discharge, Los Angeles County, California.*

- Developed and implemented groundwater flow and particle tracking models to evaluate well placement designs and optimize pumping rates for an in-situ groundwater recirculation and treatment zone. The recirculation zone was used to chemically treat groundwater contaminated with VOCs – *BNSF, Remediation Design Support, Park County, Montana.*
- Analyzed slug test data for multiple tests using several techniques to assess parameter uncertainty for a bedrock aquifer, for submission to Montana Department of Environmental Quality – *BNSF, Site Characterization for Remedial Investigation, Park County, Montana.*
- A 1D unsaturated zone flow and transport model was developed to assess the impact to groundwater of VOCs and metals present in the soil at the Facility. A future 100-year scenario was developed based on climate data from the past 100 years. Mass transport process of volatilization, linear sorption, and advection and dispersion were considered for this investigation – *SMTEK, Former Chemical Facility, Orange County, California.*

Summary of Other Selected Litigation Support Projects

- Implemented detailed regional, three-dimensional conceptual model for a 35-year period (MODFLOW and MT3DMS). Geologic data, crop-based time-variant DBCP application rates, pumping, recharge basins, and flow and transport in the unsaturated and saturated zones were used to evaluate whether label-recommended use of DBCP caused contamination in municipal wells and to establish likely source areas for high-concentration hot spots – *Sedgwick, Detert, Moran, and Arnold, Regional-Scale Pesticide Contamination Litigation Support, Fresno, California.*
- Designed and implemented three-dimensional models (LEACHM, MODFLOW, and MT3DMS) of unsaturated and saturated fluid flow and solute transport for periods of up to 150-years using soils and geologic data, rainfall records, pumping, and plant operational history to assess whether off-site groundwater contamination was caused by unanticipated releases of coal tar at numerous sites in the Midwest – *Jones, Day, Reavis, and Pogue, Former Manufactured-Gas Plant Sites, Litigation Support, Los Angeles, California.*
- The impact of different rainfall data disaggregation techniques on the results of fluid flow and solute transport simulations in the unsaturated zone was evaluated. Various disaggregation strategies were applied to simulations of contaminant fate at three former manufactured-gas plants – *Northern Indiana Public Service Company, Impact of Rainfall Data Disaggregation Techniques, Merrillville, Indiana.*
- Evaluated expert reports and thoroughly evaluated and verified a detailed water budget model. Assisted in preparation of expert report related to the application of the model – *Confidential Client, Water Budget Model Litigation Support, Pinal County, Arizona*.
- Evaluated expert reports and critiqued a detailed MODFLOW groundwater flow model for litigation of damages and fatalities from a landslide. Assisted in preparation of expert report – *Confidential Client, Landslide Initiation Litigation Support, British Columbia.*

Professional History

aquilogic, Inc., Principal Hydrogeologist, October 2020 to present.
aquilogic, Inc., Senior Hydrogeologist, February 2018 to October 2020.
Jacobson James & Associates, Inc., Principal Hydrogeologist, October 2015 to December 2017.
Independent Consultant, December 2012 to September 2015.
Kennedy/Jenks Consultants, Associate Hydrogeologist, March 2009 to November 2012.
Independent Consultant, July 2005 to February 2009.
San Francisco State University, Lecturer/Adjunct Professor, September 2003 to February 2009.
SGI The Source Group, Inc., Senior Hydrogeologist, August 2002 to June 2005.
Stanford University, Research Associate, September 2000 to July 2002
Independent Consultant/Graduate Student, October 1995 to July 2000.
U.S. Geological Survey/Graduate Student, Hydrologist, June 1992 to September 1995.

Research

- A new protocol and computer code were designed and implemented to simulate the development of redox zones in contaminated aquifers. Transport of dissolved constituents coupled to complex interactions between organic and inorganic compounds were simulated with consideration of reaction energetics, reaction-rate limitations, and advection and dispersion – *Stanford University/United States Geological Survey, Development and Fate of Redox Zones in Contaminated Aquifers, Falmouth, Massachusetts*.
- Interactions between surface water, soil-water, and groundwater were evaluated with a three-dimensional model of coupled saturated-unsaturated subsurface and surface fluid flow. Detailed rainfall data were incorporated into the model to determine the relative importance of different stormflow generation mechanisms – *Stanford University, Stormflow Generation, Chickasha, Oklahoma*.
- Conducted basin-scale modeling analysis of subsurface fluid flow in the Illinois Basin to evaluate the role of paleogroundwater flow versus fluid density in long-range, deep-basin petroleum migration – *United States Geological Survey, Basin-scale Analysis of Subsurface Fluid Flow, Illinois Basin*.
- Developed reactive solute transport models to evaluate zinc transport in a geochemically complex aquifer in Falmouth, MA. Coupled solute transport/geochemical modeling, laboratory experiments, and a two-site surface complexation model were used to represent the pH-dependent adsorption of dissolved zinc on aquifer sediments – *United States Geological Survey, Zinc Transport in a Geochemically Complex Aquifer, Falmouth, Massachusetts*.

Peer-Reviewed Publications

Abrams, R.H. and K. Loague. 2000. A compartmentalized solute transport model for redox zones in contaminated aquifers, 2, Field-scale simulations. Water Resources Research 36, 2015-2029.

Abrams, R.H. and K. Loague. 2000. A compartmentalized solute transport model for redox zones in contaminated aquifers, 1, Theory and development. Water Resources Research 36, 2001-2013.

Abrams, R.H., K. Loague, and D.B. Kent. 1998. Development and testing of a compartmentalized reaction network model for redox zones in contaminated aquifers. Water Resources Research 34, 1531-1541.

Abrams, R.H. and K. Loague. 2000. Legacies from three former manufactured-gas plants: Impacts on groundwater quality. Hydrogeology Journal 8, 594-607.

Kent, D.B., R.H. Abrams, J.A. Davis, J.A. Coston, and D.R. LeBlanc. 2000. Modeling the influence of variable pH on the transport of zinc in a contaminated aquifer using semi-empirical surface complexation models. Water Resources Research 36, 3411-3425.

Kent, D.B., R.H. Abrams, J.A. Davis, and J.A. Coston. 1999. Modeling the influence of adsorption on the fate and transport of metals in shallow ground water--Zinc contamination in the sewage plume on Cape Cod, MA. Morganwalp, D.W., and Buxton, H.T., eds., USGS WRI Report 99-4018C, 361-370.

Loague, K., R.H. Abrams, S.N. Davis, A. Nguyen, and I.T. Stewart. 1998. A case study simulation of DBCP groundwater contamination in Fresno County, California: 2. Transport in the saturated subsurface. Journal of Contaminant Hydrology 29, 137-163.

Loague, K., D. Lloyd, A. Nguyen, S.N. Davis, and R.H. Abrams. 1998. A case study simulation of DBCP groundwater contamination in Fresno County, California: 1. Leaching through the unsaturated subsurface. Journal of Contaminant Hydrology 29, 109-136.

Loague, K. and R.H. Abrams. 1999. DBCP contaminated groundwater in Fresno County: Hot Spots and nonpoint sources. Journal of Environmental Quality 28, 429-445.

Coston, J. A., R. H. Abrams, and D. B. Kent. 1998. Selected inorganic solutes, in water quality data and methods of analysis for samples collected near a plume of sewage-contaminated ground water, Ashumet Valley, Cape Cod, Massachusetts, 1993-1994. USGS WRI Report 97-4269.

Loague, K., C.S. Heppner, R.H. Abrams, A.E. Carr, J.E. VanderKwaak, and B.A. Ebel. 2005. Further testing of the Integrated Hydrology Model (InHM): Event-based simulations for a small rangeland catchment located near Chickasha, Oklahoma. Hydrological Processes 19, 1373–1398.

Loague, K. and R.H. Abrams. 2001. Stochastic-conceptual analysis of near-surface hydrologic response. Hydrological Processes 15, 2715-2728.

Loague, K., G.A. Gander, J.E. VanderKwaak, R.H. Abrams, and P.C. Kyriakidis. 2000. Technical Addendum for “Simulating hydrologic response for the R-5 catchment: A never-ending story”. Floodplain Management 2, 57-64.

Loague, K., G.A. Gander, J.E. VanderKwaak, R.H. Abrams, and P.C. Kyriakidis. 2000. Simulating hydrologic response for the R-5 catchment: A never-ending story. Floodplain Management 1, 57-83.

Grose, T. L. T. and R. H. Abrams, 1992. Geologic map of the Grasshopper Valley 15' quadrangle, Lassen County, California. California Department of Conservation, Division of Mines & Geology Open-File Report 93-07.

Grose, T. L. T. and R. H. Abrams. 1991. Geologic map of the Karlo 15' quadrangle, Lassen County, California. California Department of Conservation, Division of Mines & Geology Open-File Report 91-23.

Attachment B

Attachment B

Statements in the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) Groundwater Sustainability Plans (GSPs) establishing that the six Salinas Valley subbasins are interconnected.

- Upper Valley – Forebay boundary:
  - Page 4-10 of the draft Upper Valley GSP: "*There are no reported hydraulic barriers separating these subbasins and therefore the GSP needs to consider potential for groundwater flow between these adjacent subbasins*."
  - Page 4-10 of the draft Forebay GSP: "*There are no reported hydraulic barriers separating these subbasins*."
- Forebay – 180/400 boundary:
  - Page 4-10 of the draft Forebay GSP: "*There is no reported hydraulic barrier between the Forebay and the 180/400-Foot Aquifer Subbasin however the sediments are more stratified in the 180/400-Foot Aquifer Subbasin than in the Forebay Subbasi*n."
  - Page 4-9 of the 180/400 GSP: "*Previous studies of groundwater flow across this boundary indicate there is reasonable hydraulic connectivity with the Forebay Subbasin, although the principal aquifers change from relatively unconfined to confined near this boundary*."
- Forebay – Eastside boundary:
  - Page 4-10 of the draft Forebay GSP: "*The northwestern boundary with the adjacent 180/400-Foot and Eastside Aquifer Subbasins generally coincides with the southeastern limit of confining conditions in the 180/400-Foot Aquifer Subbasin, which is extrapolated to the Gabilan Range to define the boundary with the Eastside Aquifer Subbasin (DWR, 2004c)*."
  - Page 4-10 of the draft Eastside GSP: "*The southeastern boundary with the adjacent Forebay Subbasin is near the town of Gonzales (DWR, 2004). It is extended from the approximate southern limit of the regional clay layers that are the defining characteristic of the southern extent of the 180/400-Foot Aquifer Subbasin. There may be reasonable hydraulic connectivity with the Forebay Subbasin, although the principal aquifers change from relatively unconfined to confined near this boundary*."
    - The last sentence of this passage appears to be incorrect, as indicated on page 4-18 of the draft Eastside GSP: "*In addition to the fact that aquifer material cannot be correlated between boreholes, no evidence exists for a discrete confining layer in the Subbasin (Brown and Caldwell, 2015)*."
    - Further supporting evidence for hydraulic connection between the Eastside and Forebay is found on page 4-21 of the draft Eastside GSP: "*Subsurface recharge is primarily from inflow from the adjacent Forebay and 180/400-Foot Aquifer Subbasins to the south and west, respectively (DWR, 2004). This inflow is*

estimated to be 17,000 acre-feet (AF) on an annual basis. Total natural recharge is estimated to be 41,000 AF (DWR, 2004)."

- Eastside – 180/400 boundary:
  - Page 4-21 of the draft Eastside GSP: "*Subsurface recharge is primarily from inflow from the adjacent Forebay and 180/400-Foot Aquifer Subbasins to the south and west, respectively (DWR, 2004). This inflow is estimated to be 17,000 acre-feet (AF) on an annual basis. Total natural recharge is estimated to be 41,000 AF (DWR, 2004)*."
  - Also, on page 4-35 of the draft Eastside GSP: "*There is no recorded seawater intrusion in the Eastside Subbasin. Even though it is adjacent to the 180/400-Foot Aquifer Subbasin where seawater intrusion is occurring, the Subbasin, which is approximately 7 miles from the coastline, is not yet affected by seawater intrusion. However, there is a potential for seawater intrusion into the Subbasin*."
  - Page 4-10 of the draft Eastside GSP and page 4-9 of the 180/400 GSP: "*Previous studies of groundwater flow across this boundary indicate that there is restricted hydraulic connectivity between the subbasins*."
    - The references for the previous studies should be provided because this statement is an apparent contradiction with other statements in the draft Eastside GSP.
    - Furthermore, page ES-8 of Kennedy/Jenks (2004) states, "*We note that ground water flow direction is from the Pressure Subarea to the East Side Subarea east of the City of Salinas and along the transition zone (Agency 1997*)."
    - Additionally, page 8 of SVGWBHC (1995) states, "*Ground water can move between the East Side and Pressure Areas, and between the Forebay and Pressure Areas, the Forebay and East Side Areas, and the Upper Valley and Forebay Areas*."
    - The apparent uncertainty regarding the nature of the boundary between the Eastside and 180/400 should be listed as an identified data gap on page 4-35 of the draft Eastside GSP.
- Eastside – Langley boundary:
  - Page 4-10 of the draft Eastside GSP and page 4-10 of the draft Langley GSP: "*Although the Langley Subbasin is not on the valley floor, there are no reported hydraulic barriers separating these subbasins and therefore the GSP needs to consider potential for groundwater flow between these adjacent subbasins*."
- Langley – 180/400 boundary:
  - Page 4-10 of the draft Langely GSP: "*Although the Langley Subbasin is not on the valley floor, there are no reported hydraulic barriers separating these two subbasins; therefore, this GSP needs to consider potential for groundwater flow between these adjacent subbasins*."
  - Page 4-9 of the 180/400 GSP: "*Although the Langley Subbasin is not on the valley floor, there are no reported hydraulic barriers separating these two subbasins*."
- Monterey – 180/400 boundary:

- Page 9 of Chapter 4 of the draft Monterey GSP: "*The northeastern boundary with the 180/400-Foot Aquifer Subbasin is divided into two parts: the northern part coincides with a buried trace of the Reliz Fault (DWR, 2016); the southern part follows the contact between Aromas Sand / Paso Robles Formations (Qae/QT) and alluvium (Q). The Reliz Fault does not appear to be a barrier to groundwater flow between these subbasins (see Section 4.2.3)*."
- Page 4-9 of the 180/400 GSP: "*Although a groundwater divide is commonly found near the Subbasin boundary, there is potential for groundwater flow between these two subbasins*."
- It should be noted that for the simulations reported in Chapter 6 of the draft Monterey GSP, all reasonably possible boundary conditions, indicate groundwater flow from the Monterey to the 180/400.

Attachment C

aquilogic, Inc.
environment ● water ● strategy

245 Fischer Avenue, Suite D-2
Costa Mesa, CA 92626
Tel. +1.714.770.8040
Web: www.aquilogic.com

August 11, 2021

MEMORANDUM

To: Stephanie Hastings, Brownstein Hyatt Farber Schreck (BHFS)
Sent via email: SHastings@bhfs.com
From: Robert H. Abrams, PhD, PG, CHg, Principal Hydrogeologist, aquilogic, Inc.
Anthony Brown, CEO & Principal Hydrologist, aquilogic, Inc.

Subject: **Assessment of Groundwater Flows between Subbasins of the Salinas Valley Groundwater Basin (SVGB)**
Project No.: 018-09

Aquilogic, Inc. (**aquilogic**) is pleased to provide this memorandum on behalf of our mutual client, the Salinas Basin Water Alliance (SBWA), outlining the justification and necessity for conducting additional simulations with the Salinas Valley Integrated Hydrologic Model (SVIHM),[1] which is being used by the Salinas Valley Basin Groundwater Sustainability Agency (SVBGSA) for groundwater sustainability plan (GSP) development.

Aquilogic hypothesizes that pumping has captured significant portions of groundwater discharge that would otherwise migrate as underflow from the Upper Valley Subbasin to the Forebay Subbasin, from the Forebay Subbasin to the 180/400-Ft Aquifer Subbasin and East Side Subbasin, and potentially from the 180/400-Ft Aquifer Subbasin to the Monterey Subbasin and the Salinas River. Our primary concern is that the existing water budget analyses in at least three of the SVBGSA's draft GSPs may not provide a complete picture of the downgradient impacts caused by groundwater pumping.[2]

It should be noted that groundwater sustainability was a pertinent issue for water managers long before the advent of California's Sustainable Groundwater Management Act. There is

---

[1] The SVIHM is a provisional, unpublished model not currently available to the general public.
[2] Bredehoeft, J.D., Papadopulos, S.S., and Cooper, H.H. Jr. (1982). The water budget myth. *In* Scientific Basis of Water Resource Management, Studies in Geophysics, 51-57. Washington, D.C. National Academy Press;
Bredehoeft, J.D. (1997). Safe yield and the water budget myth. Ground Water, Vol. 35, No. 6, p. 929;
Bredehoeft, J.D. (2002). The water budget myth revisited: why hydrogeologists model. Ground Water, Vol. 40, No. 4, p. 340-345;
Bredehoeft, J.D. and Durbin, T. (2009). Groundwater development: the time to full capture problem. Ground Water, Vol. 47, No. 4, p. 506-514;
Bredehoeft, J.D. (2011). Monitoring regional groundwater extraction: the problem. Ground Water, Vol. 49, No. 6, p. 808-814.

ample support in the groundwater literature for considering multiple aspects of sustainability and undesirable results, including economic and social impacts and the contravention of water rights.[3]

ADDITIONAL SIMULATIONS

As stated in "SVIHM Frequently Asked Questions,"[4] one of the many questions that can be addressed by a model is: How much groundwater flows between subareas? Clearly, the SVIHM developers recognized the importance of this question and anticipated that it would be asked. On behalf of the SBWA, **aquilogic** requests that the SVBGSA utilize the SVIHM to conduct additional simulations that are specifically focused on the issue of inter-subbasin groundwater flows. The requested simulations will enable an improved understanding of the amount of Valley-wide groundwater discharge that is and has been captured by pumping, which may be needed to ensure the adequacy of the GSPs for each of the subbasins and important to their implementation.

Aquilogic recommends a type of "superposition" analysis, in which the results of two simulations are compared. In such an analysis, the two simulations are identical except for the process under examination, in this case groundwater pumping. Pumping would be selectively turned off in one simulation and left as currently configured in the SVIHM in the other simulation. A similar superposition analysis was done to assess pumping-induced streamflow depletion, as described in Chapter 5 of the GSPs for the Forebay Subbasin and the East Side Subbasin.

The inter-subbasin flows would then be compared, which would semi-quantitatively estimate the impact of pumping, within the limiting assumptions and uncertainties associated with the SVIHM. Ideally, the analysis should be conducted with the initial conditions of the no-pumping scenario representing a "full" SVGB. The analysis would provide an estimate of the impact of pumping on inter-subbasin groundwater flows.

Specifically, using the calibrated SVIHM historical model, **aquilogic** recommends the following outline for conducting simulations, the details of which would be worked out in consultation with the SVBGSA:

1. Develop reasonable initial conditions for the hydraulic head distribution for the no-pumping simulation. This entails turning off all pumping in the model domain while

[3] Todd, D.K. (1959). Groundwater Hydrology. Wiley, New York, 336 p.;
Domenico, P. (1972). Concepts and Models in Groundwater Hydrology. McGraw-Hill, New York, 405 p.;
Freeze, R.A. and Cherry, J.A. (1979). Groundwater. Prentice-Hall, 604 p.;
Alley, W.M., Reilly, T.E., and Franke, O.L. (1999). Sustainability of ground-water resources. U.S. Geological Survey Circular 1186, 79 p.

[4] https://www.co.monterey.ca.us/home/showdocument?id=31292

leaving all other inflows and outflows unchanged. Because the time for simulated water levels to recover may be longer than the SVIHM simulation period of 51 years (1967-2018), the simulation may have to be run multiple times before an average steady-state condition can be achieved. In this case, the hydraulic head distribution at the last time step of the previous simulation would be used as the initial condition of the subsequent simulation. This process would be repeated until the hydraulic head distribution at the last time step of a subsequent simulation is substantially identical to the last time step of the previous simulation. This would indicate that an average steady-state condition is being simulated. We assume here that the surface water inflows and reservoir releases for the 1967-2018 period would be sufficient to eventually "refill" the SVGB after several model runs.

2. When the average, no-pumping steady-state condition has been achieved with the modified SVIHM, simulated groundwater flow should occur from the East Side Subbasin to the 180/400-Ft Subbasin, and from the 180/400-Ft Subbasin to Monterey Bay, conditions that are now reversed.

3. From the final results of the no-pumping simulation, in which average steady-state conditions have been achieved, compute the inter-subbasin groundwater flows between each adjoining subbasin. Compare these flows with the inter-subbasin flows from the historical, unmodified SVIHM. The differences in inter-subbasin flows and induced recharge from the surface water system represent a semi-quantitative estimate of the impact of Valley-wide pumping.

4. Additional superposition analyses can be conducted to assess the impact of one subbasin's pumping on basin-wide groundwater levels and inter-subbasin groundwater flows, by turning on pumping in one subbasin at a time in the modified SVIHM (and leaving pumping turned off in all other subbasins) and comparing the results to the scenario with no pumping throughout the SVGB. The differences in inter-subbasin flows and groundwater levels represent a semi-quantitative estimate of the impact of one subbasin's pumping on the other subbasins.

MONTGOMERY
& ASSOCIATES
Water Resource Consultants

www.elmontgomery.com
1232 Park Street, Office B
Paso Robles, CA 93446

February 26, 2019

Mr. Les Girard
Agency Counsel
Salinas Valley Basin Groundwater Sustainability Agency
168 W. Alisal Street, 3rd Floor
Salinas, CA 93901

SUBJECT: OPINIONS ON SURFACE WATER BENEFITS FROM SALINAS VALLEY GROUNDWATER SUSTAINABILITY

Dear Mr. Girard:

You have requested our opinion with respect to the benefit surface water users (including those that rely upon diversion of any alleged underflow of the Salinas River) would receive from a balanced or sustainable groundwater basin. This request is in connection with the proposal of the Salinas Valley Basin Groundwater Sustainability Agency's (SVBGSA) consideration of charging a regulatory fee, known as the Groundwater Sustainability Fee ("Fee"), within its jurisdiction (the Salinas Valley Groundwater Basin (Basin) with limited exceptions).

As you know, the firm I work for, Montgomery & Associates, has been retained by the SVBGSA to prepare a Groundwater Sustainability Plan for the 180/400 ft. aquifer sub-basin. In particular, I have been retained as the project manager for this job. My resume is enclosed. I am familiar with the hydrology and geology of the Basin, and the interaction between groundwater and surface water in the Basin.

It has long been acknowledged that the water resources of the Salinas Valley consist of an integrated surface water and groundwater system. Historically, groundwater was the main source of water supply in the Valley and the Salinas River was the primary source of recharge for the groundwater supply (see, for example, Department of Water Resource Bulletin 52B). This assessment of a single water, integrated water source was recently confirmed in the January 2019 Report of Referee by the State Water Resources Control Board, issued as part of a reference proceeding arising from litigation in the Basin. In particular, Page 12 of the report states, "The dependency on the Salinas River as a source of recharge for the Basin and the hydrologic connection between surface water and groundwater results in a direct relationship between pumping and river flows; therefore, demonstrating that groundwater and surface water within the Salinas Valley constitute a single source." This is consistent with, and corroborates my understanding of the Salinas Valley hydrology.

This acknowledged surface water/groundwater integration underpins the approach the SVBGSA is taking to achieving groundwater sustainability throughout the Valley; the

Salinas River is an integral part of groundwater management and managing groundwater cannot be divorced from the Salinas River's operations. Similarly, groundwater management plays an important role in maintaining Salinas River flows. Larger areas of low groundwater levels in the Salinas Valley will induce more leakage from the Salinas River – reducing Salinas River flows. Maintaining adequately high groundwater levels will help maintain Salinas River flows. These higher groundwater levels that help maintain Salinas River flows is one of the desired outcomes of our groundwater management and is a benefit to surface water users. Groundwater sustainability can lead to long-term reliability in surface water supplies.

In particular, one Sustainability Indicator that must be addressed under SGMA is depletion of surface water bodies. Without the Sustainable Groundwater Management Act (SGMA), there is limited or no check on the amount that groundwater pumping can deplete the Salinas River. Developing these GSPs provides an opportunity for groundwater to be managed in a way the benefits surface water users and provides surface water reliability.

Groundwater management may be the most effective and primary method for managing future surface water reliability in the Valley. The two dams operated by the Monterey County Water Resources Agency (MCWRA are not operated for surface water reliability. The MCWRA website states that the operational pools of the Nacimiento and San Antonio Dams are for "groundwater recharge, fish passage, and operation of the Salinas valley Water Project." The dams are not necessarily operated to maintain flows in the Salinas River.

Based on our review of the integrated groundwater and surface water system in the Salinas Valley we conclude that users of surface water, including underflow, would receive clear benefits from groundwater sustainability because:

- The Salinas River has historically been viewed as primarily a source of groundwater recharge, not as an independent source of supply;
- The two dams operated by MCWRA are not operated to provide reliable surface water supplies;
- Managing groundwater levels can reduce surface water depletions, providing more reliable surface water supplies;
- Addressing surface water depletion and the resulting surface water flows is a required component of the GSPs;

The Salinas River operations, Salinas River flows, and ability to use water from the River will be clearly influenced by the decisions made during GSP development and implementation. Balanced groundwater management that maintains consistent groundwater levels will provide surface water reliability for the Valley's surface water users.

Finally, it is important to note that, for purposes of charging the Fee, the Salinas River has not yet been determined to include a "subterranean stream flowing through known and

MONTGOMERY & ASSOCIATES

definite channels," thus the surface water/groundwater integration in the Basin makes it difficult to differentiate between the two where they interface. Thus, differentiating a fee based on whether surface water or groundwater is being pumped along that interface would be an extremely difficult, if not impossible, task.

Derrik Williams

Sincerely,
Derrik Williams
E.L. MONTGOMERY & ASSOCIATES

Derrik Williams, P.G., C.Hg., Principal Hydrogeologist/Director of California Business Development

Office: PASO ROBLES

Years Experience

Total: 30

Education

M.S., Hydrology, University of Arizona (1987)

B.S., Geology, University of California at Davis (1982)

Key Areas of Expertise

Groundwater basin management

3D groundwater flow and transport models

Groundwater recharge

Conjunctive water management

Aquifer test analysis

Interagency negotiation and coordination

Independent technical review

Derrik has more than 30 years of experience in applied geology and hydrogeology and excels at assisting clients with integrating technical analyses and institutional challenges to manage their water resources. His project experience includes managing, reviewing, and assisting on water supply, groundwater recharge, wastewater disposal, and hazardous waste remediation projects. Derrik is accomplished in analytical hydrogeology, with extensive interpretation and application of groundwater flow and transport models. He is an expert in aquifer test design and analysis and is experienced in all aspects of groundwater management.

Representative Projects

Water Resource Planning | Groundwater Management

SGMA Implementation • California Department of Water Resources •
Assisted DWR develop best management practices (BMP) for implementing SGMA and assist with developing Groundwater Sustainability Plans (GSPs). Met with DWR regularly to formulate statewide SGMA policy and draft policy documents. Helped develop DWR's guidance document for sustainable management criteria which was scheduled for release September 2017. **[SACRAMENTO COUNTY, CA]**

Basin Boundary Modification • Santa Margarita Groundwater Basin Boundary Modification • Scotts Valley Water District
Managed one of the most complex basin boundary modifications for SGMA's implementation. The basin boundary modification included both technical and jurisdictional modifications to promote sustainable groundwater management. Reviewed and interpreted relevant SGMA regulations for the client and hosted meetings with DWR and SWRCB to review and obtain agreement to the modification approach. Developed the technical justification to establish a new groundwater basin that encompasses all or parts of two existing groundwater basins, along with areas previously not considered groundwater basins. Assisted the client with required stakeholder outreach and water agency notification, and developed responses to concerns raised by neighboring water agencies. Presented the modification approach and technical work at numerous Boards of Directors meetings in Santa Cruz County. Directed the development of a 3D flow model to project groundwater inflow and dewatering requirements for a proposed gold mine **[SANTA CRUZ COUNTY ,CA]**

SGMA Support • SGMA Hydrology Tech Support • Santa Cruz Mid-County Groundwater Agency
Provides senior guidance for technical and policy support to the Groundwater Sustainability Agency (GSA) for the Santa Cruz Mid-County Basin regarding SGMA. This included the GSA formation process and an approved basin boundary modification that combined parts of four basins into a single basin

Professional Registrations

Registered Professional Geologist #6044, CA

Certified Professional Hydrogeologist #35, CA

Additional Training

Awards and Distinctions

and excluding areas that do not impact groundwater management. Led efforts with the newly formed GSA to finalize a schedule and scope for GSP development. The initial activities include presentations at stakeholder workshops to ensure all stakeholders understand the basin conditions and the requirements of SGMA. [SANTA CRUZ COUNTY, CA]

Groundwater Sustainability Agency Assessment • Butte County GSA Formation • Butte County Department of Water and Resource Conservation
Provided technical assistance regarding GSA development to Butte County as a subconsultant to Kearns and West Inc. Assisted Butte County assess the potential interest and concerns of various agencies and groups regarding GSA formation under SGMA. Helped develop the outreach materials to ensure that relevant information was collected to guide Butte County's GSA development. [BUTTE COUNTY, CA]

Groundwater Management • Seaside Basin Groundwater Management • Seaside Basin Watermaster
Helped develop both a Basin Management Action Plan and Seawater Intrusion Response Plan (SIRP) for the Watermaster in Monterey County. The Basin Management Action Plan identified specific data needs, water sources, and groundwater management actions and recommended an implementation strategy to the Watermaster. The SIRP was a companion document that included exhaustive statistical and graphical analyses of groundwater quality data to identify potential seawater intrusion. [MONTEREY COUNTY, CA]

Groundwater Management for the Soquel-Aptos Basin • General Hydrology • Soquel Creek Water District
Updated the groundwater management plan, investigated conjunctive use alternatives, provided well master plan EIR support, designed and installed monitoring wells, seawater intrusion monitoring, assisted with municipal well rehabilitation and restoration, and assisted with negotiating with neighboring agencies. [SANTA CRUZ COUNTY, CA]

Hydrologic Modeling | Groundwater Management

Managed Groundwater Model Update • Groundwater Model • Kings River Conservation District
Managed the groundwater model update for the Kings River Conservation District. The model is based on the State of California's Integrated Water Flow Model (IWFM). Important aspects of this model update include a reinterpretation of agricultural water demands throughout the region, and an update of the geologic structure that underpins the model. In particular, the client requested that the updated model parameters more accurately reflect our understanding of the basin's geologic structure. [FRESNO COUNTY, CA]

Lead Modeler • Seaside Basin Groundwater Model • Seaside Basin Watermaster
Served as project manager and lead modeler for the recently completed regional Seaside Basin groundwater model. The model was developed for the Seaside Groundwater Basin Watermaster. The model accurately simulates 22 years of historical water levels across a 76 square mile area near Monterey, California. An extensive update of the basin hydrostratigraphy was needed during the development phase of the model. The model is designed to compare benefits

for various potential groundwater management actions planned to be carried out in the basin. [MONTEREY COUNTY, CA]

Technical Analysis • Regional Groundwater Model • United Water Conservation District
Provided technical oversight for an update of United Water Conservation District's regional groundwater model. The model was providing unrealistic results, and was unable to predict future conditions adequately. Identified simulated water balance problems that, when changed, improved model performance dramatically. Provided technical assistance to staff on using the model to evaluate water management alternatives by implementing various hydrologic scenarios in model runs. [VENTURA COUNTY, CA]

Groundwater Model Support • Groundwater Basin Water Supply Plan and Groundwater Model • Squaw Valley Public Service District (SVPSD)
Provided groundwater support to the SVPSD continuously since 2000, beginning with development of a basin-wide groundwater model that could be used for management and planning. As SVPSD's needs have changed, adapted the initial model to help address new concerns. Under Derrik's direction, the project team has studied groundwater management alternatives as the main option in a plan to increase the water supply. They have used the groundwater flow model to support the water supply analyses. The model has also been used to develop pumping strategies that maximize long-term basin yield, and to identify locations of new wells that the SVPSD may use to increase their water supply. [PLACER COUNTY, CA]

Basin Analysis • Basin Management Plan Analysis • Pajaro Valley Water Management Agency
Led analysis of groundwater management alternatives for Pajaro Valley Water Management Agency's (PVWMA) Basin Management Plan. Directed simulation of alternatives using the Pajaro Valley Hydrologic Model developed by the U.S. Geological Survey that incorporated the Farm Process program, which allows detailed and realistic simulations of agricultural pumping and water transfers. Evaluated and presented model results for the BMP's selected alternative that showed that the alternative will eliminate overdraft in the most productive aquifers and reduce seawater intrusion by more than 90% in those aquifers. [SANTA CRUZ COUNTY, CA]

Developed Numerical Groundwater Model • Groundwater Model • Los Osos Community Services District
Developed a water and nitrate balance of the basin, accounting for all known water recharge and nitrate sources. Incorporated the water and nitrate balance into a numerical groundwater model, used to predict future groundwater conditions. The model showed that the proposed sewer system significantly lowers nitrate levels in the shallow aquifer. Nitrate was shown to be migrating towards municipal wells, however, and will continue to impact these wells for decades into the future. [SAN LUIS OBISPO COUNTY, CA]

Impact Analysis • Groundwater Impact Analysis • San Benito County Water Agency | City of Hollister
Investigated groundwater impacts from changing wastewater quality in San Benito County. Helped develop, calibrate, and use a groundwater model of San Benito County to estimate groundwater impacts and changing salt loads near

the wastewater treatment ponds and at anticipated reclaimed water application sites. The modeling was used to develop alternative strategies to manage both salt loading and high groundwater levels. [SAN BENITO COUNTY, CA]

Developed Transport Model • Charnock Initial Regional Response Activities (CIRRA) Modeling • Environ Corporation
Helped develop and use a basin-wide flow and transport model for the Charnock Sub-Basin in Los Angeles County. Served as a senior consultant for this project, helped develop and guide the modeling program, calibrated the groundwater model, and provided quality assurance and quality control on the modeling process. [LOS ANGELES, CA]

Developed Groundwater Model • Regional Groundwater Flow Model • Santa Clara Valley Water District
Developed a groundwater flow model of the Northern Santa Clara Valley under a joint contract between the City of San Jose and the Santa Clara Valley Water District. The model is presently used by the SCVWD for future water planning. [SANTA CLARA COUNTY, CA]

Model Analysis • San Francisco Western Basin Groundwater Model • San Francisco Department of Public Works
Provided an independent review of the San Francisco Western Basin groundwater model. Produced a plan for field testing and expanding the groundwater model to include the influence of groundwater pumping in Daly City, Colma, and Burlingame on Lake Merced water levels. [SAN FRANCISCO COUNTY, CA]

Water Supply and Recharge | Groundwater Resource Development

Well Siting Study • SCWA Groundwater Assessment • Sonoma County Water Agency
Completed a well siting study for Sonoma County Water Agency's Reliability Assessment. Integrated hydrogeologic analyses of potential well sites with information on geologic hazards and existing and proposed water transmission facilities to identify optimum well locations. [SONOMA COUNTY, CA]

Designed Irrigation Wells • Golden Gate Park Replacement Wells • City of San Francisco
Managed the Golden Gate Park Replacement well project as part of a joint venture. Worked with the Department of Public Works and the Public Utility Commission to site and design two new irrigation wells. The irrigation wells were designed to meet DPW's goal of an assured water supply, while allowing PUC to use the wells as emergency potable supply. [SAN FRANCISCO COUNTY, CA]

Quantification of Interflow • Creek/Aquifer Interaction Study • Squaw Valley Public Service District (SVPSD)
Directed a unique study to establish and quantify the interflow between Squaw Creek and the adjoining shallow aquifers. The study used temperature monitoring techniques that directly estimate the flow rates between the Creek and the shallow aquifers. This project was funded by a California Department of Water Resources AB303 Local Groundwater Assistance Grant. [PLACER COUNTY, CA]

Water Supply and Recharge | Recharge & Recovery

Developed ASR System • Coastal Water Project Aquifer Storage and Recovery (ASR) • ASR Systems
Assisted with development of the ASR component of the Coastal Water Project (CWP) along the Monterey Peninsula. Helped design an ASR system that will provide peak flows to supplement supplies from the planned Moss Landing desalination plant and developed a groundwater model of the target injection zone, based on initial injection test results. [MONTEREY COUNTY, CA]

Feasibility program management • ASR Feasibility Study Management • Squaw Valley Public Service District (SVPSD)
Provided oversight of the field program that included a surface geophysical survey and installation of a monitoring well with a Sonic continuous coring rig. Reviewed the feasibility report that concluded that a suitable water storage interval for ASR in Squaw Valley is not present. [PLACER COUNTY, CA]

Developed Cost Estimates • ASR Well Costs • Sonoma County Water Agency
Developed well cost estimates for the groundwater banking program as part of a water supply EIR. Costs were developed for both new and retrofitted ASR wells. [SONOMA COUNTY, CA]

Technical Analysis • Water Supply Improvement Program • East Bay Municipal District
Coordinated the project, and performed technical analysis for the Water Supply Improvement Program. Assisted with siting and pre-design of injection and recovery facilities and served as the daily contact for EBMUD and the concerned water districts in California's Central Valley. [ALAMEDA COUNTY, CA]

Feasibility Study Implementation • Salinas Valley Reclaimed Water Injection and Recovery Program • Monterey Regional Water Pollution Control Agency
Implemented a feasibility study for reclaimed water injection/recovery (ASR) in the Salinas Valley. Developed a program for seasonally storing tertiary treated reclaimed water in the salt-water intruded portion of the Salinas Valley Aquifer. Coordinated meetings between local water agencies, city governments, the Water Pollution Control Agency, and regulatory agencies. [MONTEREY COUNTY, CA]

Geologic Assessment • Groundwater Assessment • Bear Valley | Fugro West
Conducted a geologic and hydrogeologic investigation showing that the existing wells were extracting groundwater in the most effective areas in the valley. A water budget was developed as part of the hydrogeologic investigation to estimate the amount of groundwater that could potentially be extracted from the valley. Additional wells were determined to be too expensive for the potential benefit. [ALPINE COUNTY, CA]

Hydrologic Modeling | Brackish Groundwater Development

Developed Flow Model • Saline Groundwater Intake and Disposal System Modeling and Design • City of Sand City
Developed a two-phase flow model of feedwater extraction and brine injection beneath the beach in Sand City for a planned desalination plant. The groundwater model was used to develop a unique arrangement of feedwater

wells and horizontal brine disposal wells that reduced environmental impacts on the National Marine Sanctuary. **[MONTEREY COUNTY, CA]**

Developed Flow and Transport Model • Desalination Brine Disposal Modeling • Marina Coast Water District
Developed a coupled density-dependent flow and transport model to help estimate and visualize the impacts from injecting brine from a small desalination plant beneath the sea floor. The model results suggested that the example brine discharge system created a subsurface brine mound that rose to the sea-floor surface, and entered the ocean at effectively full brine concentration. To obtain all the potential advantages of sea-floor injection, the injection system needed to inject brine over a larger area, at a lower injection rate. **[MONTEREY COUNTY, CA]**

Hydrologic Modeling | Recharge and Recovery

Developed Vadose Zone Model • Vadose Zone Modeling of Recharge with Reclaimed Water • Monterey County Regional Water Pollution Control Agency
Development of a vadose zone model for predicting travel times of water to the water table below a proposed recharge basin. The recharge basin was designed to infiltrate surplus reclaimed water from a regional wastewater treatment plant into a drinking water aquifer. The HYDRUS-2D model tested a series of likely hydraulic conductivity distributions based on field data to estimate a range of travel times. Model results showed that the testing program proposed for the recharge ponds would not result in the anticipated groundwater mounding. **[MONTEREY COUNTY, CA]**

Transport Model Development • Salinas Valley Reclaimed Water Injection and Recovery Program Modeling • Monterey Regional Water Pollution Control Agency
Employed a series of groundwater flow and contaminant transport models to study the effects of injecting reclaimed water into salt-water intruded aquifers beneath Salinas Valley. Used a local, variable density, contaminant transport model and a three-dimensional flow and transport model to demonstrate the impact of the injected reclaimed water on nearby water supply wells. **[MONTEREY COUNTY, CA]**

Hydrologic Modeling | Hydrologic Impact Study

Model Development • Avila Beach EIR Groundwater Model • Fugro West
Developed a flow and transport model of contamination beneath Avila Beach, California, where historical hydrocarbon contamination from leaking distribution pipes threatened the Pacific Ocean and the estuary of San Luis Creek. The groundwater model encompassed the entire town of Avila Beach, including the Pacific Ocean and San Luis Creek. Successfully demonstrated that significant impacts would result from proposed remediation. **[SAN LUIS OBISPO COUNTY, CA]**

Hydrologic Modeling | Contaminant Assessment & Remediation

Model Development • Groundwater TCE Plume Model • Scottsdale, Arizona
Retained as a neutral third party modeler for a TCE contaminated site with multiple potentially responsible parties. The model was used in negotiations with the USEPA to develop and implement remedial alternatives that ensure a

safe source of drinking water for the City, while preventing further degradation of the aquifers. [MARICOPA COUNTY, AZ]

Publications & Presentations

Presentations

Developing Groundwater Elevation Proxies for Surface Water Depletion Rates
Williams, D., 2017, Groundwater Resources Association Tools for SGMA Workshop, Modesto, CA, May 3

Using Cross-Sectional models to Develop Proxy Measurable Thresholds for Seawater Intrusion
Culkin, S., Tana., C., Williams, D., 2017, Groundwater Resources Association Tools for SGMA Workshop, Modesto, CA, May 4

Measuring Recharge from Ephemeral Streams
Williams, D., 2016, American Groundwater Act/American Ground Water Trust Annual Conference, Ontario, CA, Feb 17-18

First Steps in Inter-Basin Coordination for SGMA: Basin Boundary Modification Requests in Santa Cruz County
Tana, C., Culkin, S., Byler, N., Williams, D., 2016, Groundwater Resources Association of California Annual Conference, Concord, CA, September 28-29

Using Cross-Sectional Models to Develop Measurable Objectives for Seawater Intrusion
Culkin, S., Tana, C., Williams, D., 2016, California Water Environmental Modeling Forum Annual Meeting, Folsom, CA, April 11-13

Using Regional Models to Develop GSA Scale Models
Williams, D., Hundt, S., Bedakar, V., 2016, Groundwater Resources Association Role of Models and Data in Implementing SGMA, Davis, CA, February 8-9

ACWA's Groundwater Data Guidelines and SGMA
Williams, D., 2015, Association of California Water Agencies Legislative Summit, Davis, CA, June 1

Groundwater Analyses and Groundwater Models in the Sustainable Groundwater Management Act
Williams, D., 2015, American Groundwater Act/American Ground Water Trust Annual Conference, Ontario, CA, February 9-10

Eliminating Stream Depletion by Combining Time-Series Thermal Data with Aquifer Test Results
Hundt, S., King, G., Williams, D., 2014, California/Nevada American Water Works Association Whole Water Conference, Monterey, CA, June 24-26

Olympic Valley Creek/Aquifer Interaction Study
Williams, D., 2014, California/Nevada American Water Works Association Spring Conference, Anaheim, CA, March 25-28

Evaluating Water Quality with Data from Dynamic Tracer and Sampling Techniques Used in Production Wells
Tana, C., Byler, N., Quereshi, H., van Brocklin, D., Williams, D., 2014, California/Nevada American Water Works Association Spring Conference, Anaheim, CA, March 26

Beyond the Pavement: Groundwater Recharge Benefits from Urbanization
Williams, D., 2011, National Ground Water Association Cities, Suburbs, and Growth Areas Conference, Los Angeles, CA, August 8-9

Developing Drought Curtailment Criteria for a Groundwater Basin on a Model of Deep Recharge
Tana, C., King, G., Duncan, R., Williams, D., 2011, National Ground Water Association Cities, Suburbs, and Growth Areas Conference, Los Angeles, CA, August 8-9

Sustainability from the Ground Up: Groundwater Management in California, A Framework
Blacet, D., Parker, T., Aladjem, D., Williams, D. (reviewer), 2011, Association of California Water Agencies, April 2011

Managing Saltwater Intrusion with Protective Groundwater Elevation Constraints
Tana, C., King, G., Johnson, R., Lear, J., Williams, D., 2011, Proceedings from the 4th International Perspectives on Water Resources and Environment, Singapore

California Statewide Groundwater Elevation Monitoring(CASGEM) Workshop
Williams, D. (member of presenting team), 2010, California Department of Water Resources in conjunction with Association of California Water Agencies

Using PEST to Efficiently Implement Conceptual Model Changes in a Regional Groundwater Model
Tana, C., Williams, D., 2009, The PEST Conference, Potomac, MD, November 2-4

Using Uncertainty Analysis to Manage Seawater Intrusion
Tana, C., van Brocklin, D., Williams, D., 2009, The PEST Conference, Potomac, MD, November 2-4

Managing Seawater Intrusion without Knowing the Seawater Interface Location
Williams, D., van Brocklin, D., Tana, C., 2008, International Ground Water Modeling Center, Golden, CO, May 18-21

Successful and Unsuccessful Applications of Inverse Methods on a Regional Groundwater Model
Tana, C., Williams, D., 2007, Geological Society of America Annual Meeting, Denver, CO

Developing Sustainable Water Supplies from a Small Coastal Aquifer with both Onshore and Offshore Environmental Constraints
Williams, D., Feeney, M., 2003, The Second International Conference on Salt Water Intrusion and Coastal Aquifers in Monitoring, Modeling, and Management, Merida, Yucatan, Mexico, March 30-April 2

The Significance of Groundwater Gradient Magnitude on Flow Paths in Simulations of Heterogeneous Aquifers
Oliver, D., Williams, D., 2002, Bridging the Gap Between Measurement and Modeling in Heterogeneous Media, International Groundwater Symposium, Berkeley, CA, March 25-28

Publications

Conceptual Modeling of a Well Developed Alluvial Basin, in Subsurface Fluid Flow (Ground Water and Vadose Zone) Modeling
Williams, D., Johnson, N.M., Fowler, A.C., 1996, American Society of Testing and Materials, Philadephia, PA

WATER RESOURCES AGENCY

MEMORANDUM

Monterey County

DATE: March 4, 2019

TO: Gary Petersen, General Manager, SVBGSA
Leslie J. Girard, SVBGSA General Counsel

FROM: Howard Franklin, P.G.

SUBJECT: Opinion on Groundwater and Surface Water Interdependence in the Salinas Valley Groundwater Basin

As you know, I am currently employed as a Senior Hydrologist with the Monterey County Water Resources Agency ("Agency") and am a licensed professional geologist with the State of California. I have been employed by the Agency for over 23 years; a copy of my C.V. is enclosed. I also currently serve on the SVBGSA Advisory Committee, and am assisting in the development of the Salinas Valley Integrated Hydrologic Model (SVIHM) by the United States Geological Survey. The SVIHM will be utilized, in part, by the SVBGSA in preparing GSPs for the Salinas Valley Groundwater Basin ("Basin"). During my time with the Agency I have become familiar with the hydrology and hydrogeology of the Basin, and the relationship and interaction between groundwater and surface water in the Basin.

Regarding, the Salinas River within the Basin, the river does not meet the definition of a "subterranean stream, which is defined as groundwater that is flowing through known and definite channels." Although not a subterranean stream, the river is operated by the Agency with a specific objective of providing recharge to the Basin. Of an estimated 504,000 acre-feet per year of inflow to the Basin, approximately 50 percent occurs as stream recharge, most of which can be attributed to flows within the Salinas River channel. Surface water within the Salinas River channel is therefore a primary source of recharge to the Basin.

In much of the Basin, groundwater extraction and/or surface water diversions occurs from wells that are in direct communication with the shallow alluvial of the Salinas River channel. In these areas, it is difficult to differentiate between the extraction of groundwater and the diversion of surface waters. Additionally, as was experienced and monitored throughout the Basin during the most recent drought period, lowering of the groundwater table has a significant impact on the Agency's ability to operate the reservoirs to a controlled range of flows at the Salinas River Diversion Facility. As such, overdraft of the groundwater basin, resulting in a reduction in groundwater levels significantly impacted surface water flows, depleting the availability of surface water to riparian water users.

Groundwater and surface water users alike will benefit when projects designed to recharge the groundwater basin and provide water for fish passage, spawning and rearing, maintain groundwater levels. For this reason, within the Basin, groundwater and surface water can be regarded as an interdependent system.

Based on this interdependence, it is my opinion that both surface water and groundwater users in the Basin will benefit from projects operated to achieve a sustainable groundwater basin. It is also my opinion that the benefit received from a sustainable groundwater basin cannot easily be differentiated between the two user groups.

HOWARD B. FRANKLIN

Phone: (831) 755-4860 9442 Saddler Drive
franklinh@co.monterey.ca.us Gilroy, CA 95020

EDUCATION

MS University of Nevada, Reno, Hydrology/Hydrogeology August 1993
Thesis: "Applications of GIS Technology in Water Resource Investigations"
Advisor: John Warrick, PHD

BA Southern Illinois University, Carbondale, Biological Sciences May 1981
Minor: Geology
Minor: Geography (Cartography)
Minor: Microbiology

PROFESSIONAL QUALIFICATIONS

Manage and supervise professional geologist and engineers, scientist, technicians, general labor and administrative staff. Participate in strategic planning and budget development; Scope projects and develop budgets; Perform large scale and site specific scientific investigations; Oversee the development and implementation of complex basin wide integrated surface water groundwater models; Develop write and implement grant funded projects; Effectively planned and built heli-portable camps under extreme artic conditions.

Education, training and work experience in hydrology, hydrogeology, geology, geophysics, environmental science and water resource management. Licensed Professional Geologist in California (No. 8456).

Coordinated and implemented innovative projects in diverse environments; major metropolitan, agricultural, delta, desert, mountain and artic regions.

WORK EXPERIENCE

Monterey County Water Resources Agency, Salinas, California 1995 to present

- Hydrologist / Program Manager / Senior Water Resources Hydrologist

Reporting directly to the General Manager, plan, organize and manage the Hydrology section of the Monterey County Water Resources Agency; manage the most complex, innovative and large scale hydrogeologic investigations, projects and programs; prepare conceptual designs and investigations, manage detail design of project phases by other staff and engineers; conduct and guide subordinate supervisors in performance appraisals and employee counseling; select candidates for employment; prepare and manage program, project and section budgets; participate in the development of Agency wide budgets; represent the Agency at Board of Directors and County Board of Supervisor meetings; prepare grant applications; negotiate and administer contracts with vendors, agencies, and consultants; collaborate and coordinate with regulatory agencies; negotiate, prepare, review and administer agreements with other departments or public agencies; analyze proposed and current legislation and government policies, rules and regulations and develop strategic recommendations.

Parsons Engineering Science, Alameda, CA 1993 to 1995

- Hydrologist / Hydrogeologist

Performed hydrogeologic modeling, analysis, and report preparation of surface and ground water contamination sites. Developed geospatial database and performed analysis of major projects involving multiple sampling media. Utilized remote sensing technologies to locate and evaluate potential disposal sites on military instillations involving unexploded ordnance. Performed water resource evaluations, watershed characterizations, and geostatistical analysis projects.

Washoe County Department of Comprehensive Planning, Natural Resources Division, Reno, Nevada 1991 to 1993

- Graduate Intern

Developed, installed, and monitored a data collection network of rain gages, weirs, and weather stations for water resource evaluations. Performed streamflow measurements and snow pack surveys. Responsible for GIS data development and mapping.

Western Geophysical Company, International Division, Houston, Texas 1981 to 1991

- Exploration Manager

Managed the operation of geophysical exploration crews in extreme environments. Led projects in artic, coastal, delta, swamp, desert, mountain, agricultural, and urban regions. Supervised the coordination of air, aquatic, and terrestrial operations.

Global Marine Drilling, Inc, Homer, Louisiana Summers: 1978 and 1979

- Roustabout / Roughneck

Worked aboard the deep-sea exploration ship the Glomar Grand Isle performing duties in support of all drilling activities. Offshore Gulf Coast and South America.

PROFESSIONAL LICENSE

State of California Board for Professional Engineers, Land Surveyors, and Geologist
Licensed Professional Geologist (No. 8456) 2008 to Present

State of California, Cal/OSHA
Licensed Geophysical Blaster (Explosive purchase and use license) 1982 to 1985

PUBLICATIONS/REPORTS

- "Special Report: Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin", October 2017

- Salinas Valley Water Project Annual Flow Report: Water Years 2010 - 2018

- Groundwater Elevation Contours: 1995,1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015, 2017

- Seawater Intrusion Maps: 2011, 2013, 2015, 2017

- Groundwater Extraction Reports: 2011, 2012, 2013, 2014, 2015, 2016

- Quarterly Salinas Valley Water Conditions Reports: Water Years 2003 – 2018

- Water Resources Data Report: Water Years 1994 – 1997

- "Special Report: A GIS Analysis of the Effects of land Use Constraints and Water Delivery on Water Demands in North Monterey County", December 1996

PRESENTATIONS

- UCC Irrigation and Nutrient Meeting, February 2018: Presenter - "Update on Seawater Intrusion in the Salinas Valley"

- California Groundwater Resources Association Annual Conference, October 2013: Presenter - "Groundwater level Trends and the Implementation of Water Supply Projects in the Salinas Valley, CA"

- American Association of Petroleum Geologists, 1999 Pacific Section Convention: Oral and Poster Presentations – "Monterey County Water Resources Agency's use of GIS Technology in the Salinas Valley" and "The Benefits of Proper Data Capture and Management Practices at Monterey County Water Resources Agency"

PROFESSIONAL TRAINING

Unexploded Ordinance (UXO) – Remote Sensing Seminar
Colorado School of Mines, Golden, Colorado, September 1993

Workshop and seminar on location and management of UXO detection and risk utilizing remote sensing technologies.

Groundwater-Surface Water Interaction: California's Legal and Scientific Disconnect - Symposium
Groundwater Resources Association of California, June 2011
Groundwater and surface-water are connected in the physical system, but not in the legal system, and the regulatory framework places pseudo boundaries to define under the influence. A debate has been heating up over the past few years as to whether the legal and regulatory system need to be changed to reflect physical reality and to protect the environment from further damage, whether local management initiatives and practice can effectively address the challenges, or some sort of hybrid needs to be developed for parts of the state. Our esteemed speakers and panelists will debate the pros and cons of the current system, and discuss their vision for California's future groundwater policy.

Principals of Groundwater and Flow Transport Modeling – Short Course
Groundwater Resources Association of California, September 2001
Principles and practical aspects of groundwater modeling.

PROFESSIONAL AFFILIATIONS

- Groundwater Resources Association of California
- Monterey Bay Geological Society

TECHNICAL ADVISORY

Salinas Valley Groundwater Basin Investigation, Technical Advisory Committee, Monterey County Water Resources Agency, Salinas, California, 2010 to present.
Manage and coordinate participation of qualified professionals in support of the development of a Salinas Valley Integrated Hydrologic Model (SVIHM) built on the USGS Integrated Hydrologic Model, One-Water Hydrologic Flow Model (MODFLOW-OWHM) in cooperation with the U.S. Geological Survey.

Technical Advisory Committee: Seaside Watermaster, 2004 to present
Provide technical assistance and guidance to Seaside Adjudicated Basin Watermaster

Technical Advisory Committee: Pajaro Valley Water Management Agency, 2010 to 2014
Development of USGS Integrated Hydrologic Model, One-Water Hydrologic Flow Model (MODFLOW-OWHM) of the Pajaro Valley, Santa Cruz and Monterey Counties, California

Technical Advisory Committee (Computer Model Update Subcommittee): Paso Robles Groundwater Basin, San Luis Obispo County, California, 2008 – 2014

Provide technical assistance and guidance in support of the Paso Robles Groundwater Basin Investigation.

COMMUNITY SERVICE

City of Gilroy, California
2010 General Plan Update Committee, 2008 - 2010

South Santa Clara County Planning Advisory Committer
City of Gilroy Representative, Santa Clare County, California, 2009 - 2012

LANGUAGES

English: Native Language

COMPUTER SKILLS

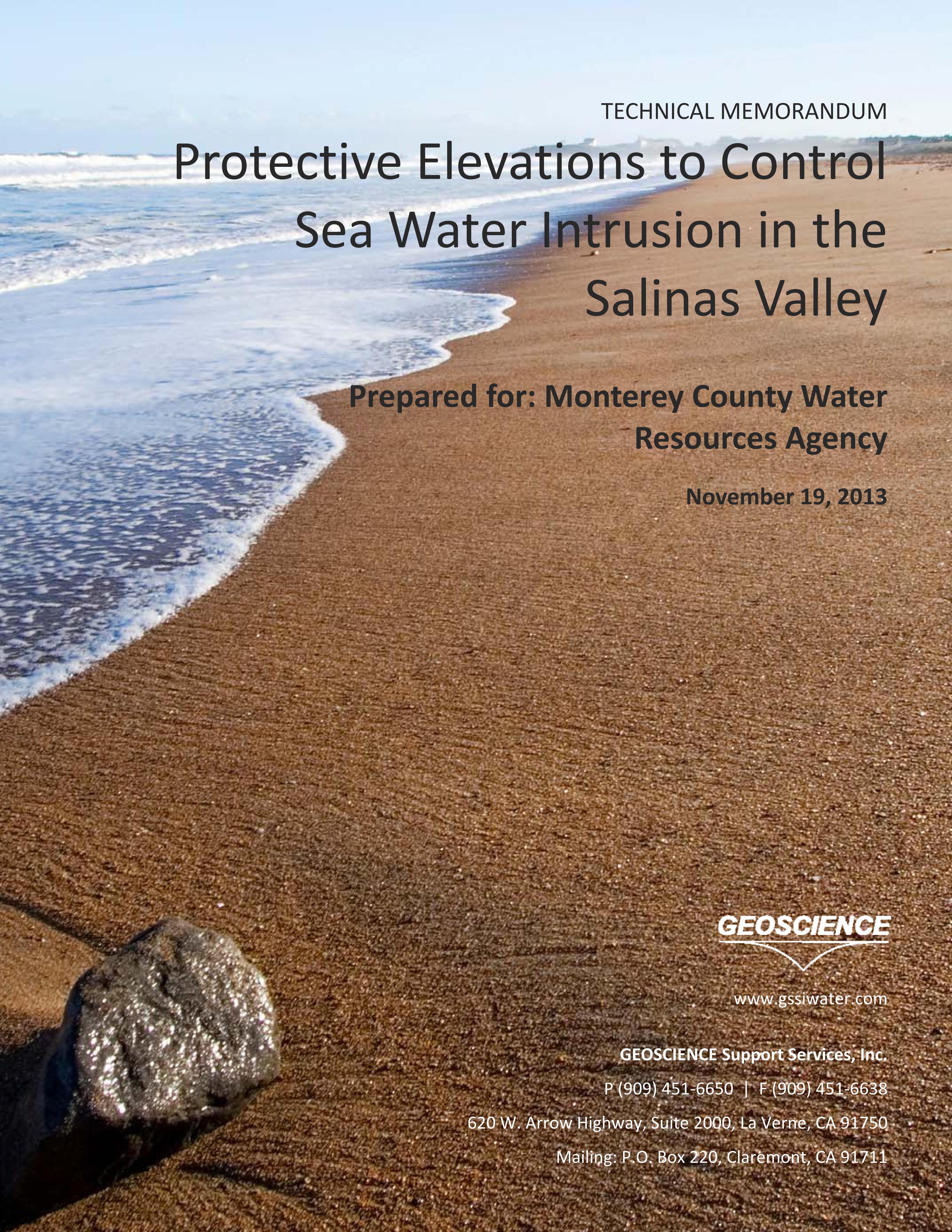
Programming: Python (limited) JavaScript (limited)

Applications: GIS, MS Office Suite (Proficiency in Word, Excel, PowerPoint, Access)

Platforms: MS Windows, iOS, Unix/Linux, Cloud, Social Media

OTHER

- LinkedIn: https://www.linkedin.com/pub/howard-b-franklin/b/3a6/b12
- PADI and NAUI Scuba Certified



TECHNICAL MEMORANDUM

Protective Elevations to Control Sea Water Intrusion in the Salinas Valley

Prepared for: Monterey County Water Resources Agency

November 19, 2013

GEOSCIENCE

www.gssiwater.com

GEOSCIENCE Support Services, Inc.

P (909) 451-6650 | F (909) 451-6638

620 W. Arrow Highway, Suite 2000, La Verne, CA 91750

Mailing: P.O. Box 220, Claremont, CA 91711

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA

FIGURES

TABLES

APPENDIX

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA

1.0 BACKGROUND

This technical memorandum was prepared in support of preventing revocation of Permit 11043 (State of California Division of Water Rights Permit for Diversion and Use of Water - Amended Permit 11043 dated 11-Jul-49). Permit 11043 allows for appropriation of water from the Salinas River in Monterey County California, the quantity of which shall not exceed 400 cfs with an annual maximum diversion amount not to exceed 168,538 acre-ft/yr. Beneficial uses of the diverted water would add to and complement existing projects or implement new projects such as:

- Increase Ground Water Levels in the Pressure Area to Control Sea Water Intrusion
- Provide Additional Recharge to the Forebay And East Side Areas
- Provide More Water to the Salinas Valley Water Project
- Expansion of CSIP Deliveries
- Reduce Pumping in Pressure Area (in Lieu Recharge)

This report addresses one of the potential beneficial uses, that is, using the diverted water to help increase ground water levels in the Pressure and East Side Subareas to control seawater intrusion. The high quality diverted water would also result in improvement of ground water quality by blending with native ground water.

2.0 DESCRIPTION OF AQUIFER SYSTEMS

Water-bearing materials in the northern portion of the Salinas Valley, from oldest to youngest, consist of the Pliocene Marine Purisima Formation, Plio-Pleistocene Paso Robles Formation, Pleistocene Aromas Red Sands and the Holocene Valley Fill materials (Greene, 1970). In the Salinas Valley, according to Hanson et al. (2002), the upper portion of the aquifer system is present in the Holocene river and dune deposits, Valley Fill, Pleistocene Aromas Sands and the Paso Robles Formation. These water-bearing deposits consist of sand and gravel units which form aquifers in the upper 1,000 ft bgs[1] . Between 1,000 ft and 2,000 ft, the Pliocene Purisima Formation contains permeable sedimentary deposits which form a deeper aquifer system.

Aquifers in the Salinas Valley Ground Water Basin have been named for the average depth at which they occur. Beneath the center of the Salinas Valley within nine miles of the coast, the “180-Foot Aquifer” lies at an approximate depth of 50 to 250 ft, and has a thickness of 50 to 150 ft (Greene, 1970). The 180-Foot aquifer may correlate in part with the older valley-fill and upper Aromas Sands (Kennedy/Jenks Consultants, 2004; DWR, 1973; and Greene, 1970) and underlies a confining layer known as the Salinas Valley Aquitard (DWR, 2003; Hanson et al., 2002). The Salinas Valley Aquitard varies in thickness from 25 ft to more than 100 ft near Nashua Road, five miles west of Salinas (DWR, 1973; Montgomery Watson, 1994). Zones of discontinuous aquifers and aquitards approximately 10 to 200 ft thick underlie the 180-Foot aquifer (DWR, 1973). The “400-Foot Aquifer” lies at an approximate depth between 200 to 400 ft bgs, has a thickness of 230 to 350 ft, and may correlate with the lower Aromas Red Sands or Paso Robles Formation (Hanson et al., 2002; Greene, 1970). A deeper aquifer, also referred to as the “900-Foot Aquifer,” is separated from the overlying 400-Foot aquifer by a blue marine clay aquitard (DWR, 2003) and may be correlated with the Paso Robles Formations (Hanson et al., 2002). Figure 1 and Figure 2 depict the 180-Foot and 400-Foot aquifers. The 900-Foot aquifer is not shown on Figure 1 or Figure 2.

Existing published reports contain geohydrologic cross-sections of varying detail and applicability – such as those available in Greene (1970), DWR (1973), Harding ESE (2001), Hanson et al. (2002), and Kennedy/Jenks (2004). Cross-sections prepared by Kennedy/Jenks (2004) were used to help evaluate the extent of the base of the 180-Foot and 400-Foot aquifers and are discussed in a subsequent section of this memorandum (also see Appendix A).

[1] Below ground surface

3.0 PRESSURE AND EAST SIDE HYDROLOGIC SUBAREAS

Hydrologic subareas of the Salinas Valley have been delineated based on sources of ground water -recharge as well as stratigraphy. Historically, recharge to the Northern Salinas Valley comes primarily from two hydrologic subareas: underflow from the southern Forebay Subarea and underflow from the northeast East Side Subarea. The East Side Subarea is bounded by the Pressure Subarea on the west and Forebay Subarea on the south.

The East Side Subarea is recharged by streams draining the Gabilan Range to the northeast and from direct precipitation during wet years. The 180-Foot and 400-Foot aquifer zones in the Pressure Subarea are not found in the East Side Subarea. However, the East Side Shallow and Deep Aquifers can be time-stratigraphically correlated to equivalent zones in the Pressure Subarea (i.e. 180-Foot and 400-Foot aquifers). Therefore, the Pressure and East Side are in fact, hydrologically connected.

At one time (before excessive pumping), the East Side Subarea was one of the natural sources of recharge to the adjacent Pressure Subarea with ground water flowing from the northeast to the southwest. However, historical ground water level declines have resulted in a reversal of the gradient. That is, ground water now flows from the Pressure Subarea to the East Side Subarea (i.e. from the southwest to the northeast—see Figures 3 and 4).

4.0 HISTORICAL INTRUSION OF SEA WATER IN THE 180-FOOT AND 400-FOOT AQUIFERS

In general, ground water flows from areas of recharge to areas of discharge and the Salinas Valley is no exception. In the main Salinas Valley, ground water flows in a northwesterly direction from the inland recharge areas (Forebay Subarea) to the coast. Ground water also historically flowed from the East Side Subarea southwesterly into the Pressure Subarea. This natural flow of fresh ground water (towards the ocean) controlled inland migration of salt water into coastal aquifers. However, historical pumping has lowered ground water levels in both the 180-Foot and 400-Foot aquifer systems such that there is a landward hydraulic gradient which has caused extensive sea water intrusion (see Figures 3 and 4). It is believed that the primary mechanism of seawater intrusion is through the submarine outcrops of the 180-Foot and 400-Foot aquifers offshore of Monterey Bay. These outcrops are in direct hydraulic continuity with the Pressure Zone 180-Foot and 400-Foot aquifers. Graphical plots published by Monterey County Water Resources Agency (MCWRA, 2012) delineating historical extent of seawater intrusion, are shown on Figures 5 and 6 for the 180-Foot and 400-Foot aquifers respectfully. An analysis of these figures shows that the rate of seawater intrusion has progressively slowed due to implementation of the Salinas Valley Water Project and the Monterey County Recycling Projects. However, intrusion continues (albeit at a slower rate), migrating inland and salinating fresh-water aquifer systems. The following table summarizes the rate of seawater intrusion in the northern Salinas Valley as measured from the MCWRA plots (Figures 5 and 6).

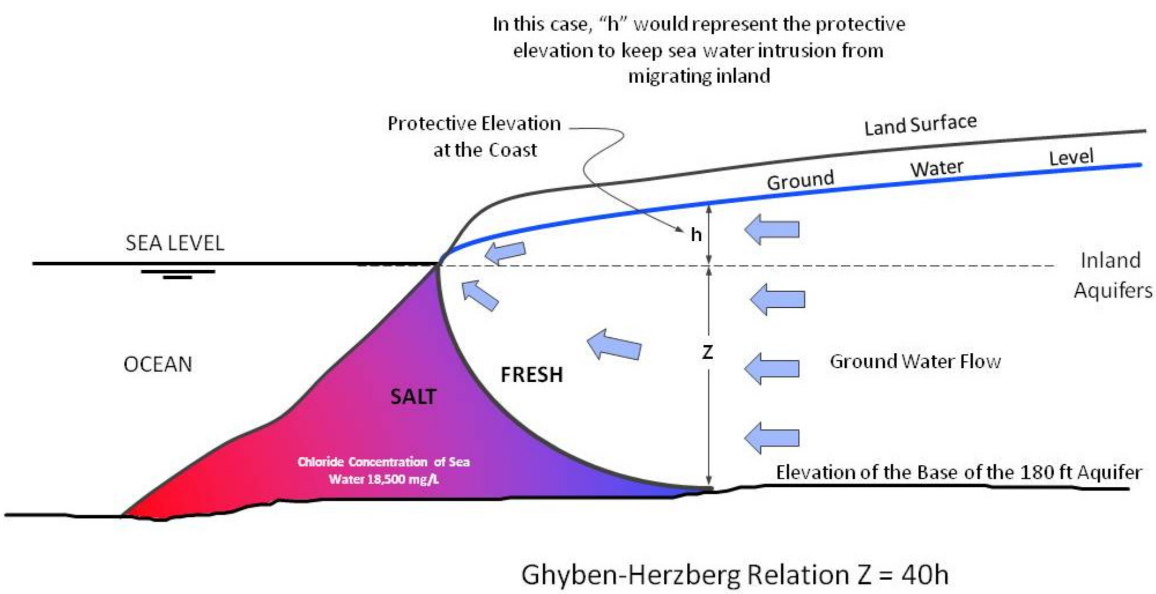
Table 1
Historical Rate of Sea Water Intrusion in the 180 and 400-Foot Aquifers, ft/yr

Time Interval	Aquifer	
	180-Foot	400-Foot
1944-1965	557	-
1959-1975	-	391
1965-1975	659	-
1975-1985	665	545
1985-1993	930	406
1993-1997	1028	1185
1997-1999	4086	1829
1999-2001	1418	1243
2001-2005	722	572
2005-2007	760	303
2007-2009	430	183
2009-2011	600	134

5.0 CONTROL OF SEA WATER INTRUSION – PROTECTIVE ELEVATIONS

Well over 100 years ago, two independent investigators Ghyben and Herzberg determined that salt water in aquifers was found at a depth below sea level of approximately 40 times the height of the fresh water above sea level (Todd, 1980). This distribution was due to the hydrostatic equilibrium between the densities of fresh water and seawater. The equation which explains this phenomenon is referred to as the Ghyben-Herzberg relation and assumes under hydrostatic conditions that the weight of a unit column of fresh water, extending from the ground water level to a point on the fresh/salt water interface, is balanced by a unit column of salt water extending from sea level to the same point on the interface. The figure below illustrates this principle.

Schematic Showing Protective Elevations and the Ghyben-Herzberg Relation



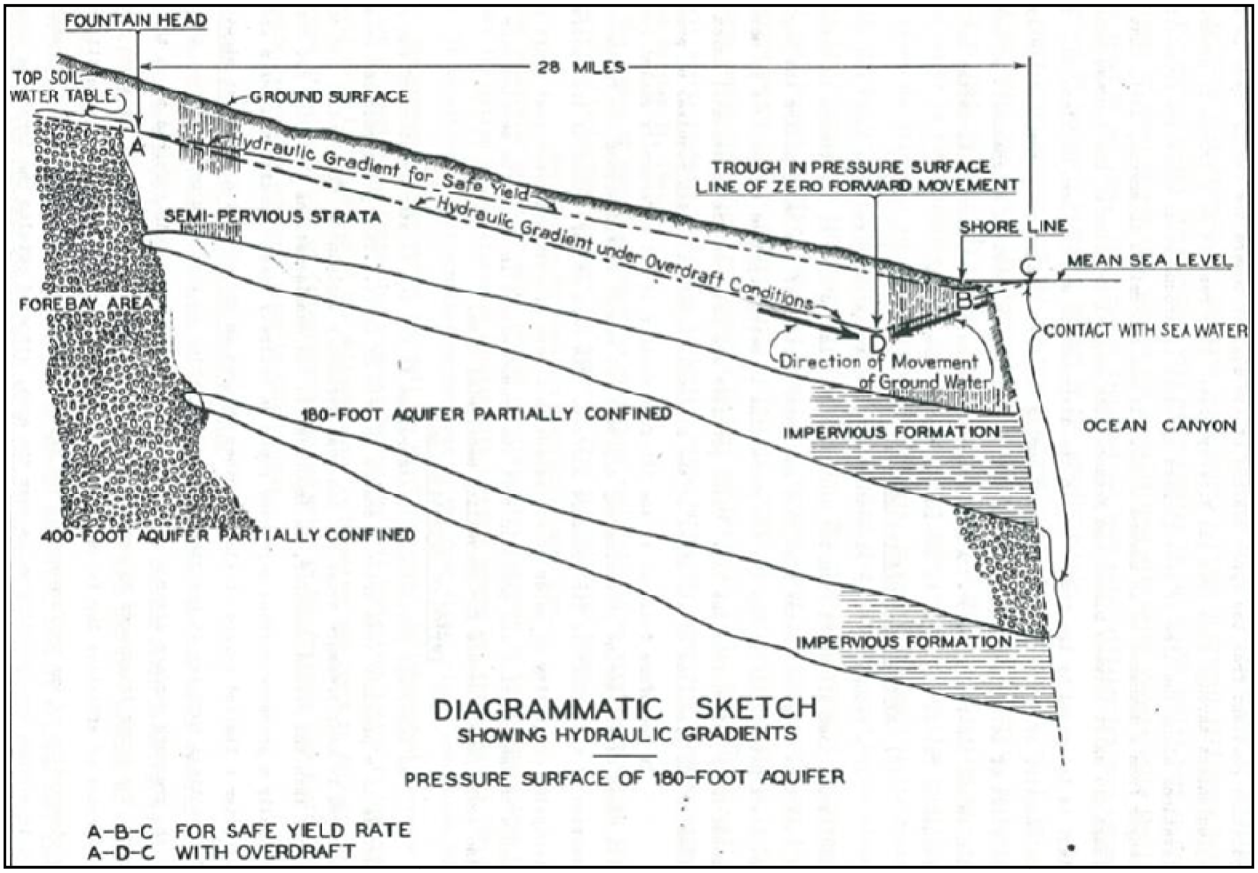
Protective elevations are defined as those ground water elevations which will keep the fresh/salt water interface from migrating inland. In the northern portion of Salinas Valley these elevations need to be above sea level and the flow of ground water towards the coast.

Ground water recharge (direct and in lieu), could be used to replenish storage and maintain a seaward hydraulic gradient. Additional recharge in the Forebay area would result in additional recharge to the northern pressure zone as underflow. Artificial recharge in the East Side Subarea would reduce subsurface inflow from the Pressure Subarea and eventually restore the historical northeast to southwest recharge. Both northwest underflow from the Forebay Subarea as well as southwest recharge from the East Side Subarea would help control seawater intrusion.

6.0 PROTECTIVE ELEVATIONS FOR THE 180-FOOT AND 400-FOOT AQUIFERS

One of the initial steps in the planning process for control of seawater intrusion is to quantify the protective elevations. As discussed above, in a simple hydrostatic case, protective elevations are defined as those ground water elevations (above sea level) which, due to density differences between fresh ground water and seawater, create a balance or equilibrium condition of the fresh water-salt water interface.

Schematic Showing Water Level Needed to Prevent Sea Water Intrusion (DWR, 1946)



The above sketch is from Plate 10 in DWR (1946) and shows the concept of establishing a seaward hydraulic gradient to prevent seawater intrusion. Near the coast it may be assumed that the chloride concentration is that of pure seawater (18,500 mg/L)[2] and the Ghyben-Herzberg 40:1 relation applies.

[2] http://shorestation.ucsd.edu/active/index_active.html

The extent of seawater intrusion varies in different aquifers due to a multitude of factors including aquifer depth, tidal influence, variation in hydrology and other water balance components. However, for planning purposes, the protective elevations as calculated in this technical memorandum are considered realistic for control of seawater intrusion. Protective elevations were calculated near the coast and merged with historical (1938) elevations obtained from Plates 8 and 9 (DWR, 1946).

Specifically, protective elevations for the 180-Foot and 400-Foot aquifers were calculated as follows:

1. The elevation of base of the 180-Foot and 400-Foot aquifers were obtained from recent geologic cross-sections and other publications (Figures 7, 8 and Appendix A).
2. The Ghyben-Herzberg relation of 40:1 was used to calculate the protective elevations at the Coast for each aquifer (see Figures 1 and 2).
3. Using the protective elevations at the coast and historical ground water flow directions as obtained from DWR Bulletin 52 (1946), the protective elevations were created assuming a seaward hydraulic gradient of 0.0002 (1 ft/mile) for both the 180-Foot and 400-Foot aquifers. This seaward hydraulic gradient is somewhat less than the historical gradient but as long as the coastal protective elevations are maintained by seaward flow, seawater intrusion can be controlled.

Figures 9 and 10 show the protective elevations and direction of ground water flow in the Northern Salinas Valley.

7.0 HISTORICAL DEPLETION OF STORAGE IN A PORTION OF THE 180-FOOT AND 400-FOOT AQUIFERS

The ground water storage depletion between the protective elevations (Figures 9 and 10) and current ground water elevations (Figures 3 and 4) was made for a portion of the 180-Foot and 400-Foot aquifers between the town of Salinas and the Coast. Historical ground water storage depletion was estimated by multiplying the historical change in hydraulic head by the area and aquifer storativity. For example, for the 180-Foot aquifer, the current ground water elevations (Figure 3) were subtracted from the protective elevations (Figure 9). This difference was then multiplied by the 180-Foot aquifer area and the storativity. Similarly, for the 400 Foot aquifer, the depletion in storage was calculated by subtracting current water levels (Figure 4) from protective elevations (Figure 10) and multiplying by the area and the 400-Foot aquifer storativity. Incremental areas and storativity values for each aquifer were obtained from the SVIGSM[3] model cells.

Keep in mind that since these aquifers are confined and semi-confined, the change in ground water storage is relatively small and is due to the compression of the aquifer and expansion of the water. This volume is several orders of magnitude lower than the water which would drain by gravity (from aquifer pore space) in an unconfined state. Table 2 summarizes historical change in ground water storage.

Table 2
Historical Depletion of Storage in a Portion of the 180-Foot and 400-Foot Aquifers Between the Town of Salinas and the Coast

Aquifer	Area Between the Coast and Salinas, acres	Average Decline of Water Level ft	Aquifer Storativity	Volume of Storage Depleted acre-ft
180-Foot	84,000	33	0.004	11,100
400-Foot	84,000	51	0.00009	400
			TOTAL	11,500

[3] Salinas Valley Integrated Ground Water-Surface Water Model

8.0 FLOW NEEDED TO MAINTAIN A SEAWARD HYDRAULIC GRADIENT

Table 2 (above) shows that a relatively small amount of water is necessary to replenish confined and semi-confined aquifer storage. More important in controlling seawater intrusion however, is the re-establishment of the coastal protective elevations and seaward hydraulic gradients. It is estimated that between 1970 and 1992 approximately 16,000 acre-ft/yr of intrusion occurred in the 180-Foot and 400-Foot aquifers (Montgomery Watson, 1994).

The amount, location and timing of ground water recharge (direct and in lieu), needed to maintain protective elevations and a seaward hydraulic gradient was determined using the SVIGSM. Based on model results, and assuming 2030 land use conditions, 12,000 acre-ft/yr will be required from the SVWP Phase I facilities and 48,000 acre-ft/yr will be required from the SVWP Phase II facilities. Given the hydrologic variability in the Salinas Valley area, in order to supply a total of 60,000 acre-ft/yr (on average), to the SVWP, it will be necessary to have the right to divert up to 135,000 acre-ft/yr from the Salinas River.

9.0 REFERENCES

California Department of Public Works, Water Resources Division (DWR), 1946. Salinas Basin Investigation, Bulletin 52.

California Department of Water Resources (DWR), 1973. Lower Salinas Valley Seawater Intrusion Investigation.

_____, 1977. North Monterey Water Resources Investigation. Prepared pursuant to cooperative agreement between Department of Water Resources and Monterey County Flood Control and Water Conservation District. March 23, 1977.

_____, 2003. California's Groundwater - Bulletin 118, Update 2003. October, 1, 2003.

Greene, Gary H., 1970. Geology of Southern Monterey Bay and its Relationship to Ground Water Basin and Sea Water Intrusion. U.S. Geologic Survey Open-File Report.

Hanson, R.T., R. Everett, M. Newhouse, S. Crawford, M.I. Pimental, and G. Smith, 2002. Geohydrology of a Deep-Aquifer Monitoring-Well Site at Marina, Monterey County, California. U.S.G.S. Water-Resources Investigations Report 02-4003. Prepared in cooperation with Monterey County Water Resources Agency.

Harding ESE, 2001. Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina Salinas Valley, California. Prepared for Monterey County Water Resources Agency. April 28, 2001.

Johnson, M., 1983. Ground Water in North Monterey County, California, 1980. U.S.G.S. Water-Resources Investigations Report 83-4023. Prepared in cooperation with the Monterey County Flood Control and Water Conservation District. July 1983.

Kennedy/Jenks Consultants, 2004. Hydrostratigraphic Analysis of the Northern Salinas Valley.

Monterey County Water Resources Agency (MCWRA), 2012. Historic Seawater Intrusion Maps – 500 mg/L Chloride Areas. August 6, 2012. http://www.mcwra.co.monterey.ca.us/SVWP/01swi180.pdf; http://www.mcwra.co.monterey.ca.us/SVWP/01swi400.pdf Accessed 22-Jan-13

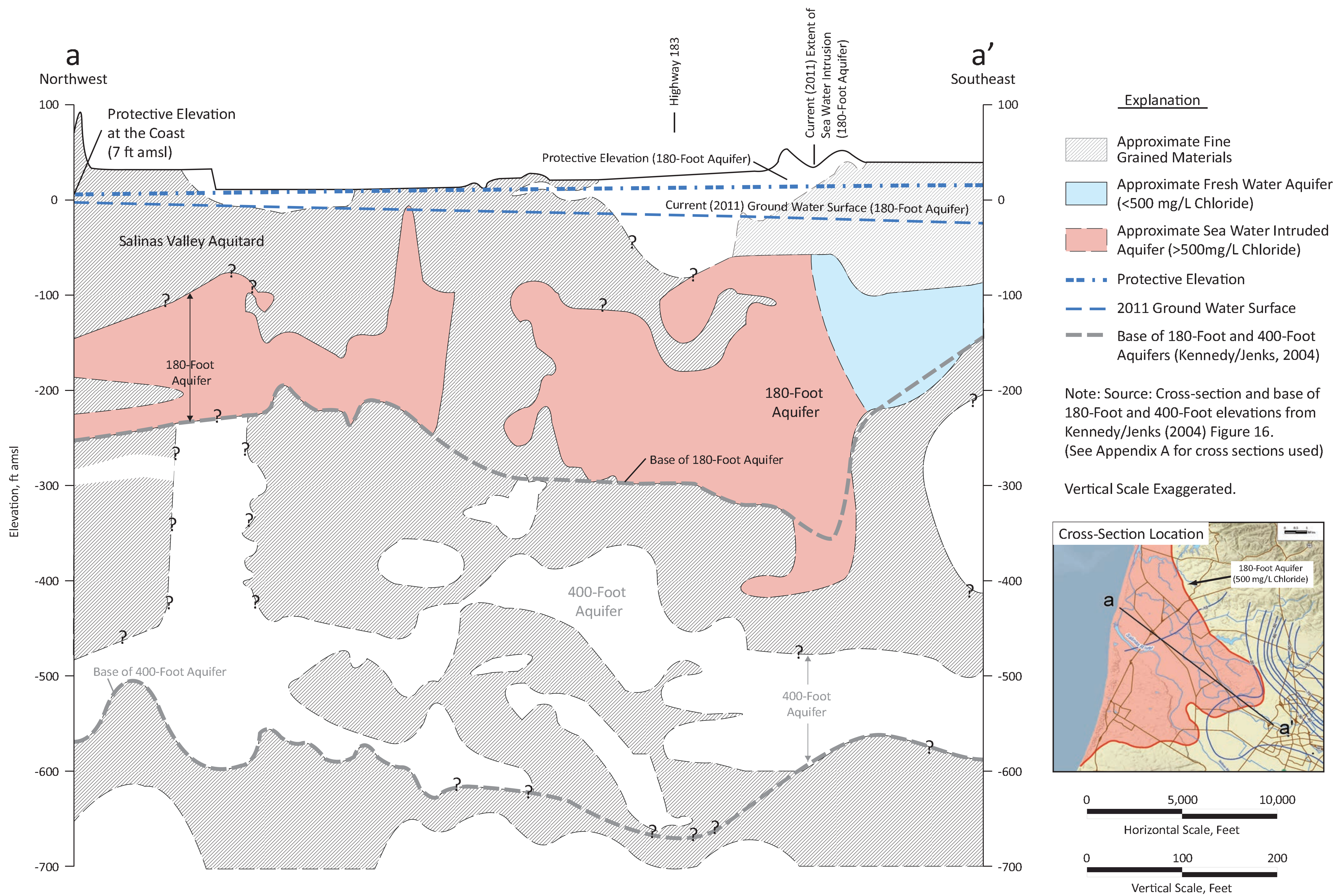
Montgomery Watson, 1994. Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Ground Water Flow and Quality Model Report. Prepared for Monterey County Water Resources Agency. February 1994.

Timothy J. Durbin, Inc., 2007. Groundwater Flow and Transport Model Seaside Groundwater Basin Monterey County, California. Prepared for RBF Consulting. October 26, 2007.

Todd, David K., 1980. Groundwater Hydrology, Second Edition. New York: John Wiley & Sons, 1980.

Yates, E.B., M.B. Feeney, and L.I. Rosenberg, 2005. Seaside Groundwater Basin: Update on Water Resource Conditions. Prepared for Monterey Peninsula Water Management District. April 14, 2005.

FIGURES



GEOSCIENCE

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

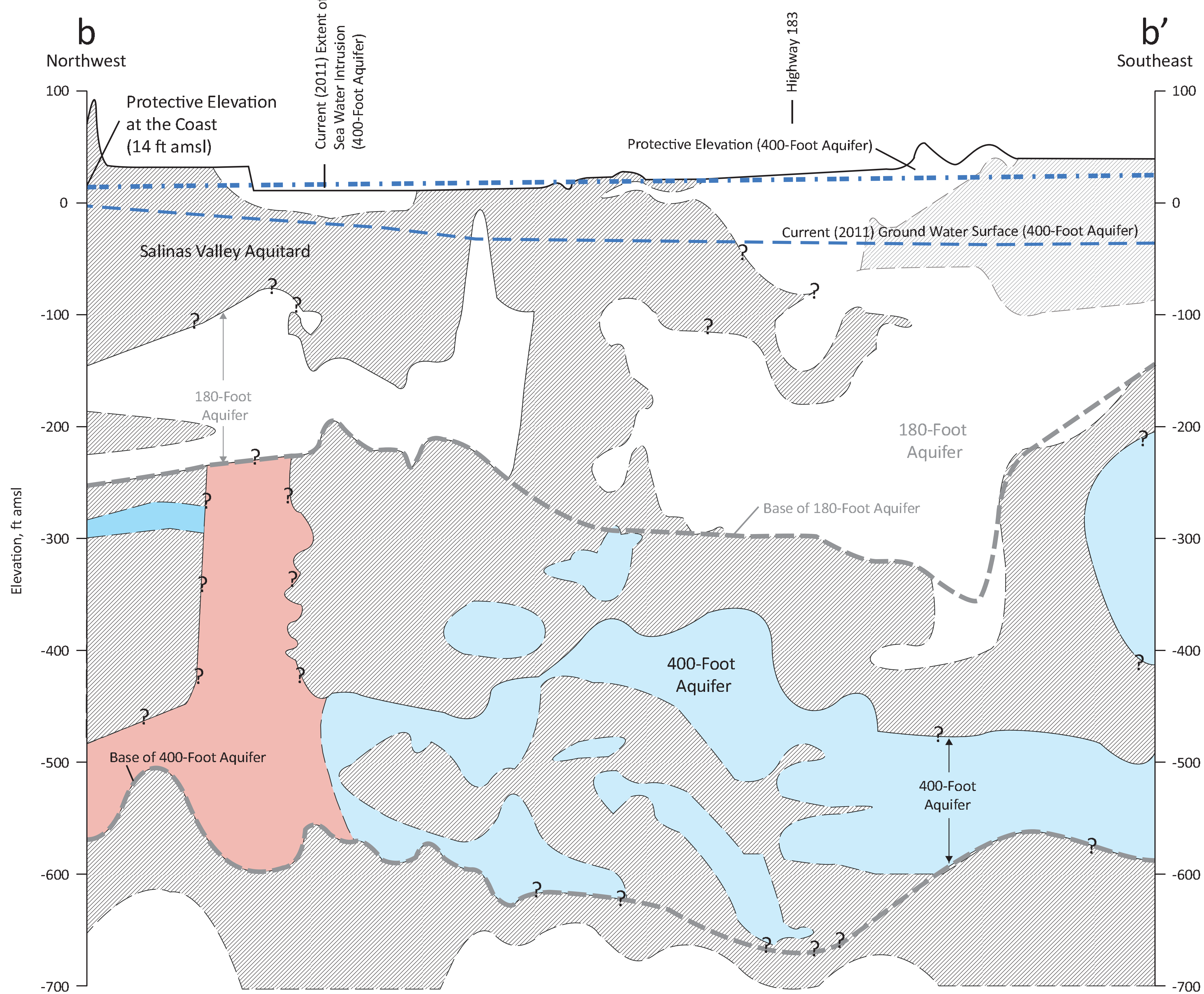
MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATION
180-FOOT AQUIFER

Drawn: LB
Checked: JK
Approved:
Date: 19-Nov-13

Figure 1

Projects\Downey-Brand\01) Salinas_Valley_Permit 11043\01) TM_Sea_Water_Intrusion\03) Revisions 19-Nov-13\01) TM figures\Fig_1_xsec_a-a_180_PE_11-13.ai



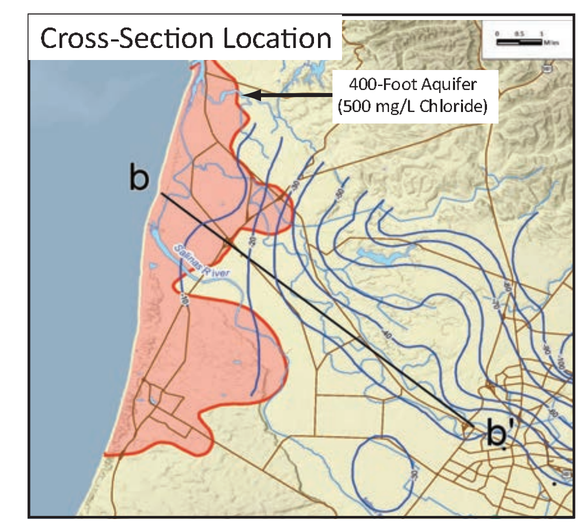
Explanation

- Approximate Fine Grained Materials
- Approximate Fresh Water Aquifer (<500 mg/L Chloride)
- Approximate Sea Water Intruded Aquifer (>500mg/L Chloride)
- Protective Elevation
- 2011 Ground Water Surface
- Base of 180-Foot and 400-Foot Aquifers (Kennedy/Jenks, 2004)

Note: Source: Cross-section and base of 180-Foot and 400-Foot elevations from Kennedy/Jenks (2004) Figure 16. (See Appendix A for cross sections used)

Vertical Scale Exaggerated.

Cross-Section Location



0 5,000 10,000
Horizontal Scale, Feet

0 100 200
Vertical Scale, Feet

GEOSCIENCE
GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATIONS
400-FOOT AQUIFER

Drawn: LB
Checked: JK
Approved:
Date: 19-Nov-13

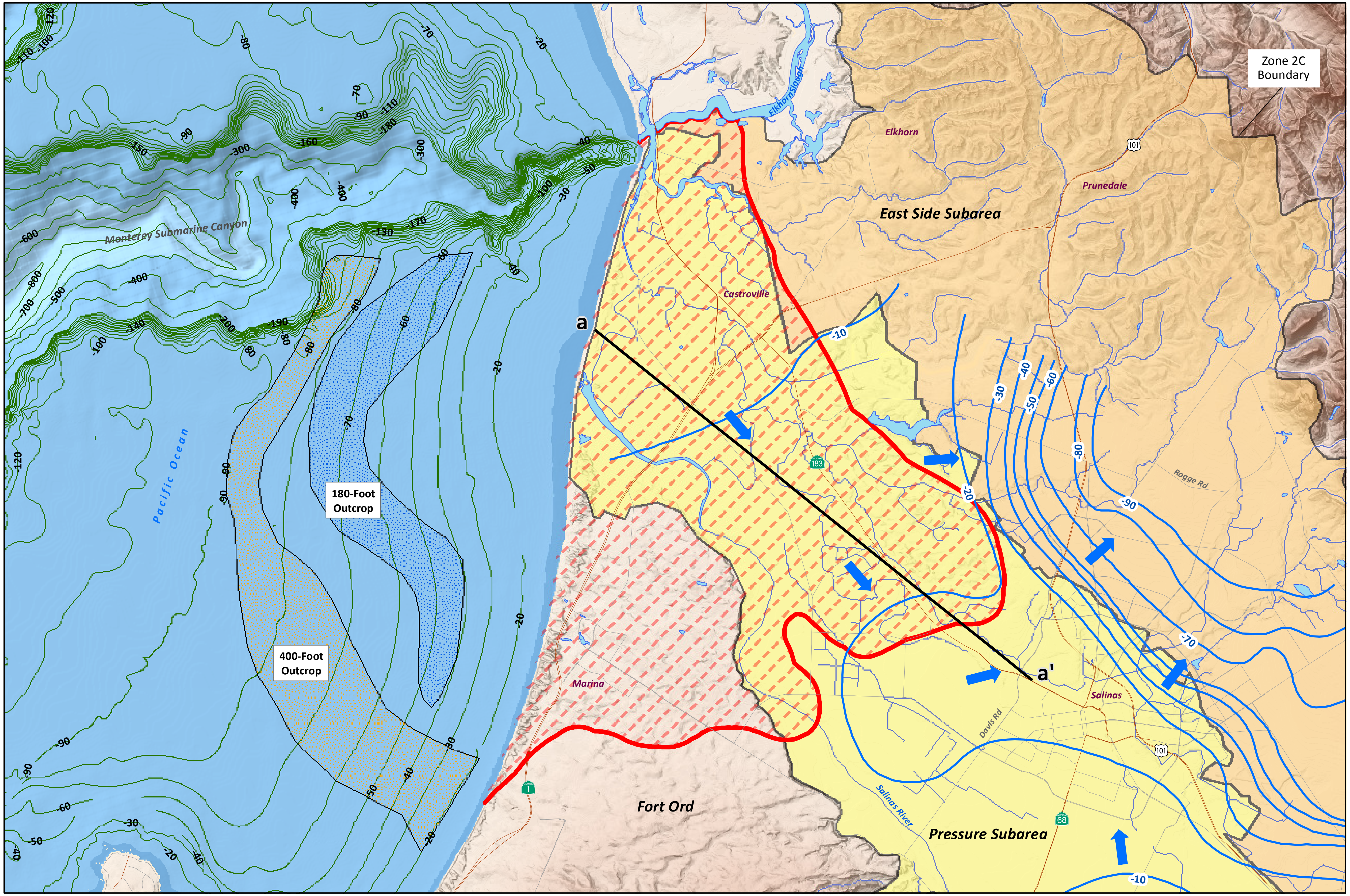
Figure 2

Projects\Downey-Brand\01) Salinas_Valley_Permit 11043\01) TM_Sea_Water_Intrusion\03) Revisions 19-Nov-13\01) TM figures\Fig_2_xsec_b-b_400_PE_11-13.ai

MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA

CURRENT GROUND WATER ELEVATIONS 180-FOOT AQUIFER



EXPLANATION

-50 Ground Water Elevation, ft amsl in the 180-Foot Aquifer August 2011 (MCWRA, 2012)

Ground Water Flow

a —— a' Geohydrologic Cross-Section (See Figure 1)

Current Extent (2011) of Sea Water Intrusion in the 180-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

-10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

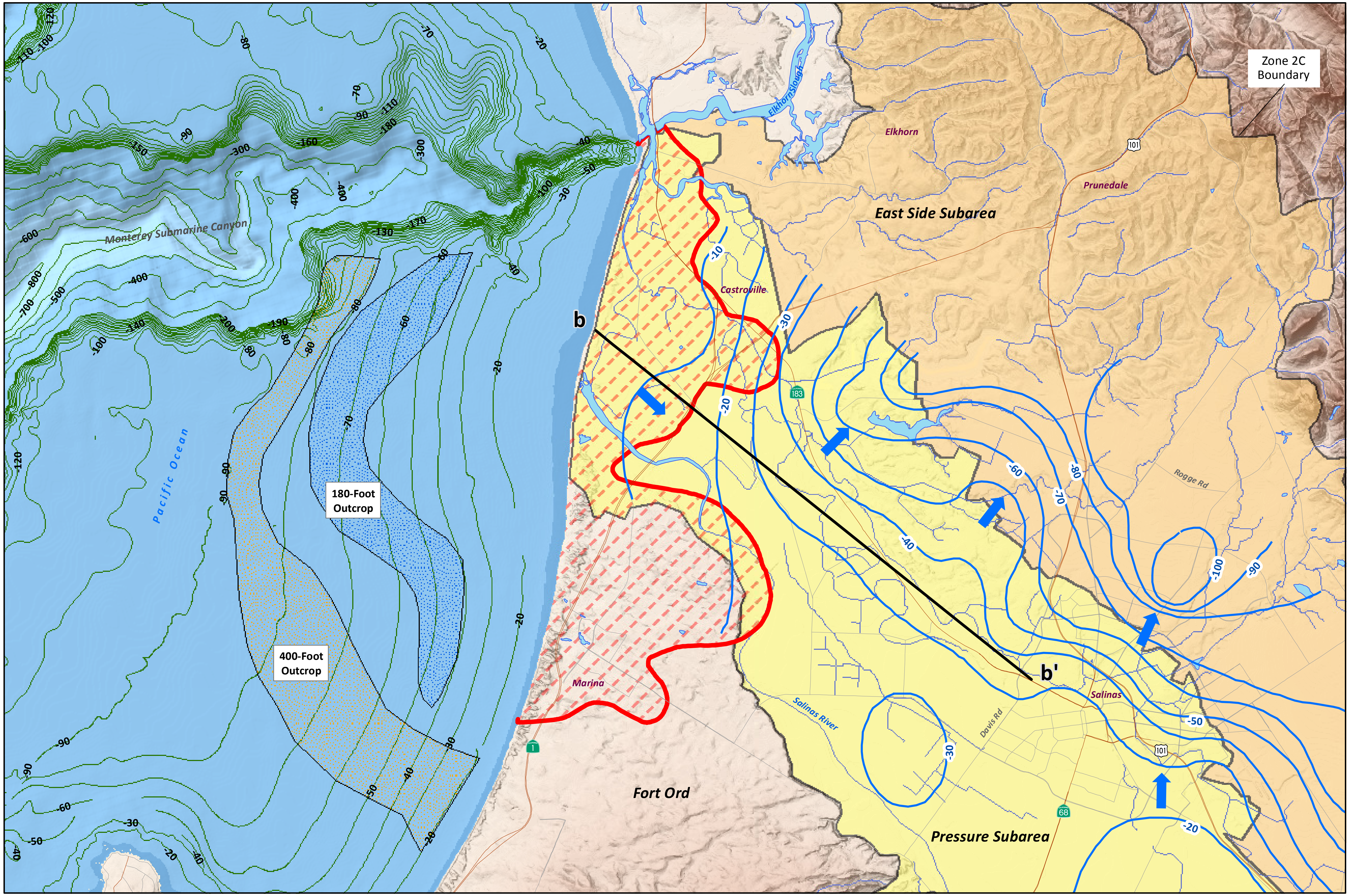
0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 3

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_3_2011_GWE_180ft_11-13.mxd

CURRENT GROUND WATER ELEVATIONS 400-FOOT AQUIFER



EXPLANATION

-50 — Ground Water Elevation, ft amsl in the 180-Foot Aquifer August 2011 (MCWRA, 2012)

Ground Water Flow

b — b' Geohydrologic Cross-Section (See Figure 1)

Current Extent (2011) of Sea Water Intrusion in the 180-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

-10 — Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

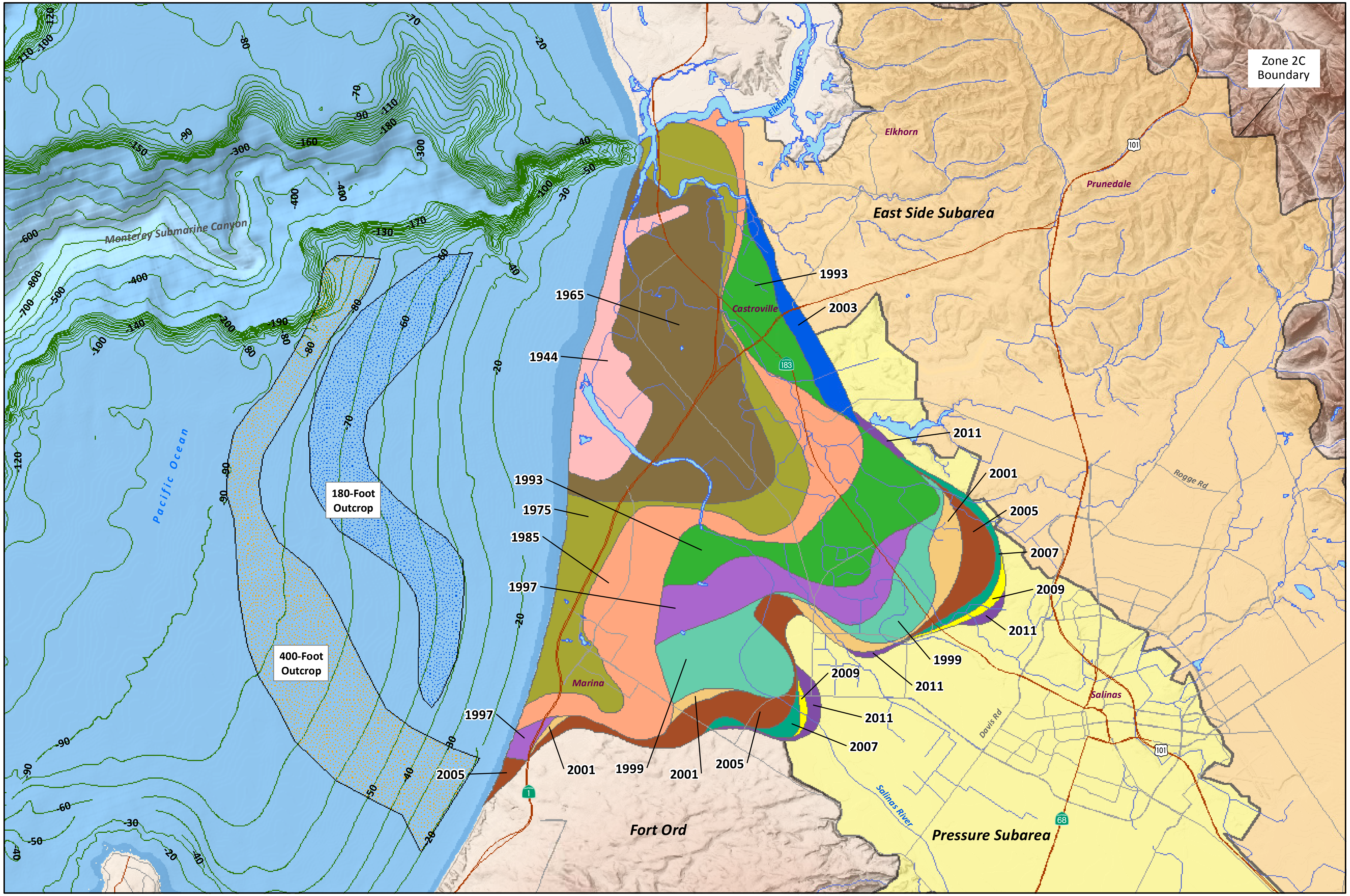
0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 4

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_4_2011_GWE_400ft_11-13.mxd

HISTORICAL SEA WATER INTRUSION 180-FOOT AQUIFER



EXPLANATION

Historical Sea Water Intrusion (>500 mg/L Chloride) (MCRWA, 2012)

1944	2001
1965	2003
1975	2005
1985	2007
1993	2009
1997	2011
1999	

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

- 180-Foot Aquifer
- 400-Foot Aquifer

-10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

NORTH

0 2 4 Miles

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

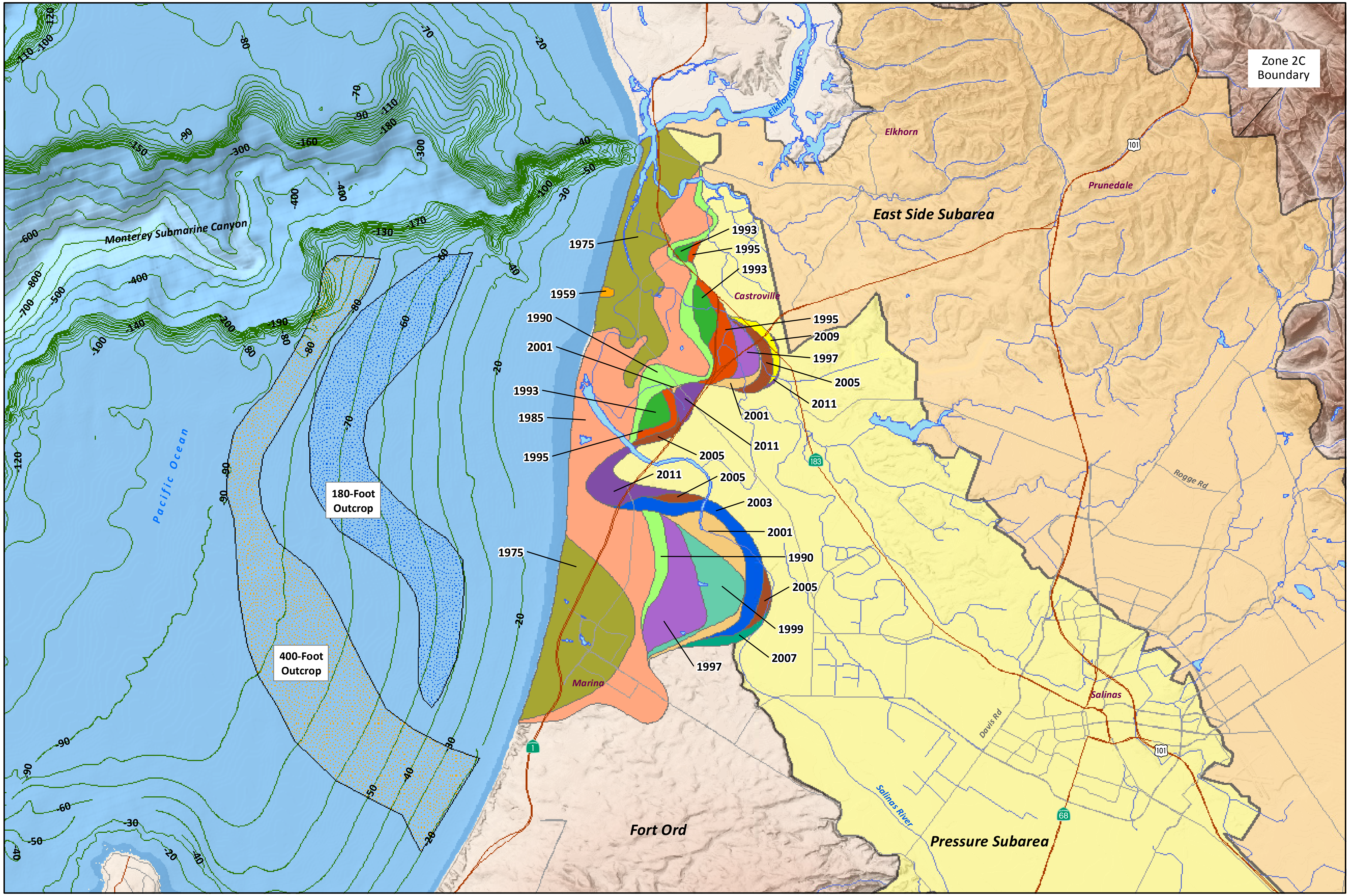
GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 5

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_5_180ft_swi_11-13.mxd

MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA



HISTORICAL SEA WATER INTRUSION 400-FOOT AQUIFER

EXPLANATION

Historical Sea Water Intrusion (>500 mg/L Chloride) (MCRWA, 2012)

1959	1999
1975	2001
1985	2003
1990	2005
1993	2007
1995	2009
1997	2011

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

-10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

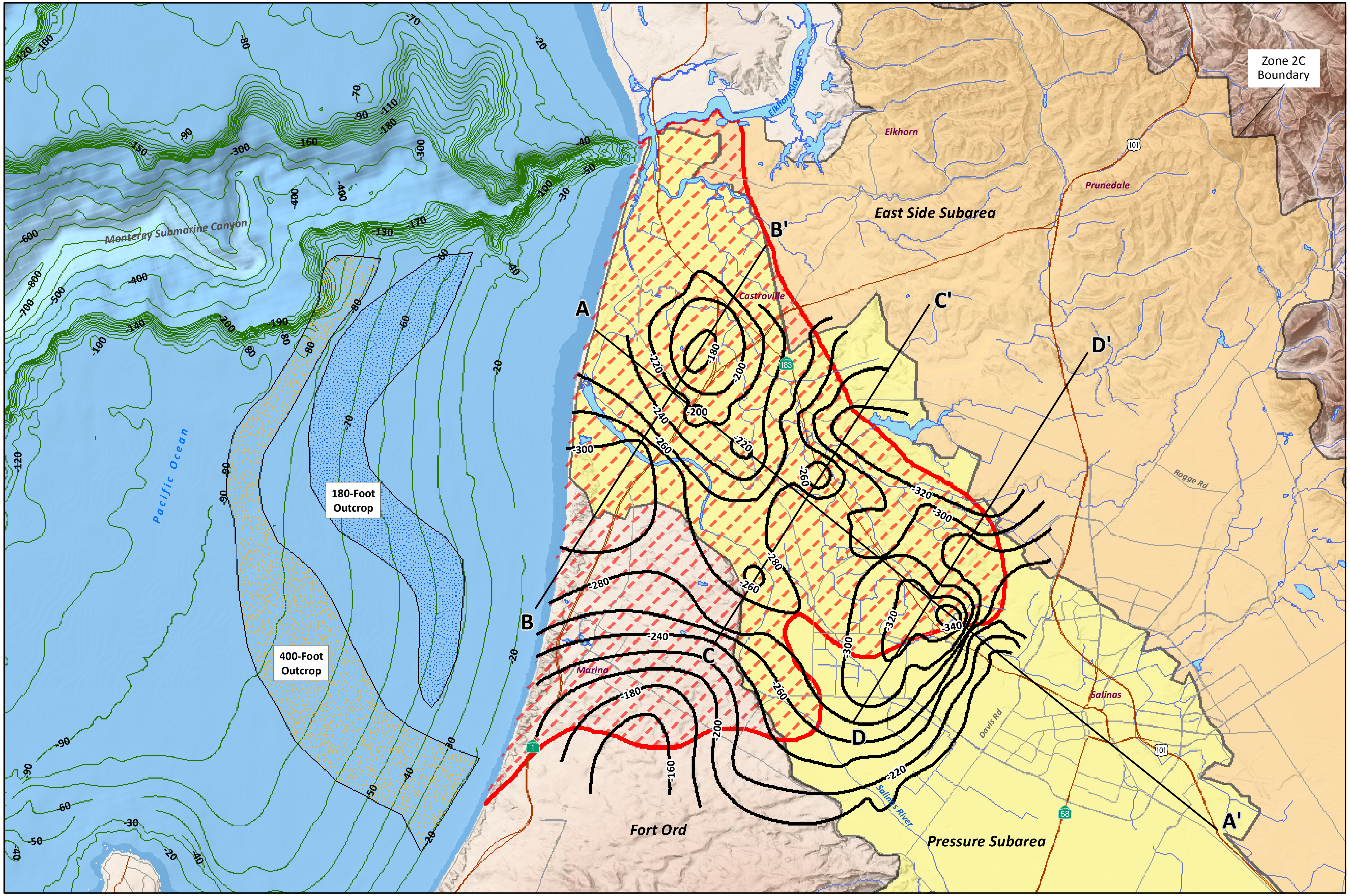
0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 6

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_6_400ft_swi_11-13.mxd

BASE OF THE 180-FOOT AQUIFER



EXPLANATION

- -50 Base of 180-Foot Aquifer, ft amsl (Interpolated from geologic cross-section prepared by Kennedy/Jenks, 2004)
- A ____ A' Geologic Cross-Section Location Used as Aquifer Base Elevation Control (Kennedy/Jenks, 2004. See Appendix A)
- Current Extent (2011) of Sea Water Intrusion in the 180-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

- 180-Foot Aquifer
- 400-Foot Aquifer
- -10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

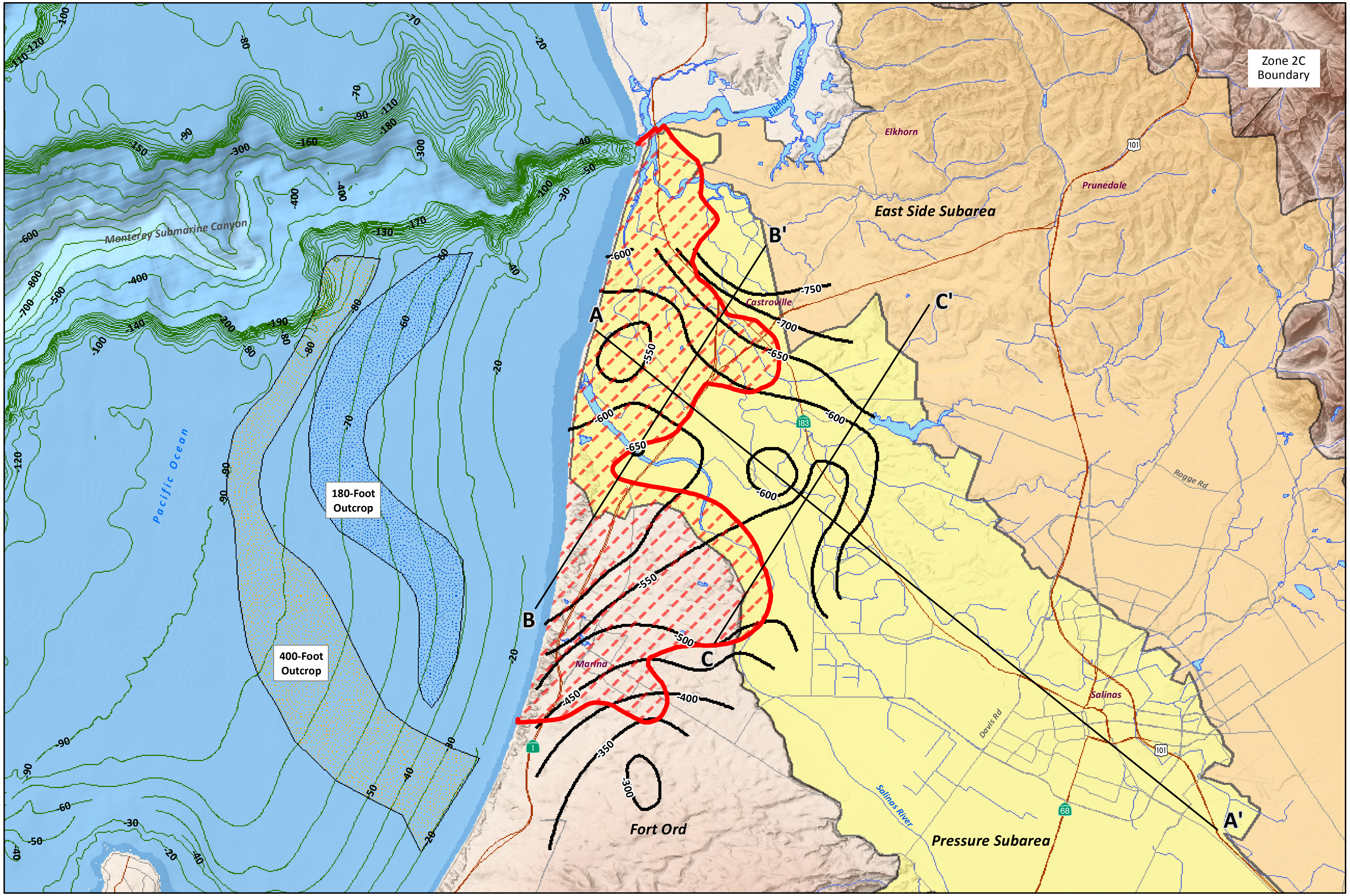
Figure 7

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_7_base_180ft_11-13.mxd

MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA

BASE OF THE 400-FOOT AQUIFER



EXPLANATION

-500 Base of 400-Foot Aquifer, ft amsl (Interpolated from geologic cross-section prepared by Kennedy/Jenks, 2004)

A ___ A' Geologic Cross-Section Location Used as Aquifer Base Elevation Control (Kennedy/Jenks, 2004. See Appendix A)

Current Extent (2011) of Sea Water Intrusion in the 180-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

-10 Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

NORTH

0 2 4 Miles

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

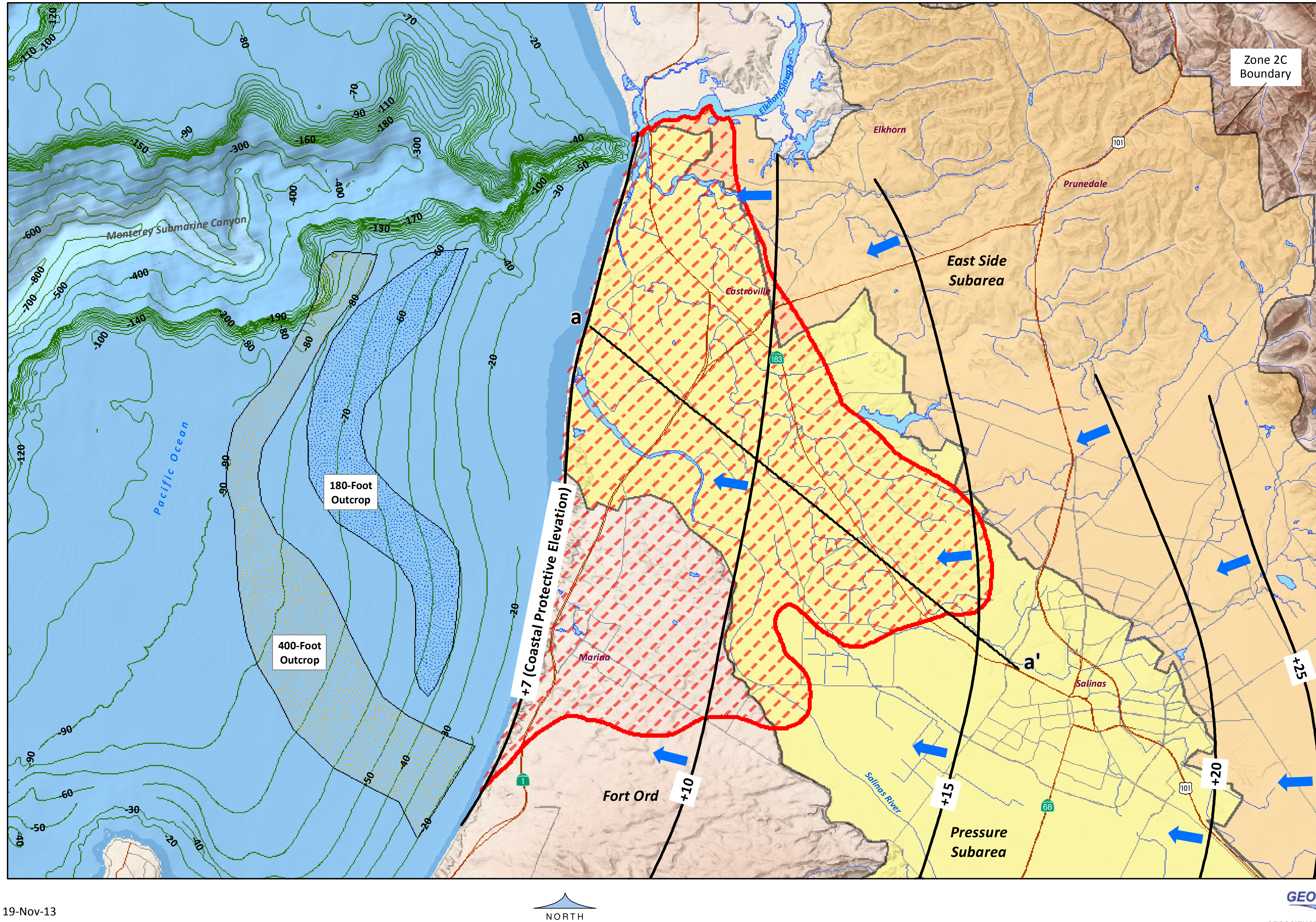
GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 8

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_8_base_400ft_11-13.mxd

MONTEREY COUNTY WATER RESOURCES AGENCY

PROTECTIVE ELEVATIONS TO CONTROL SEA WATER INTRUSION IN THE SALINAS VALLEY, CA



PROTECTIVE ELEVATIONS 180-FOOT AQUIFER

EXPLANATION

—10— Minimum Protective Elevations for the 180-Foot Aquifer, ft amsl Assumes 0.0002 (1 ft/mi) and 1938 ground water directions as per DWR (1946)

Ground Water Flow

a ____ a' Geohydrologic Cross-Section Used to Assess Protective Elevations (modified from Kennedy/Jenks, 2004)

Current Extent (2011) of Sea Water Intrusion in the 180-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

—-10— Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

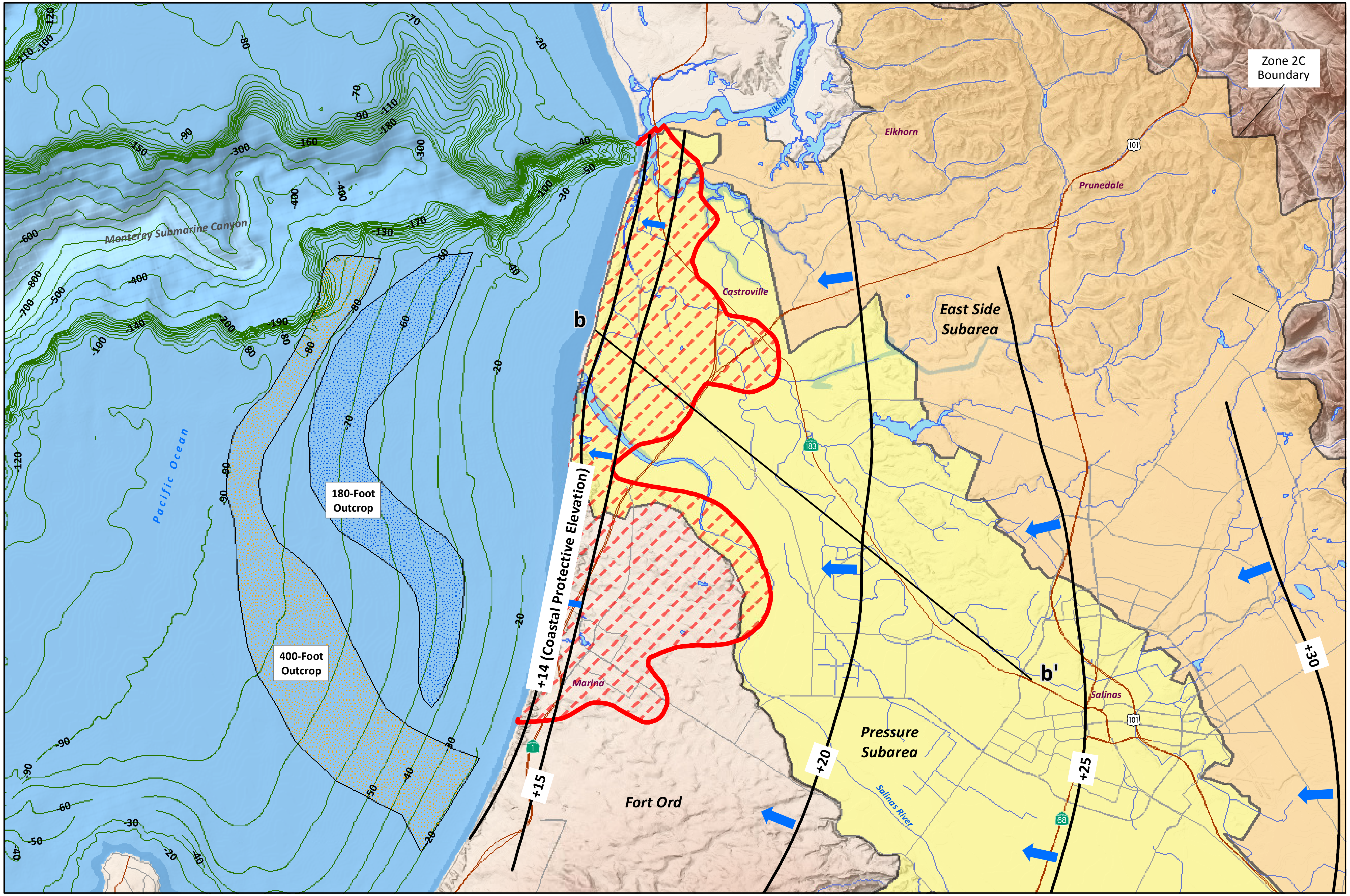
Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 9

GIS_proj/downey_brand_mont_water_rights_1-13/5_Fig_9_xsec_I-I_180ft_11-13.mxd

PROTECTIVE ELEVATIONS 400-FOOT AQUIFER



EXPLANATION

—20— Minimum Protective Elevations for the 400-Foot Aquifer, ft amsl Assumes 0.0002 (1 ft/mi) and 1938 ground water directions as per DWR (1946)

Ground Water Flow

b ___ b' Geohydrologic Cross-Section Used to Assess Protective Elevations (modified from Kennedy/Jenks, 2004)

Current Extent (2011) of Sea Water Intrusion in the 400-Foot Aquifer (>500 mg/L Chloride) (MCWRA, 2012)

Offshore Aquifer Outcrop (Green, 1970; DWR, 1973)

180-Foot Aquifer

400-Foot Aquifer

—-10— Elevation of Sea Floor, meters (Wong, F.L. and Eittreim, S.L., 2001)

19-Nov-13

Prepared by: DWB. Map Projection: State Plane 1983, Zone IV.

NORTH

0 2 4 Miles

GEOSCIENCE
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 10

APPENDIX A

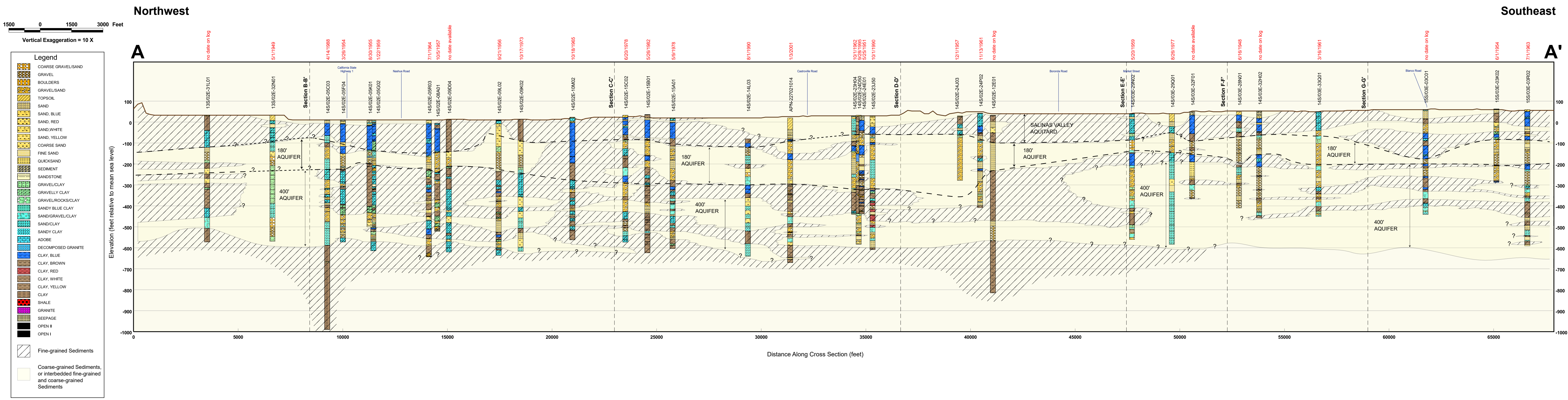
Cross-Sections Used to Delineate Base of 180-Foot and 400-Foot Aquifers

GEOSCIENCE

APPENDIX A

CROSS-SECTIONS USED TO DELINEATE BASE OF 180-FOOT AND 400-FOOT AQUIFERS

CONTENTS



Kennedy/Jenks Consultants

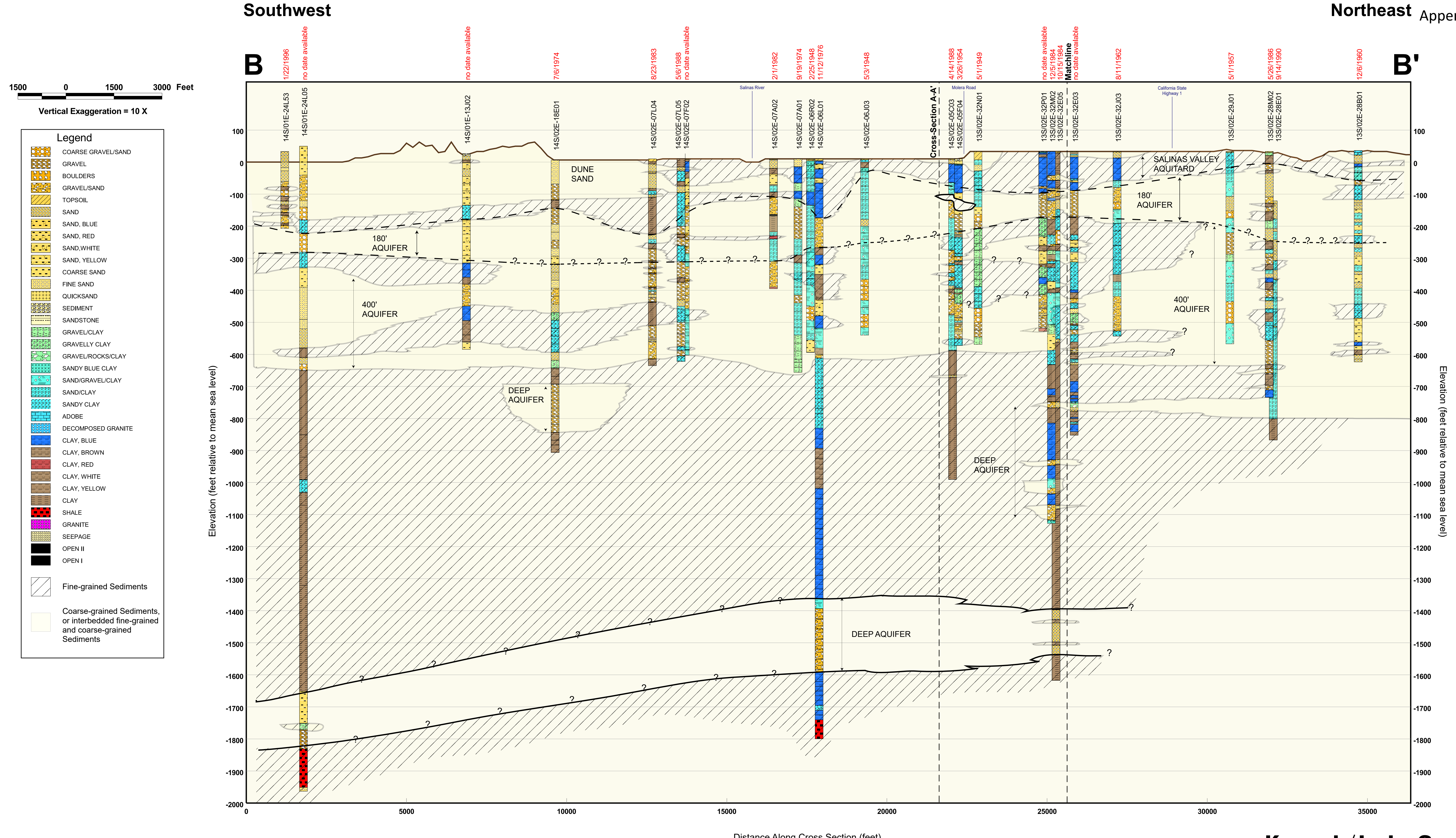
Monterey County Water Resources Agency
Salinas, California

Cross-Section A-A'

K/J 035901.00
May 2004

Figure 3

H:\mcwra_swi\Report_200405\figure_03.pdf



Kennedy/Jenks Consultants

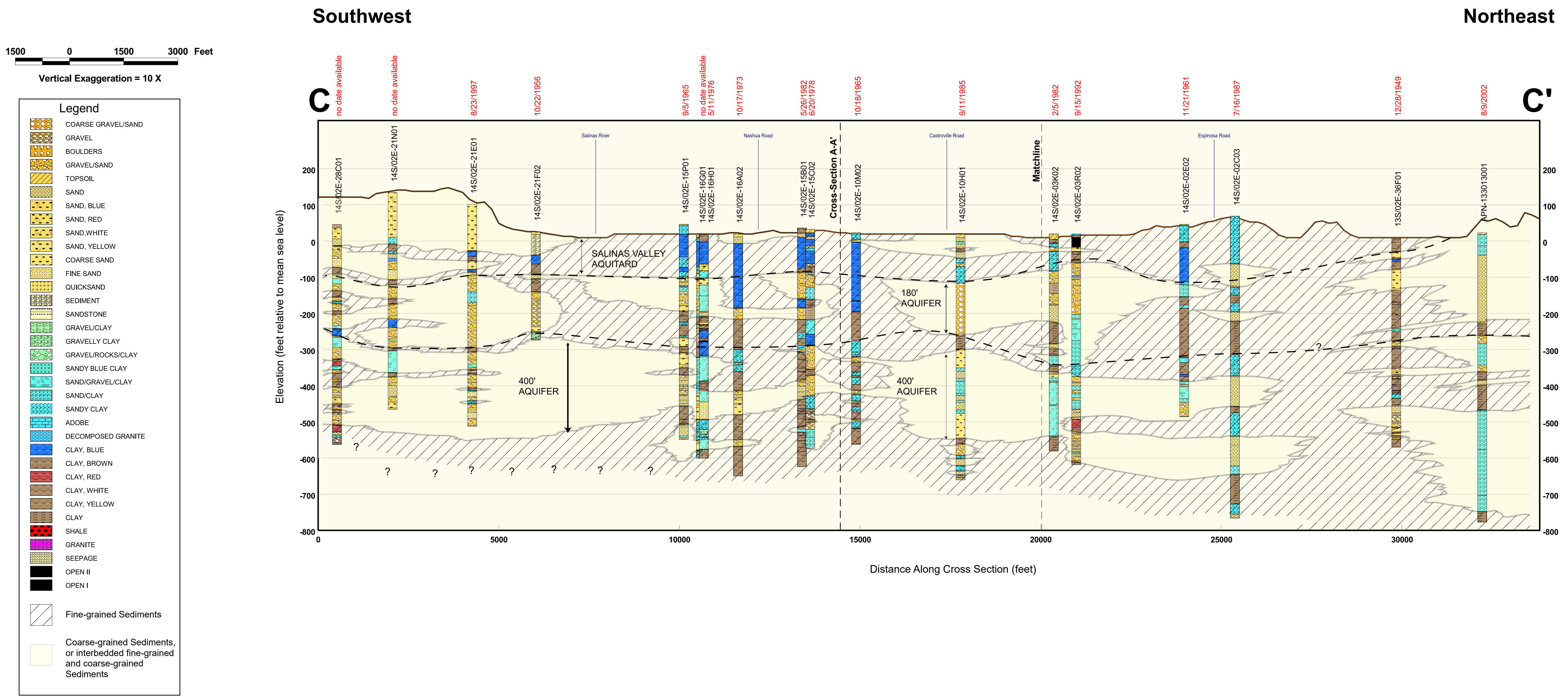
Monterey County Water Resources Agency
Salinas, California

Cross-Section B-B'

K/J 035901.00
May 2004

Figure 4

H:\mcwra_swi\Report_200405\figure_04.pdf



Kennedy/Jenks Consultants

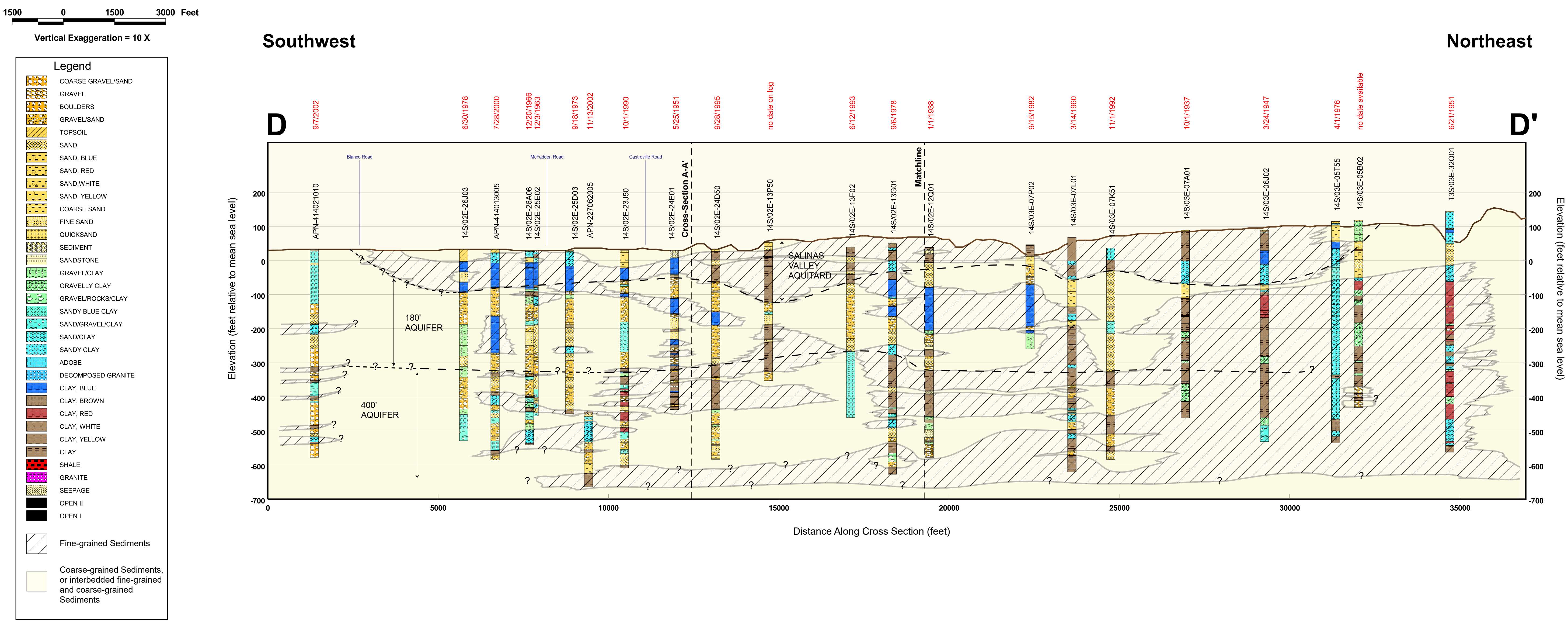
Monterey County Water Resources Agency
Salinas, California

Cross-Section C-C'

K/J 035901.00
May 2004

Figure 5

H:\mcwra_swi\Report_200405\figure_05.pdf



Kennedy/Jenks Consultants

Monterey County Water Resources Agency
Salinas, California

Cross-Section D-D'

K/J 035901.00
May 2004

Figure 6

H:\mcwra_swi\Report_200405\figure_06.pdf

GEOSCIENCE Support Services, Inc. | P (909) 451-6650 | F (909) 451-6638
620 W. Arrow Highway, Suite 2000, La Verne, CA 91750 | Mailing: P.O. Box 220, Claremont, CA 91711

HYDROGEOLOGY AND WATER SUPPLY

OF SALINAS VALLEY

A White Paper prepared by

Salinas Valley Ground Water Basin
Hydrology Conference

For
Monterey County Water Resources Agency

June 1995

TABLE OF CONTENTS

CONCLUSIONS

- No member of this panel has any substantive disagreement with the conclusions of previous reports.
- The panel reached unanimous agreement on all major issues.
- Data that are available have been useful in determining regional and local surface water and ground water relationships and quality.
- Based on all the studies completed to date, there appears to be an adequate supply of water within Salinas Valley to meet all existing and projected future requirements.
- Despite this abundance, past and present water distribution and management practices have caused seawater intrusion, declining ground water levels in the East Side Area, and nitrate contamination.
- The solution for the seawater intrusion and declining ground water levels in Salinas Valley that was recommended in 1946 is so compelling we could not refrain from recommending it.
- Some form of extraction and conveyance system should be constructed.
- More recent studies conducted by Monterey County Water Resources Agency (MCWRA) since 1946 have reaffirmed and endorsed the original concepts.
- Residents of Salinas Valley are fortunate that an in-valley conjunctive use solution is available to them.

RECOMMENDATIONS

Monterey County Water Resources Agency should:

- Complete the extraction facilities and conveyance system, similar to those that were outlined in California Department of Water Resources Bulletin 52 in 1946, that are integral components of a total project.

- Continue studies to determine the relationships between fertilizer application, irrigation practices, plant growth, movement of water past the root zone, and ground water contamination under growing conditions prevalent in Salinas Valley.

- Use these studies to develop and demonstrate improved irrigation and fertilizer management methods that farmers can adopt with confidence.

- Continue to evaluate seawater intrusion monitoring data.

- MCWRA should continue their surface water and ground water monitoring program for quantity and quality. The data should be evaluated to ensure that the information is adequate for effective management of water resources.

INTRODUCTION

Purpose and Scope

The Monterey County Water Resources Agency (MCWRA) convened a panel of 10 geologists, hydrogeologists, and engineers familiar with Salinas Valley ground water basin to attempt to reach agreement on the basic physical characteristics of the basin, and the surface and ground water flow within the basin. Agreement on the completeness and accuracy of existing data and previous hydrogeological studies was seen as an important first step in identifying and implementing a technically sound solution acceptable to the public that would stop seawater intrusion that began some 60 years ago.

Mike Armstrong, General Manager of MCWRA, instructed the panel to review and, if possible, reach consensus on the hydrogeological characteristics of the basin, define clearly the water resources problems in the basin, and determine surface water and ground water flow within the basin. We were not requested to discuss specific local projects or political and institutional aspects of the problems.

The panel met in a closed-door session in Monterey on May 24 and 25, 1995. The session was closed to the public and the press to enable the panelists to discuss and explore ideas and opinions freely without worrying about statements, questions, and hypotheses being repeated out of context.

Members of the panel believe the process worked very well. This report presents our findings, conclusions, and recommendations. We were able to achieve more than our original scope of work. There was remarkable unanimity of opinion on our understanding of the physical characteristics of the basin, the hydrologic system, the interaction between surface water and ground water, and definition of the specific ground water problems in the basin.

In summary, the facts we agreed upon point so compellingly toward an already identified *regional* solution to the Valley's ground water resources problems that the panel has included a potential solution. We have included a strong recommendation in this White Paper for implementing that regional solution.

Panel Members

The panel consisted of 9 members and 1 facilitator/editor:

Mr. Carl Hauge, California Department of Water Resources, Sacramento, facilitator/editor.

Dr. Steven Bachman, Integrated Water Technologies, Santa Barbara.

Mr. Tim Durbin, HCI Hydrologic Consultants, Davis.

Mr. Martin Feeney, Fugro West, Monterey.

Mr. Joseph Scalmanini, Luhdorff and Scalmanini, Woodland.

Mr. Jim Schaaf, Schaaf & Wheeler, San Jose (attended May 25 only).

Dr. Dennis Williams, GEOSCIENCE, Claremont.

Mr. Gus Yates, Jones & Stokes Associates, Sacramento.

Dr. Young Yoon, Montgomery Watson, Sacramento.

Mr. Matt Zidar, Monterey County Water Resources Agency, Salinas.

Previous Reports

One of the first reports published on the hydrology of Salinas Valley was California Department of Water Resources Bulletin 52, *Salinas Basin Investigation,* released in 1946. Bulletin 52 recommended construction of a project consisting of dams to provide additional recharge and yield throughout the Valley, ground water extraction facilities, and a water conveyance facility to transport some of the additional yield to the area near the coast.

Other recent reports include:

Durbin, T.J. Kapple, G.W., and Freckleton, J.R., 1978, *Two-dimensional and three-dimensional digital flow models of the Salinas Valley ground water basin, California*; U.S. Geological Survey Water-Resources Investigation 78-113, 134 p.

Leedshill-Herkenhoff, Inc., 1985, *Salinas Valley Seawater Intrusion Study.*

Montgomery Watson, 1994, *Salinas River Basin Water Resources Management Plan, Task 1.09 SalinasValley Groundwater Flow and Quality Model Report.*

Todd, D.K., Consulting Engineers, Inc., 1989, *Sources of Saline Intrusion in the 400-Foot Aquifer, Castroville Area, California.*

Yates, E.B., 1988, *Simulated Effects of Ground-Water Management Alternatives for the Salinas Valley, California,* United States Geological Survey Water Resources Investigation Report 87-4066.

PROBLEM STATEMENT

The water resources problem in Salinas Valley is not a water supply problem. It is a water distribution problem. The basin has enough surface and ground water to meet existing and projected future average annual agricultural, and municipal and industrial (M & I) water demand through the year 2030. The problem lies in managing those supplies to meet water demands at all locations in the Valley at all times.

The overall water resources problem has three principal components:

- Seawater intrusion

  Seawater intrusion occurs near the coast principally because extraction of fresh ground water in the northern part of Salinas Valley exceeds recharge in the northern part of the Valley.

  In recent decades, the annual volume of intrusion has ranged from 2,000 to 30,000 acre feet per year (afy) and has averaged 17,000 acre feet per year.

  Seawater has advanced about 6 miles inland.

  About 20,000 acres of agricultural land near the coast are underlain by one or more aquifers that contain water too salty to use for irrigation.

- Declining ground water levels in the East Side Area

  Ground water levels continue to decline in the East Side Area.

  Lower ground water levels in the East Side Area induce additional recharge from the Pressure Area and the Forebay Area but also cause conditions for potential movement of additional seawater inland into the coastal area.

- Nitrate contamination

  Nitrate has contaminated ground water to varying concentrations throughout the Valley, but the level of contamination is especially high in the East Side, Forebay, and Upper Valley Areas.

  The maximum contaminant level (MCL) for drinking water is 45 mg/l as nitrate. In 50 percent of the wells sampled throughout the Valley, nitrate exceeds 45 mg/l; in some wells nitrate has reached several hundred mg/l.

High concentrations of nitrate limit beneficial use of the ground water for potable uses and for some agricultural uses.

An additional long-range problem is the build up of salts in the basin that is occurring because there is no subsurface outflow from the basin. Although the impacts of such a condition are manifested much more slowly than other problems, there is a long-term increase in salt concentration within the aquifer system. At some time in the future, such a build up will render the aquifer system unusable for certain beneficial uses.

These water resources problems result in economic and institutional consequences primarily because of water quality standards and the loss of supply associated with violation of those standards. The severity of the economic and institutional problems is not the same for all 3 of the problems and is dependent on the specific location and the use of the water.

The variability of precipitation and runoff is an important component of water supply planning and management. Water supply issues may appear to be non-existent when the *average* annual water supply is used for planning purposes. But in dry years, which are also a part of that average, those same supply issues become critical.

DESCRIPTION OF THE BASIN

Hydrogeology

The Salinas Valley ground water basin is one hydrologic unit. Four subareas based on differences in local hydrogeology and recharge have been identified: Upper Valley Area, Forebay Area, East Side Area and Pressure Area (which includes the area near the coast). All information collected to date indicates there are no barriers to the horizontal flow between these subareas, although aquifer characteristics decrease the rate of ground water flow in certain parts of the basin (for example, from the Pressure Area to the East Side Area, and especially from the Forebay Area to the Pressure Area). Ground water can move between the East Side and Pressure Areas, and between the Forebay and Pressure Areas, the Forebay and East Side Areas, and the Upper Valley and Forebay Areas. The "boundaries" between these areas have been identified as zones of transition between different depositional environments in past millennia.

While Salinas Valley ground water basin is one hydrologic unit, the impacts of ground water use are not distributed uniformly throughout the Valley. The impacts of ground water extraction occur mostly within the local area of the extraction. The impacts diminish rapidly with distance from the extraction, and the impacts tend to be very small at large distances from the extraction.

The alluvial fill in Salinas Ground Water Basin encompasses approximately 344,000 acres. The Upper Valley and Forebay Areas are unconfined and in direct hydraulic connection with Salinas River. The Upper Valley Area covers an area of approximately 92,000 acres near the south end of Salinas Valley from Greenfield to Bradley. Primary ground water recharge to the Upper Valley Area occurs from percolation in the channel of Salinas River.

The Forebay Area from Gonzales to Greenfield, consists of approximately 87,000 acres (including Arroyo Seco Cone) of unconsolidated alluvium. Principal recharge to the Forebay Area is from percolation of water from Salinas River and Arroyo Seco Cone, and ground water outflow from the Upper Valley.

Arroyo Seco Cone is located on the west side of southern Salinas Valley and is a part of the Forebay Area. Arroyo Seco Cone receives recharge from percolation in channels of Arroyo Seco and tributaries. The Cone covers approximately 26,000 acres of the Forebay Areas. The Arroyo Seco Cone may provide some opportunity for additional recharge.

The Pressure Area covers an area of approximately 91,000 acres between Gonzales and Monterey Bay. The Pressure Area is composed primarily of confined and semi-confined aquifers separated by clay layers (aquitards) that limit the amount of vertical recharge. Three primary water bearing strata have been identified in the Pressure Zone: the 180 Foot Aquifer, the 400 Foot Aquifer, and the Deep Zone. These aquifers are separated by aquitards, although some vertical recharge occurs locally where the aquitards are thin or missing. The uppermost aquitards allow some limited recharge from Salinas River directly to the 180-foot aquifer in the area near Spreckels. The areas of thin or missing aquitards also allow some interconnection between the shallow (180 foot) and deeper (400 foot) aquifers.

The exact nature of the connection between the Deep Zone and the ocean is unknown. Seawater intrusion has not been detected in Deep Zone wells, but there is no evidence indicating that the Deep Zone is not connected to the ocean. Lacking this evidence, it must be assumed that the deep zone, like the 180-foot and 400-foot aquifers above it, is connected to the ocean and vulnerable to seawater intrusion if ground water levels fall below sea level. Similarly, the aquitards between the 400-foot and the Deep Zone are subject to leakage of degraded water downward to the Deep Zone as the water level is lowered.

The Deep Zone is currently undefined both geologically and areally. In some locations, it is considered to be Purisima Formation, in others, lower Paso Robles Formation. Some recent evidence suggests that it may be Santa Margarita Formation. Water levels in Deep Zone wells have fallen approximately 60 feet since the late 1970s and are now substantially below sea level. Total extraction over this period of time has averaged less than 5,000 acre-feet per year. Water quality in the Deep Zone is unsuitable for agriculture because of extremely high sodium-adsorption ratios (SAR).

The East Side Area consists of 74,000 acres and contains unconfined and semiconfined aquifers in the northern portion of the Basin that historically received recharge from percolation from stream channels on the west slope of the Gabilan Range. As a result of extraction in excess of recharge, the decline in ground water level in the East Side Area has induced subsurface recharge from the Pressure Area, as well as from Salinas River and the Forebay Area. This inflow is now a larger source of recharge than the stream channels coming from the Gabilan Range.

Sources of Recharge

Ground water recharge in Salinas Valley is principally from infiltration from Salinas River, Arroyo Seco Cone, and, to a much lesser extent, from deep percolation of rainfall. Minor amounts are derived from infiltration from small streams and inflow from bedrock areas adjoining the basin. Deep percolation of applied irrigation water is the second largest component of the ground water budget, but because it represents recirculation of existing ground water rather than an inflow of "new" water, it is not considered a source of recharge for this discussion. Seawater intrusion is another source of inflow to the basin, but because it is not usable fresh water it is also excluded as a source of recharge for this discussion.

Infiltration from Salinas River and deep percolation of rainfall would occur under natural conditions, but both are increased by present water use patterns in the Valley. Ground water extraction increases the amount of infiltration from the river upstream of Salinas. Irrigation increases the amount of rainfall that percolates past the root zone by increasing antecedent soil moisture at the beginning of the rainy season. The low permeability of the Salinas Valley aquitard in the Pressure Area decreases but does not altogether eliminate deep percolation of rainfall and irrigation return flow directly to the 180-foot aquifer in the Pressure Area.

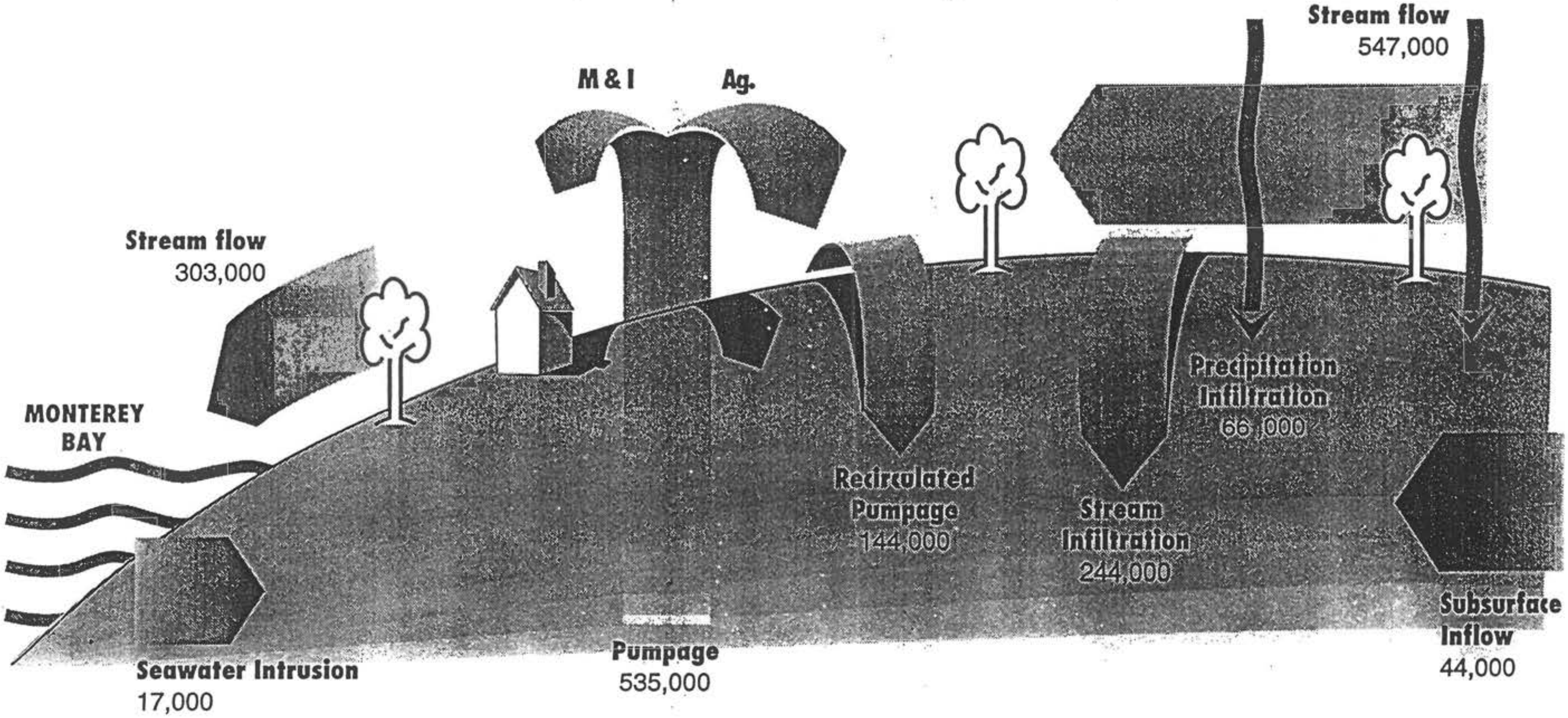
Figure 1 shows estimates of the average annual amounts of recharge derived from each source during 1970-1992 for the entire Valley. Average annual recharge, including irrigation return flow and seawater intrusion, totals 514,000 afy.

The estimates of items in the water budget are derived from a combination of direct measurement and extrapolation using three different and independently designed ground water models. It is important to recognize that the models include all available measured data and that all three of the modeling efforts completed to date have resulted in very similar estimates of the average annual basin-wide water budget. Our confidence in the general magnitude and proportion of flows in the budget is fairly high.

The water budget shown in Figure 1 is an average annual budget indicative of the long-term balance of components of the budget. It does not reveal the large amount of variation in annual flows in the water budget. These annual variations are an important factor in management of water resources and must be considered in any solution to water management in Salinas Valley.

The water budget indicates that ground water storage in the Valley has declined by 460,000 acre feet from 1970 to 1992, an average rate of 20,000 afy. However this decline was

Average Annual Basin-Wide Surface and Ground-Water Flows in Salinas Valley (AFY, 1970-1992 average flows)



Change in Ground Water Storage = -20,000 AFY

caused largely by the 1987 through 1992 drought.

Infiltration of water from Salinas River is relatively constant from year to year, partly because river flows are partially regulated by Nacimiento and San Antonio reservoirs and partly because ground water extraction--which induces a substantial amount of infiltration from the river--also remains fairly constant. In contrast, rainfall recharge is much more variable, with little, if any, recharge occurring in below-average rainfall years and large amounts occurring in wet years.

In the Upper Valley and Forebay Areas recharge from Salinas River is a rapid process, so that the effects of dry years on ground water levels are rapidly reversed in subsequent normal and wet years. After declining somewhat during the 1976-1977 and 1986-1992 droughts, water levels in the Upper Valley and Forebay Areas recovered fully within 1 to 2 years following the resumption of normal streamflow, including reservoir releases. This demonstrates the feasibility of conjunctively using ground water storage capacity in those areas to increase overall system yield.

BASIN MANAGEMENT

Seawater Intrusion

Analysis of water samples from wells in the Pressure Area has indicated that seawater has been intruding the aquifers for the last 60 or so years. The intrusion has moved progressively landward within the 180-foot and 400-foot aquifers during this time. To date, there has been no observed intrusion in the Deep Zone. The intrusion has moved as much as 6 miles inland in the 180-foot aquifer and 2 miles inland in the 400-foot aquifer, rendering wells in the intruded area unusable and decreasing usable basin storage. Between 1970 and 1992, the annual decrease in usable basin storage for ground water because of seawater intrusion has amounted to an average of 17,000 acre feet per year. While the average is 17,000 acre feet per year, it has varied from 2,000 acre feet per year to 30,000 acre feet per year. The cumulative total of seawater intrusion during the period 1970 to 1992 is about 374,000 acre feet.

Seawater intrudes coastal aquifers when ground water levels in the aquifers in contact with seawater decline below sea level. When this occurs, the normal gradient that produces ground water discharge into Monterey Bay is reversed. This reversal of ground water gradient in the Pressure Area resulted from extraction of ground water in excess of recharge in that Area. Seawater has intruded the aquifer in response to the reversed gradient that was caused by lowered ground water levels.

This saline water can move both horizontally within the aquifer or vertically through breaches in the various aquitards or through improperly constructed wells, wells that were abandoned but not destroyed, or through failed well casings. Most of the salinity is caused by intrusion of seawater through the offshore outcrops of the aquifers. An additional source of salinity may be the dewatering of salty marine clays within or between the aquifers in response to the lowered pressure levels in the aquifer system.

If the intrusion of seawater is left unchecked, seawater will continue to advance inland, eventually contaminating the East Side and Pressure Areas as far inland as Salinas. This will degrade the water supply of additional agricultural areas and will also degrade municipal drinking water supplies.

The only effective solution to controlling seawater intrusion in Salinas Basin is the re-establishment of higher ground water levels by relieving pumping stresses in the coastal portion of the aquifer. This can most efficiently be achieved by the cessation of pumping and the delivery of an alternative source of water to this area. This solution will allow recovery of water levels in the aquifer, thereby halting the advance of seawater intrusion and restoring normal aquifer pressures. The re-establishment of these conditions will also control the other possible sources of saline degradation such as the dewatering of marine clays and interaquifer leakage.

If a solution other than the delivery of water to the coastal area is to be considered, additional information regarding the components of the saline intrusion may be advisable.

Overdraft

In general, the term overdraft has been used to describe conditions where extraction from a ground water basin exceeds the perennial yield over a period of time, resulting in undesirable conditions. Undesirable conditions may include subsidence, seawater or other saline water intrusion, lower ground water level, and depletion of the supply. Perennial yield is sometimes called the safe yield or the sustained yield of the basin.

In Salinas Valley, the undesirable conditions lowered ground water levels and seawater intrusion. The conditions are the result of:

a) the physical characteristics of ground water occurrence in the Valley,

b) physical connection between the aquifers and seawater,

c) areal distribution of extraction from the aquifer system, and

d) water use practices.

These conditions require that management of ground water in different parts of the Valley recognize local hydrogeologic issues specific to each area.

There is a difference between total ground water in storage and usable ground water storage. The **total** storage of ground water in Salinas Valley is in the millions of acre feet. The **usable** storage is only a portion of the total volume in storage because all of the ground water is not available for extraction without causing some of the undesirable impacts that were listed above. Usable storage can be greatly influenced by the distribution of extraction and recharge facilities, water management practices, and physical facilities for storage and distribution of surface water and ground water.

Valley-wide, the ground water basin is only slightly out of balance because total inflow to the aquifer system is less than total outflow. Fresh water inflow consists of recharge from precipitation, streamflow, and recirculated irrigation water. Outflow consists of ground water extraction, which totals 20,000 afy more than total fresh water inflow.

Seawater is another source of inflow because of the lowering of ground water levels near the coast. The high chloride content, however, makes this water unusable. The average seawater intrusion totals about 17,000 afy. Thus, the Valley-wide water budget shows an average fresh water deficit of 37,000 afy.

In addition to the overdraft in the East Side Area and seawater intrusion in the Pressure Area, 2 other factors exacerbate the ground water supply problem in the Valley. First, nitrate concentrations in ground water are increasing in many areas of the Valley. Second, the basin is hydraulically closed to subsurface outflow, leading to long-term salt accumulation.

The undesirable conditions in the Valley include: seawater intrusion near the coast, decreasing ground water in storage in the East Side Area, nitrate increases in the Forebay and Upper Valley Area, and the salt build-up caused because the Valley is hydraulically closed. These conditions are occurring despite the fact that an essentially full aquifer system has existed under the major portion of the Valley.

The solution to these problems lies in focused relief of the pumping stresses. Such relief could include reduced local extraction in the areas where intrusion and declining water levels are occurring, development of a supplemental water supply to replace the reduced extraction, while maintaining current beneficial uses.

Nitrate

Nitrate contamination of ground water poses a significant threat to the beneficial use of ground water for drinking water and for some agricultural water uses. Nitrate concentrations exceed drinking water standards in many parts of the basin. The principal source of nitrates to ground water is almost certainly excess fertilizer that is leached by rainfall and applied irrigation water. Nitrates also originate from animal and human waste. The contribution of nitrate from various sources has been estimated at 90 percent from agriculture and 10 percent from urban sources. Contamination by nitrate has been observed in the unconfined aquifer and in some locations in the 180-foot aquifer of the Pressure Area.

Nitrate contamination can best be controlled by integrated on-farm fertilizer and water management practices. Such practices may require the voluntary implementation of improved water and fertilizer management by growers, possibly with incentives from MCWRA.

Water Conservation

There are probably some water supply benefits that can be achieved by implementing agricultural and urban water conservation measures. In agriculture, the potential savings would be achieved by decreasing direct evaporative losses during irrigation and by minimizing outflow of irrigation return flow from coastal areas to Monterey Bay. The potential for agricultural conservation of irrigation water is closely linked with interactions in the plant root zone, crop yield, and salt build-up. Any attempt to improve irrigation efficiency must evaluate each of these factors.

Water conservation by itself would not be sufficient to solve the problems of seawater intrusion near the coast and overdraft in the East Side Area.

PROBLEM SOLUTION

Seawater Intrusion and Overdraft

The only reasonable and effective solution for controlling seawater intrusion and overdraft in Salinas Valley is re-establishment of higher ground water levels by relieving pumping stresses in the aquifers in the Pressure and East Side Areas. The 2 alternatives for relieving pumping stresses are either 1) fallow land in the Pressure and East Side Areas, or 2) deliver an alternate supply of water to replace the reduced pumpage. If present agricultural and urban beneficial uses of water are to continue, the obvious solution is some sort of program to deliver water in lieu of ground water extraction. The Castroville Seawater Intrusion Project is a step in this direction, but it will not provide enough water to replace current extraction sufficiently to halt seawater intrusion.

Two approaches could be used to relieve overdraft in the East Side Area. One approach would be to allow water levels to continue declining. They would eventually stabilize near a level low enough to induce increased inflow from the Forebay and Pressure Areas at a rate sufficient to balance ground water extractions. This approach would result in high ground water extraction costs for the indefinite future and continued seawater intrusion in the Pressure Area.

An alternative approach would be to deliver in-lieu water to the East Side Area by means of a surface conveyance facility. This approach would decrease local ground water extraction costs and avoid the intrusion risk but would incur construction and pumping costs for the surface water facility.

The water-supply problem in Salinas Valley is the result of a water distribution problem. The water supply in Salinas Valley is the streamflow runoff from Salinas River watershed and the deep infiltration of precipitation on the Salinas Valley floor. However, a substantial part of this water supply is not captured at present and discharges to Monterey Bay from Salinas River. This discharge occurs mostly during storm periods, and the largest part of the discharge occurs during extreme flood events. The water-management solution to stop overdraft consists of facilities and management practices that use part of the discharge to Monterey Bay from Salinas River, while providing protection for instream uses in the River and in wetlands.

Valley-wide water management in Salinas Valley could best be accomplished by the conjunctive use of surface water and ground water storage. Storage could be used to retain some storm runoff from Salinas Valley watershed and the stored water could be made available for beneficial use within Salinas Valley. At present, runoff is stored in San Antonio and Nacimiento Reservoirs and within the ground water basin, but the current use of ground water storage is not adequate to resolve the problems of seawater intrusion into the Pressure Area and water-level declines within the East Side Area. More intensive management is required to address such conjunctive operation of surface water and ground water storage.

The need for conjunctive operation of surface water and ground water storage was recognized as early as 1946. In 1946, the California Department of Water Resources published a report on Salinas Valley that described the occurrence of seawater intrusion and declining ground water levels. The report recommended a project to eliminate these problems that included development of surface water and ground water storage. Surface water storage was to be accomplished by the construction of dams on tributaries to Salinas River, and ground water storage was to be accomplished by ground water transfers from the Forebay Area to the Pressure Area and East side Area. The Department recommended transfer facilities that included wells in the Forebay Area, conveyance facilities from the Forebay Area to the Pressure and East Side Areas, and distribution facilities within the Pressure and East Side Areas.

In such a conjunctive operation, the increased extraction in the Forebay Area and conveyance of water to the Pressure and East Side Areas would vacate ground water storage in the Forebay Area. This empty storage space would be refilled by additional infiltration from Salinas River. This mode of operation would effectively capture some of the water that presently flows to the ocean and would make it available for conveyance to the Pressure and East Side areas. The well-documented rapid recovery of ground water levels in the Forebay and Upper Valley Areas following recent drought years demonstrates the physical feasibility of this type of conjunctive use.

Part of the recommended facilities for surface water and ground water storage have been completed by the construction of the dams for SanAntonio and Nacimiento reservoirs, but the facilities for the effective use of ground water storage have not been completed. The operation of San Antonio and Nacimiento reservoirs has produced benefits to salinas Valley, but the ultimate benefits that would result from the construction and operation of transfer facilities have not been realized.

The panel concluded that the facilities recommended in 1946 by the California Department of Water Resources should be completed immediately. The Department recommended both dams and transfer facilities. Since that time, additional studies conducted by MCWRA have served to reaffirm and validate the original recommendations.

The dams that were recommended have been constructed, but the companion transfer facilities have not been constructed. The result of partially completing the project has been an uneven distribution of benefits throughout the Valley. The Forebay Area and Upper Valley Areas have enjoyed relatively large benefits from San Antonio and Nacimiento reservoirs that would have been shared equally with the Pressure and East Side Areas if the intended transfer facilities had been built. In the absence of the transfer facilities, seawater intrusion into the Pressure Area and water-level declines within the East Side Area have not been mitigated.

Instead, within the Forebay Area ground water levels are 20 to 30 feet higher than would have occurred without the dams. The Upper Valley Area has also benefited from somewhat higher ground water levels, and has used the yield of the 2 reservoirs to significantly increase the amount of irrigated land in this Area. Benefits have accrued also to the Pressure Area where seawater intrusion is 30 percent less than would have occurred. Benefits to the Pressure and East Side Areas have been relatively small

When Nacimiento and San Antonio dams were built, the effect of the additional water on seawater intrusion could not be predicted, and a "wait and see" attitude was adopted. Since the 2 dams have been operating, it has become clear that the Forebay Area has benefitted from essentially "full" ground water storage, but the ground water flow into the Pressure and East Side Areas has not been sufficient to stop the seawater intrusion and overdraft in these 2 areas. The remaining components of the solution proposed originally, an overland transfer of water directly to the intruded and overdrafted areas, are necessary to solve those problems.

The California Department of Water Resources recommended an effective plan for water-supply management within the Salinas Valley. That plan has been partly implemented. We recommend in the strongest terms that the transfer component be implemented immediately. Transfer of ground water from the Forebay Area to the Pressure and East Side Areas is the only feasible approach to eliminating seawater intrusion into the Pressure Area and water-level declines within the East Side Area. As recommended by the Department and others, transfers would be accomplished by extraction within the Forebay Area, conveyance of the extracted ground water to the Pressure Area, and distribution of water within the Pressure and East Side Areas.

The transfer facilities would produce minor water level declines within the Forebay Area. However, studies estimate that the solution can be accomplished by limiting the average decline to about 5 feet, and maximum localized decline to about 20 feet. The Forebay Area has enjoyed an average water-level rise of 25 feet due to operation of San Antonio and Nacimiento reservoirs. With transfer facilities, the average annual water-level rise, relative to pre-project conditions within the Forebay Area, would still be about 20 feet, seawater intrusion into the Pressure Area would be eliminated or severely curtailed, and water-level declines would be stopped within the East Side Area. With transfers, benefits would be distributed more uniformly throughout the Valley. Without transfers, the benefits would continue to be weighted toward the Forebay and Upper Valley Areas.

Nitrate

MCWRA knows enough about the nitrate problem to recommend initial steps to manage it. However, additional study is needed to understand the complex interrelationships of crop, irrigation, fertilizer, and soil management under conditions prevalent in Salinas Valley. Additional research into the plant-water-soil-nutrient relationships on specific soils in Salinas Valley will be required to maintain an acceptable salt balance and acceptable crop yields.

Critical information is not available to encourage growers to adopt best management practices for the mitigation of nitrate contamination of ground water. An intensive program must be undertaken by MCWRA to provide information on the effectiveness of practices for the management of soils for water conservation and the mitigation of nitrate contamination. Information is available to make initial steps toward developing best management practices, but additional information is critical to the long-term success of improved soils management.

Water Conservation

Some water supply benefits can probably be achieved by implementing agricultural and urban water conservation measures. In agriculture, the potential savings would be achieved by decreasing direct evaporative loss during irrigation and minimizing outflow of irrigation return flow from coastal areas to Monterey Bay, while maintaining a favorable salt balance.

On-farm management of irrigation needs to be done jointly with management of fertilizer application and salt leaching requirements. We recommend that MCWRA undertake studies to further understand these interrelated issues and develop best management practices tailored to growing conditions in Salinas Valley.

However, water conservation by itself would not be sufficient to solve the problems of seawater intrusion near the coast and overdraft in the East Side Area.

LAST WORD

The solution to the water resource problems within the Salinas Valley has been known since at least 1946. The solution that was proposed then by the California Department of Water Resources recognized that sufficient supplemental water could be developed within the basin. That proposal also recognized the need to transfer water from the Forebay Area to the Pressure and East Side Areas. The solution proposed in 1946 remains the best solution even today.

We urge the MCWRA to focus its attention on the completion of the original plan by the construction and operation of water transfer facilities. The MCWRA should avoid diverting its attention to suggested alternatives that are less viable economically or less effective technically. These less viable and less effective alternatives would <u>not</u> provide the same benefits as the original plan, would be more expensive, and the projected price of water would be significantly higher for all parties.

The panel believes strongly that Salinas Valley is fortunate that an in-Valley solution is available. We urge the Salinas Valley community to support the MCWRA in this effort to distribute the available water supplies for more efficient water management and lasting benefits for all residents of the Valley.

October 15, 2021

Salinas Valley Basin GSA
P.O. Box 1350
Carmel Valley, CA 93924

Submitted via web: https://form.jotform.com/201537036733047

Re: Public Comment Letter for the Langley Aquifer Subbasin Draft GSP

Dear Donna Meyers,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Langley Aquifer Subbasin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is not sufficiently** considered.
3. Data gaps **are not sufficiently** identified and the GSP **needs additional plans** to eliminate them.
4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the Langley Aquifer Subbasin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment E	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists

Samantha Arthur
Working Lands Program Director
Audubon California

Danielle V. Dolan
Water Program Director
Local Government Commission

E.J. Remson
Senior Project Director, California Water Program
The Nature Conservancy

Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy

Heather Lukacs, Ph.D.
Director of Community Solutions
Community Water Center

Justine Massey
Policy Manager and Attorney
Community Water Center

Attachment A

Specific Comments on the Langley Aquifer Subbasin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes, groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities and Drinking Water Users

The identification of Disadvantaged Communities (DACs) and drinking water users is **incomplete**. The GSP provides information on DACs, including identification by name and location on a map (Figure 2-3), and identifying the water source for DAC members. However, the GSP fails to identify the population of each identified DAC.

The GSP provides a density map of domestic wells in the subbasin. However, the GSP fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the subbasin.

These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, and to support the development of sustainable management criteria and projects and management actions that are protective of these users.

RECOMMENDATIONS
● Include a map showing domestic well locations and average well depth across the subbasin. ● Provide the population of each identified DAC.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISW) is **insufficient**, due to lack of supporting information provided for the ISW analysis. To assess ISWs, the GSP used the Salinas Valley Integrated Hydrologic Model (SVIHM). The GSP states (p. 4-22): *"Although seepage along the ISW reaches is based on assumed channel and aquifer parameters as model inputs, the preliminary SVIHM is the best available tool to estimate ISW locations. The model construction and uncertainty are described in Chapter 6 of this GSP."* However, Chapter 6 of the GSP, the water budget chapter, presents very little information on the model. No further information in the GSP was presented providing description of the location of groundwater wells or stream gauges used in the analysis, or description of temporal (seasonal and interannual) variability of the data used to calibrate the model.

The GSP states (p. 4-22): *"The blue cells [in Figure 4-9] indicate areas where surface water is connected to groundwater for more than 50 percent of the number of months in the model period and are designated as areas of ISW. The clear cells represent areas that have interconnection less than 50 percent of the model period and require further evaluation to determine whether the SMC, discussed in Chapter 8, apply."* Note the regulations [23 CCR §351(o)] define ISW as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted". "At any point" has both a spatial and temporal component. Even short durations of interconnections of groundwater and surface water can be crucial for surface water flow and supporting environmental users of groundwater and surface water. The GSP states (p. 4-22): "Interconnection between surface water and groundwater can vary both in time and space. A seasonal analysis is included in Appendix 4A." The appendix was not included in the public draft copy of the GSP, however.

RECOMMENDATIONS

- Describe available groundwater elevation data and stream flow data in the subbasin. ISWs are best analyzed using depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought), to determine the range of depth and capture the variability in environmental conditions inherent in California's climate.

- Overlay the stream reaches shown on Figure 4-9 with depth-to-groundwater contour maps to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of groundwater wells in the subbasin used to create the contour maps.

- For the depth-to-groundwater contour maps, use the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.

- On Figure 4-9 (Locations of Interconnected Surface Water), consider any modelled stream grid cells with >0% connection to groundwater as potential ISWs until more data is available. In other words, consider any stream cell with connection to groundwater for any length of time as a potential ISW.

- Describe data gaps for the ISW analysis. Reconcile these data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**, due to a lack of comprehensive, systematic analysis of the subbasin's GDEs.

The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset) and other sources. The GSP does not discuss how the NC dataset was verified with the use of groundwater data, however. The GSP states (p. 4-26): "*The SVBGSA reviewed the NCCAG dataset and assessed each GDE's potential* *connection to groundwater by determining if the GDE was underlain by shallow groundwater that has been delineated as being part of a Bulletin 118 principal aquifer, and if depth to groundwater is less than 30 feet."* However, no further details are provided in the GSP. Based on the description provided in the GSP, it is unclear if Figure 4-10 (Groundwater Dependent Ecosystems) presents the entire NC dataset, or further analysis based on the 30 feet threshold as described in the text. Without an analysis of groundwater data to verify the NC dataset polygons, it will be difficult or impossible to adequately monitor and manage the subbasin's GDEs throughout GSP implementation.

We commend the GSA for listing the threatened and endangered species likely to depend on groundwater, as determined from several sources including the US Fish and Wildlife Service (USFWS) website, California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB), and TNC Critical Species LookBook (Table 4-1). Vegetation species present in the subbasin's potential GDEs were not included in the GSP, however.

RECOMMENDATIONS

- Develop and describe a systematic approach for analyzing the subbasin's GDEs. For example, provide a map of the NC Dataset. On the map, label polygons retained, removed, or added to/from the NC dataset (include the removal reason if polygons are not considered potential GDEs, or include the data source if polygons are added). Discuss how local groundwater data was used to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer.

- Refer to Attachment B for more information on TNC's plant rooting depth database. Deeper thresholds are necessary for plants that have reported maximum root depths that exceed the averaged 30-ft threshold, such as valley oak (*Quercus lobata*). We recommend that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to-groundwater threshold of 80 feet should be used instead of the 30-ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

- Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth-to-groundwater contours across the landscape.

- If insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons as “Potential GDEs” in the GSP until data gaps are reconciled in the monitoring network.

- Please provide a complete inventory, map, or description of fauna (e.g., birds, fish, amphibian) and flora (e.g., plants) species in the subbasin (see Attachment C of this letter for a list of freshwater species located in the Langley Subbasin).

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required[1,2] to be included in the water budget. The integration of native vegetation into the water budget is **insufficient**. The water budget includes a separate item for evapotranspiration, but based on the text it is unclear whether the values shown in the budget tables apply to riparian evapotranspiration only or contain crop evapotranspiration as well. The omission of explicit water demands for native vegetation is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions. The GSP states that managed wetlands are not present in the subbasin.

RECOMMENDATION

- Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation.

B. Engaging Stakeholders

Stakeholder Engagement during GSP development

Stakeholder engagement during GSP development is **incomplete**. SGMA’s requirement for public notice and engagement of stakeholders[3] is not fully met by the description in the Communication and Public Engagement section of the GSP (Chapter 2).

The GSA’s outreach activities include conducting interviews with DAC community leaders to identify strategies to work together during GSP planning and implementation; conducting workshops with partners on water and groundwater sustainability; identifying concerns from DACs and underrepresented communities; planning listening sessions around GSA milestones; developing a resource hub with partner organizations; identifying community allies to partner with

[1] “’Water use sector’ refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation.” [23 CCR §351(al)]

[2] “The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow.” [23 CCR §354.18]

[3] “A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin.” [23 CCR §354.10(d)(3)]

in reducing barriers to participation from DACs; and planning to convene a working group on domestic water that includes DACs and underrepresented communities. However, there is no specific pathway for feedback from DAC residents and representatives to be considered and included in the GSP and its implementation.

We note additional deficiencies with the overall stakeholder engagement process. While environmental organizations have a representative serving on the board of directors and are listed as stakeholders and as members of the GSP Advisory Committee, there is no specific outreach described that is directly targeted to environmental stakeholders during the GSP development and implementation processes.

RECOMMENDATIONS

- In the Communication and Public Engagement Plan, describe active and targeted outreach to engage environmental stakeholders during the remainder of the GSP development process and throughout the GSP implementation phase. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.

- DAC and environmental stakeholder engagement should be improved by incorporating feedback and recommendations from DAC and environmental stakeholders engaged in the GSP process.

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results[4] and establishing minimum thresholds.[5,6]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, the GSP discusses minimum thresholds impact on domestic wells (Section 8.6.2.2). The GSP states (p. 8-14): *"In the Langley Subbasin, 85% of the domestic wells will have at least 25 feet of water in them as long as groundwater elevations remain above minimum thresholds and measurable objectives. These percentages were considered reasonable despite the limitations of this analysis."* The GSP states (p. 8-8): *"The minimum thresholds for chronic lowering of groundwater levels are set to 2019 groundwater elevations, adjusted based on well-specific elevation assessments."* The GSP does not explain the rationale behind using 2019 groundwater elevation data instead of data from the period before the SGMA benchmark date of 2015.

[4] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[5] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[6] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

Section 8.6.4 defines undesirable results for the chronic lowering of groundwater level SMC. The GSP states (p. 8-20): *"The chronic lowering of groundwater levels undesirable result is: more than 15% of the groundwater elevation minimum thresholds are exceeded."* However, undesirable results should inform the development of minimum thresholds, not the other way around. The GSP should establish minimum thresholds at the representative monitoring wells that account for the specific undesirable results the GSA has determined for the subbasin. The current analysis, which only considers 41 out of 823 wells, is insufficient and does not use best available information, for example including Public Land Survey System (PLSS) section location data, as was used in the 180/400 Foot Aquifer GSP.

For degraded water quality, the GSP identifies constituents of concern (COCs) within the subbasin. The GSP states (p. 5-21): *"The SVBGSA does not have regulatory authority over groundwater quality and is not charged with improving groundwater quality in the Salinas Valley Groundwater Basin."* Table 8-4 provides a list of constituents and number of wells that must exceed regulatory standards in order to trigger minimum thresholds but fails to provide justification for how those numbers were selected. The GSP also sets measurable objectives identical to minimum thresholds; the exceedance of minimum thresholds is supposed to trigger additional actions but since minimum thresholds in this plan are identified as measurable objectives, it is unclear what action is triggered. Furthermore, the regulatory standards are not explicitly provided in the GSP.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs and drinking water users when defining undesirable results for chronic lowering of groundwater levels. For the analysis of minimum threshold impact on domestic wells, use best available information such as Public Land Survey System (PLSS) section location data.

- Establish minimum thresholds at the representative monitoring wells that account for the specific undesirable results the GSA would like to avoid. Use groundwater level data from the period before the SGMA benchmark date of 2015 for the analysis.

Degraded Water Quality

- Describe direct and indirect impacts on DACs and drinking water users when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[7]

- Set measurable objectives at lower levels than minimum thresholds (i.e., indicative of better water quality).

---

[7] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.

- Set concentration-based minimum thresholds and measurable objectives for COCs in the subbasin that are impacted by groundwater use and/or management. Ensure they align with drinking water standards[8].
- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs and drinking water users.

Groundwater Dependent Ecosystems and Interconnected Surface Waters

Sustainable management criteria for chronic lowering of groundwater levels provided in the GSP do not consider potential impacts to environmental beneficial users. The GSP neither describes nor analyzes direct or indirect impacts on environmental users of groundwater when defining undesirable results. This is problematic because without identifying potential impacts to GDEs, minimum thresholds may compromise, or even destroy, these environmental beneficial users. Since GDEs are present in the subbasin, they must be considered when developing SMC.

Sustainable management criteria for depletion of interconnected surface water are established by proxy using shallow groundwater elevations observed in 2019 near locations of interconnected surface water. To describe impacts to ecological surface water users, the GSP states (p. 8-49): *"There are no known flow prescriptions on any surface water bodies in the Subbasin. Therefore, the current level of depletion has not violated any ecological flow requirements. This is not meant to imply that depletions do not impact potential species living in or near surface water bodies in the Subbasin. However, any impacts that may be occurring have not risen to the level that triggers regulatory intervention. Therefore, the impacts from current rates of depletion on ecological surface water users is not unreasonable."* The GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the subbasin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

RECOMMENDATIONS

- When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results[9] in the subbasin. Defining undesirable results is the crucial first step before the minimum thresholds[10] can be determined.

---

[8] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

[9] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]

[10] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when minimum thresholds in the subbasin are reached[11]. The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law[6,12].

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations[13] require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.

The integration of climate change into the projected water budget is **insufficient**. The GSP does incorporate climate change into the projected water budget using DWR change factors for 2030 and 2070. However, the GSP does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for their basins. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant, therefore they should be included in groundwater planning.

We acknowledge and commend the inclusion of climate change into key inputs (e.g., precipitation, evapotranspiration, surface water flow, and sea level) of the projected water budget. However, the GSP does not calculate a sustainable yield based on the projected water budget with climate change incorporated. If the water budgets are incomplete, including the omission of extremely wet and dry scenarios, and sustainable yield is not calculated based on climate change projections, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems, DACs, and domestic well owners.

---

11 "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]

12 Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf

13 "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]

RECOMMENDATIONS

- Integrate climate change, including extremely wet and dry scenarios, into all elements of the projected water budget to form the basis for development of sustainable management criteria and projects and management actions.
- Calculate sustainable yield based on the projected water budget with climate change incorporated.
- Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of specific plans to increase the Representative Monitoring Sites (RMSs) in the monitoring network that represent shallow groundwater elevations around DACs and domestic wells in the subbasin. The monitoring network that represents water quality conditions around DACs and domestic wells in the subbasin is sufficient in terms of spatial distribution but is insufficient in terms of depth representation.

Figure 7-1 (Langley Area Representative Monitoring Network for Groundwater Levels) shows that no monitoring wells are located across portions of the subbasin near DACs and domestic wells. Beneficial users of groundwater may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network[14].

The GSP provides discussion of data gaps for GDEs and ISWs in Section 7.7 (Interconnected Surface Water Monitoring Network) of the GSP. The GSP could be improved by describing biological monitoring that could be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the subbasin.

RECOMMENDATIONS

- Provide maps that overlay monitoring well locations with the locations of DACs and domestic wells to clearly identify potentially impacted areas. Increase the number of representative monitoring sites (RMSs) in the shallow aquifer across the subbasin for the groundwater elevation and groundwater quality condition indicators. Prioritize proximity to DACs and drinking water users when identifying new RMSs.
- Describe biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the subbasin.
- Ensure groundwater elevation and water quality RMSs are tracking groundwater conditions spatially and at the correct depth for *all* beneficial users - especially DACs, domestic wells, GDEs, and ISWs. Groundwater elevation and quality RMS data gaps

[14] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

(spatial and depth) in relation to key beneficial users in the subbasin are provided in Attachment E.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient**, due to the failure to completely identify benefits or impacts of identified projects and management actions to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

The GSP states (p. 8-14): *"In the Langley Subbasin, 85% of the domestic wells will have at least 25 feet of water in them as long as groundwater elevations remain above minimum thresholds and measurable objectives."* Therefore, up to 15% of domestic wells could be impacted when water levels drop below measurable objectives, and even more could be impacted when water levels reach minimum thresholds. In Section 9.5.3 (Implementation Action D3: Dry Well Notification System), the GSP states (p. 9-46): *"The GSA could develop or support the development of a program to assist well owners (domestic or state small and local small water systems) whose wells go dry due to declining groundwater elevations."* The GSP states that the program could involve a notification system, monitoring triggered by lowered groundwater elevations, public outreach, *"...referral to assistance with short-term supply solutions, technical assistance to assess why it went dry, and/or long-term supply solutions."* No further specifics on a drinking water well impact mitigation program are provided, however.

RECOMMENDATIONS

- For DACs and domestic well owners, provide specific plans for implementation of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.

- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSA plans to mitigate such impacts.

- Recharge ponds, reservoirs, and facilities for managed stormwater recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document"[15].

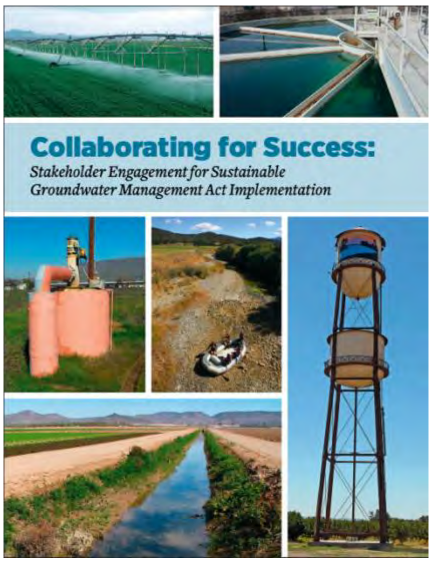
- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

[15] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

Stakeholder Engagement and Outreach



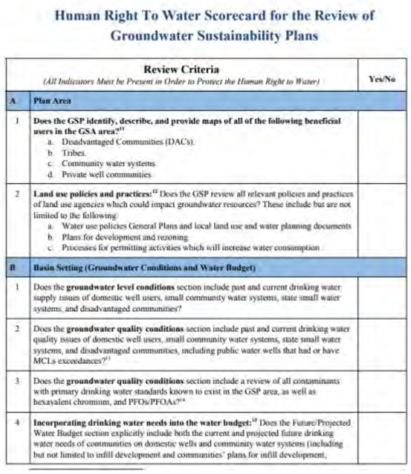
Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.

- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.

- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

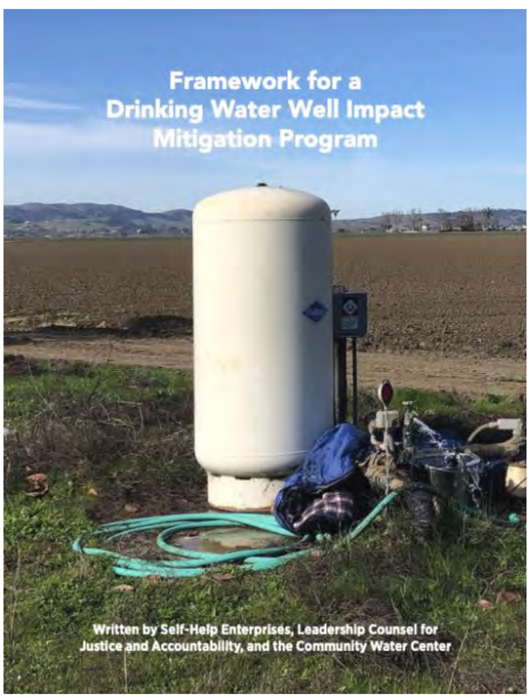


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	**Yes/No**
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development.	

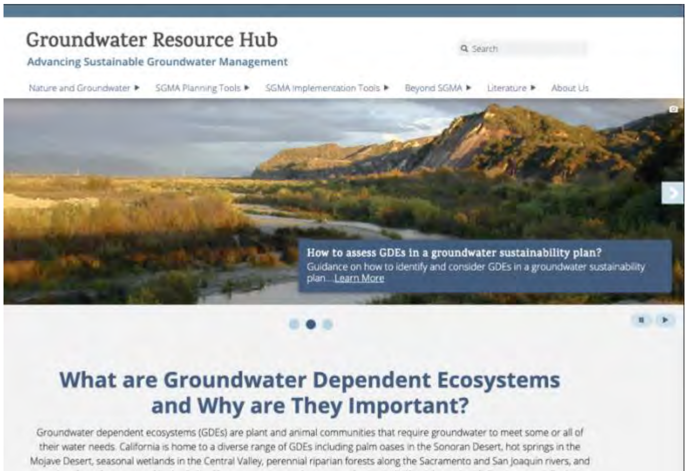
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



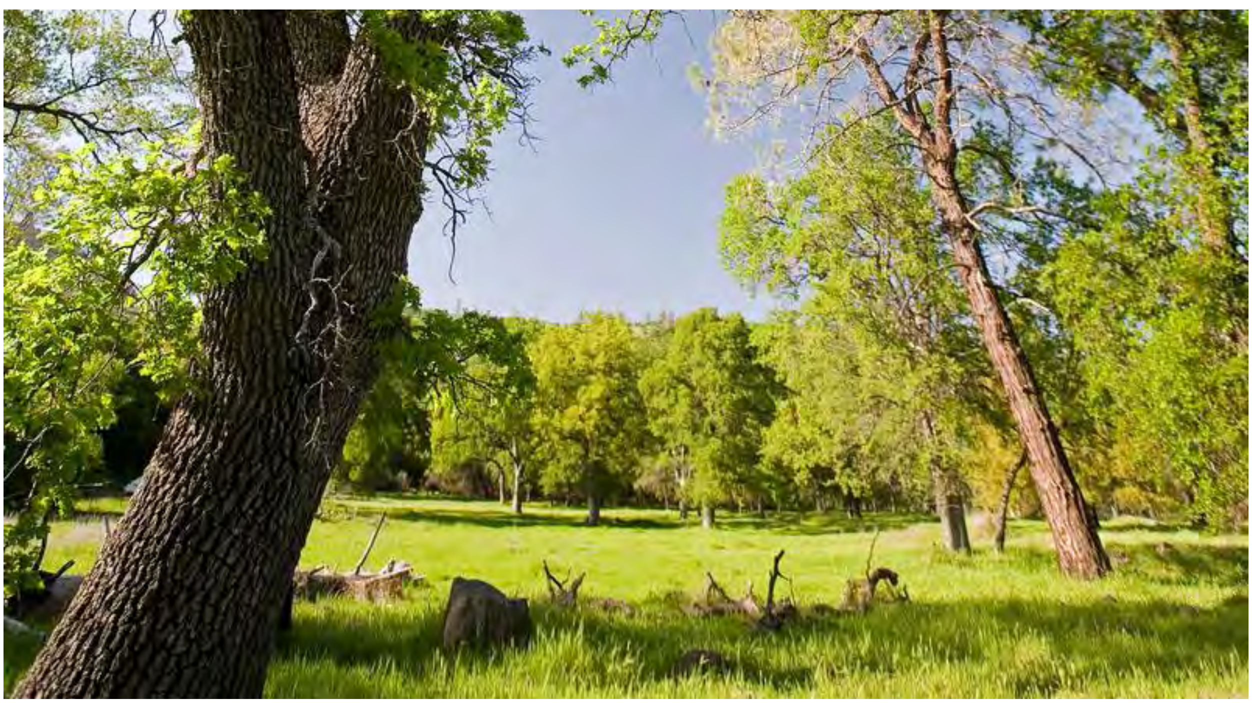
The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

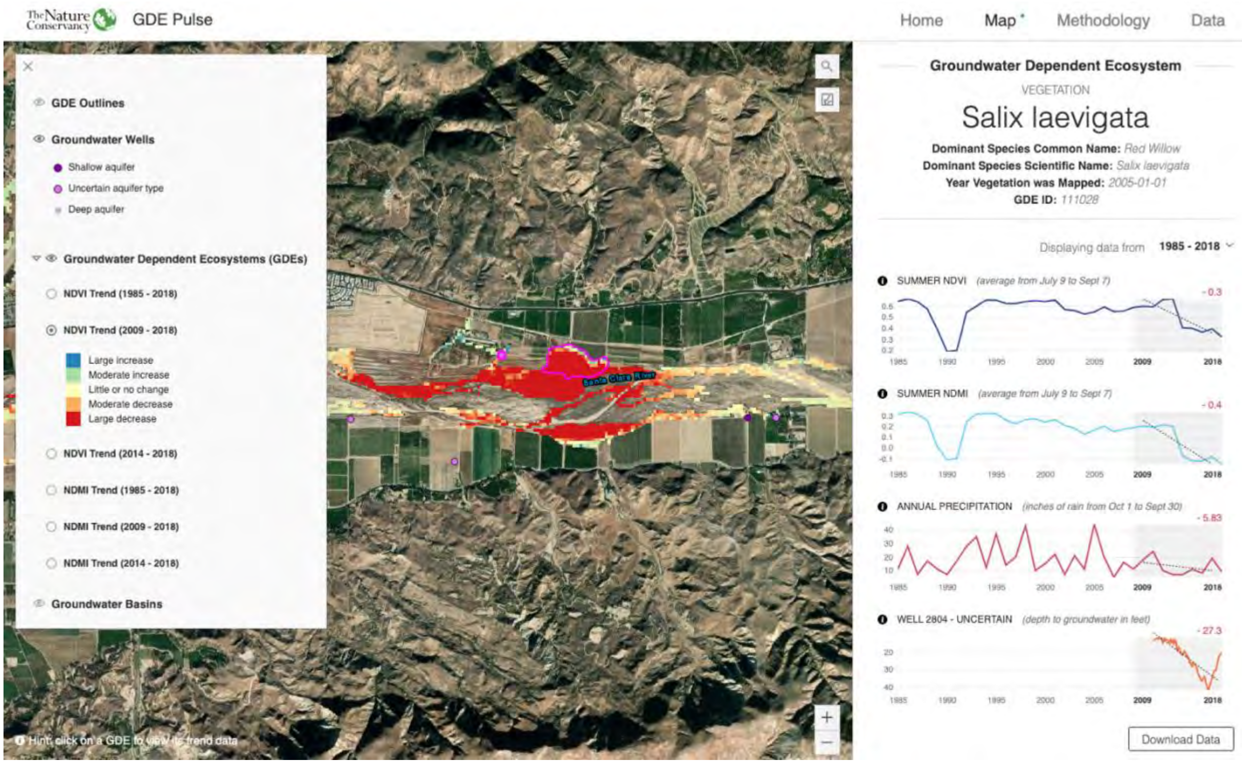
How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

---

[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

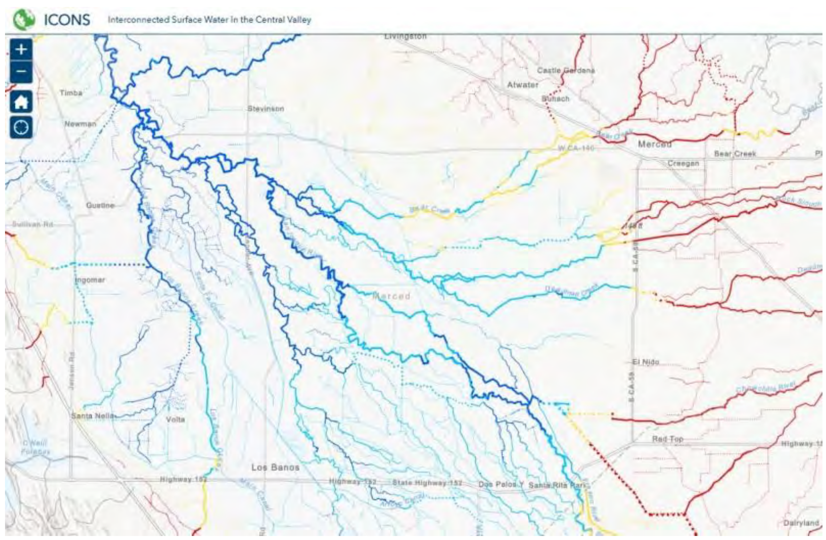
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



ICONS maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the Langley Area Basin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the Langley Area Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	State	Other
BIRDS				
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Anas cyanoptera	Cinnamon Teal			
Anas discors	Blue-winged Teal			
Anas platyrhynchos	Mallard			
Anser albifrons	Greater White-fronted Goose			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya affinis	Lesser Scaup			
Aythya valisineria	Canvasback		Special	
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Chen caerulescens	Snow Goose			
Egretta thula	Snowy Egret			
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Phalacrocorax auritus	Double-crested Cormorant			
Podilymbus podiceps	Pied-billed Grebe			

[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
FISH				
Oncorhynchus mykiss - SCCC	South Central California coast steelhead	Threatened	Special Concern	Vulnerable - Moyle 2013
HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Taricha torosa	Coast Range Newt		Special Concern	ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
Anaxyrus boreas halophilus	California Toad			ARSSC
Pseudacris regilla	Northern Pacific Chorus Frog			
INSECTS & OTHER INVERTS				
Pantala flavescens	Wandering Glider			
Plathemis lydia	Common Whitetail			
MAMMALS				
Lontra canadensis canadensis	North American River Otter			Not on any status lists
PLANTS				
Carex harfordii	Harford's Sedge			
Cotula coronopifolia	NA			
Euthamia occidentalis	Western Fragrant Goldenrod			
Hypericum anagalloides	Tinker's-penny			
Perideridia gairdneri gairdneri	Gairdner's Yampah		Special	CRPR - 4.2
Populus trichocarpa	NA			Not on any status lists
Psilocarphus tenellus	NA			

Salix laevigata	Polished Willow			
Salix lasiolepis lasiolepis	Arroyo Willow			

Attachment D

July 2019

IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

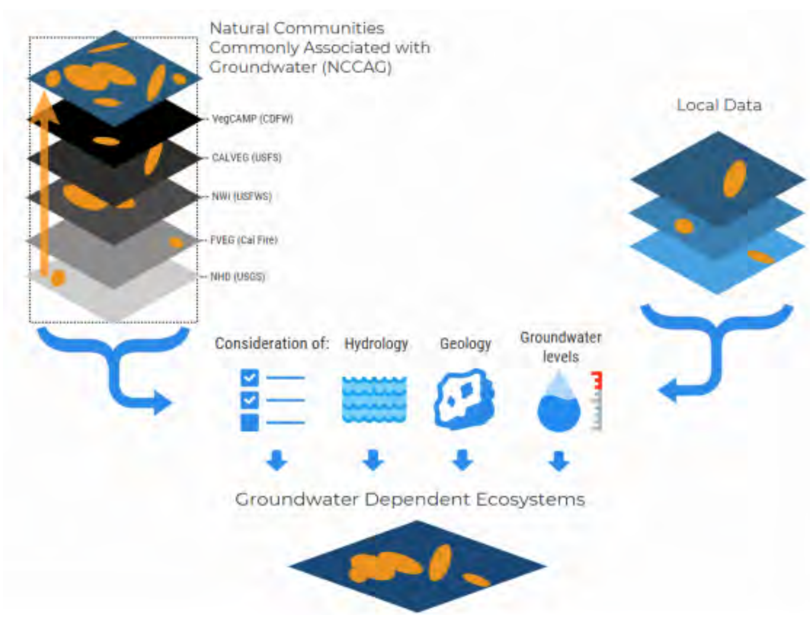


Figure 1. Considerations for GDE identification.
Source: DWR[2]

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/
[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf
[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/
[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

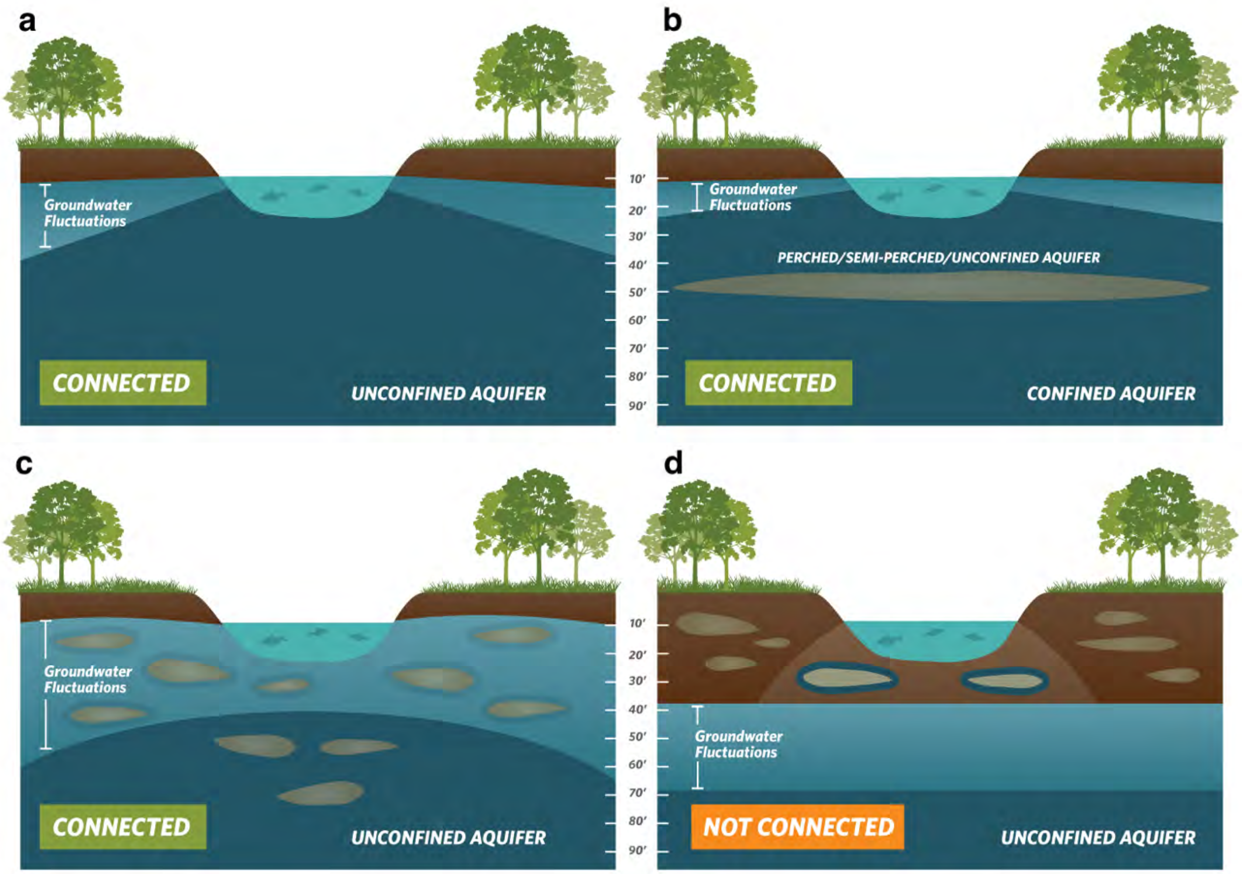


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

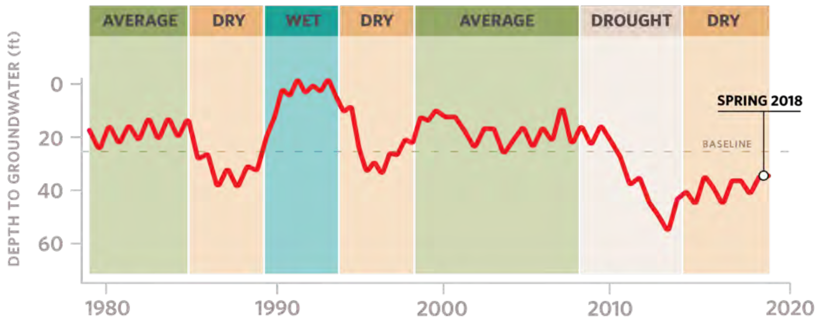


Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

---

[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

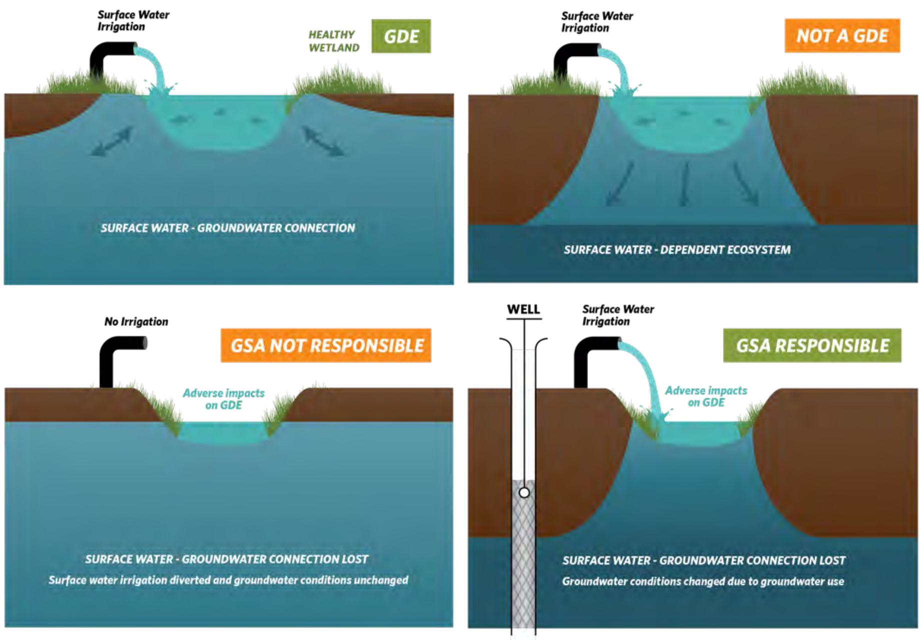


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

---

[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

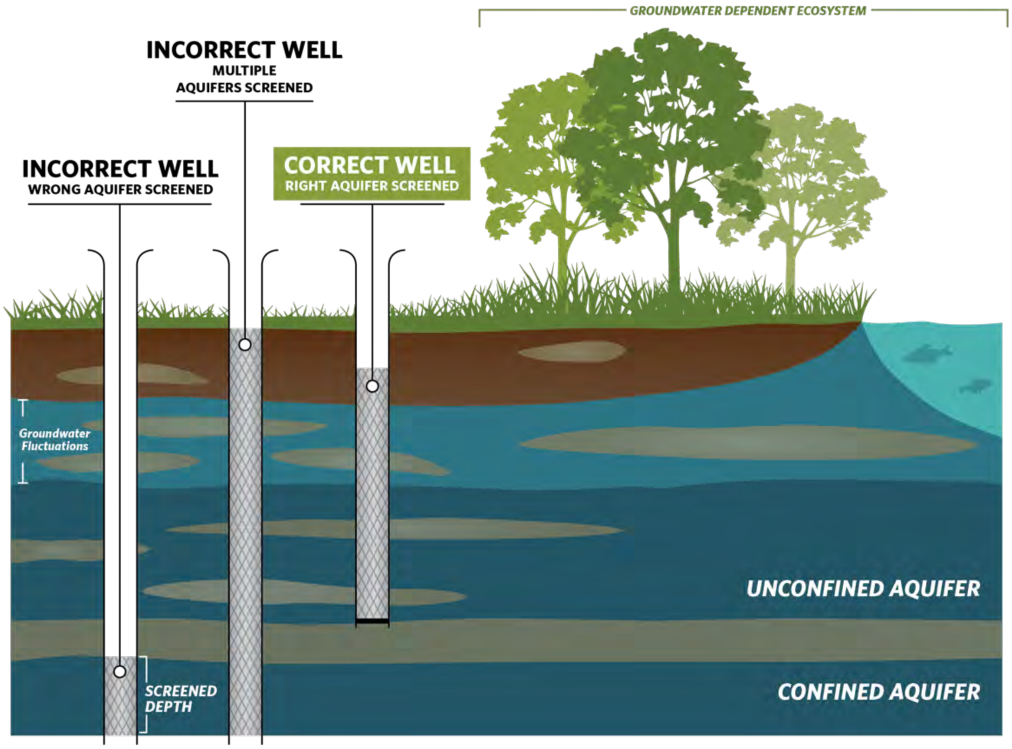


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

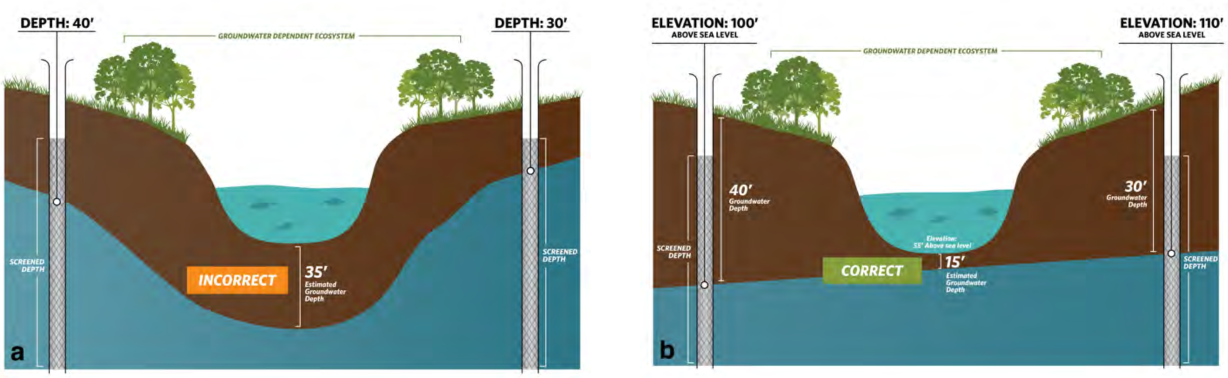


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

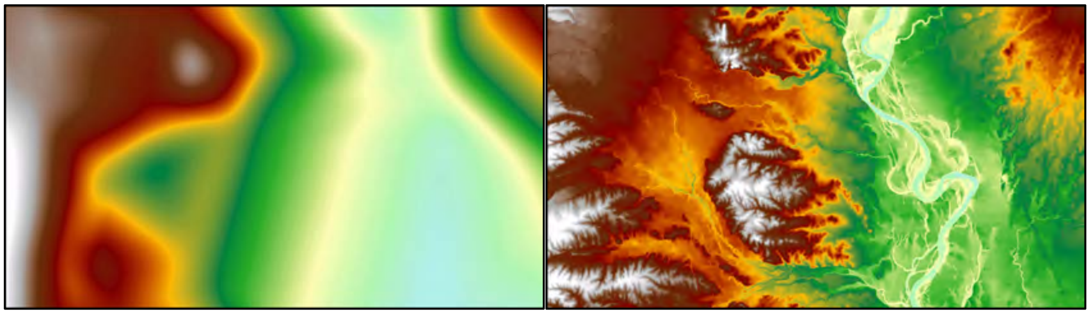


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

Maps of representative monitoring sites in relation to key beneficial users

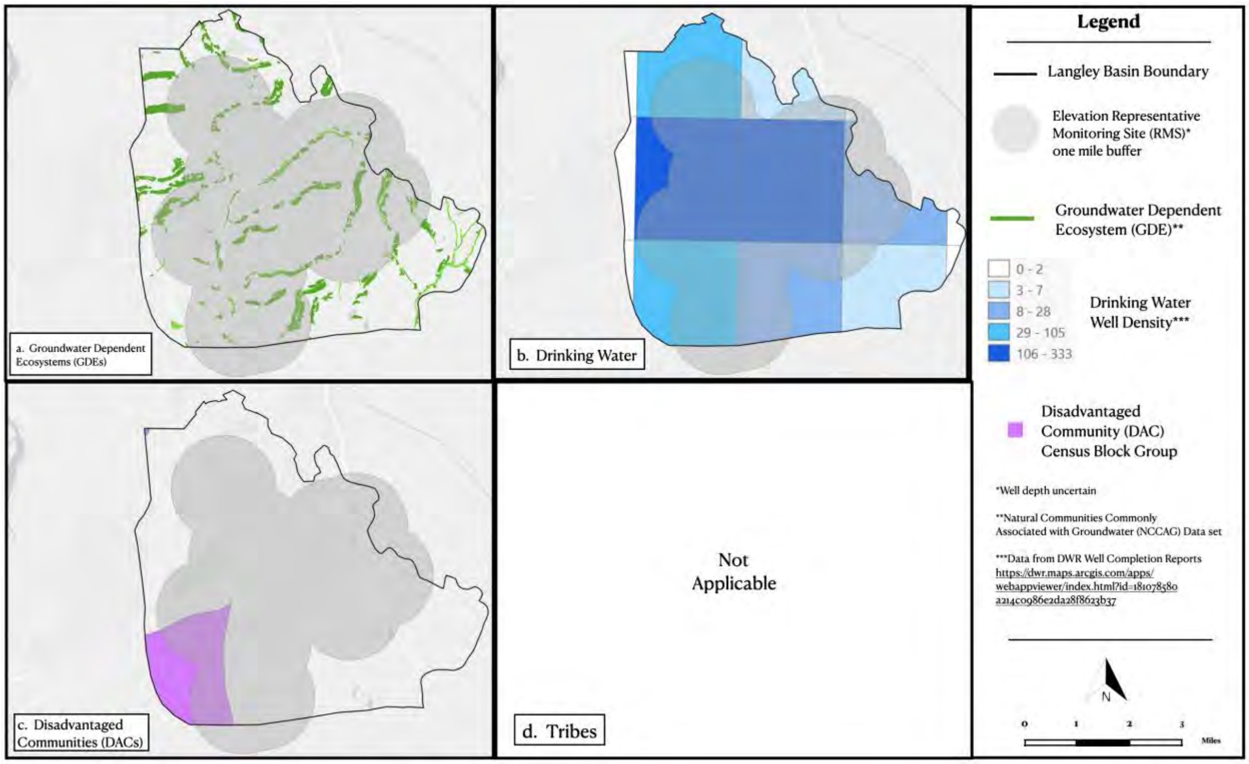


Figure 1. Groundwater elevation representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

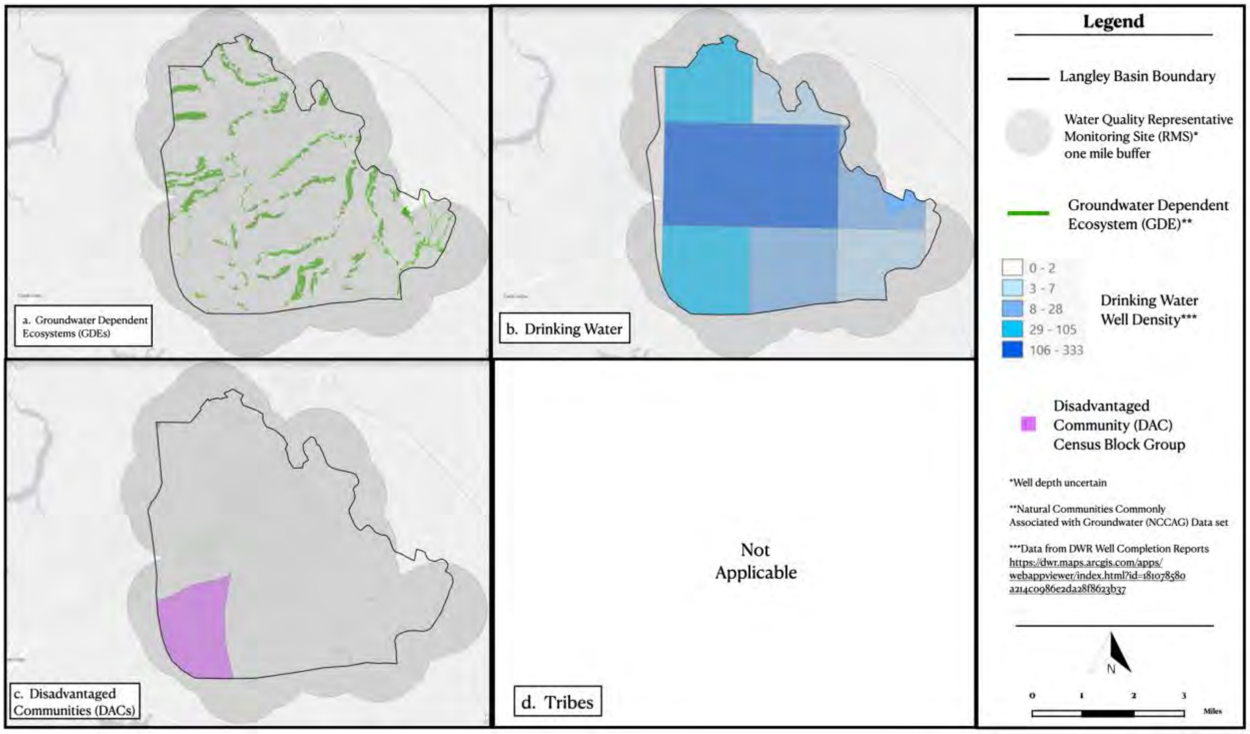


Figure 2. Groundwater quality representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

PAGE NO./SECTION NO.	SUGGESTED WORDING TO BE ADDED (NEW WORDING SHOWN IN RED, EXISTING WORDING IS IN BLACK)
6-10/6.1	Transient boundary conditions tied to historical water level observations (within the 180/400 Foot Aquifer Subbasin), simulated water levels from existing groundwater flow models (within the Seaside Area Subbasin this refers to the Watermaster's Seaside Basin Groundwater Flow Model developed by HydroMetrics/Montgomery & Associates), and freshwater equivalent sea levels (along the Monterey Coast);
6-15/6.2.2	Subsurface exchanges with the Seaside Area Subbasin are calculated by the MBGWFM using a general head boundary condition. The MBGWFM calculates subsurface flow based on modeled groundwater head outputs at the Seaside boundary from the historical Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018) and lateral hydraulic conductivities at boundary cells. Translating modeled boundary conditions from the Seaside Subbasin to the Monterey Subbasin is not completely accurate because the MBGWFM has a single model layer representing the Paso Robles and Santa Margarita aquifers, whereas the Seaside Basin model has each aquifer as a separate model layer. Early GSP implementation will include improving the MBGWFM boundary conditions so that the two models have more closely aligned hydrogeologic conditions at their shared boundary.
6-23/6.4.1.1.3	918 AFY of net annual inflows from the Seaside Subbasin into the Monterey Subbasin. These flows are represented as positive in Table 6-1 because even though there are both inflows and outflows from Seaside basin to the Monterey Subbasin, overall there is net inflow from the Seaside Subbasin to the Monterey Subbasin. Estimates of the magnitude of these inflows is ~~generally~~ not consistent with those estimated by the Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018). The probable reason for this is discussed in Section 6.2.2, which also identifies the modeling limitations to be addressed within the first five years of GSP implementation.
6-28/6.4.2.1.3	1,310 AFY of net annual inflows from the Seaside Subbasin into the Marina-Ord Area WBZ.
6-33/6.4.3.1.3	392 AFY of net annual outflows from the Corral de Tierra Area WBZ into the Seaside Subbasin.
6-36/6.5.1	Seaside Basin Groundwater Flow Model. Final (September 2018) historical groundwater elevations output from the Seaside model (Hydrometrics 2009 & 2018) were used to develop projected groundwater elevations at the Seaside Area Subbasin boundary. As discussed in Section 6.2.2, the model boundary condition heads output from the Seaside Basin Groundwater Flow Model represent the Paso Robles and Santa Margarita aquifers separately, while the MBGWFM combines those into one model layer. It is recognized the translation of heads is inaccurate because of the model layer differences between the two models. The MBGWFM's boundary condition assumptions will be improved to address the issue within this first five years of GSP implementation

6-38/6.5.1.3	Each of these boundary condition scenarios are predicated on the assumption that (a) the 180/400 Foot Aquifer subbasin will be managed to its SMCs over the 50-year projected model period and (b) Seaside subbasin, which is an adjudicated subbasin, will be managed sustainably such that groundwater levels remain stable into the future. However, the Seaside Basin Watermaster's modeling (using the Seaside Basin Groundwater Flow Model) found that it would be impossible for the Laguna Seca subarea of the Seaside subbasin to be managed such that groundwater levels would remain stable in that subarea in the future. The reason for this is that even if all pumping within the Laguna Seca Subarea were to be discontinued (an infeasible undertaking) groundwater would flow in an easterly direction out of the Laguna Seca subarea and into the Corral de Tierra subarea. This would be caused by low groundwater levels in the Corral de Tierra subarea compared to groundwater levels in the easterly portion of the Laguna Seca subarea. This highlights the importance of raising groundwater levels within the Corral de Tierra in order to not impede the ability of the Seaside subbasin to be sustainably managed.
6-39/6.5.1.3	The Seaside basin is subject to adjudication requirements that require that rates of groundwater extraction within the Subbasin not exceed the estimated basin safe yield. As such, in all three boundary conditions scenarios, groundwater levels in the adjudicated Seaside basin are assumed to remain stable into the future. However, as noted in Section 6.7, and contrary to the language in Section 6.5.1.3, the Seaside Basin Watermaster predictive modeling of the Laguna Seca subarea of the Seaside subbasin found that groundwater levels in the eastern portion of the Laguna Seca subarea could not be managed such that groundwater levels would remain stable, even if all pumping in the Laguna Seca subarea stopped, because of the effects of pumping in the Corral de Tierra Subarea. This boundary condition assumption discrepancy will be addressed and resolved during the early stage of implementation of the GSP. Water levels along the Seaside Subbasin boundary have been set to model predicted values at the end of the Historical Period (i.e., September 2018) in the Marina-Ord Area or at the established MTs (i.e. based on ~~2015~~ 2008 water levels) in the Corral de Tierra Area wherever they were below MTs at the end of the Historical Period.
6-49/6.5.4.1.3	However, inflows from the Seaside Basin will also be significantly influenced by groundwater levels in the Seaside basin, which have been assumed to stay constant at 2018 levels[10]. However, as noted in Section 6.7, and contrary to the language in Section 6.5.1.3, the Seaside Basin Watermaster's predictive modeling found that it would be impossible for the Laguna Seca subarea of the Seaside subbasin to be managed such that groundwater levels would remain stable in that subarea. Further analysis of potential inflows and outflows along the Seaside subbasin boundary is proposed as part of proposed future modeling efforts identified in implementation action Future Modeling of Seawater Intrusion and Projects, Section 9.5.6.
6-63/6.7	*Incomplete conceptualization of Principal Aquifer units in the Seaside Basin Groundwater Flow Model.* The Seaside model does not explicitly simulate groundwater flow from each principal aquifer unit defined in the Monterey

	Subbasin GSP, but rather uses a unique conceptualization of aquifer units that is primarily based on the main geologic formations encountered in the Seaside Area Subbasin (i.e., the Aromas Sands, Paso Robles Formation, and Santa Margarita/Purisima Formations). As such, there is considerable uncertainty surrounding the assumptions employed to link outputs from the Seaside model to individual layers of the MBGWFM[15], which may impact resulting calculations of Seaside Area Subbasin exchanges within the water budget. Further analysis of potential inflows and outflows along the Seaside subbasin boundary is proposed as part of proposed future modeling efforts identified in implementation action Future Modeling of Seawater Intrusion and Projects, Section 9.5.6.

To: Teo Espero <tespero@mcwd.org>
Subject: Re: Groundwater Sustainability Planning - Erika Marx

Groundwater Sustainability Planning

Name	Erika Marx
Organization	US Army Presidio of Monterey
Email Address	erika.r.marx.civ@mail.mil
Chapter	9
Section	Table 9-1 (M2)
Page Number(s)	395
Comments	The US Army Garrison Presidio of Monterey (USAG POM) is currently developing plans to decommission a 66-inch diameter stormwater outfall located within the Fort Ord Dunes State Park. The outfall, owned by USAG POM, currently discharges stormwater collected from approximately 4,657 acres that span multiple jurisdictions, including USAG POM (Ord Military Community), City of Seaside, State Parks, and Bureau of Land Management. Cumulative discharge volumes range from 21 AF (85th percentile storm event) up to 364 AF (100-year storm event). USAG POM (Ord Military Community) contributes approximately 7% of the total runoff volume. USAG POM is planning to install a percolation pond to manage the runoff from the Ord Military Community only (excluding privatized military housing areas); all other jurisdictions that discharge stormwater to the outfall will be required to implement their own stormwater management alternatives. The outfall decommissioning and construction of the percolation pond is anticipated to occur in FY25. USAG POM is interested in discussing with the GSA whether this percolation pond could be beneficial to the GSP. Depending on the location, the percolation pond could potentially contribute to subbasin recharge.

CALIFORNIA STATE UNIVERSITY
Monterey Bay

Facilities Management
100 Campus Center Bldg.37
Seaside, CA 93955-8001
831-582-3700
831-582-3545 Fax

Mr. Remleh Scherzinger
General Manager
Marina Coast Water District
11 Reservation Road
Marina, CA 93933-2099

10/29/2021

Subject: Marina Coast Water District, Draft Groundwater Sustainability Plan, Monterey Subbasin, dated September 2021

Dear Mr. Scherzinger:

Thank you for the opportunity to provide comment on the MCWD GSA Draft Groundwater Sustainability Plan for the Monterey Subbasin. We appreciate the effort that has gone into the preparation of this draft. (Note for ease of searching the page numbers listed here reflect the electronic pdf pagination and not the page numbers printed in the document.)

Page 19 Section 2.3.1 Local Land Use Planning Agencies: As a state entity, California State University Monterey Bay has exclusive land use planning jurisdiction and sovereign authority over its lands and facilities, and should be added to and described in this section. Alternatively, and more precisely, a separate section should be included titled “State Government Stakeholders,” describing CSUMB as a state entity with exclusive land use planning jurisdiction and authority over land and facilities it owns and/or controls.

Page 36, Figure 3-2: The area shown in purple and labelled “California State University Monterey Bay” should be shown in light green to denote state jurisdiction.

Page 40 3.1.5: California State University Monterey Bay has sovereign and land use planning authority over the land it owns or controls within the Subbasin.

Page 55 MCWD 2020 Urban water management plan: The second paragraph is very unclear, is the demand short of the supply or is the supply short to satisfy the demand ? In Ord there only appears to be a 10 AFY difference between the projected demand of 6,610 AFY and 6,600 AFY supply, yet a number of 1,693 AFY is portrayed as the difference between something and something? The paragraph only begins to have a semblance of making sense when footnote 10 is taken into account. The paragraph should be rewritten to bring that crucial footnoted information into the body of the text and to clarify the meaning.

Page 55 MCWD 2020 Urban water management plan: Third paragraph given that the shortfall portrayed is really not Ord Community wide but only occurs on an allocated jurisdictional basis, and there is more than one jurisdiction that is projected to exceed their allocation, the “potential shortfall” should be referred to as “potential jurisdictional shortfalls” (plural).

Page 56: Bullet points

Commercial, Industrial and Institutional accounts: Unlike the other bullet points on this page this one is devoid of any substance that bears on demand management measures, it is simply a list of some the different user classes the District has identified within its customer base with no description of any relationship to demand management practices.

Page 62 section 3.5: CSUMB as an entity of the State of California has sovereign and land use authority over the lands and facilities it owns and/or controls that are in the Monterey Subbasin.

Page 71: Suggest add a section "3.5.1.6 CSUMB Master Plan" as follows:
California State University, Monterey Bay (CSUMB) is in the process of updating its approved Master Plan with one with a 2035 planning horizon. The proposed CSUMB Master Plan (proposed Master Plan), includes Project Design Features (PDFs) drawn from the CSUMB Master Plan Guidelines (based on the 2017 public draft Comprehensive Master Plan) and provides the basis for the physical development of the campus. It provides a blueprint for land uses and building and facility space requirements to support an on-campus enrollment of 12,700 full-time-equivalent students and 1,776 FTE faculty and staff.

The proposed Master Plan strives to meet 11 objectives that include "conserve natural resources and ecosystem services and connect people to the natural environment" as well as implement multiple PDFs that conserve water and promote resiliency.

Water supply and wastewater collection service is currently provided by the Marina Coast Water District (MCWD) within the Ord Community service area. Both CSUMB's proposed Master Plan buildout and MCWD's Urban Water Management Plan demonstrate there is adequate water available for the buildout of the proposed Master Plan.

Page 72: 3.5.2 : Suggest add a bullet point as follows:
"The CSUMB master plan strategy relative to water demand is to grow the campus within its existing water allocations while being conscious of the effect of potential subbassin wide management actions affecting water allocations in aggregate. The University remains engaged in the success of the GSP, but retains the autonomy vested in it as a state entity to determine how to allocate its limited resources in order to best accomplish its educational mission. The University remains open to participation in projects and management actions that set the stage for future growth beyond its current master plan and beyond the forecast identified in the 2020 MCWD UWMP, but so long as the University can realize current and future plans within these forecasts and allocations, participation will be a result of voluntary decisions, not as a result of an imposed regime.

Page 72 3.5.3: need to distinguish between "new development" which could be defined as new developments not entitled as of time of writing versus "new developments" that exceed a jurisdiction's allocation, or allocation as modified by this GSP. The latter definition should be applied in arriving at "fees levied on such new developments"

Page 211 analog years 41-50 are shown as 1999-2008, is 2008 a typo of 2018 ? If not, then an explanation would be warranted.

Page 264 Groundwater Elevation Monitoring Network: A number of wells established by the U.S. Army on lands now under the jurisdiction of CSUMB were or still are operated for the specific purpose of Base Cleanup and Re-use. The U.S. Army is responsible for closure of the wells and removal of the encumbrance on the property records when the wells are no longer needed for that purpose. It should not be assumed that these wells will transition to the monitoring network without the express permission of CSUMB when the U.S. Army's clean-up objectives are achieved. This comment is also directly applicable to the footnote on page 10-5 indicating that MCWD plans to obtain ownership of wells once the Army's remediation efforts terminate. Any transfer of well ownership as opposed to closure, will be from Army to current fee title owner of property, MCWD may negotiate for ownership or use with the fee title holder.

Page 310 8.1 Definitions: At first glance it seems like the first two sustainability indicators "chronic lowering of groundwater levels" and "reduction of groundwater storage" are so closely inter related as they may really be a single indicator. However, it becomes clear later in the SMC section that sea water intrusion can cause a reduction in groundwater storage via a change in water composition. A note or footnote elucidating the reader at this point might be beneficial.

Page 311 8.2 Sustainability Goal: Limiting the sustainability goal of the Monterey subbasin to benefiting its "residents and businesses" appears to exclude other constituencies, such as state entities, from benefiting from the goal of the plan. It also neglects the established political subdivisions and processes that distill the many opinions that may exist within the communities that overly the subbasin on what a benefit consists of, or valuing tradeoffs that may need to be made. Suggest the language be modified to "The sustainability goal of the Monterey Subbasin is to manage groundwater resources for long-term community, financial , and environmental benefits to the subbasins communities as determined by their respective land use ownership and jurisdictions" noting the previous comments on the inclusion of CSUMB, as sovereign authority over land and facilities it owns and/or controls.

The listing of potential projects and management actions prior to any discussion of SMC's, of what constitutes undesirable result or an estimation of the likelihood of the occurrence of undesirable result in the document is premature and seems intended to lead to a conclusion. Suggest projects and management actions only be discussed in Chapter 9.

Page 316 Table 8-1:
"Chronic lowering of groundwater levels" The undesirable result language is unclear because of the use of the word "exceedance" and "more" to define undesirable results. If the intent is that an undesirable result occurs when ground water levels become 20% BELOW those identified in the minimum threshold column then simpler to state that.

"Reduction in groundwater storage": Given that criteria is stated in the table for elevation change it is suggested this table state the corresponding criteria for sea water intrusion thresholds.

"Seawater intrusion:" The sea water intrusion thresholds are stated here

The first three Sustainable Management Criteria SMC's seem to have an interdependency and overlap that results in an unnecessary complication of SMC's.
SMC 1: ground water level
SMC 2: ground water level and sea water intrusion
SMC 3: sea water intrusion

Suggest get rid of SMC 2

"Subsidence:" Minimum Threshold is stated as "Long Term" yet performance measurement is year over year and not cumulative which seems at odds with "Long Term".

Depletion of ISW: How was the two consecutive year parameter arrived at for the undesirable result ? If there is a high correlation between ISW and annual precipitation and figure 6.3 shows runs of up to six years of below average precipitation is two years too short a timeframe ?

Pages 325-334 Presentation Measurable Objective (MO) and Minimum Threshold (MT) and Historical charts of ground water elevations relative to): The intent of establishing an MO and MT is to be able to measure performance against established target values and to be able to gauge that performance relatively based on how near or how far current readings are from the MO and MT. However, it appears that the methodology used for selecting MO and MT from historical data in some cases yield MO's and MT's that are in fact very close to each (in a few cases they are the same). Having MO's and MT's that are very near each other appears to defeat the purpose of being able to describe relative performance. Put another way if a reading is near the MO things are going well and if a reading is below the MT things are going poorly, when the MO and MT are very close to each other or the same, and a reading that is below either value is obtained what does that really mean? Suggest some minimum separation of MO and MT be established and that some significance be attached to how much a value is distant from MO or MT.

Page 335: should paragraph 2 read "to verify seawater intrusion does NOT expand?"

Page 343 8.7.3.8: The minimum thresholds are targets established by the GSP, they are not measured (they may have been derived from past measurements). Actual water elevation readings are taken from the RMS Network and compared against the corresponding Minimum Threshold target to determine performance.

Page 343 Measurable objectives: This paragraph seems to support that the MO should be different than the MT.

Page 346 8.7.4.2 Interim Milestones: The prefacing of this section with "projects" is again jumping to conclusions. One would have expected a discussion of current conditions of each sustainability indicator relative to its MO, MT and Undesirable Result prior to a discussion of interim milestones or projects. Milestones is an indication that a course of action has been undertaken, when so far, the discussion has only been around historical information and the establishment of a monitoring framework.

Page 352 8.8.2.1 and 8.8.2.2: Seems to confirm that SMC #2 is redundant.

Page 363 8.10.2.3 Effects on Beneficial Users and Land Use: The paragraph's meaning is unclear. Is it intended to state that the SMC will limit selected GSP projects, or limit selected land use development projects within the GSP area? If the projects are "selected" then there appears to be some knowledge of which these are, if so they should be stated.

Page 371 "ecological land uses and users": Should the paragraph read "it can be inferred that PREVENTION OF the degradation of ground water quality minimum thresholds provide generally positive benefits…" (follow on: do the thresholds degrade or does the water quality degrade and approach the thresholds?)

Page 373 8.11.3.1: Given that the Subsidence minimum thresholds are set by the measurement error of the available data gathering tools suggest that as the first investigational step of 8.11.2.1 be to re-verify the accuracy of the measurements.

Second paragraph "or other projects are implemented within the Valley." "the Valley" is not a defined term and has not figured in the 392 pages of discussion so far. Needs clarification.

Third Paragraph: Suggest "should view these POTENTIAL projects and management actions"

Fourth paragraph: Suggest following language "Specific approaches for implementing management actions and projects will provide individual landowners and public entities, notably land use jurisdictions, flexibility in how they manage water use within their control in support of the Subbasin achieving groundwater sustainability"

Page 395 P/MA# M1: It should not be assumed that any reduction in groundwater use as a result of management actions will provide long term in lieu recharge as many land use jurisdictions will simply re-deploy their FORA ground water allocations to new development unless the management action prevents them from doing so by holding the jurisdictions to their allocations or proportionally reducing allocations.

Page 395 P/MA# M2: As stated it is not clear how existing policies will result in a beneficial change. Assuming that rainfall is constant how will the existing policies improve stormwater catchment and infiltration over the current situation? The management action implies there is currently an inefficiency that will be eliminated, but it would behoove to inform.

Page 396 P/MA# M3: It should not be assumed that 100% of groundwater water use converted to recycled irrigation provides long term in-lieu recharge as many land use jurisdictions intend to redeploy their FORA ground water allocations to new development when they are freed up by application of recycled. The 600 AFY and 827 AFY having already been allocated to land use jurisdiction by FORA only subsequent projects are likely to provide net recharge. The cost responsibility for those projects should be proportional to a jurisdiction's planned exceedance of its allocations.

Page 402 Evaluation of Benefits: It is crucial to be clear that project benefit (or lack thereof) is tied directly to water quantity or availability. Because the longstanding planning yardstick of availability to land use jurisdictions on the former Fort Ord are the FORA water allocations, both potable and recycled, it stands that any measure of project benefit will need to be taken against those underlying allocation numbers on a jurisdictional basis. The narrative seems to assume that projects will occur and that the alternate hypothetical condition is one where projects did not occur. This seems backwards, the base case should be no project, and the negative impacts to allocations evaluated, similarly to the procedure described in 9.4.8 “pumping allocations and controls” proposed for the Coral de Tierra area. A project case can then be presented and each jurisdiction can choose to participate and receive the positive benefit, or can choose not to participate and suffer the negative benefit. Participation in a project is not just conceptual, it is financial, and jurisdictions need to understand that. It is unlikely that future participation will exactly mirror the current FORA allocations, or current usage relative to allocations, therefore the share of benefit between jurisdictions will never be equal, which will mean that the financial contributions of the customer bases in each jurisdiction will need to be different, i.e. different rates and capacity charges will need to apply in each jurisdiction.

Another way of looking at this is that MCWD 2020 UWMP page 27 table 4.5 indicates that some jurisdiction wills be below their FORA allocations at the end of the forecast period, while some will be over. Those jurisdictions that will be below their allocations will essentially be voluntarily providing in-lieu recharge, similarly to management action M1. Those jurisdictions providing in-lieu recharge in this form should receive some form of consideration as compared to those jurisdictions that are exceeding their allocations, thereby contributing more to any potential overdraft condition, when determining project benefit.

Page 437, Recycled Water generation, collection and treatment: Suggest explicitly identify the change in operational responsibility and ownership of infrastructure when the waste water enters the M1W system that runs along the coast. As it reads, it appears MCWD conveys waste water all the way to the treatment plant.

Page 438 Landscape Irrigation: If MCWD truly intends to deliver recycled water for irrigation in 2022 as stated, then some more concrete actions towards converting existing users that already have agreements to receive such water might be warranted. Note Page 440 indicates 2023, there seems to be some confusion, and on page 442 its back to 2022.

Page 441, 9.4.6.4 Public Noticing: California State University Monterey Bay should be listed as a key stakeholder. See also above comments.

Page 506 10.7 Plan Implementation Costs:

The planning level costs identified in the first 7 bullet points of this section appear appropriate for inclusion in standard rates and charges for water delivered to MCWD customers, much as the cost of ensuring the safety of drinking water is today. Caution should be exercised in ensuring that this new cost is spread evenly over all water used and not heavily loaded on one class of user or tier of usage. Additionally, the inclusion of costs to support adjacent subbasins, notably listed as TBD, is concerning. Each subbasin bears the cost responsibility for managing itself, while technical cooperation between basins is understood to be needed suggest that this potential expenditure be capped at some percentage of overall Monterey Subbasin management expense.

page 513: It is notable that despite its apparently greater challenges in reaching sustainability the estimated 5 year operating cost to the SVBGSA for the Coral de Tierra area at $1,398,000 is 37% of the proposed MCWD 5 year operating cost for the MCWD area.

Page 514 10.7.3 Funding for Projects and Management Actions:
The projected water budget demand for the Marina-Ord WBZ is the District’s approved 2020 UMWP which includes growth in every jurisdiction that receives water from the Monterey Subbasin, such growth increasing water demand from 3,376 AFY to 9,584 AFY (MCWD 2020 UWMP page 27 table 4.5) . The draft Monterey subbassin GSP also concludes that even with this growth the Marina-Ord WBZ will not be in overdraft so long as adjacent subbasins are

managed sustainably. Taken together these statements indicate that any future overdraft in the Marina Ord WBZ that result in projects or management actions will be due to growth by the jurisdictions or by failure of the adjacent subbasins to meet their GSP management objectives. Because a significant component (and perhaps the exclusive component) of the need for projects (that result in infrastructure) or management actions (intended to avoid infrastructure investment by instituting practices and procedures that yield similar benefit), is supporting growth, the associated costs are in effect "Capacity Charges" regardless of the form in which they are collected. By virtue of the San Marcos Legislation (Gov't Code 54999 et Seq) State Agencies and Educational Facilities such as CSU are not required to pay Capacity Charges unless an agreement is reached with the imposing public utility/entity and such agreement results in charges to CSU that are nondiscriminatory, meaning that they fund only facilities that benefit CSU and such funding reflects CSU's proportionate share of cost relative to CSU's proportionate share of use/benefit. CSU has expressed a willingness to negotiate capacity charge agreements for Water, Sewer and Recycled Water with the District and would extend this willingness to GSP projects and management actions when they are better defined.

Overall, and as a matter of general comment, there is no mention in this 516+page GSP of the court's recent ruling regarding MCWD's rate structure. In *Bay View Community DE, LLC v. Marina Coast Water District*, Superior Court of California, County of Monterey, Case Number 18CV000765, dated 8/20/2019, the Honorable Susan J. Matcham stated that "Tier 2 customers subsidize Tier 1 customers by paying far more than their fair share. Consequently, the 2018 Rates violate Proposition 218." The court's final disposition/ruling states that: "The court holds that MCWD's 2014 and 2018 Rates are invalid because they violate Proposition 218."

We appreciate the opportunity to comment and provide input on this draft GSP. Should any questions arise please feel free to contact me.

Sincerely,

MLerch

Mike Lerch
Director of Energy & Utilities
California State University Monterey Bay

cc: Anya Spear, CSUMB
Marcel Forte, CSUMB
Glen Nelson, CSUMB
Julie Wyrick CSUMB
Lawrence Samuels, CSUMB
Dawn Theodora CSU Chancellors Office
Patrick Breen, MCWD

From:	Tina Wang
To:	Qiwen Zhang
Subject:	Fw: Review on Monterey-subasin
Date:	Tuesday, November 23, 2021 8:52:25 AM

Tina Wang, P.E.
EKI Environment & Water, Inc.
2001 Junipero Serra Boulevard, Suite 300
Daly City, California 94014
T: (650) 292-9100 | D: (650) 292-9050
twang@ekiconsult.com | www.ekiconsult.com

From: Emily Gardner <gardnere@svbgsa.org>
Sent: Monday, November 1, 2021 10:02 AM
To: Tina Wang <twang@ekiconsult.com>; Patrick Breen (pbreen@mcwd.org) <pbreen@mcwd.org>
Cc: Abby Ostovar <aostovar@elmontgomery.com>
Subject: Fwd: Review on Monterey-subasin

Comment for Monterey Subbasin.

Thanks,

Emily

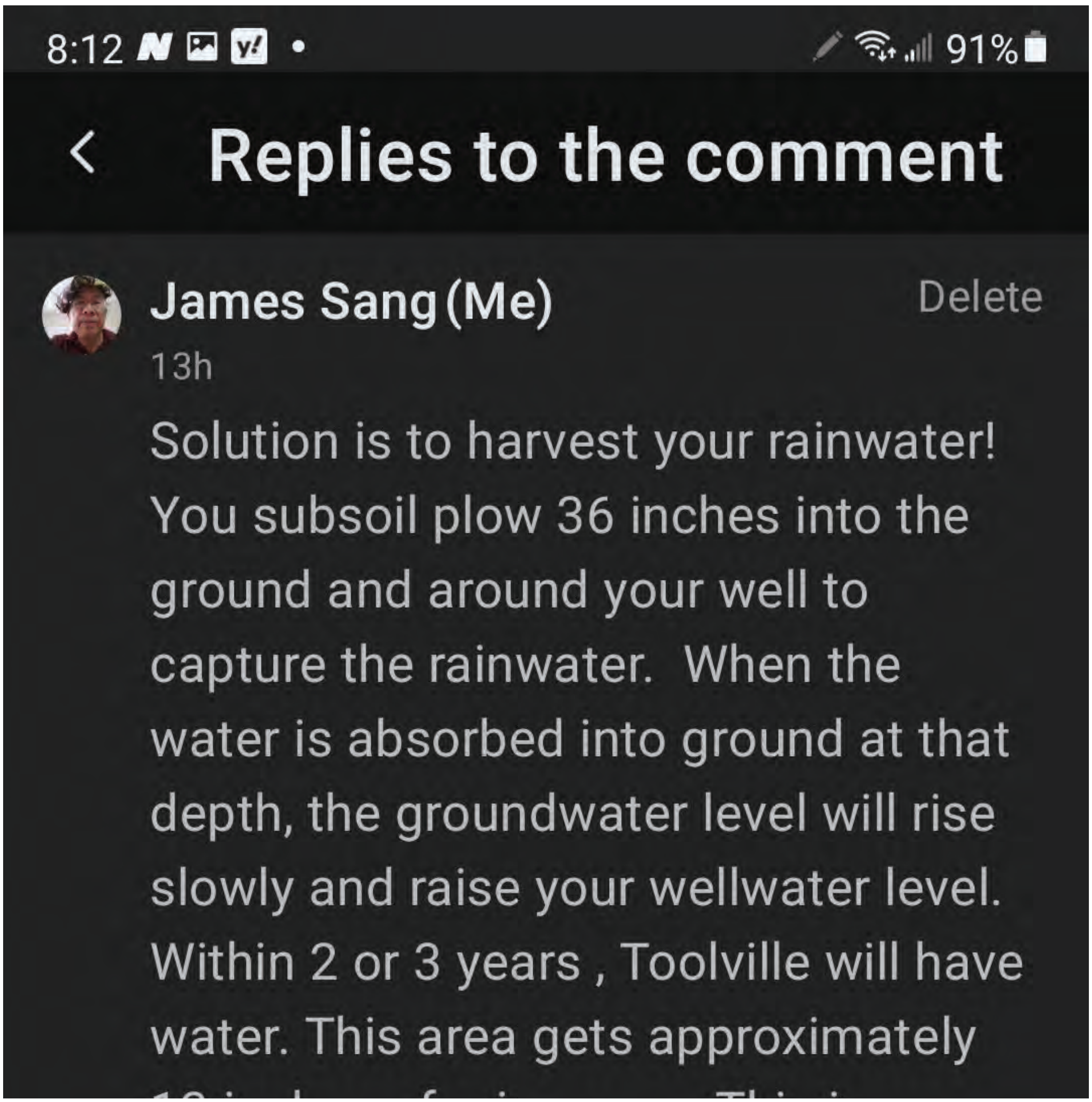
---------- Forwarded message ---------
From: **Yahoo Mail** <sangjames@yahoo.com>
Date: Sun, Oct 31, 2021 at 10:26 PM
Subject: Review on Monterey-subasin
To: Donna Meyers <meyersd@svbgsa.org>, Emily Gardner <gardnere@svbgsa.org>, Gary Petersen <peterseng@svbgsa.org>, svgbsa clerk <clerk@svbgsa.org>, Derrik Williams <dwilliams@elmontgomery.com>, Abby Ostovar <aostovar@elmontgomery.com>, BoardSVBGSA <board@svbgsa.org>
Cc: john phillips <district2@co.monterey.ca.us>, Chris Lopez <district3@co.monterey.ca.us>, wendy askew <district4@co.monterey.ca.us>, mary adams <district5@co.monterey.ca.us>, luis alejo <district1@co.monterey.ca.us>, Tony Barrera <tonyb@ci.salinas.ca.us>, Carla Gonzalez <carlag@ci.salinas.ca.us>, Anthony Rocha <anthonyr@ci.salinas.ca.us>, Kimberly Craig <kimbleyc@ci.salinas.ca.us>, Orlando Osernio <orlandoo@ci.salinas.ca.us>, Steve McShane <stevem@ci.salinas.ca.us>, james sang <sangjames@yahoo.com>, david jacobs <davidj@ci.salinas.ca.us>, Robert Rivas <robert.rivas@asm.ca.gov>, Anna Caballero <senator.caballero@senate.a.gov>, Melissa Hurtado <senator.hurtado@senate.ca.gov>, Marisa Hernandez <marisa.hernandez@sen.ca.gov>, Andrew Fisher <afisher@ucsc.edu>, Andrew Millison <millisan@hort.oregonstate.edu>, Bruce Taylor <btaylor@taylorfarms.com>, Kia Vang <kia.vang@sen.ca.gov>, Sarah <hardgraves@co.monterey.ca.us>, christine cromenes <district5@ci.salinas.ca.us>, Christopher Neely <chris@mcweekly.com>, California dept of water resources . groundwater <sgmps@water.ca.gov>, Diane Kennedy <dianeckennedy@prodigy.net>, diana.marcum@latimes.com <diana.marcum@latimes.com>, Gary Tanimura

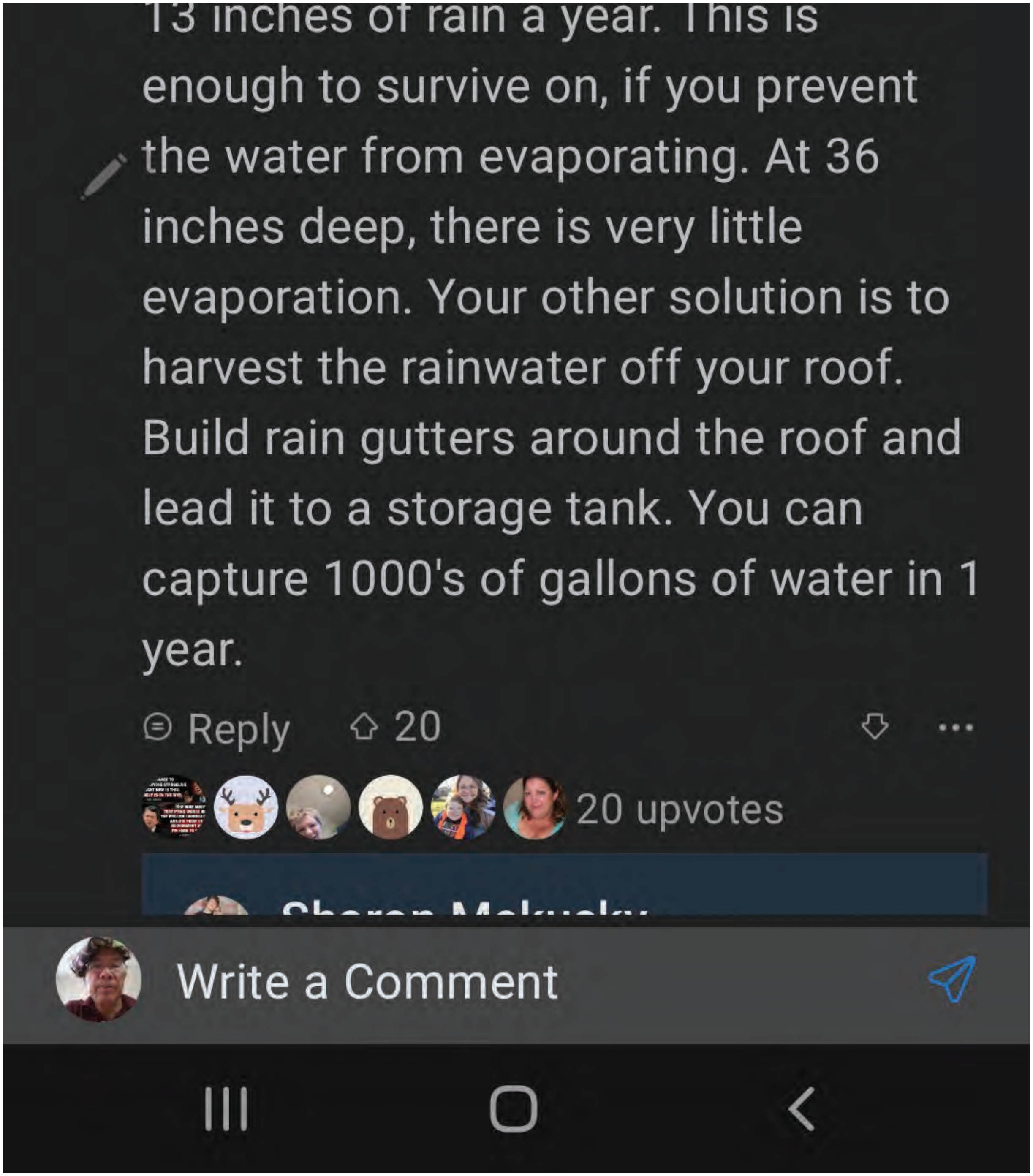
<garytanimura@comcast.net>, John Abatzoglou <jabatzoglou@ucmerced.edu>, Jimmy Panetta <ca20jpima@mail.house.gov>, Keith Van Der Maaten <kvandermaaten@mcwd.org>, Lois Henry <sjvwater@sjvwater.org>

These my thoughts about the Monterey Subbasin. Please forward this to all the Subcommittee heads and members.

First, the below is a comment that I typed on how I would solve the drought problem in Tooleville, California. This is a response to an article written in the LA Times.

----- Forwarded Message -----
From: Yahoo Mail <sangjames@yahoo.com>
To: james sang <sangjames@yahoo.com>
Sent: Saturday, October 30, 2021, 08:13:02 PM PDT
Subject:





Hello All,

These are the solutions that have been proposed to make the Monterey Sub-basin sustainable
1. They have proposed limiting pumping , fallowing land, buying property owners land. This is a terrible idea. This means less agricultural sales, lay off of employees, reducing the sales of all businesses in Monterey County. 2. Waste water recycling. This means upgrading existing CUS waster treatment plant. I like this idea even though it is super expensive. The capital cost is $28,635,000 and will only give us 232 acre feet of water per year. We should be able to recycle at least 70 percent of the water, which should help reduce the amount of groundwater pumping. This should help future growth in this area. A problem

that may be happening is that Cal Am may be forced to not take any more water from the Carmel River and they are a major supplier of water in this area. This has not been discussed. 3. Check dams are proposed on the tributaries in the Coral de Tierra area. These little dams are supposed to slow down the flow of stream water and allow it to be absorbed in the ground. The cost is $5,143,000 and give us 150 acre feet of water. I wonder if the designers of this project have considered that if the drought continues, we will get less and less rainfall and that even this small 150 acre feet of water will not be attainable, if climate change is real. With the increased CO2 production and the burning of our forest, which produces the water vapor to help precipitation. I would think that our rainfall will decrease. At least that has been what has been happening the last ten years or more. 4.They are proposing de-salination at a cost of $395,000,000 for an impressive addition of 15,000 acre feet water per year. Will we be able to afford this? I would like to know the arguments for and against this project. 5. They want to increase groundwater production from Upper Corral to the lower Corral at a cost of $13,275,000 for a benefit of 160 acre feet of water a year. Is this possible with the current lowering of our groundwater levels and will this source of water be for the long term? This project has not been discussed. 6. They want to introduce roof top rainwater capture and graywater reuse. The cost will be $100,000 for the classes and the benefit will be 5 acre feet of water per year for 75 households. I like roof top rain capture. If it rains 12 inches per year and you have a 1000 square foot area of roof, you can store 7,440 gallons a year. Currently our average rainfall is about 16 inches per year. In the Toro area, 39 percent of the wells have above average arsenic levels. Monterey County should notify these people and ask them to add a water filtration system to filter out the arsenic or go to roof top water harvesting and filter this water out for potable use. 7. Storm water recharge is a good idea. This diverts water off the streets, sidewalks, nonagricultural water and into swales. The cost is $200,000 to educate the people and can recharge 182 acre feet of water a year into swales, if it rains enough. Best practices require that this water be run over vegetation in order to detoxify it. If this is not done, you will be introducing street toxins into your groundwater and aquifers. There are other projects but they don't effect the Monterey sub basin.

The data on sustainable yield(amount of water coming in versus going out) for the Marina District(half of the Monterey sub-basin) and the Corral de Tierra(half of the Monterey sub-basin) area is not precise. An estimate is Marina District is minus 4000 acre feet of water a year and the Corral de Tierra is minus 3000 acre feet of water a year. None of these projects come close to bringing the Monterey sub-basin to sustainability except for maybe the de salination project and the benefits of that project will be spread to maybe the 180-400 sub-basin and the Eastside sub-basin . The completion of a de-salination project is years away and millions of dollars away. By that time we will all be THIRSTY!!

As I have mentioned before, the DWR's goal of water sustainability in the basins is incorrect! The goal should be to recharge and raise the water levels of each well. This is where the growers and the domestic users need to have their water. Do you really expect the growers and domestic users to drive their trucks to the area where the water is and fill their trucks and drive back?!! If we reach sustainability (water in equals water out) and some wells are still going dry, what will you do?? Build a pipe line here and build another pipeline there. This would be an endless project!!

We have a better chance of solving the water problems by using my idea of either subsoil plowing 2 or 3 feet or to build swales and trenches around the well heads in order to capture the rainwater every year. With the rainwater capture near the well head, we have a good chance of raising the well water levels, raising the groundwater levels and raising the water aquifer levels. These projects may only last the rainiest months (November, December, January) or last the full rainy season(October, November, January, February, March). After this they can plow over this area and grow their produce. This subsoil plowing and trenching can be done on any land to make it more water sustainable . Domestic well users can also implement this project, but on a smaller scale. Remember 1 acre of subsoiled or trenched land at 12 inches of rainfall a year will capture 350,000 gallons of water!

Other issues: 1. The Marina District area has a lot of toxins in the old Fort Ord area. These should be remediated as soon as possible before any recharge can be done. Maybe Assemblyman Richard Rivas or Senator Anna Caballero can help. There are approximately 15 areas that have to be cleaned. 2. There is over 9,000 acre feet of water going into 180-400 sub-basin yearly from the Monterey sub-basin. This might be caused by severe pumping by growers in the 180-400 subbasin. 3. Any further construction in this area should have their rooftop water go into recycling. 4. $7,000,000 has been awarded to the 180-

400 sub-basin. I would like see some of that monies go to using the technique of subsoil plowing and swale building in the Salinas Valley 5. About arsenic poisoning, this is a class 1 carcinogen . If you have to much arsenic in your blood increase your folic acid intake to 400 mcg and you will urinate it out [Folic acid supplementation lowers blood arsenic by Gamble, etc.]

Thanks for reading, any questions , please ask

James Sang sangjames@yahoo.com

Sent from Yahoo Mail on Android

--

Luhdorff & Scalmanini
Consulting Engineers

November 1, 2021

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road
Marina, CA 93933
Attn: Patrick Breen, Water Resources Manager
Email: pbreen@mcwd.org

Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Attn: Emily Gardner, Deputy General Manager and Derrik Williams, GSP Project Manager
Email: gardnere@svbgsa.org; dwilliams@elmontgomery.com

SUBJECT: Comments on Monterey Subbasin Public Draft GSP Chapter 6

Dear Mr. Breen, Ms. Gardner, and Mr. Williams:

This letter is submitted on behalf of California American Water and provides comments on Chapter 6 (Water Budget) for the Public Draft Monterey Subbasin GSP Chapter 6 released on September 3, 2021. It also includes a brief review of how previous comments by the Hydrogeologic Working Group (HWG) on Monterey Subbasin GSP Chapters 4 (HCM) and 5 (Groundwater Conditions), which are attached to this comment letter, were not addressed in the recently released Public Review Draft versions of these chapters. Detailed comments are provided along with a summary of the main comments.

DETAILED COMMENTS

Specific comments are organized by subsection with page numbers referenced below.

Section 6.1 (Water Budget Method)

- The GSP states that the water budget information is based on use of a groundwater flow model developed for the subbasin (p. 6-8). **Comment: The model documentation (Appendix 6B) was not provided for review; thus, it is not possible to provide complete comments on the water balance without being able to review documentation for the model used to produce the water balance. Without the supporting documentation, stakeholders and the public are not able to adequately comment on the relevant issues.**

- The GSP states that a soil moisture budget (SMB) accounting model is used to estimate groundwater recharge (p. 6-10). **Comment: While Appendix 6-A provides some tables with output data from the SMB, no model documentation is provided. Thus, it is not possible to provide complete comments on the water balance without being able to review documentation for the SMB model used to**

provide key input to the groundwater model and water balance. Without the supporting documentation, stakeholders and the public are not able to adequately comment on the relevant issues.

- The GSP states, "As discussed in Appendix 6B, the MBGWFM has been calibrated against 30,354 historical water level measurements to achieve normalized calibration error statistics of less than 2% and thus adequately represents the historical conditions of the Basin. Therefore, it is appropriate to use the MBGWFM to estimate water budgets for the Monterey Subbasin." (p. 6-10). **Comment: Appendix 6B was not provided for review. While good calibration to water levels is important, it does not in and of itself validate use of the model for producing a valid water balance. Other key considerations include the fact that simulated water levels and subsurface inflows/outflows can be highly variable depending on boundary conditions. Thus, various combinations of recharge, discharge, aquifer parameters, and boundary conditions can produce similarly good model calibrations to water levels (i.e., models are non-unique). For example, a groundwater model with less vertical recharge could produce a good calibration to groundwater levels with a different set of aquifer parameters and/or boundary conditions. Therefore, additional justification is needed for use of the model for water balance output, such as comparison to adjacent subbasin water balances and the amount of vertical recharge (e.g., precipitation recharge, excess irrigation recharge) per acre. For example, the 180/400-Foot Aquifer Subbasin historical water budget has vertical recharge amounting to 0.22 ft/acre compared to the Monterey Subbasin historical water budget with vertical recharge of 0.33 ft/acre, or 50% greater vertical recharge than the immediately adjacent 180/400-Foot Aquifer Subbasin.**

- The GSP states, "To quantify all required water budget components as specified in the GSP Emergency Regulations (CCR § 354.18(b)), this GSP presents results from both the SMB for the land surface system and the MBGWFM for the groundwater system." (p. 6-11). **Comment: The GSP Emergency Regulations (CCR § 354.18(b.1)) require, "Total surface water entering and leaving a basin by water source type." A surface water budget is not provided in Chapter 6; this would include total streamflow and any imported water entering and leaving the Monterey Subbasin.**

<u>Section 6.2 (Water Budget Components)</u>

- The GSP states that inter-basin cross-boundary flows (e.g., between the Monterey Subbasin and the 180/400 Aquifer Subbasin) are based on model general head boundary conditions (p. 6-15). **Comment: The details of the general head conditions used (i.e., heads, conductance) are not provided and cannot be reviewed. Presumably such details would be provided in the Model Documentation in Appendix 6B if it were made available for public review.**

<u>Section 6.4 (Historical and Current Water Budget)</u>

- GSP Table 6-1 provides historical and current groundwater water budget results (p. 6-20). **Comment: The historical and current Monterey Subbasin water budgets show net subsurface outflows of 12,265 to 12,565 AFY to the 180/400-Foot Aquifer Subbasin. Review of the DWR-approved GSP for the 180/400-Foot Aquifer Subbasin shows historical and current water balance net subsurface**

inflows from the Monterey Subbasin of 3,000 AFY. Thus, there is a large discrepancy between the two GSPs regarding subsurface cross-boundary flows. If the Monterey Subbasin GSP cross-boundary flows are correct, the difference between inflows and outflows for the historical groundwater budget for the 180/400-Foot Aquifer Subbasin GSP changes from -12,900 AFY to -3,635 AFY, which has significant implications for the 180/400-Foot Aquifer Subbasin GSP. In general, this uncertainty in cross-boundary flows also points out that subbasin sustainability should be based (primarily) on balancing the vertical components of recharge and discharge. This eliminates the uncertainty regarding cross-boundary flows (and associated dependency) in evaluating projects/management actions needed to achieve sustainability.

- A footnote to Table 6-1 states, "All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400 Foot Aquifer Subbasin boundary, as evidenced by no observed expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period." (p. 6-20). This issue is also discussed in the first bullet at the top of page 6-23, and first bullet at the top of page 6-24. **Comment: Review of seawater intrusion maps prepared by MCWRA indicates this statement/conclusion is not correct – the seawater intrusion front in Monterey Subbasin has expanded over the historical time period.**

- GSP Figure 6-4 (p. 6-21) indicates subsurface flow occurs from the Corral de Tierra Area to the Marina Ord Area. **Comment: Review of topography and studies by others (e.g., Geosyntec, 2007) indicates essentially no flow between the two Areas, but rather subsurface flow from the Corral de Tierra Area strictly to the 180-400 Foot Aquifer Subbasin. The water balance for Marina-Ord Area assumes such subsurface inflow amounts to 1,544 AFY, but this is likely not the case.**

- The GSP states that outflows to the ocean occur from the Dune Sand Aquifer (p. 6-22). **Comment: The HCM and groundwater elevation contour maps indicate that the Dune Sand Aquifer and 180-Foot Aquifer merge inland of the coast where the FO-SVA aquitard pinches out and the combined groundwater flow moves inland. The GSP presents no evidence of outflow to the ocean.**

- The GSP notes that estimated net annual inflows/outflows between the Monterey Subbasin and the Seaside Subbasin are consistent with the estimates from the Seaside Basin Groundwater Flow Model. However, this same statement of consistency is not made by the GSP for estimated net annual inflows/outflows between the Monterey Subbasin and the 180/400 Foot Aquifer Subbasin. **Comment: As noted above, there is a major discrepancy between the 3,000 AFY of net inflow to the 180/400 Foot Aquifer Subbasin from the Monterey Subbasin estimated in the 180/400 Foot Aquifer Subbasin GSP versus the 12,365 AFY of net inflow to the 180/400 Foot Aquifer Subbasin estimated in the Monterey Subbasin GSP.**

- The GSP notes that the Dune Sand Aquifer has seaward gradients that result in 534 AFY of net outflow to the ocean (p. 6-23). **Comment: The groundwater elevation contour maps presented in Chapter 5 do not include data points near the coast and provide no evidence of outflow to the ocean. In fact, other data indicate there is no outflow to the ocean from the Dune Sand Aquifer as described above.**

- The GSP states that groundwater elevations in the 180/400 Foot Aquifer Subbasin are 40 feet below mean sea level (MSL) in the 180 and 400-Foot Aquifers and 100 feet below MSL in the Deep Aquifer

(p. 6-24). **Comment: It should also be noted here that groundwater elevations in the Monterey Subbasin are 20 to 30 feet below MSL in the 180 and 400-Foot Aquifers and 50 to 70 feet below MSL in the Deep Aquifer.**

- Figure 6-5 (p. 6-27) shows an area of seawater intrusion in Monterey Subbasin with arrows showing groundwater flow directions in this area. The text describes these arrows as, "…the general direction of presumed freshwater and seawater cross-boundary flows…" (p. 6-28). The GSP also states, "…it is difficult to predict if seawater inflows from the ocean will continue to pass through the Monterey Subbasin into the 180/400 Foot Aquifer subbasin as they did during the historical period." (p. 6-42). **Comment: The area of seawater intrusion does not match the sea water intrusion maps prepared by MCWRA and does not distinguish seawater intrusion in the 180-Foot Aquifer vs. 400-Foot Aquifer as done by MCWRA. In addition, the groundwater flow direction arrows within the zone of seawater intrusion are incorrect and do not correlate with the groundwater elevation contours included on the map, which indicate a portion of the groundwater within the seawater intrusion zone flowing towards the middle inland portion of Monterey Subbasin. It is not clear why the groundwater flow directions shown are based on "presumed" directions rather than the flow arrows that would be derived based on actual groundwater elevation contour lines shown on the figure.**

- The GSP states, "…pumping in the Corral de Tierra Area is estimated using the known data, and may be missing a significant amount of pumping." (p. 6-33). **Comment: If a significant amount of pumping is not accounted for in the Corral de Tierra Area, then subsurface outflow is significantly overestimated.**

<u>**Section 6.5 (Projected Water Budget)**</u>

- Projected water demands for the MCWD service area are estimated to increase from 3,367 to 8,314 AFY, and it is assumed that increased pumping would be divided evenly between the 180 and 400 Foot Aquifers and the Deep Aquifer based on historical MCWD operations (pp. 6-37 and 6-38). **Comment: Given the evolution of MCWD pumping distribution between the Deep Aquifer and shallower aquifers to the point where Deep Aquifer pumping has apparently increased to become more than two-thirds of total MCWD pumping in recent years, it is apparent that the 180 and 400 Foot Aquifers cannot accommodate the proposed future pumping increases stated in the GSP. The future model scenario should assign all future increases in pumping to the Deep Aquifer. This pumping distribution will likely have a major effect on future scenario model results.**

- The GSP states that model boundary conditions used in future scenarios include: minimum thresholds (MT), measurable objectives (MO), and seawater intrusion protective boundary conditions (p. 6-38). **Comment: The seawater intrusion protective boundary conditions are not defined in terms of what they are or how they were derived, or how likely they are to occur. Since they are not provided in GSPs for adjacent subbasins as likely to occur, they do not seem appropriate to use.**

- The GSP states that for the MT Boundary Conditions in the projected model scenario run, "Groundwater levels in RMS wells located near the Monterey Subbasin are raised from 2018 model predicted values to water level MTs established in the 180/400 Foot Aquifer GSP…" (p. 6-38). **Comment: Review of water level data from MCWRA indicates that 2015 to 2016 water levels**

were generally lower than 2018 water levels. The 180/400-Foot Aquifer Subbasin GSP set MTs one foot above 2015 water level elevations. Thus, it is not clear why model-predicted 2018 water levels in boundary condition areas would need to be raised to be at MT levels established in the 180/400-Foot Aquifer Subbasin unless model-predicted groundwater elevations for 2018 were substantially lower than observed values. If model-predicted values are substantially lower than observed values in boundary condition areas, the model would likely significantly overestimate groundwater outflow from the Monterey Subbasin to the 180/400-Foot Aquifer Subbasin.

- The GSP states that seawater intrusion protective elevations are, "…consistent with the MTs for seawater intrusion established in the 180/400 Foot Aquifer GSP." (p. 6-39). **Comment: Based on this statement, it is not clear how seawater intrusion protective elevations differ from MT elevations. Several figures in the GSP suggest seawater intrusion protective elevations are much higher than MT elevations.**

- The GSP Project Scenario calls for increased use of recycled water from 600 AFY in 2023 to 5,495 AFY in 2040, with total demand in 2040 and beyond of 10,955 AFY. **Comment: This Project scenario assumes that recycled water can provide 50% of total water demand for MCWD, which is likely unrealistic. In addition, other documents (MCWD Urban Water Master Plan, MCWD Water Supply Master Plan) indicate future recycled water use would be limited to no more than 1,500 AFY.**

- The GSP states, "…the projected water budget results indicate that the climate scenarios have a much smaller impact on changes in storage and groundwater levels within the subbasin than the identified boundary conditions." (p. 6-43). **Comment: While this statement may be true relative to horizontal groundwater flows, it is not true with regard to vertical groundwater recharge that increases substantially (about 10 to 20%) under future climate change scenarios. Additional projected model runs should be made using historical groundwater recharge amounts due to the significant uncertainty in future groundwater recharge increases.**

- GSP Table 6-5 (Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ) shows 8,767 AFY of groundwater pumping versus 6,823 AFY of total groundwater recharge (p. 6-45). **Comment: Under these scenarios groundwater pumping exceeds groundwater recharge by approximately 2,000 AFY and is not sustainable.**

- The GSP states, "…ocean inflows into the basin also decrease as water levels at this boundary increase from MTs, to MOs, and to SWI protective elevations…However, there is little reduction in net ocean inflows between the historical water budget and the projected baseline water budgets under MT boundary conditions or MO boundary conditions." (p. 6-48). **Comment: This statement would seem to indicate that ocean inflows are driven by Monterey Subbasin groundwater elevations.**

- The GSP states, "…projected water budgets also indicate that substantial groundwater outflows from Monterey Subbasin continue to occur into the 180/400-Foot Aquifer Subbasin under MT and MO boundary condition scenarios." **Comment: It should be determined how much of this groundwater outflow across Subbasin boundaries is due to sea level rise.**

- With respect to the Marina-Ord Area, the GSP states, "…these projected water budget results indicate that this management area will not be in overdraft if adjacent basins are managed sustainably and SMCs are achieved." (p. 6-50). **Comment: Given that pumping exceeds recharge by 2,000 AFY in in the Marina-Ord Area per Table 6-5, it is not clear how this Area can be considered to not be in overdraft under projected future conditions.**

- The GSP states, "…it is difficult to predict if…changes in boundary conditions and increased extraction in the subbasin could cause saline groundwater from the 180/400 Foot Aquifer subbasin or ocean to flow further inland within the Monterey subbasin. It is noted that MCWD has significant operational flexibility regarding rates of extraction from its wells and could potentially modify the location and depth at which groundwater is extracted to limit such impacts." (p. 6-50 to 6-51). **Comment: The groundwater model should be able to provide some indication of the potential for saline water from the ocean to flow further inland within the Monterey Subbasin. As discussed in other comments, MCWD does not appear to have operational flexibility on depth of extraction and additional pumping is likely to occur from the Deep Aquifer.**

- In reference to Figure 6-8, the GSP states, "This figure indicates that variable climate conditions have limited impacts on projected water levels in RMS wells relative to boundary condition scenarios." (p. 6-51). **Comment: This figure and the associated statement here are misleading with regard to the impacts of variable climate conditions assumed in the future scenario. The future climate change assumptions result in an increase in groundwater recharge ranging from 10 to 20%, which is highly uncertain. A better approach would be to assume groundwater recharge in the future will be similar to historical groundwater recharge. The assumption of increased future groundwater recharge may exacerbate overdraft that is already predicted to occur even with the assumed increased in groundwater recharge (see Table 6-5 where groundwater pumping exceeds future groundwater recharge by approximately 2,000 AFY).**

- The GSP states, "…these results suggest that projects and/or management actions may be required to consistently maintain water levels above MTs and to achieve MOs within the Marina-Ord Area unless SWI protective boundary conditions are achieved in the adjacent subbasins." (p. 6-51). **Comment: The 180/400 Foot Aquifer Subbasin GSP is approved by DWR with the MO/MT included in the GSP. It is not reasonable to evaluate/assume boundary conditions could be at the apparently much higher "SWI protective boundary conditions". Thus, it should be assumed that projects/management actions will be required in Monterey Subbasin to maintain water levels above MTs and achieve MOs within the Marina-Ord Area.**

- GSP Figure 6-8 indicates that Monterey Subbasin does not meet its MT when using MT boundary conditions for adjacent basins and does not meet its MO when using MO boundary conditions for adjacent basins in future project model runs for "No Project" conditions (p. 6-52). **Comment: These results demonstrate that projects/management actions will be necessary to meet MT and MO in Monterey Subbasin. The GSP Project with water supply augmentation by recycled water of 5,500 AFY far exceeds any other current projections of available recycled water (less than 1,500 AFY in MCWD UWMP).**

Section 6.6 (Historical, Current, and Projected Overdraft and Sustainable Yield)

- The GSP presents three methods of calculating sustainable yield of the Marina-Ord Area (p. 6-59 to 6-60). **Comment: Two of the three methods are based on comparing historical and current overdraft to groundwater pumping during these time frames, with resulting sustainable yield ranging from 2,714 to 3,294 AFY, or an average of approximately 3,000 AFY. This estimate is likely reasonable given that historical and current pumping amounts ranging from 3,503 to 4,346 AFY have resulted in groundwater basin overdraft and seawater intrusion. The third method of calculating sustainable yield in the GSP erroneously concludes that the projected water budget results support an estimated sustainable yield of 9,870 AFY, which is three times the amount of groundwater pumping that has already resulted in overdraft and seawater intrusion. Furthermore, this sustainable yield estimate is on the order of 50% greater than total groundwater recharge. While the GSP claims a sustainable yield of up to 9,900 AFY, it is clear from historical and current data that the sustainable yield of the Marina-Ord Area is likely no greater than about 3,000 AFY.**

- The GSP states that under the "no project" scenario RMS well groundwater levels "…are generally higher than MTs during non-drought periods under all identified boundary conditions and climate scenarios…" and that RMS well groundwater levels "…reach MOs if SWI protective boundary conditions are achieved in adjacent subbasins." (p. 6-60). **Comment: Review of Figure 6-7 indicates that groundwater levels are below the MTs more than 50% of the time after 2040 under MT boundary conditions, which is contrary to statements in the GSP. In addition, the DWR-approved 180/400 Foot Aquifer Subbasin GSP does not propose to achieve SWI protective groundwater levels; therefore, Monterey Subbasin RMS wells will not achieve proposed MOs.**

- The GSP states that the future projected sustainable yield ranges between 4,400 and 9,900 AFY if adjacent subbasins are managed sustainably and the 180/400 Foot Aquifer Subbasin reaches its SMCs (p. 6-60). **Comment: While there is some interdependence between subbasins that may impact the sustainability of adjacent subbasins, each subbasin in the Salinas Valley needs to be managed sustainably on its own to make the entire Salinas Valley sustainable. The 180/400 Foot Aquifer Subbasin GSP has been approved by DWR as doing its part to achieve sustainability. Seaside Basin has been adjudicated and is doing its part to be sustainable. Monterey Subbasin cannot rely on inflows from other subbasins (e.g., from Seaside Basin) nor simply blame other subbasins (e.g., the 180/400 Foot Aquifer Subbasin) for its own inability to reach sustainability. The Monterey Subbasin should do its part to become sustainable by balancing its vertical inflows and outflows (i.e., do not include adjacent subbasin inflows and outflows), including a sufficient allowance for outflows to the ocean to avoid seawater intrusion. Alternatively, Monterey Subbasin GSAs may choose to work with the adjacent 180/400 Foot Aquifer Subbasin to develop other means of achieving sustainability such as by implementing a coordinated groundwater extraction barrier to address seawater intrusion.**

- The GSP states with regard to the projected sustainable yield range for the Marina-Ord Area of 4,400 to 9,900 AFY, that that ability to conduct this amount of pumping without inducing seawater intrusion needs to be verified (p. 6-60). **Comment: It is not clear why pumping amounts in excess of historical pumping amounts that induced seawater intrusion would be proposed in a GSP without first**

verifying that they would not be expected to induce seawater intrusion. The groundwater model developed for the GSP should be applied to address this issue.

OTHER GENERAL COMMENTS

- The HWG previously reviewed Draft GSP Chapters 4 and 5 for the Monterey Subbasin, and provided comments dated April 5, 2021 (attached to this letter). While the HWG comments were acknowledged as being received by the GSA, the Public Draft versions of Chapters 4 and 5 include no significant changes to the text or figures related to the HWG comments. Furthermore, unlike responses provided to other comments submitted on the draft GSP chapters, there have been no responses to the HWG comments. Given that GSP development is a public process that is required include substantial public and stakeholder participation, and given that GSPs must be based on the best available science, the GSP should be revised to address the HWG's comments and the comments set forth herein. If the GSAs disagree with any of the subject comments, the GSAs should at the very least provide responses to the comments as they did for other comments.

- Chapter 6 of the GSP makes several references to details of the groundwater model being described in Appendix 6B; however, Appendix 6B had not been provided for review as of October 29, 2021, and comments were due on November 1, 2021. Given that the entire Chapter 6 is essentially based on the groundwater model developed for the GSP, the GSAs' failure to provide this model documentation precludes stakeholders and the public from being able to adequately review and comment on a foundational element of the entire GSP. The GSP cannot undergo adequate review until a sufficient review period is provided for Appendix 6B Model Documentation, and additional time should be provided to comment on Appendix 6B once it is provided to the public.

SUMMARY OF COMMENTS

The Monterey Subbasin GSP emphasizes in several places that subbasin sustainability is dependent on adjacent subbasins becoming sustainable. While there is some interdependence between subbasins that may impact the sustainability of adjacent subbasins, the GSAs in the Monterey Subbasin should focus on their role in making the Subbasin sustainable. This is best achieved by comparing groundwater recharge (just the vertical components of flow from the soil moisture balance, not including subsurface inflows form adjacent subbasins) in the Marina-Ord Area to groundwater pumping in the Marina-Ord Area. In addition, there needs to be excess groundwater recharge over and above total pumping for significant outflow to the ocean to prevent seawater intrusion.

A summary of several other major Chapter 6 comments includes:

- Groundwater model documentation is key to understanding the water balance, but is not included in available Public Draft GSP documents made available for review;
- Soil moisture budget accounting model documentation is key to understanding the water balance, but is not included in available Public Draft GSP documents made available for review;
- The surface water system water budget required under SGMA is not provided;
- There is a major inconsistency in estimated net subsurface inflow between the Monterey Subbasin and the 180/400 Foot Aquifer Subbasin presented in the GSPs for the two subbasins (i.e., 12,500 AFY vs. 3,000 AFY);

- The extent of seawater intrusion within the Monterey Subbasin has expanded over the historical period covered by the GSP, which is in contrast to statements/assumptions in the GSP;
- Some of the boundary conditions used in the groundwater model for future project scenarios are not realistic and are inconsistent with the 180/400 Foot Aquifer Subbasin GSP;
- The GSP Marina-Ord Area water balance indicates that increases in groundwater pumping for the future project scenario are not realistic and are not sustainable, because they exceed Marina-Ord Area groundwater recharge and do not allow for outflow to combat seawater intrusion;
- Future project scenarios should be more conservative and should not assume groundwater recharge will increase in the future by 10 to 20% due to climate change;
- Groundwater model results indicate that MTs and MOs will likely not be achieved in the Monterey Subbasin if realistic boundary conditions are applied; and
- The sustainable yield estimate of 4,400 to 9,900 AFY for the Marina-Ord Area is significantly overestimated, and will likely have detrimental impacts on adjacent subbasins (i.e., the Seaside Basin and the 180/400 Foot Aquifer Subbasin).

Thank you for the opportunity to provide these comments.

Sincerely,

LUHDORFF AND SCALMANINI
CONSULTING ENGINEERS

Peter Leffler,
Principal Hydrogeologist

Attachment: HWG Comments on Draft Monterey Subbasin Groundwater Sustainability Plan, Chapters 4 and 5, dated April 5, 2021

April 5, 2021

Marina Coast Water District
11 Reservation Road
Marina, CA 93933
Attn: Patrick Breen, Water Resources Manager
Email: pbreen@mcwd.org

Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Attn: Emily Gardner, Deputy General Manager and Derrik Williams, GSP Project Manager
Email: gardnere@svbgsa.org; dwilliams@elmontgomery.com

SUBJECT: HWG COMMENTS ON DRAFT MONTEREY SUBBASIN GROUNDWATER SUSTAINABILITY PLAN, CHAPTERS 4 AND 5

Dear Mr. Breen, Ms. Gardner, and Mr. Williams:

This letter provides the comments of the Hydrogeologic Working Group (HWG) on the Draft Monterey Subbasin Groundwater Sustainability Plan (GSP) Chapters 4 and 5. This letter provides both an Executive Summary highlighting some of our main comments, and a Detailed Comments section. It should be noted that the Executive Summary and Detailed Comments provided in this letter are not necessarily intended to be comprehensive, and additional comments may be provided at a later time.

EXECUTIVE SUMMARY

Our comments on the Draft Monterey Subbasin GSP Chapters 4 and 5 generally relate to the following items: description of geologic conditions, conclusions regarding groundwater conditions, preferential use of airborne electromagnetics (AEM) data over field data, and hydrogeologic interpretation of AEM data. Our high-level summary comments on Draft GSP chapters 4 and 5 are provided below, with a detailed comments section following this Executive Summary.

HWG summary comments on Chapters 4 and 5 are:

- The GSP presents a hydrogeologic conceptual model (HCM) with some inaccuracies based on invalid hydrogeologic interpretations of the AEM surface geophysics and other data that is not in agreement with available field data including boring logs, aquifer test, groundwater level, and groundwater quality data;
- The GSP does not utilize the most up-to-date hydrogeologic conceptual model for the northern Monterey Subbasin and southern 180/400 Aquifer Subbasin area in understanding the

hydrogeology of the area even the though the HWG conducted the most recent and extensive investigation of the hydrogeology specific to this area (e.g., HWG Technical Report, November 2017);

- Groundwater levels/quality and aquifer/aquitard continuity are mischaracterized in the northern Monterey Subbasin and southern 180/400 Aquifer Subbasin due to: inappropriate application of the Fort Ord Site Conceptual Model to this area; use of inaccurate hydrogeologic interpretations from AEM data; and lack of using all available field data and the most recent comprehensive hydrogeologic conceptual model of the area;
- The Dune Sand Aquifer (DSA) is not a Principal Aquifer and has been misclassified in the Monterey Subbasin GSP, and is in conflict with the 180/400 Foot Aquifer Subbasin GSP where the Dune Sand Aquifer is not classified as a Principal Aquifer;
- The inaccurate HCM analyses create conflicts with the 180/400-Foot Aquifer Subbasin GSP;
- While the HWG concur that achieving sustainability within the 180/400-Foot Aquifer Subbasin is important for achieving sustainability within Monterey Subbasin, the cause of depressed groundwater elevations and seawater intrusion in the Monterey Subbasin is mischaracterized as essentially being entirely due to pumping within the 180-/400-Foot Aquifer Subbasin and Seaside Subbasin; however, pumping from wells within Monterey Subbasin have played a major role in historical/current undesirable groundwater conditions and the Monterey Subbasin needs to do its part in achieving local and regional sustainability;
- The Monterey Subbasin GSP relies primarily on a study conducted by WRA Environmental (and by reference a study by Formation Environmental) in its discussion of groundwater dependent ecosystems (GDEs); however, there are many concerns about the methods/conclusions used in these studies to establish groundwater dependency of ecosystems that have been documented previously by HWG and supplemented by a recent study conducted by Geoscience/AECOM.

More specific and detailed comments on Monterey Subbasin Draft GSP chapters 4 and 5 are provided below.

DETAILED COMMENTS

Chapter 4 – Hydrogeologic Conceptual Model

1. The GSP states, “The geology described here is based on previously published scientific reports from investigations conducted by the USGS, State of California, other consulting firms, and academic institutions.”(Section 4.1.1, Geological and Structural Setting, p. 64).

HWG Comment: *We note that extensive field work conducted by the HWG between 2013 and 2018, including test slant well installation/testing, drilling of several borings and installation of an extensive monitoring well network, extensive data analyses covering the coastal southern 180/400-Foot Aquifer Subbasin and coastal northern Monterey Subbasin are documented in publicly available reports prepared by the HWG and posted on the Monterey Peninsula Water Supply Project (MPWSP) website (e.g., HWG,* *November 2017). These HWG documents incorporated data from previous studies by others (many of which are cited in the Monterey Subbasin GSP), and allowed for improved hydrogeologic interpretations by incorporating both existing and new field data collected by HWG. The Monterey Subbasin GSP ignores these HWG documents and makes geologic interpretations that are inconsistent with the most recent data that has been collected. Some of the specific inconsistencies are noted in other comments in this letter.*

2. The GSP mischaracterizes the Dune Sand Aquifer in multiple instances in Chapter 4. One example is the attempt to label the Dune Sand Aquifer as a "Principal Aquifer" (Section 4.2.1, Hydrogeology in the Marina-Ord Area, Table 4-1, page 79).

HWG Comment: *The Dune Sand Aquifer is not a Principal Aquifer in the subbasin. The Draft GSP prepared by City of Marina (2019) stated the Dune Sand Aquifer, "…is not commonly used for drinking water or agricultural irrigation". The Monterey County Water Resources Agency (MCWRA), which has studied and characterized the groundwater basin for many decades, does not consider the Dune Sand Aquifer as a principal aquifer (e.g., no seawater intrusion maps are prepared for the Dune Sand Aquifer by MCWRA). The 180/400-Foot Aquifer Subbasin GSP, which the MCWD GSA adopted and submitted to DWR, also does not classify the Dune Sand Aquifer as a Principal Aquifer. The Dune Sand Aquifer is not a Principal Aquifer due in part to its lack of capability for use in groundwater production (e.g., thin saturation, groundwater quality issues related to sea water intrusion and nitrates, etc.). In addition, the Hydrogeology section for the Corral de Tierra Area in Monterey Subbasin GSP Chapter 4 states that following about the upper 120 feet of sediments, "Several small domestic wells draw groundwater from these local alluvial aquifers, but these volumes of groundwater are minimal…Since this volume of groundwater is neither economic or significant, these shallow sediments are not considered a principal aquifer…Groundwater in these sediments is hydraulically connected to the small streams found in the area…" (page 111 of Chapter 4). This conclusion for the Corral de Tierra Area is inconsistent with designating the Dune Sand Aquifer, which cannot even claim to be tapped by "several small domestic wells", as a Principal Aquifer. As noted above, designation of the Dune Sand Aquifer as a Principal Aquifer is inconsistent with the 180/400-Foot Aquifer Subbasin GSP (where the Dune Sand Aquifer also is present), which specifically did not designate the Dune Sand Aquifer as a Principal Aquifer. It is also important to point out that the Dune Sand Aquifer, as defined in the Monterey Subbasin GSP, consists of two distinct aquifers – the coastal Dune Sand Aquifer that directly overlies the 180-Foot Aquifer and the perched/mounded Dune Sand Aquifer (known as the A-Aquifer in Fort Ord studies) that overlies the Fort-Ord Salinas Valley Aquitard (FO-SVA) clay layer (incorrectly referred to as Salinas Valley Aquitard in the Monterey Subbasin GSP). The coastal Dune Sand Aquifer is intruded with sea water, while the perched/mounded Dune Sand Aquifer is perched in areas, has thin saturation, is impacted by nitrates, and is not developed with production wells for any significant water supply uses.*

3. The GSP relies on old geologic cross-sections from 2001 (Section 4.2.1.1, Cross-Sections, pages 80-85).

HWG Comment: *The cited geologic cross-section references and Figures 4-9 through 4-12 do not utilize best available science and most recent borehole and geophysical logs for wells drilled in the area, nor do* *they utilize the most recent geologic cross-sections developed based on these data (see HWG, November 2017). This results in mischaracterization of hydrogeologic conditions for the GSP Plan Area. Geologic cross-sections that use the latest available data and include areas within the Monterey Subbasin are provided in previously published HWG documents (HWG, November 2017; HWG et al., February 2020).*

4. With regard to the Dune Sand Aquifer, the GSP states, "The aquifer is perched further away from the coast in areas where the SVA exists… " (Section 4.2.12, Principal Aquifers, page 86).

HWG Comment: *The HWG agrees with this GSP statement about the Dune Sand Aquifer being perched in areas where it is underlain by the SVA (more correctly referred to as the FO-SVA). However, perched aquifers should not be designated as Principal Aquifers as is being done in the Monterey Subbasin GSP.*

5. The GSP refers to an average saturated thickness of the Dune Sand Aquifer being approximately 50 feet (Section 4.2.12, Principal Aquifers, page 86).

HWG Comment: *As described above, there are two distinct aquifers being referred to collectively in the GSP as the Dune Sand Aquifer. While the coastal DSA may have a saturated thickness of 50 feet or more in some areas, the perched/mounded DSA has a saturated thickness considerably less than 50 feet.*

6. The GSP does not distinguish and describe the differences between the Salinas Valley Aquitard (SVA) and Fort-Ord Salinas Valley Aquitard (FO-SVA) and its significance to the perched/mounded aquifer (underlain by FO-SVA) versus the Dune Sand Aquifer and its equivalents (not underlain by FO-SVA) in many places in the document (Chapter 4).

HWG Comment: *It should be noted that the SVA and FO-SVA are not the same aquitard and FO-SVA occurs at a higher elevation; therefore, they should not be referred to as the same aquitard.*

7. The GSP shows a Conceptual Site Model diagram that was developed from Fort Ord studies, and implies that the Fort Ord Conceptual Site Model diagram applies throughout the Monterey Subbasin (Section 4.2.1.2, Principal Aquifers, Figure 4-13, p.87).

HWG Comment: *Recent studies completed by the HWG demonstrate that the Fort Ord Conceptual Site Model does not apply in the southern portion of the 180/400 Foot Aquifer Subbasin or the northern portion of the Monterey Subbasin. In particular, the concepts of an Intermediate 180-Foot Aquitard and lack of a 180/400 Foot Aquitard do not apply outside of Fort Ord. Work completed by HWG demonstrates that the 180-Foot Aquifer is one vertically continuous aquifer and that the 180/400 Foot Aquitard is present (HWG, November 2017).*

8. The GSP states that horizontal hydraulic conductivity in the DSA ranges from 0.14 to 120 feet/day (Section 4.2.1.2, Principal Aquifers, p.87).

HWG Comment: *It is important to distinguish the two major portions of what is referred to in the GSP as the DSA – coastal and perched/mounded. While the coastal DSA does have K values on the higher end of the cited range, perched/mounded portion of the DSA only has K values at the lower end of the cited range.*

9. The GSP makes general statements on hydrogeologic interpretations of AEM data, including outside of the GSP Plan area (Section 4.2.1.2, Principal Aquifers, p. 88).

HWG Comment: *It is not clear why the GSP is speculating on aquifer conditions outside of the Monterey GSP Plan Area based solely on AEM data, and without consideration of geologic and well data. The GSP also provides no demonstration/evidence of how these conclusions were reached. The HWG has previously provided extensive documentation of erroneous hydrogeologic interpretations of the AEM data (HWG, November 2017, January 2018, August 2018, January 2019, March 2019, and April 2019). The HWG April 2019 document clearly demonstrates with field data that the hydrogeologic interpretations of aquitard gaps from the AEM study are invalid. Furthermore, as described above, MPWSP monitoring well borehole logs demonstrate that areas of uncertain aquitard continuity identified by MCWRA (who did not have MPWSP monitoring well borehole data available to them at the time of their study) near the northern Monterey Subbasin boundary are no longer uncertain and clearly have significant aquitard material present. Furthermore, review of water level and water quality data for the MPWSP clearly demonstrate the presence and continuity of the 180/400-Foot Aquitard in this area.*

The Monterey Subbasin GSP does not describe the applicability of the concept of a sea water wedge (i.e., where sea water intrusion occurs, less saline water often overlies more saline water in a given aquifer) to explain the expected presence of less saline water overlying more saline water in some areas of the vertically continuous 180-Foot Aquifer. The presence of less saline water in the upper portion of an aquifer does not demonstrate the aquifer is not sea water intruded. Furthermore, given the standard of 500 mg/L chloride applied by MCWRA for defining the area of seawater intrusion, the AEM data collected in the area are not capable of distinguishing between a chloride concentration below the standard (e.g., 200 mg/L) from a chloride concentration above the standard (e.g., 600 mg/L) given inherent uncertainties in AEM data interpretation and the complicating variable of lithologic influences on AEM data.

10. The GSP states, "South of the City of Marina, in a portion of the former Fort Ord, the 180-Foot Aquifer is separated into an "upper" zone of sandy deposits with some gravel and a "lower" zone of gravel with sand and clay lenses; the two zones are separated by a thin clay layer (Ahtna Engineering, 2013). Data collected within the former Fort Ord show that significant head differences exist between the upper and lower ones of the 180-Foot Aquifer." (Section 4.2.1.2, Principal Aquifers, p. 91).

HWG Comment: *The HWG agrees that the area where this conceptual model applies is in a portion of former Fort Ord to the south of the City of Marina. However, the GSP implies this conceptual model (illustrated in Figure 4-13) applies throughout the GSP Plan Area, including north of Reservation Road, which is not correct as documented in work by HWG that is not referenced in this GSP (e.g., HWG, November 2017).*

11. The GSP discussion of the "Middle (180/400) Aquitard" suggests it is not present beneath the majority of the Marina-Ord Area, and implies this conceptual model applies throughout the Monterey Subbasin as illustrated by Figure 4-13 (Section 4.2.1.2, Principal Aquifers, p. 91).

HWG Comment: *As noted above with other aspects of the conceptual model presented in Figure 4-13, the concept that the 180/400 Foot Aquitard is not present in northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is erroneous (see recent work by HWG not referenced in the GSP, as well as MCWD well logs). For example, HWG work demonstrates similar groundwater elevations in the upper and lower 180 Foot Aquifer (MW-6), and significantly different groundwater elevations and fluctuations in the 180 and 400 Foot Aquifers (multiple MPWSP monitoring wells).*

12. The GSP states, "The Lower 180-Foot Aquifer zone and the 400-Foot Aquifer in the vicinity of the City of Marina are functionally the same due to the missing Middle (180/400-Foot) Aquitard in this area." (Section 4.2.1.2, Principal Aquifers, p. 94).

HWG Comment: *As discussed above with other aspects of the Site Conceptual Model (Figure 4-13), this characterization does not apply to Northern Monterey Subbasin, contrary to what is stated/implied in the GSP.*

13. The GSP states, "Near the Monterey-Seaside subbasin boundary, a depression exists in the groundwater potentiometric surface of the 400-Foot Aquifer…These data suggest that a potential connection may exist between the 400-Foot Aquifer and the Deep Aquifer in this area." (Section 4.2.1.2, Principal Aquifers, p. 94.)

HWG Comment: *There is no geologic evidence provided in the GSP to support this statement. Preliminary review of geologic data (lithologic logs and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.*

14. The GSP states, "As shown in Section 6 below, groundwater flow direction in the 400-Foot Aquifer is strongly influenced by groundwater pumping in the Salinas Valley Groundwater Basin, inland of the Monterey Subbasin." (Section 4.2.1.2, Principal Aquifers, p. 94)

HWG Comment: *A primary theme of this GSP here and elsewhere is that pumping in the 180/400 Foot Aquifer Subbasin is essentially solely responsible for seawater intrusion in the 180-Foot Aquifer and 400-Foot Aquifer within Monterey Subbasin, and for depressed Deep Aquifer groundwater elevations in the within Monterey Subbasin. However, the history of groundwater development in the Monterey Subbasin demonstrates how groundwater production wells developed for MCWD and Fort Ord resulted in seawater intrusion in the 180-Foot Aquifer and 400-Foot Aquifers in Monterey Subbasin (for example, see quote below from Harding ESE, 2001). In addition, Deep Aquifer groundwater elevations were fluctuating around sea level prior to pumping of Deep Aquifer wells by MCWD that dropped Deep Aquifer groundwater elevations well below sea level. Thus, groundwater pumping from wells screened in the 180-Foot, 400-Foot, and Deep Aquifers within Monterey Subbasin have played a significant role in historical/current seawater intrusion and depressed groundwater elevations within Monterey Subbasin.*

Harding ESE (2001) states: "Seawater intrusion beneath the city of Marina was observed soon after installing several production wells in the 180-Foot Aquifer (MCWD-1, the first city well, was installed in

1956). Subsequent seawater intrusion into this area was closely related to ground water withdrawal by the city of Marina and former Fort Ord. Deteriorating water quality forced the city of Marina to discontinue pumping most of its 180-Foot Aquifer wells by the late 1970's and install water-supply wells in the 400-foot (MCWD-8, -8a, and -9) and Deep Aquifers (MCWD-10, -11, and-12)."

15. The GSP states with respect to the Deep Aquitard (otherwise known as 400 Foot/Deep Aquitard), "There is no analysis available for its spatial occurrence or geologic composition." (Section 4.2.1.2, Principal Aquifers, p. 95).

HWG Comment: *The GSP could have conducted the "missing" analysis of the aquitard for the Monterey Subbasin given that several MCWD production wells (e.g., MWCW 10, 11, 12) and other wells (e.g., USGS deep nested monitoring well, agricultural wells) have available lithologic and geophysical logs. Such an analysis would demonstrate the presence of a 200 to 300 foot thick clay layer (i.e., 400/Deep Aquitard) between the 400-Foot Aquifer and uppermost Deep Aquifer Zone. The lack of seawater intrusion in the Deep Aquifer, which has groundwater elevations on the order of 50 to 100 feet below sea level in the northern Monterey Subbasin area and a strong vertically downward gradient from the 400-Foot Aquifer, combined with high salinity in the 400-Foot Aquifer within and surrounding the northern Monterey Subbasin also shows the strong integrity of the aquitard between the 400-Foot Aquifer and Deep Aquifer. T*he large difference in water levels between the 400-Foot Aquifer and Deep Aquifers also provides evidence of a thick/tight aquitard separating these aquifer zones.

16. The GSP describes the Reliz Fault as displaced the Monterey Formation, which is the base of the Deep Aquifer, shifted downward on the northeast side by 1,000 feet. It then states the fault does not appear to impede groundwater flow within the Dune Sand Aquifer, 180-Foot Aquifer, or 400-Foot Aquifers (Section 4.2.1.3, Structural Restrictions to Flow, p. 98).

HWG Comment: *The GSP does not comment on the possibility of the Reliz Fault altering groundwater flow within the Deep Aquifer.*

17. This section of the GSP begins, "This Section presents a general discussion of the natural fresh groundwater quality in the Marina-Ord Area, focusing on general geochemistry (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *Given the significance of historical and ongoing seawater intrusion in the Dune Sand Aquifer, 180-Foot Aquifer, and 400-Foot Aquifer in the Marina-Ord Area, it is unclear why this section would only describe the fresh water within the Marina-Ord Area.*

18. With regard to the Dune Sand Aquifer, the GSP states, "Groundwater in this aquifer is primarily fresh; minimal seawater intrusion has occurred in this aquifer (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *The coastal Dune Sand Aquifer is intruded by seawater, as demonstrated by monitoring wells at the MCWD office on Reservation Road (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996, 2001) and in the vicinity of the CEMEX site (HWG, November 2017).*

19. The GSP states, "The Dune Sand Aquifer contributes recharge to the 180-Foot Aquifer…" (Section 4.2.1.4, General Water Quality, p. 98).

HWG Comment: *It should be noted that this recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is minimal (likely on the order of a few hundred acre-feet per year). This recharge has not stopped seawater intrusion from occurring in this area.*

Chapter 5 – Groundwater Conditions

1. The GSP notes data sources used in the GSP, which includes documents/data for Monterey Peninsula Landfill (Section 5.1.1, Data Sources, p. 6).

HWG Comment: *We note that Monterey Peninsula Landfill (MPL) is not located within Monterey Subbasin. In addition, if data from Monterey Peninsula Landfill are being used, why are data from MPWSP monitoring network not being used. Notably, later in Chapter 5, the GSP uses AEM data outside of Monterey Subbasin and within the area of MPWSP monitoring network data, yet there is no use of MPWSP data that contradicts the hydrogeologic interpretation of AEM data provided in the GSP.*

2. The GSP states that the Dune Sand Aquifer is a Principal Aquifer and that the 180-Foot Aquifer contains two distinct layers, known as the upper- and lower- 180-Foot Aquifer (Section 5.1.2.1, Marina-Ord Area, p.7).

HWG Comment: *The Dune Sand Aquifer should not be designated as a Principal Aquifer, and is in conflict with the 180/400 Foot Aquifer Subbasin GSP in this regard. Furthermore, the splitting of the 180-Foot Aquifer into two distinct aquifers only applies in the Fort Ord area, and does not apply in northern Monterey Subbasin (HWG, November 2017). While the entire thickness of the 180-Foot Aquifer is intruded by seawater near the coast and for a significant distance inland, the presence of less saline water within the upper portion of the 180-Foot Aquifer further inland is merely a function of the nature of seawater intrusion wedges, and not a function of the presence of an intermediate aquitard within the 180-Foot Aquifer in northern Monterey Subbasin.*

3. The GSP describes groundwater flow conditions in the 180-Foot Aquifer, and states, "…inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion." (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *Any groundwater flow that may occur from the Perched/Mounded portion of the inland Dune Sand Aquifer to the underlying 180-Foot Aquifer has historically not prevented seawater* *intrusion from occurring within the 180-Foot Aquifer, which has been and remains heavily intruded with seawater. Any claims to the contrary, such as in this referenced statement from the Monterey Subbasin GSP, are incorrect. As noted above, there are not geologically distinct Upper and Lower 180 Foot Aquifers in northern Monterey Subbasin. The amount of recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is small, as can easily be demonstrated by calculation of the amount of precipitation recharge in the Dune Sand Aquifer within the area west of the groundwater divide that has potential to recharge the 180-Foot Aquifer (e.g., on the order of a few hundred AFY, before subtracting Ford Ord remedial pumping). Furthermore, in order to dilute incoming seawater to a fresh water concentration, there would need to be over 30 times more fresh water than seawater in the mixing zone to create a net fresh water condition. Thus, a few hundred AFY of fresh water can effectively only dilute about 10 to 20 AFY of incoming seawater.*

4. The GSP states, "…the lower 180-Foot Aquifer is hydraulically connected to the 400-Foot Aquifer in the Marina-Ord Area due to the discontinuous nature of the 180/400-Foot Aquitard within this region…As such, groundwater elevation and gradients in the lower 180-Foot Aquifer are similar to those in the 400-Foot Aquifer in the Marina Ord Area of the Subbasin…" (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *This characterization of the discontinuous nature of the 180-400 Aquitard is not applicable to the northern portion of the Monterey Subbasin. Groundwater levels in the 180-Foot Aquifer and 400-Foot Aquifer are clearly different and distinct in the northern half of Monterey Subbasin and in the adjacent 180/400-Foot Aquifer Subbasin (HWG, November 2017). The Monterey Subbasin GSP does not demonstrate the similarity or difference in groundwater elevations to justify its characterization.*

5. Figures 5-1 and 5-5 show the western extent of the FO-SVA north of Monterey Subbasin as extending to MPWSP MW-3.

HWG Comment: *The extent of FO-SVA shown on the maps is outdated and also does not incorporate more recent data and analyses based on the MPWSP borehole/well data. We also note that groundwater elevation figures for all units except the Dune Sand Aquifer extend northward across the Monterey Subbasin/180-400 Foot Aquifer Subbasin boundary, even though many Dune Sand Aquifer well locations are available and shown on the figures for the MPWSP and MPL monitoring networks. In addition, there are several monitoring wells located at the MCWD District office headquarters and treatment plant on Reservation Road near the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996 and 2001).*

6. In describing groundwater elevations in the 400-Foot Aquifer the GSP states, "A local groundwater depression exists just north of the Monterey-Seaside Subbasin boundary where a potential connection between the 400-Foot Aquifer and the Deep Aquifers may be located ." (Section 5.1.2.1, Marina-Ord Area, p.8).

HWG Comment: *The GSP provides no geologic evidence for a potential connection at this location between the two aquifers. The GSP only cites to HLA (2001) for cross-sections in this area, but other geologic cross-sections are available to consider from previous reports (e.g., HWG, 2017; Yates et.al., 2005). The location of this depression, which is more centrally located within Monterey Subbasin than described in the GSP text, is only about 1.5 miles south of MCWD Deep wells where a thick (i.e., 200 to 300 feet) aquitard exists between the 400 Foot Aquifer and Deep Aquifer.*

7. GSP Figures 5-1 and 5-5 (Groundwater Level Contours in the Dune Sand Aquifer – Fall 2017 and Spring 2018) show locations of MPWSP and MPL wells, but do not use the data to prepare groundwater level contours.

HWG Comment: *It is not clear why the GSP maps would show these MPWSP/MPL well locations but not use the data. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or to develop an understanding of the geologic conditions for the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data.*

8. GSP Figures 5-2 and 5-5 (Groundwater Level Contours in the 180-Foot Aquifer – Fall 2017 and Spring 2018) show locations of only three of the MPWSP wells (MW-6, MW-8, and MW-9), and do not use data from MW-8 and MW-9.

HWG Comment: *It is not clear why the GSP maps only show selected MPWSP well locations and do not use most of the data from the selected wells that are shown on the maps. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or in developing an understanding of the geologic conditions underlying the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data. We also note that groundwater is indicated to flow inland from the ocean to a pumping center in the north central portion of Monterey Subbasin.*

9. Figures 5-3 and 5-7 (Groundwater level Contours in the 400-Foot Aquifer – Fall 2017 and Spring 2018) show a +10 feet MSL contour as the shoreline in Marina Subbasin.

HWG Comment: *There is no well control to support this +10 feet MSL contour line, or even the zero contour line. We note that groundwater elevations in the 400-Foot Aquifer for MPWSP MW-3 (very close to the shoreline) ranged from 0 to -15 feet NAVD88 during this time period. We also note that groundwater is indicated to flow inland from the ocean to a depressed area in the south central portion of Monterey Subbasin. The Fall 2017 groundwater levels show that the pumping depression in the southern central area of Monterey Subbasin contributes to a broader depression that extends to the 180/400 Foot Aquifer Subbasin. Spring 2018 groundwater levels appear to indicate occurrence of a temporal groundwater divide around the MCWD well field.*

10. The GSP states, "…water levels in the Dune Sand Aquifer increase and decrease during extended wet and dry periods." This statement is apparently in reference to Figure 5-11: Representative Groundwater Elevation Hydrographs in the Dune Sand Aquifer (Section 5.1.3.1, Long-Term Groundwater Elevation Trends, Marina-Ord Area, p. 21).

HWG Comment: *The seven hydrographs shown in Figure 5-11 do not appear to respond to wet and dry periods. The only short-term response observed is around the year 2000 in the hydrograph for MW-OU2-05-A. This apparent stability of groundwater levels in the Perched/Mounded portion of the Dune Sand Aquifer is quite unlike the seasonal fluctuations that occur in response to pumping in the underlying aquifers, and further confirms that the DSA is undeveloped and essentially undevelopable as a water supply and therefore not a Principal Aquifer.*

11. The GSP states, "Groundwater elevations in the Lower 180-Foot Aquifer are generally equivalent to those observed in the 400-Foot Aquifer…" (Section 5.1.3.1, Long-Term Groundwater elevation Trends, 180-Foot Aquifer, Lower 180-Foot Aquifer, p. 21).

HWG Comment: *The GSP provides no evidence that groundwater elevations in the Lower 180-Foot Aquifer are equivalent to those in the 400-Foot Aquifer. In addition, no geologic evidence is provided that defines distinct Upper and Lower 180-Foot Aquifers in terms of a continuous intermediate aquifer throughout the Monterey Subbasin. MPWSP monitoring well MW-6 is a nested well cluster with separate wells in the upper and lower 180-Foot Aquifer and shows essentially identical groundwater elevations and fluctuations – it is located along Blanco Road on the border of the Monterey Subbasin with the 180/400-Foot Aquifer Subbasin.*

12. The GSP states that groundwater elevation data for MPWMD#FO-10 and MPWMD#FO-11 suggest, "…(1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells." (Long-Term Groundwater Elevation Trends, 400-Foot Aquifer, p. 22).

HWG Comment: *Insufficient evidence is provided to make the stated conclusions; for example, no geologic evidence is provided to support these claims. In addition, more groundwater elevation data are needed to evaluate the gradient and flow direction in this portion of the aquifer. Preliminary review of geologic data (lithologic logs and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.*

13. GSP Figure 5-15 shows groundwater hydrographs for Deep Aquifer wells near the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary. Figure 5-16 shows Deep Aquifer groundwater pumping over time. In reference to the adjacent 180/400-Foot Aquifer Subbasin, the GSP states that, "…groundwater elevations in wells located near Cooper Road and Blanco Road have declined more than 5 ft/year over the past 15 years."

HWG Comment: *We note that the three wells in the 180/400-Foot Aquifer Subbasin have data through about 2020 and generally show fluctuating but overall stable groundwater elevations from about 2015 to 2020. Several of the MCWD wells within the Monterey Subbasin shown in the figure are lacking data from about 2017 to 2020, but the overall trend from available data appears to be declining groundwater elevations within Monterey Subbasin from 2015 to 2020. We note that Figure 5-16 shows significant increases in both agricultural and urban pumping from the Deep Aquifer after 2013, with urban pumping comprising approximately half of the total Deep Aquifer pumping over that time period. Figure 5-16 shows a doubling of urban pumping between 2013 and 2018, but no discussion/explanation of the sharp jump in urban pumping is provided in the text. Overall, the characterization of recent Deep Aquifer groundwater elevation trends between the two subbasins in the text appears to be inaccurate based on review of the figures.*

14. The GSP states, "These downward vertical gradients are caused by areal surface recharge, groundwater extraction from deeper aquifers, and laterally extensive aquitards, which exist in the Marina-Ord Area." (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, pp. 31-32).

HWG Comment: *We note that the GSP references the presence of laterally extensive aquitards separating Principal Aquifers throughout Monterey Subbasin, a statement that we agree with, and yet the conceptual model described in GSP Chapters 4 and 5 provides for essentially no aquitard between the 180-Foot and 400-Foot Aquifers and a big hole in the thick aquitard between the 400-Foot Aquifer and Deep Aquifers.*

15. The GSP states that in the central Marina-Ord Area the groundwater elevations in the upper 180-Foot Aquifer are 70 feet lower than in the Dune Sand Aquifer (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, p. 32).

HWG Comment: *This 70 foot difference in groundwater elevation almost certainly reflects the presence of perched aquifer conditions in the Dune Sand Aquifer at this location, which is why the HWG refers to the portion of the so-called Dune Sand Aquifer overlying the FO-SVA as the Perched/Mounded Aquifer. This observation also begs the question of why the Dune Sand Aquifer is being classified as a Principal Aquifer in this GSP, when much of it is a thinly saturated perched aquifer.*

16. The GSP states, "Within the Monterey Subbasin, seawater intrusion has been documented in the northern portion of the lower 180-Foot and 400-Foot Aquifers." (Section 5.3, Seawater Intrusion, p. 36).

HWG Comment: *As discussed other HWG comments in this letter, the designation of a geologically distinct lower 180-Foot Aquifer does not apply in the northern portion of the Monterey Subbasin. The entire thickness of the 180-Foot Aquifer is intruded at the coast and for some distance inland, with a seawater wedge having formed further inland (i.e., less saline water overlying more saline water due to density differences).*

17. The GSP describes data sources used in their analysis of seawater intrusion for the GSP, which include two airborne electromagnetic (AEM) surveys (Section 5.3.1, Seawater Intrusion, Data Sources, p. 36).

HWG Comment: *We note that the GSP utilizes an AEM profile entirely within the 180/400-Foot Aquifer Subbasin that passes through/near several MPWSP boreholes/wells, yet the GSP does not use the readily available MPWSP borehole/well data in its analysis. Furthermore, the HWG has conclusively demonstrated in previous documents (e.g., HWG, April 2019) that hydrogeologic interpretations derived from AEM data are flawed and inconsistent with borehole/well data.*

18. The GSP devotes several pages and two figures (5-26 and 5-27) to describing AEM surveys, primarily a profile entirely outside of the Monterey Subbasin (Section 5.3.1.2, Geophysical Data, pp. 36-38, 41-42, and 45-46).

HWG Comment: *It is not clear why the GSP relies so heavily on AEM data (primarily outside the Monterey Subbasin) in its discussion of seawater intrusion (and disregards borehole/well data for the same area) – especially given the flaws in the hydrogeologic and groundwater quality interpretations made using AEM data previously described in multiple HWG documents (e.g., January, March, April 2019). The hydrostratigraphy shown on the AEM profiles (Figures 5-26 and 5-27) is incorrect; particularly with regard to its depiction of aquitards (i.e., the presence of a continuous intermediate aquitard within the 180-Foot Aquifer and absence of a 180/400 Aquitard). In essence, the GSP is inappropriately trying to apply the Fort Ord hydrogeologic conceptual model (developed for a limited area south of Reservation Road) throughout the northern Monterey Subbasin and into the adjacent 180/400 Foot Aquifer Subbasin. Field borehole/well data demonstrate that application of the Fort Ord HCM to northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is incorrect. There is no evidence/basis to support the stratigraphic interpretations in Figures 5-26 and 5-27 related to the presence (or absence) of aquitards between various aquifers. We note that there are no control points for the majority of the cross-section in Figure 5-26, yet the figure implies an abundance of fresh water. Field water quality data from MW-7M do not match that indicated on the profile. The two profiles are inconsistent; where control points exist with a TDS color coded legend the profiles are not shaded accordingly; however, where no control points exist to validate AEM water quality the profiles are shaded.*

19. In describing the purpose of the AEM surveys, the GSP states, "The studies' goal was to evaluate the understanding of the hydrostratigraphy in the study area and to interpret that distribution of groundwater quality indicated by available well data." (Section 5.3.1.2, Geophysical Data, p. 37).

HWG Comment: *While this statement references "available well data", it does not actually cite or use available well data. Rather, the GSP interpretations of hydrostratigraphy and seawater intrusion in this section are based primarily on interpretations of AEM data that are at odds with well data (see various HWG documents such as January 2019, March 2019, and April 2019).*

20. The GSP describes how AEM data (i.e. electrical resistivity) are dependent on, "…the amount of clay, the amount of water, and/or the salinity of the water…" (Section 5.3.1.2, Geophysical Data, p. 37).

HWG Comment: *While we agree with this statement, these facts also point out the high level of uncertainty associated with interpretation of AEM data in this coastal seawater intruded setting where multiple variables are impacting recorded AEM (resistivity) values. This allows for multiple non-unique interpretations of AEM data to be made in such settings, which creates more uncertainty in those hydrostratigraphic and groundwater quality interpretations. The GSP itself acknowledges that water quality interpretation is "difficult to discern" for a wide range of AEM resistivity values. The GSP does not acknowledge that geochemical interpretation of AEM resistivity values even outside of the cited large range are still subject to uncertainties related to variation in lithologic/saturation conditions.*

21. The GSP states, "The AEM surveys have found that high salinity groundwater as a result of seawater intrusion exists within the lower 180-Foot Aquifer and 400-Foot Aquifers of the Monterey Subbasin. This volume of high salinity groundwater is overlain by fresh groundwater in the Dune Sand and upper 180-Foot Aquifers. The results of the AEM study are consistent with water quality data collected within the Subbasin (EKI, 2019)." (Section 5.3.1.2, Geophysical Data, p. 38).

HWG Comment: *Both the AEM data and borehole/well data demonstrate that the coastal Dune Sand Aquifer and essentially the entire thickness of the 180-Foot Aquifer are seawater intruded from the ocean shoreline to approximately one mile inland. At that point, the coastal Dune Sand Aquifer begins to transition to the Perched/Mounded Aquifer that overlies of FO-SVA that is generally not seawater intruded because it is an elevated thinly saturated perched aquifer further inland, and the fully seawater intruded area of the 180-Foot Aquifer transitions to a seawater intrusion wedge with less saline water overlying more saline water due to density differences. While the results of the AEM survey may be consistent with the primarily Perched/Mounded Aquifer groundwater quality data cited in EKI (2019), the AEM survey based hydrostratigraphic and groundwater quality interpretations are inconsistent with the groundwater quality data collected for the MPWSP (e.g., HWG, April 2019) and key MCWD and Seaside Basin wells.*

22. The GSP presents an analysis (Figure 5-23) that demonstrates the definition of 500 mg/L chloride as the threshold for defining seawater intrusion is equivalent to a TDS of 1,000 mg/L. The GSP also cites the State of California upper Secondary Maximum Contaminant Level of 1,000 mg/L for TDS (Section 5.3.2, Defining Seawater Intrusion, p. 40).

HWG Comment: *We concur with the use of 500 mg/L chloride (although a good argument can be made for use of 250 mg/L chloride as a better indicator) and 1,000 mg/L TDS as an appropriate standards/thresholds for drinking water and seawater intrusion. We note that the AEM studies (study authors and study proponents) continue to argue for a drinking water and seawater intrusion threshold of 3,000 mg/L TDS, but this is at odds with GSP stated seawater intrusion and drinking water standards/thresholds of 500 mg/L and 1,000 mg/L TDS. Furthermore, due to the significant uncertainties in AEM groundwater quality interpretations, the AEM studies primarily attempt to differentiate* *groundwater above and below 3,000 mg/L TDS. The use of AEM data with a lower cutoff value (e.g., 1,000 mg/L TDS) results in even greater uncertainty in interpreted results than are achieved using the already uncertain AEM interpretations based on a cutoff of 3,000 mg/L TDS. We note that the GSP adopts a double standard by saying seawater intrusion has occurred when TDS exceeds 1,000 mg/L or chloride exceeds 500 mg/L in the Deep Aquifer, yet concentrations of 3,000 mg/L TDS and over 1,000 mg/L chloride represent low-TDS groundwater that is considered a source of drinking water supply in the AEM studies cited in the GSP.*

23. In reference to the AEM profiles shown in Figures 5-26 and 5-27, the GSP states, "TDS and AEM data shown on these cross-sections confirm that seawater intrusion in the Monterey Subbasin primarily exists in the lower 180-Foot Aquifer and 400-Foot Aquifer, whereas groundwater in the Dune Sand and upper 180-Foot Aquifers remains fresh." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *While the statement refers to Monterey Subbasin, it should be noted that the Figure 5-26 is located entirely outside (north of) Monterey Subbasin, and Figure 5-27 contains very little data for the AEM profile within Monterey Subbasin. Furthermore, we have previously commented (in this letter and previous documents) on the flaws in the hydrostratigraphic and water quality interpretations shown on these AEM profiles (e.g., HWG, April 2019). Actual borehole/well data show the coastal Dune Sand Aquifer and entire thickness of the 180-Foot Aquifer are heavily intruded with seawater at the coast and for a significant distance inland. We recommend that AEM data only be used where results can be clearly validated with actual lithologic and water quality data. By not using this approach, the groundwater conditions are being misrepresented.*

24. In reference to the 180-Foot and 400-Foot Aquifers, the GSP states, "It appears that seawater intrusion in these two aquifers forms a unified intrusion wedge, due to the discontinuity of the 180/400-Foot Aquitard near the coast." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *The HWG has previously demonstrated the flaws and inaccuracies in the hydrostratigraphic/water quality interpretations from AEM data inherent in this statement (i.e., absence of 180/400 Aquitard) (see HWG, April 2019).*

25. The GSP states, "Based on available TDS and AEM data, Figure 5-28 depicts the estimated extent of seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41).

HWG Comment: *The area covered by Figure 5-28 does not include the AEM profile shown in Figure 5-26 and the AEM profile in Figure 5-27 provides very little data for the mapped area in Figure 5-28. Therefore, Figure 5-28 presumably is based essentially exclusively on TDS data. Furthermore, the area covered by Figure 5-28 has separate 180-Foot and 400-Foot Aquifers separated by an aquitard, so one map is mixing data from different aquifers and should be revised to be two separate figures as is done by the MCWRA.*

26. The GSP states, "…the 180-Foot Aquifer in the Subbasin is divided by an intermediate aquitard into an upper zone and a lower zone. There is no observed seawater intrusion in the upper portion of the 180-Foot Aquifer." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42).

HWG Comment: *As discussed previously in this letter, the area covered by Figure 5-28 does not have a continuous intermediate aquitard in the 180-Foot Aquifer, does have a 180/400-Foot Aquitard, and seawater intrusion is present in a significant zone along (and inland of) the ocean throughout the entire thickness of the 180-Foot Aquifer (see HWG, 2017; Staal, Gardner & Dunne, 1992; Fugro West 1996 and 2001).*

27. In reference to Figure 5-28, the GSP states, "The figure shows that depressed groundwater elevations in the 180/400 Foot Aquifer Subbasin are creating inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42).

HWG Comment: *It should be noted that there are also depressed groundwater elevations from groundwater pumping within the Monterey Subbasin that are contributing to inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin. In fact, the groundwater elevation contour map provided in Figure 5-28 indicates flow lines from the ocean end in a groundwater depression within the Monterey Subbasin. Furthermore, much greater historical pumping from Fort Ord and MCWD wells within the Monterey Subbasin created seawater intrusion within the Monterey Subbasin. Once seawater intrusion occurs, it requires many decades of maintaining seaward gradients to flush saline water back out of the aquifers.*

28. GSP Figure 5-24 purports to show TDS concentrations and the extent of seawater intrusion in Monterey Subbasin (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 43).

HWG Comment: *The dark blue zone in the Dune Sand Aquifer map extending approximately 0.5 miles inland from the shoreline suggests presence of fresh water coastal Dune Sand Aquifer, which is attributed to the 2018 AEM Survey report according to the map legend. The light blue zone that presumably attempts to define TDS concentrations below 1,000 mg/L includes a lobe that extends west of the FO-SVA extent that is not supported by any well data. On the contrary, available well data from the MCWD office site on Reservation Road for the Dune Sand Aquifer shows significant seawater intrusion has occurred in the area the AEM Survey report shown to be fresh water in the Dune Sand Aquifer along the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996a and 1996b; Fugro West, 2001).*

29. The GSP states, "…seawater continues to flow across the area that is intruded towards the 180/400 Foot Aquifer Subbasin, while there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 48.)

HWG Comment: *While the title of this GSP section refers to "Historical Progression of Seawater Intrusion", it fails to actually discuss the historical progress of seawater intrusion within Monterey Subbasin. As indicated in seawater intrusion maps prepared by MCWRA (Appendix 5B), a significant lobe of seawater intrusion into the 180-Foot Aquifer and 400-Foot Aquifer solely within Monterey Subbasin occurred south of Reservation Road in the 1970's and 1980's. This initial seawater intrusion into Monterey Subbasin occurred as a result of groundwater pumping from MCWD and Fort Ord wells screened in the 180-Foot Aquifer and 400-Foot Aquifer production zones, which were sequentially abandoned and moved inland and/or deeper as seawater intrusion moved inland in response to pumping of MCWD and Fort Ord production wells (Harding ESE, 2001). Most of the saline water that was induced to flow into Monterey Subbasin in the 1970s and 1980s still resides in Monterey Subbasin aquifers, and remains part of the overall area of seawater intrusion that exists today.*

30. Figure 5-29 of the GSP (Total Dissolved Solid Concentration Trends in the Lower 180-Foot, 400-Foot Aquifer) shows historical and recent TDS concentrations in various wells, including MCWD Wells MCWD-29 and MCWD-31. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 49).

HWG Comment: *Figure 5-29 indicates TDS concentrations of approximately 400 mg/L during 2019 in MCWD-29 and MCWD-31. Review of the 2019 AEM Survey Report Table 4-1 shows that AEM based TDS concentrations in the zone screened by these wells is estimated to be greater than 1,000 mg/L (about three times the field measured concentrations). Based on analysis (AEM data is a major data source of mapping sweater intrusion in the GSP) and relationships between chloride and TDS established in the GSP (e.g., chloride concentrations of 500 mg/L equate to TDS concentrations of approximately 1,000 mg/L), it seems that MCWD wells MCWD-29 and MCWD-31 should be included within the area of mapped seawater intrusion. In fact, this discrepancy demonstrates how interpretation of AEM data with regard to water quality can result in significant errors relative to field measured data. Interpreted AEM data has also been shown to significantly underpredict TDS/chloride concentrations (e.g., HWG, April 2019) is some areas.*

31. The GSP relies on a study conducted by WRA Environmental (2020) to conclude that 19.51 acres of aquatic and upland biological communities at six ponds are dependent upon groundwater (Section 5.7.1, Groundwater Dependent Ecosystems, Coastal Vernal Ponds within the City of Marina, p. 68).

HWG Comment: *We note that the five authors of the report by WRA Environmental are all biologists, with no apparent contribution from a hydrogeologist to help evaluate groundwater conditions and dependence of the plant communities on groundwater. The only investigation of groundwater in the report was digging a hole to 14 inches in depth to look for soil saturation; however, these field efforts are inadequate to determine groundwater conditions at the sites because there may be shallow fine-grained sediment layers supporting perched/saturated soils in the upper few feet of soil. The WRA report also cites the fact that their field efforts were conducted in June 2020, well after the end of the rainy season, and water was still observed in most of the ponds (implying it must be groundwater). However, review of monthly precipitation data for the 2019 and 2020 water years indicates the 2019 year was very wet (133% of normal) and the 2020 water year was wet (105% of normal). In addition, heavy rainfall* *occurred in March and April 2020 (about 6.5 inches or close to half the average annual rainfall) with smaller amounts of rainfall in May and June; therefore, it would be expected that surface runoff remained in the ponds with near surface saturation at the time of WRA's June 2020 site visits. We also note that the WRA Report relies on other studies such as Formation Environmental (April 2020) and the draft City of Marina GSA GSP (2020). The HWG has previously commented on these studies, and Geoscience/AECOM conducted the most recent study on the vernal pools (HWG, November 2019; Geoscience and AECOM, August 18, 2020). Summary Geoscience/AECOM comments on the Formation Environmental TM included: 1) very limited use of available groundwater data from MPWSP MW-4 and MW-7 to one point in time without considering entire record and impact of agricultural irrigation return flows in immediate vicinity; 2) relies solely on ET data to justify conclusion that Armstrong Ranch Ponds are groundwater dependent without consideration of alternative water sources such a seasonal surface water from rainfall; 3) failure to account for perched aquifer conditions underlying area; 4) failure to account for effects of urbanization surrounding six ponds in city of Marina that caused ponds to become primarily reliant of surface water runoff and leading to ponds becoming perennial. Furthermore, all six ponds in the Marina area are not hydraulically connected to the coastal Dune Sand Aquifer (thus, pumping from coastal Dune Sand Aquifer will not affect them); and all ponds received surface discharge from storm drains that empty into the ponds. Several ponds were found to have hardpan layers beneath them that limit percolation and likely account for WRA observations of shallow saturation. In addition, water quality data suggest that ponds are more influenced by stormwater runoff than groundwater from the perched aquifer system. Overall, it was found that the Formation Environmental study is fundamentally flawed , misrepresents potential impacts on ponds from pumping in the coastal Dune Sand Aquifer, and does not consider all available evidence concerned the nature of these pond resources and potential impacts to them from pumping. HWG comments on the City of Marina GSA Draft GSP state, "the fact that nearby GDEs are seasonally flooded and have a seasonal nature to them (and are associated with "a lens of less pervious soil") suggests a surface water source is most likely sustaining vegetation in these areas. The GSP evaluation to determine if potential GDEs are actual GDEs did not consider that shallow groundwater in these nearby potential GDE areas is saline or the likelihood that fresh surface water is the primary sustaining factor for these areas and (which means they are not GDEs)."*

32. We note that the City of Marina Draft GSP stated the following with regard to pumping from Marina Coast Water District Deep Aquifer wells, "The combined extraction from these wells was approximately 1,823 AFY in 2015, and is forecast to increase to 3,905 AFY by 2035…" (Section 3.1.8, page 3-17).

HWG Comment: *While the Monterey Subbasin GSP comments on the impacts of increasing pumping from the Deep Aquifer in the adjacent 180/400-Foot Aquifer Subbasin, it is silent on the issue of increased pumping from existing (and potential future new) MCWD Deep Aquifer wells. The cited MCWD Deep Aquifer pumping numbers represent a greater than doubling of the amount of current MCWD pumping from the Deep Aquifer, a pumping amount that already results in Deep Aquifer water levels within Monterey Subbasin on the order of 50-100 feet below sea level. Such increased pumping from the Deep Aquifer by MCWD and others is likely not sustainable.*

33. We note that the City of Marina Draft GSP stated, "In the Monterey Subbasin, groundwater demand from the Deep Aquifer by MCWD to supply the City of Marina is expected to increase….however, the increase is projected to be within MCWD's allocated pumping rights." (Section 3.3.10.4, page 3-69).

HWG Comment: *Regardless of the validity of allocated pumping rights (which is yet to be determined), it remains unclear if the proposed MCWD increase in pumping from the Deep Aquifer is sustainable. In addition, the increased pumping from the Deep Aquifer to the east to support agricultural expansion is based on overlying rights, not allocated (paper water) pumping rights, and are thereby presumably superior to MCWD rights.*

Monterey Subbasin GSP Comment Log (Prepared by SVBGSA)

1. In Comment 41 (dated 1/7/21) Tina Wang states, "…There is one thing we pointed out in that chapter, is the dune sand aquifer and the upper 180 foot aq is not SWI intruded, it is fresh."

HWG Comment: *As pointed out in our comments on GSP Chapters 4 and 5, the Fort Ord Site Conceptual Model (i.e., continuous intermediate aquitard within 180-Foot Aquifer and lack of a 180/400-Foot Aquitard) does not apply in northern Monterey Subbasin. Furthermore, available field data indicate that the Dune Sand Aquifer and upper portion of the 180-Foot Aquifer are seawater intruded (chloride greater than 500 mg/L) for a significant distance inland from the coast in the northern Monterey Subbasin and Southern 180/400-Foot Aquifer Subbasin. We also note that EKI's (and others) definition of fresh water in many previous documents related to the MPWSP has been TDS up to 3,000 mg/L; however, HWG have shown such levels of TDS also have greater than 1,000 mg/L chloride in the area, which is far in excess of the 500 mg/L standard applied by MCWRA for seawater intrusion. The Monterey Subbasin GSP uses AEM data outside of Monterey Subbasin (i.e., in southern 180/400-Foot Subbasin) to claim the presence of this so-called fresh water, yet actual field data show seawater intrusion has occurred at the coast and for a significant distance inland in this area (see HWG, 2017).*

2. In Comment 44 (dated 1/7/21) Derrik Williams responds to the commenter (Bob Jaques) that, "We have discussed the AEM data with some members of the blue ribbon panel…the didn't have too many concerns.'

HWG Comment: *If the commenter is referring to the Hydrogeologic Working Group, this statement by Derrik Williams is incorrect. The HWG has many concerns about the hydrogeologic interpretation of the AEM data and has documented our concerns in numerous documents (e.g., HWG, 2017; HWG, 2018; HWG, January 2019; HWG, March 2019; HWG, April 2019; HWG, June 2020).*

Sincerely,

The Hydrogeologic Working Group (Dennis Williams, Tim Durbin, Martin Feeney, Peter Leffler)

____

Dennis Williams

____

Tim Durbin

____

Martin Feeney

____

Peter Leffler

REFERENCES

California Public Utilities Commission (CPUC), CalAm Monterey Peninsula Water Supply Project Environmental Impact Report/Environmental Impact Statement, SCH#2006101004, March 2018.

City of Marina Groundwater Sustainability Agency, *Draft Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin*, October 2019.

City of Marina Groundwater Sustainability Agency, *Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin*, January 2020.

EKI Environment & Water, *Fresh Groundwater in Dune Sand and 180-Foot Aquifer South of Salinas River, 180/400 Foot Aquifer & Monterey Subbasins*, December 2019.

Formation Environmental, *Assessment and Protection of Groundwater-Dependent Ecosystems Near the Proposed Monterey Peninsula Water Supply Project Slant Wells, Marina, California*, Technical Memorandum prepared for City of Marina, April 12, 2020.

Fugro West, *Summary of Operations, Construction and Testing of Seawater Intake Well and Brine Injection Well*, Report prepared for Marina Coast Water District, April 1996.

Fugro West, *Marina Coast Water District Seawater Desalination Project; Initiation of Inland Groundwater Monitoring*, Letter Report prepared for Marina Coast Water District, December 31, 1996.

Fugro West, *Inland Groundwater Monitoring; Regional Water Quality Control Board Monitoring and Reporting Program No. 00-117; Third Quarter Sampling and Training Session for MCWD Staff*, Project Memorandum prepared for Marina Coast Water District, August 29, 2001.

Geoscience and AECOM, *Understanding the Influence of Subsurface Aquifer Drawdown Upon Surface Water and Wetlands for the Proposed Monterey Peninsula Water Supply Project*, Technical Memorandum prepare for California American Water, August 18, 2020.

Harding ESE, *Final Report, Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California*, Report prepared for Monterey County Water Resources Agency, April 12, 2001.

The Hydrogeologic Working Group (HWG), *Monterey Peninsula Water Supply Project – Test Slant Well Long Term Pumping Test and Coastal Development Permit #A-3-MRA-14-0050*, letter addressed to California Coastal Commission, July 23, 2015.

HWG, *HWG Hydrogeologic Investigation Technical Report*, November 6, 2017.

HWG, *Memorandum Responding to Comments on HWG Hydrogeologic Investigation Technical Report*, January 4, 2018.

HWG, *HWG Comments on Technical Appendices/Attachments to Letters Submitted by MCWD and City of Marina to the CPUC and MBNMS on April 19, 2018, Letter to John Forsythe/CPUC and Paul Michel/MBNMS*, August 15, 2018.

HWG, *HWG Comments on Technical Presentations and Letters/Memorandum Prepared by HGC, EKI, and MCWD for City of Marina Public Workshop on MPWSP Coastal Development Permit Held on January 8, 2019*, January 25, 2019.

HWG, *HWG Responses to Dr. Knight Letter Addressed to HWG and Submitted During City of Marina Planning Commission Hearing on MPWSP Coastal Development Permit Held on February 14, 2019*, March 6, 2019.

HWG, *HWG Comments on Remy Moose Manley Letter Attachments Prepared by HGC, EKI, and AGF for City of Marina Planning Commission Hearing Agenda Item #6A on MPWSP Coastal Development Permit Held on February 14*, 2019, April 12, 2019.

HWG, *HWG Comments on City of Marina Draft Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin Dated October 2019*, submitted to City of Marina Groundwater Sustainability Agency, November 1, 2019.

HWG, ESA, and HydroFocus, *Response to Tom Luster Email Dated January 30, 2020*, Responses to questions posed by Weiss Associates (third party independent reviewer for California Coastal Commission [CCC]) and Mr. Tom Luster in the CCC proceeding on the Monterey Peninsula Water Supply Project, February 20, 2020.

HWG, *HWG Comments on AGF Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District, Undated*, June 26, 2020; Exhibit 14 in Latham & Watkins LLLP, September 17, 2020, *Special Meeting Agenda Items Th3a & 4a: Monterey Peninsula Water Supply Project, Coastal Development Permit, Application No. 9-19-0918, and Appeal No. A-3-MRA-19-0034*.

Marina Coast Water District Well Logs – Wells 8A, 10, 11, 12, Well A, Well C.

Staal, Gardner & Dunne, *Feasibility Study, Seawater Intake Wells, Marina County Water District Wastewater Treatment Facility, Marina, California*, Report prepared for Marina County Water District, February 1991.

Staal, Gardner & Dunne, *Feasibility Study, Saline Ground Water Intake System, Monterey Sand Company Site, Marina, California*, Report prepared for Monterey Peninsula Water Management District, February 1992.

WRA Environmental, *Biological Resource and Groundwater Dependency Analysis of Marina Vernal Ponds*, Report prepared for City of Marina, July 30, 2020.

LIST OF ACRONYMS & ABBREVIATIONS

AEM	Aerial Electromagnetics
bgs	below ground surface
Cal Am or CalAm	California American Water Company
CPUC	California Public Utilities Commission
DSA	Dune Sand Aquifer
FO-SVA	Ford Ord Salinas Valley Aquitard
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeologic Conceptual Model
HWG	Hydrologic Working Group
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Agency
MPL	Monterey Peninsula Landfill
mg/L	Milligrams per Liter
MGSA	Marina Groundwater Sustainability Agency
MPWSP	Monterey Peninsula Water Supply Project
MW	Monitoring Well
SGMA	Sustainable Groundwater Management Act
SVB	Salinas Valley Basin
TDS	Total Dissolved Solids
USGS	United States Geological Survey

ENGINEERING & PUBLIC WORKS DEPARTMENT
440 Harcourt Avenue
Seaside, CA 93955
www.ci.seaside.ca.us
Telephone 831-899-6835
Fax 831-899-6211

November 1, 2021

Remleh Scherzinger
General Manager
c/o Paula Riso
Executive Assistant to the Board
Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road
Marina CA 93933-2099

RE: Groundwater Sustainability Plan – Monterey Subbasin
Marina Coast Water District Groundwater Sustainability Agency
Salinas Valley Basin Groundwater Sustainability Agency

Dear Mr. Remleh Scherzinger:

The City of Seaside received a notice dated September 20, 2021 from the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) that they had prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (the GSP) as required by the Sustainable Groundwater Management Act (SGMA). Staff reviewed the draft Groundwater Sustainability Plan, Monterey Subbasin prepared by EKI Water & Environment, Inc. for the Marina Coast Water District Groundwater Sustainability Agency and the Salinas Valley Basin Groundwater Sustainability Agency dated September 2021 (the GSP) download from the MCWD website on October 13, 2021 from the following link https://mcwd.org/gsa_gsp.html. The following comments are submitted for your consideration.

1. The City of Seaside requests to be included as stakeholder (page 28)
2. The City of Seaside is requests membership in the Technical Committee (page 8-10)
3. Since the Framework agreement between the MCWD GSA and the SVBGSA (the Agreement) appears to give MCWD additional jurisdiction within the City of Seaside city limits beyond the MCWD GSA boundary, the Agreement should be made available for review and comment by the City of Seaside (page 12).
4. The MCWD should clarify how the Water Augmentation Project would be implemented to ensure proposed development would not cause exceedances of groundwater extraction allocations (pages 6-57 and 9-31)
5. The GSP should clarify how the sustainable yield would be affected by the 180/400 & the Seaside Subbasins operated under conditions similar to current conditions or probable future conditions that do not meet MT or MO boundary conditions (page 6-59).
6. The MCWD should support the Seaside Watermaster to facilitate the development of alternative water for replenishing the Seaside Subbasin to ensure that the Seaside

Subbasin is able to achieve Protective Water Levels to mitigate seawater intrusion (page 9-13).

7. The GSP should clarify if Project R2, Regional Municipal Supply, is substantially different than the Regional Project as proposed by Cal Am. If not, why is "Further analysis and scoping ... needed to determine the exact location of the desalination plant, end uses, and desalination technology [9.4.2]"? If so, how are they different? (page 9-26)
8. In Section 9.4, the GSP should tabulate the scope of and capital costs for the proposed Seawater Extraction Barrier Project (page 9-26). The scope should clarify alternatives for discharging and/or reusing extracted brackish water (page 9-28).
9. It is assumed that additional investment is required to reimburse the capital expenditures and debt servicing incurred by MCWD for producing 600 AFY of recycled water. The MCWD should clarify what this investment is (page 9-58).
10. Since the GSP states that potable water could be delivered to Zone 2C by direct diversion and treatment from the Salinas River during certain months with some minor permit modifications, it should also be possible to deliver irrigation water through direct diversion. This should be explored and promoted as an alternative for providing irrigation water to supplement the more expensive treated water from Pure Water Monterey (i.e. $1,100/AF versus $1,600/AF, respectively) (page 9-22)
11. Section 10.7.1, "MCWD GSA Start-up Budget and Funding to Meet Costs," should be modified to include capital projects costs which are part of the costs for implementing the GSP over the next five years and should include an estimated cost to rate payers if no grant funding becomes available (page 10-16).

In addition, attached is a table of minor comments and requests for clarifications on the GSP. Please contact me at npatel@ci.seaside.ca.us or (831) 899-6884 if you require any further clarification on our comments.

Sincerely,

Nisha Patel
Public Works Director/ City Engineer

Attachment

cc: Sheri Damon
Roberta Greathouse
Patrick Breen

Review Comments
Marina Coast Water District GSA Groundwater Sustainability Plan

Page Label	Comments
12	Please add "the City of Seaside" to the definition of the Marina-Ord Management Area.
12	Since the Framework agreement between the MCWD GSA and the SVBGSA (the Agreement) appears to give MCWD additional jurisdiction within the City of Seaside city limits beyond the MCWD GSA boundary, the Agreement should be made available for review and comment by the City of Seaside.
28	Please confirm that the City of Seaside would be included in the stakeholder database.
55	If the "2020 UWMP anticipates that projected water demand within the entire District would be 9,584 AFY by 2040, including 2,974 AFY within the City of Marina and 6,610 AFY for the existing and future developments within the Ord Community," why is it shown as 9,300 AFY here?
145	The ordinate scales on the groundwater elevation graphs are too large to confirm if a linear trend line is best fit for determining trend lines. Please clarify why linear trend lines were selected to approximate groundwater elevations in the 400-ft aquifer.
149	Confusion in datum for groundwater elevations. Figure 5-12 states that it is both msl and NAVD88. These are not the same datum.
213	Why has the inflow from Seaside Basin increased by 45% from historic to current? Is this trend expected to continue?
215	Was annual well pumping determined from well meters (i.e. does it include non-revenue water or leakage)? If not, then that component of leakage should be omitted from the estimated recharge.
233	What does the following statement mean? "... fall within the middle of the range of projected boundary conditions."
235	Unclear. Is the assumption that the MT or MO Boundary conditions are achieved in the short term?
238	Why is well pumping under the "No Project" scenario shown as 8,767 AFY when the MCWD UWMP estimates that the demand would be 9,584 AFY. Applying the 5% leakage rate used in this GSP indicates future pumping should be 10,088 AFY. Please clarify.
243	Could groundwater extraction along the coast mitigate the inland flow of seawater? Could modeling this scenario help?
244	Should modeling be performed to predict scenarios under which MCWD alters pumping regime to minimize seawater intrusion?
245	What causes groundwater elevations to instantaneously increase by 2 feet under the no project condition?
245	How was the MO of approximately 7-ft increase determined?
245	How was the MT of 2-ft increase determined?
248	Is this correct? Outflow from the 180/400 Subbasin are affecting the Monterey Subbasin?
250	Note (c) is missing.
250	Table 6-5 (No Project Condition) shows outflow to 180/400 Subbasin at 3,849 AFY and 1,927 AFY for MT and MO boundary conditions, respectively. Table 6-8 (Project Condition) shows 6,833 AFY and 4,901 AFY respectively. This appears to indicate that the MT and MO boundary conditions to the 180/400 Subbasin are attained at significantly different times or are different for the "No Project" and "Project" scenarios. This appears to also be the case for inter-basin transfer to the Seaside Basin. Can this be better explained?
250	Table 6-5 (No Project) shows well pumping at 8,767 AFY for MT and MO boundary conditions. Table 6-8 (Project) shows 4,488 AFY for MT and MO boundary conditions. Does the model account for variability in pumping conditions since the Water Augmentation project would not come on-line for at least 6 years (see Fig. 9-6)? That is, what would cause and when would pumping exceed 4,488 AFY under the "Project" Conditions?
250	Do the future pumping rates shown in Table 6-8 account for leakage?
251	Are the increases in groundwater elevations shown here mostly attributed to actions performed, and MTs and MOs achieved, in adjacent subbasins?
252	It appears that this report is stating that if the adjacent subbasins are no operated sustainably, then the Monterey Subbasin could not be managed sustainably?
252	The groundwater levels appear to stabilize within the first 10 years due to assumed actions in adjacent subbasins. It could be important to consider the effects on water budget for scenarios where the adjacent subbasins are not operated under MT and MO boundary conditions.
253	It is unclear how the range of 4,400 to 9,900 AFY was determined? Above the report states that 2,714 AFY is the lower limit of the range and Table 6-5 suggests that 8,767 AFY is sustainable if MOs are achieved.
256	Is there a discontinuity in the modeling geometry at the interface of the Seaside Basin and MBGWFM? If so, how can this be rectified?
311	Based upon Table 6-4, it appears that sustainability goal can be achieved mostly by inter-basin coordination.
312	How will Seaside Watermaster Actions be supported?
315	The City of Seaside or the Seaside Watermaster should consider requesting membership in the Technical Committee.
316	Why was 2004 groundwater elevation used for this MO?
329	Are the MT and MO for the 180/400 Subbasin approximately -8 and -3.4 near Well MW-B-05-180? If not, why are -8 and-3.4 the MT and MO for this well?
329	1992 to 1998 data for MW-OU2-29-180 and MW-B-05-180 seem to be skewed and may need to be ignored when determining MT and MO.

Review Comments
Marina Coast Water District GSA Groundwater Sustainability Plan

Page Label	Comments
330	Is this one out-lier determining the MT of -13.3 for MP-BW-42-295. (see MT-10 for adjacent Well MW-OU2-66-180).
335	Setting the MTs to 2015 groundwater elevations seems to contradict the goal of preventing seawater intrusion.
342	Can the following statement be clarified to state whether the proposed MTs and MOs help Seaside Basin obtain its adjudication requirements: "Monterey Subbasin minimum thresholds do not prevent the Seaside basin from meeting its adjudication requirements, including the occurrence of Material Injury."
392	Should a column be added to Table 9-1 for "... a description of the measurable objective that is expected to benefit from the project or management action [354.44(a)(1)"? If not, is this information given elsewhere?
394	If the extraction barrier is a necessary component of Project R2 (see Section 9.4.2.7 which states it is a precursor), should it be included here? If not, why is the seawater extraction barrier not included as a separate project in Table 9-1?
394	Please confirm estimated cost of $172M fro R1 (Section 9.4.1.7 seems to indicate $181M)
396	The costs for pilot scale modeling should be moved from Project M4 to Project M3.
396	The demand for 1,427 AFY irrigation water at a unit production cost of $1,600/AF seems high. Section 9.4.6.7 states "MCWD's 2020 UWMP estimates that 950 AFY of landscape irrigation demand can be met by recycled water by 2030 and 1,270 AFY by 2040"
398	Should the costs shown here only reflect costs to the MCWD GSA?
398	The Seaside Watermaster supports the construction of a facility that would allow water to be imported and injected into the Seaside Basin (see letter to M1W et al dated May 24, 2021). Can this section be clarified to state potential actions that will be implemented by the GSA to support the Seaside Watermaster desire to import water?
399	Should the costs shown here only reflect costs to the MCWD GSA?
399	Projects I5 and I6 appear to be the same action. Please clarify how one could be implemented without the other.
399	Please consider adding an action that supports modeling integration with Seaside Subbasin.
400	Should Project I9 be modified to include wells that become non-productive due to such things as high TDS?
403	Section 9.4 would be more readable if the organization of project descriptions followed Table 9-1 and used the P/MA # found there.
407	Does the FORA HCP have water rights and flow prescriptions for the Salinas River?
407	Since the GSP states that potable water could be delivered to Zone 2C by direct diversion and treatment from the Salinas River during certain months with some minor permit modifications, it should also be possible to deliver irrigation water through direct diversion. Should this be explored and promoted as an alternative for providing irrigation water to supplement the more expensive treated water from Pure Water Monterey (i.e. $1,100/AF versus $1,600/AF, respectively)?
411	Where is the scope of work and capital costs described for the Seawater Intrusion Extraction Barrier Project?
411	Project R2 states "The plant will produce approximately 15,000 AFY of potable water for use." Chapter 6 states that there is approx increased demand of 5,300 AFY. Why is desal plant being proposed that could provide almost 3 times the future demand?
411	Is Project R2 substantially different than the Regional Project as proposed by Cal Am? If not, why is "Further analysis and scoping ... needed to determine the exact location of the desalination plant, end uses, and desalination technology"? If so, how are they different?
411	Table 9-1 does not include "Priority Project 6." Please clarify where this project is tabulated.
412	Please clarify how extracting an additional 35,000 AFY from the basin reduces groundwater extraction and will "either raise groundwater elevations or reduce the rate of groundwater elevation decline over time."
412	Please clarify if the extraction wells are extracting 100% seawater. If not, how is this project able to reduce groundwater extraction.
412	Please clarify how extracting water from the basin will reduce any potential for land subsidence.
412	Please clarify " This would reduce groundwater extraction by that amount, increase the Subbasin's groundwater storage." Unless the extraction wells are pumping 100% seawater, there is not a one-for-one benefit for reduction in groundwater extraction.
413	Please clarify alternatives for discharging and/or reusing extracted brackish water. If none, please clarify if there are potential cost effective alternatives to Project R2.
416	Please clarify where this cost data is derived from.
417	Why is the seawater intrusion extraction barrier project not better described in this section?
440	Please clarify how IPR would increase groundwater elevations.
440	Since Project M3 is not a supplemental water supply project, it is unclear how it would "add" water to the aquifer for future development? Please clarify.
443	Have all the capital expenditures been paid for the 600 AFY? If not, please clarify the investment needed to reimburse the capital expenditures and debt servicing for the 600 AFY.
443	Please clarify if the "soft costs" provided here include debt servicing. If not, why not?

Review Comments
Marina Coast Water District GSA Groundwater Sustainability Plan

Page Label	Comments
445	Please confirm that RUWAP pipe extends south of Coe Ave in GJM Blvd.
487	Can the Monterey Subbasin Model be coordinated with the Seaside Basin model to simulate conditions across the subbasins?
491	Addressing potential overdraft could be managed by producing documents such as a monitoring and management plan and a management action plan that addresses policies and procedures to monitor and respond to water elevation concerns.
497	Can extraction wells be added to the monitoring network?
497	The annual report could also address if milestones and goals are being attained and, if necessary, potential corrective actions that may be employed to respond to deviations from goals.
507	What is the estimated additional costs to rate payers if no grant funding becomes available?
508	Please clarify why Administration and Legal costs are 30% of the total cost.

November 1, 2021

Salinas Valley Basin GSA
P.O. Box 1350
Carmel Valley, CA 93924

Submitted via web: https://form.jotform.com/201537036733047

Re: Public Comment Letter for Monterey Subbasin Draft GSP

Dear Donna Meyers,

On behalf of the above-listed organizations, we appreciate the opportunity to comment on the Draft Groundwater Sustainability Plan (GSP) for the Monterey Subbasin being prepared under the Sustainable Groundwater Management Act (SGMA). Our organizations are deeply engaged in and committed to the successful implementation of SGMA because we understand that groundwater is critical for the resilience of California's water portfolio, particularly in light of changing climate. Under the requirements of SGMA, Groundwater Sustainability Agencies (GSAs) must consider the interests of all beneficial uses and users of groundwater, such as domestic well owners, environmental users, surface water users, federal government, California Native American tribes and disadvantaged communities (Water Code 10723.2).

As stakeholder representatives for beneficial users of groundwater, our GSP review focuses on how well disadvantaged communities, drinking water users, tribes, climate change, and the environment were addressed in the GSP. While we appreciate that some basins have consulted us directly via focus groups, workshops, and working groups, we are providing public comment letters to all GSAs as a means to engage in the development of 2022 GSPs across the state. Recognizing that GSPs are complicated and resource intensive to develop, the intention of this letter is to provide constructive stakeholder feedback that can improve the GSP prior to submission to the State.

Based on our review, we have significant concerns regarding the treatment of key beneficial users in the Draft GSP and consider the GSP to be **insufficient** under SGMA. We highlight the following findings:

1. Beneficial uses and users **are not sufficiently** considered in GSP development.
    a. Human Right to Water considerations **are not sufficiently** incorporated.
    b. Public trust resources **are not sufficiently** considered.
    c. Impacts of Minimum Thresholds, Measurable Objectives and Undesirable Results on beneficial uses and users **are not sufficiently** analyzed.
2. Climate change **is not sufficiently** considered.
3. Data gaps **are not sufficiently** identified and the GSP **needs additional plans** to eliminate them.

4. Projects and Management Actions **do not sufficiently consider** potential impacts or benefits to beneficial uses and users.

Our specific comments related to the deficiencies of the Monterey Subbasin Draft GSP along with recommendations on how to reconcile them, are provided in detail in **Attachment A.**

Please refer to the enclosed list of attachments for additional technical recommendations:

Attachment A	GSP Specific Comments
Attachment B	SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users
Attachment C	Freshwater species located in the basin
Attachment D	The Nature Conservancy's "Identifying GDEs under SGMA: Best Practices for using the NC Dataset"
Attachment E	Maps of representative monitoring sites in relation to key beneficial users

Thank you for fully considering our comments as you finalize your GSP.

Best Regards,

Ngodoo Atume
Water Policy Analyst
Clean Water Action/Clean Water Fund

J. Pablo Ortiz-Partida, Ph.D.
Western States Climate and Water Scientist
Union of Concerned Scientists

Samantha Arthur
Working Lands Program Director
Audubon California

Danielle V. Dolan
Water Program Director
Local Government Commission

E.J. Remson
Senior Project Director, California Water Program
The Nature Conservancy

Melissa M. Rohde
Groundwater Scientist
The Nature Conservancy

Attachment A

Specific Comments on the Monterey Subbasin Draft Groundwater Sustainability Plan

1. Consideration of Beneficial Uses and Users in GSP development

Consideration of beneficial uses and users in GSP development is contingent upon adequate identification and engagement of the appropriate stakeholders. The (A) identification, (B) engagement, and (C) consideration of disadvantaged communities, drinking water users, tribes,[1] groundwater dependent ecosystems, streams, wetlands, and freshwater species are essential for ensuring the GSP integrates existing state policies on the Human Right to Water and the Public Trust Doctrine.

A. Identification of Key Beneficial Uses and Users

Disadvantaged Communities and Drinking Water Users

The identification of Disadvantaged Communities (DACs) and drinking water users is **incomplete**. The GSP provides information on DACs, including identification by name and location on a map (Figure 1), and identifying the water source for DAC members. However, the GSP fails to clearly state the population of each DAC.

The GSP provides a density map of domestic wells in the subbasin (Figure 3-7). However, the plan fails to provide depth of these wells (such as minimum well depth, average well depth, or depth range) within the subbasin.

These missing elements are required for the GSA to fully understand the specific interests and water demands of these beneficial users, and to support the consideration of beneficial users in the development of sustainable management criteria and selection of projects and management actions.

RECOMMENDATIONS
• Provide the population of each identified DAC. • Include a map showing domestic well locations and average well depth across the subbasin.

Interconnected Surface Waters

The identification of Interconnected Surface Waters (ISWs) is **insufficient**, due to lack of supporting information provided for the ISW analysis. The GSP does not present a map of interconnected stream reaches in the subbasin. Furthermore, the GSP does not show the location of groundwater wells or stream gauges in the subbasin, or provide description of temporal availability of groundwater data.

[1] Our letter provides a review of the identification and consideration of federally recognized tribes (Data source: SGMA Data viewer) within the GSP from non-tribal members and NGOs. Based on the likely incomplete information available to our organizations for this review, we recommend that the GSA utilize the California Department of Water Resources' "Engagement with Tribal Governments" Guidance Document (https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents) to comprehensively address these important beneficial users in their GSP.

The GSP presents maps showing depth-to-groundwater contours for depths within 20 feet of the ground surface for two dates, fall 2017 and fall 2019. The GSP does not present an explanation of why 20 feet was chosen for the maximum depth shown on the contour maps. Furthermore, using seasonal groundwater elevation data over multiple water year types is an essential component of identifying ISWs. The use of two fall dates does not reflect the temporal (seasonal and interannual) variability inherent in California's climate.

RECOMMENDATIONS

- Describe available groundwater elevation data and stream flow data in the subbasin. ISWs are best analyzed using depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought), to determine the range of depth and capture the variability in environmental conditions inherent in California's climate.

- Provide a map of stream reaches in the subbasin. Overlay the stream reaches with full depth-to-groundwater contour maps (not just to 20 feet below ground surface) to illustrate groundwater depths and the groundwater gradient near the stream reaches. Show the location of groundwater wells in the subbasin used to create the contour maps.

- For the depth-to-groundwater contour maps, use the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a Digital Elevation Model (DEM) to estimate depth-to-groundwater contours across the landscape. This will provide accurate contours of depth to groundwater along streams and other land surface depressions where GDEs are commonly found.

- On the map of stream reaches, consider any segments with data gaps as potential ISWs and clearly mark them as such. Describe data gaps for the ISW analysis. Reconcile these data gaps with specific measures (shallow monitoring wells, stream gauges, and nested/clustered wells) along surface water features in the Monitoring Network section of the GSP.

Groundwater Dependent Ecosystems

The identification of Groundwater Dependent Ecosystems (GDEs) is **insufficient**, due to a lack of supporting information provided for the GDE analysis. The GSP took initial steps to identify and map GDEs using the Natural Communities Commonly Associated with Groundwater dataset (NC dataset). Additional local habitat management plans and studies were used to map GDEs located at the City of Marina coastal vernal ponds and Fort Ord wetlands. The GSP presents GDEs on Figure 5-37 and has retained all GDEs from these sources as potential GDEs in the GSP.

The GSP states (p. 5-68): *"These potential GDEs within the former Fort Ord are located within the federal land areas of the Subbasin not subject to SGMA."* However, SGMA states plans shall include "efforts to develop relationships with State and Federal regulatory agencies" [Water Code §10727.4(j)], and that "The federal government...may voluntarily agree to participate in the preparation and administration of a groundwater sustainability plan" [Water Code §10720.3(c)]. Finally, SGMA defines the federal government as a beneficial user of groundwater [Water Code §10723.2(g)]. Please include information on what steps were taken to address these requirements.

The GSP does not attempt to verify the NC dataset with groundwater data, however. While the GSP does acknowledge that shallow groundwater data in areas near GDEs is a data gap, no map is provided that shows the location of existing groundwater wells in the subbasin, or a description of spatial and temporal availability of existing groundwater data. Describing groundwater conditions within the basin's GDEs is an essential precursor to identifying data/monitoring gaps and evaluating potential effects on GDEs when establishing SMCs.

While the GSP discusses the vegetation communities at the City of Marina coastal vernal ponds observed during a site visit in June 2020, this is the only mention of vegetation communities within the subbasin's GDEs. The GSP does not provide further discussion or an inventory of the flora or fauna species present in the subbasin's GDEs or acknowledge endangered, threatened, or special status species in the subbasin.

RECOMMENDATIONS
• Discuss available shallow groundwater data. Use depth-to-groundwater data from multiple seasons and water year types (e.g., wet, dry, average, drought) to determine the range of depth to groundwater around NC dataset polygons. We recommend that a baseline period (10 years from 2005 to 2015) be established to characterize groundwater conditions over multiple water year types. Refer to Attachment D of this letter for best practices for using local groundwater data to verify whether polygons in the NC Dataset are supported by groundwater in an aquifer. • Provide depth-to-groundwater contour maps, noting the best practices presented in Attachment D. Specifically, ensure that the first step is contouring groundwater elevations, and then subtracting this layer from land surface elevations from a digital elevation model (DEM) to estimate depth-to-groundwater contours across the landscape. • Provide a complete inventory, map, or description of fauna (e.g., birds, fish, amphibian) and flora (e.g., plants) species in the subbasin (see Attachment C of this letter for a list of freshwater species located in the Monterey Subbasin). Note any threatened or endangered species. • Provide further information about the steps taken to involve or collaborate with the federal government regarding potential GDEs located within the former Fort Ord area.

Native Vegetation and Managed Wetlands

Native vegetation and managed wetlands are water use sectors that are required to be included in the water budget.[2,3] The integration of native vegetation into the water budget is **insufficient**. The GSP text discusses evapotranspiration, but combines crop, urban, and native evapotranspiration in the discussion. Despite explicit mention that evapotranspiration is included in the Soil Moisture Budget (SMB) model, no evapotranspiration results for the land surface

[2] "'Water use sector' refers to categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation." [23 CCR §351(al)]

[3] "The water budget shall quantify the following, either through direct measurements or estimates based on data: (3) Outflows from the groundwater system by water use sector, including evapotranspiration, groundwater extraction, groundwater discharge to surface water sources, and subsurface groundwater outflow." [23 CCR §354.18]

system are included in the GSP. The omission of explicit water demands for native vegetation is problematic because key environmental uses of groundwater are not being accounted for as water supply decisions are made using this budget, nor will they likely be considered in project and management actions. Managed wetlands are not mentioned in the GSP and are not included in the water budgets.

RECOMMENDATION
● Quantify and present all water use sector demands in the historical, current, and projected water budgets with individual line items for each water use sector, including native vegetation and managed wetlands (if present).

B. Engaging Stakeholders

Stakeholder Engagement During GSP Development
Stakeholder engagement during GSP development is **sufficient**. SGMA's requirement for public notice and engagement of stakeholders is fully met by the description in the Communications and Stakeholder Engagement section (Chapter 2).[4]

The GSA's outreach activities include an Advisory Committee including representation by underrepresented communities (URCs), rural residential well owners, and environmental stakeholders, Marina Coast Water District (MCWD) GSA Board Meetings, stakeholder workshops, and one-on-one meetings with interested parties.

Despite the outreach to DACs, there is no specific pathway for feedback from DAC residents and representatives to be considered and included in the GSP and its implementation.

We note specific engagement with DACs and environmental organizations during the GSP implementation process. The GSP states (p. 10-11): *"MCWD and SVBGSA's Stakeholder Communication and Engagement Plans (SCEPs) will continue to be refined, updated, and executed during GSP implementation."* These activities include subbasin planning committees transitioning to implementation committees , engaging residents of DACs during GSP implementation through engagement of MCWD customers and coordination with the City of Marina, and GSAs routine reporting to the public about GSP implementation and progress towards sustainability and needs for efficient groundwater use.

RECOMMENDATIONS

[4] "A communication section of the Plan shall include a requirement that the GSP identify how it encourages the active involvement of diverse social, cultural, and economic elements of the population within the basin." [23 CCR §354.10(d)(3)]

- In the Communications and Stakeholder Engagement section, provide more information on how DACs and environmental stakeholders were included in the Advisory Committee and the role that it plays in GSP development.

- DAC and environmental stakeholder engagement should be improved by incorporating feedback and recommendations from DAC and environmental stakeholders engaged in the GSP process.

- Further describe efforts to engage with stakeholders during the GSP *implementation* phase in the Communications and Stakeholder Engagement section of the GSP. Refer to Attachment B for specific recommendations on how to actively engage stakeholders during all phases of the GSP process.

- Utilize DWR's tribal engagement guidance to comprehensively address all tribes and tribal interests in the subbasin within the GSP.[5]

C. Considering Beneficial Uses and Users When Establishing Sustainable Management Criteria and Analyzing Impacts on Beneficial Uses and Users

The consideration of beneficial uses and users when establishing sustainable management criteria (SMC) is **insufficient**. The consideration of potential impacts on all beneficial users of groundwater in the basin are required when defining undesirable results and establishing minimum thresholds.[6,7,8]

Disadvantaged Communities and Drinking Water Users

For chronic lowering of groundwater levels, the GSP discusses minimum thresholds impact on domestic wells (Section 8.7.3.2). The GSP states (p. 8-35): *"In the Corral de Tierra Area, 100% of the domestic wells should have at least 25 feet of water in them to remain operable if groundwater elevations are at minimum thresholds. Therefore, the minimum thresholds appear to be reasonably protective for domestic users.*" However, the analysis was only based on 19 wells out of the total 169 domestic wells in the OSWCR database. Furthermore, the GSP states (p. 8-35): *"Some domestic wells may draw water from shallow, perched groundwater that is not managed in this GSP.*" The GSP states (p. 4-36): *"There is one single principal aquifer in the Corral de Tierra Area called the El Toro Primary Aquifer System."* The shallow perched zones are part of the primary aquifer system and are still governed by the requirements of SGMA. The current analysis, which only considers 19 out of 169 wells, is insufficient and does not use best available information, for example including Public Land Survey System (PLSS) section location data, as was used in the 180/400 Foot Aquifer GSP.

---

[5] Engagement with Tribal Governments Guidance Document. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Best-Management-Practices-and-Guidance-Documents/Files/Guidance-Doc-for-SGM-Engagement-with-Tribal-Govt_ay_19.pdf

[6] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results." [23 CCR §354.26(b)(3)]

[7] "The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

[8] "The description of minimum thresholds shall include [...] how state, federal, or local standards relate to the relevant sustainability indicator. If the minimum threshold differs from other regulatory standards, the agency shall explain the nature of and the basis for the difference." [23 CCR §354.28(b)(5)]

The GSP states (p. 8-20): *"Groundwater elevation minimum thresholds in the Corral de Tierra Area are defined as follows: Groundwater elevation observed in 2015 in the El Toro Primary Aquifer System."* The GSP does not describe or analyze the impact on DACs and domestic well owners to minimum thresholds that are set to drought-level groundwater elevations, nor does it describe how the existing groundwater level minimum thresholds will avoid significant and unreasonable impacts on DACs and domestic well users beyond 2015 and be consistent with Human Right to Water policy.[9]

For degraded water quality, the GSP identifies constituents of concern (COCs) within the subbasin in Table 8-5, which provides a list of constituents and number of wells that must exceed regulatory standards in order to trigger minimum thresholds. However, the GSP fails to provide justification for how those numbers were selected. The GSP also sets measurable objectives identical to minimum thresholds. The exceedance of minimum thresholds is supposed to trigger additional actions but since minimum thresholds in this plan are identified as measurable objectives, it is unclear what action is triggered. Furthermore, the regulatory standards are not explicitly provided in the GSP.

RECOMMENDATIONS

Chronic Lowering of Groundwater Levels

- Describe direct and indirect impacts on DACs and drinking water users when defining undesirable results for chronic lowering of groundwater levels. For the analysis of minimum threshold impact on domestic wells, use best available information such as Public Land Survey System (PLSS) section location data.

- Establish minimum thresholds at the representative monitoring wells that account for the specific undesirable results the GSA has determined for the subbasin.

Degraded Water Quality

- Describe direct and indirect impacts on DACs and drinking water users when defining undesirable results for degraded water quality. For specific guidance on how to consider these users, refer to "Guide to Protecting Water Quality Under the Sustainable Groundwater Management Act."[10]

- Set measurable objectives at lower levels than minimum thresholds (i.e., indicative of better water quality).

- Set concentration-based minimum thresholds and measurable objectives for COCs in the subbasin that are impacted by groundwater use and/or management. Ensure they align with drinking water standards.[11]

[9] California Water Code §106.3. Available at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=WAT&sectionNum=106.3
[10] Guide to Protecting Water Quality under the Sustainable Groundwater Management Act https://d3n8a8pro7vhmx.cloudfront.net/communitywatercenter/pages/293/attachments/original/1559328858/Guide_to_Protecting_Drinking_Water_Quality_Under_the_Sustainable_Groundwater_Management_Act.pdf?1559328858.
[11] "Degraded Water Quality [...] collect sufficient spatial and temporal data from each applicable principal aquifer to determine groundwater quality trends for water quality indicators, as determined by the Agency, to address known water quality issues." [23 CCR §354.34(c)(4)]

- Evaluate the cumulative or indirect impacts of proposed minimum thresholds for degraded water quality on DACs and drinking water users.

Groundwater Dependent Ecosystems and Interconnected Surface Waters

Sustainable management criteria for chronic lowering of groundwater levels provided in the GSP do not consider potential impacts to environmental beneficial users. The GSP neither describes nor analyzes direct or indirect impacts on environmental users of groundwater when defining undesirable results. This is problematic because without identifying potential impacts to GDEs, minimum thresholds may compromise, or even destroy, these environmental beneficial users. Since GDEs are present in the subbasin, they must be considered when developing SMC.

Sustainable management criteria for depletion of interconnected surface water are established by proxy using minimum shallow groundwater elevations historically observed between 1995 and 2015 near locations of interconnected surface water. To describe impacts to ecological surface water users, the GSP states (p. 8-76): *"There are no known flow prescriptions on the El Toro Creek or any tributaries in the Corral de Tierra Area. Therefore, the current level of depletion has not violated any ecological flow requirements. This conclusion is not meant to imply that depletions do not impact potential species living in or near surface water bodies in the Corral de Tierra Area. However, any impacts that may be occurring have not risen to a level that triggers regulatory intervention. Therefore, the impacts from current rates of depletion on ecological surface water users adjacent to the El Toro Creek are not unreasonable."* The GSP makes no attempt to evaluate the impacts of the proposed minimum threshold on environmental beneficial users of surface water. The GSP does not explain how the chosen minimum thresholds and measurable objectives avoid significant and unreasonable effects on surface water beneficial users in the subbasin, such as increased mortality and inability to perform key life processes (e.g., reproduction, migration).

RECOMMENDATIONS

- When defining undesirable results for chronic lowering of groundwater levels, provide specifics on what biological responses (e.g., extent of habitat, growth, recruitment rates) would best characterize a significant and unreasonable impact to GDEs. Undesirable results to environmental users occur when 'significant and unreasonable' effects on beneficial users are caused by one of the sustainability indicators (i.e., chronic lowering of groundwater levels, degraded water quality, or depletion of interconnected surface water). Thus, potential impacts on environmental beneficial uses and users need to be considered when defining undesirable results in the subbasin.[12] Defining undesirable results is the crucial first step before the minimum thresholds can be determined.[13]

- When defining undesirable results for depletion of interconnected surface water, include a description of potential impacts on instream habitats within ISWs when

[12] "The description of undesirable results shall include [...] potential effects on the beneficial uses and users of groundwater, on land uses and property interests, and other potential effects that may occur or are occurring from undesirable results". [23 CCR §354.26(b)(3)]

[13] The description of minimum thresholds shall include [...] how minimum thresholds may affect the interests of beneficial uses and users of groundwater or land uses and property interests." [23 CCR §354.28(b)(4)]

minimum thresholds in the subbasin are reached.[14] The GSP should confirm that minimum thresholds for ISWs avoid adverse impacts to environmental beneficial users of interconnected surface waters as these environmental users could be left unprotected by the GSP. These recommendations apply especially to environmental beneficial users that are already protected under pre-existing state or federal law.[6,15]

- When establishing SMC for the subbasin, consider that the SGMA statute [Water Code §10727.4(l)] specifically calls out that GSPs shall include "impacts on groundwater dependent ecosystems".

2. Climate Change

The SGMA statute identifies climate change as a significant threat to groundwater resources and one that must be examined and incorporated in the GSPs. The GSP Regulations require integration of climate change into the projected water budget to ensure that projects and management actions sufficiently account for the range of potential climate futures.[16] The effects of climate change can intensify the impacts of water stress on GDEs, making available shallow groundwater resources more critical for their survival. Research shows that GDEs are more likely to succumb to water stress and rely more on groundwater during times of drought.[17] When shallow groundwater is unavailable, riparian forests can die off and key life processes (e.g., migration and spawning) for aquatic organisms, such as steelhead, can be impeded.

The integration of climate change into the projected water budget is **insufficient**. The GSP incorporates climate change into the projected water budget using DWR change factors for 2030 and 2070. However, the plan does not consider multiple climate scenarios (e.g., the 2070 extremely wet and extremely dry climate scenarios) in the projected water budget. The GSP should clearly and transparently incorporate the extremely wet and dry scenarios provided by DWR into projected water budgets or select more appropriate extreme scenarios for the subbasin. While these extreme scenarios may have a lower likelihood of occurring, their consequences could be significant and their inclusion can help identify important vulnerabilities in the subbasin's approach to groundwater management.

If the water budgets are incomplete, including the omission of extremely wet and dry scenarios, then there is increased uncertainty in virtually every subsequent calculation used to plan for projects, derive measurable objectives, and set minimum thresholds. Plans that do not adequately include climate change projections may underestimate future impacts on vulnerable beneficial users of groundwater such as ecosystems and domestic well owners.

---

[14] "The minimum threshold for depletions of interconnected surface water shall be the rate or volume of surface water depletions caused by groundwater use that has adverse impacts on beneficial uses of the surface water and may lead to undesirable results." [23 CCR §354.28(c)(6)]

[15] Rohde MM, Seapy B, Rogers R, Castañeda X, editors. 2019. Critical Species LookBook: A compendium of California's threatened and endangered species for sustainable groundwater management. The Nature Conservancy, San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/Critical_Species_LookBook_91819.pdf

[16] "Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, climate change, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow." [23 CCR §354.18(e)]

[17] Condon et al. 2020. Evapotranspiration depletes groundwater under warming over the contiguous United States. Nature Communications. Available at: https://www.nature.com/articles/s41467-020-14688-0

The GSP states that climate change is incorporated into key inputs (e.g., precipitation, evapotranspiration, surface water flow, and sea level rise) of the projected water budget. However, we were unable to confirm this since Appendix 6B (Monterey Subbasin Groundwater Flow Model Documentation) was not available at the time of the Draft GSP's publication.

RECOMMENDATIONS

- Integrate climate change, including extremely wet and dry scenarios, into all elements of the projected water budget to form the basis for development of sustainable management criteria and projects and management actions.
- Provide details in the GSP on how climate change was incorporated into key inputs (e.g., precipitation, evapotranspiration, surface water flow, and sea level rise) of the water budget.
- Incorporate climate change scenarios into projects and management actions.

3. Data Gaps

The consideration of beneficial users when establishing monitoring networks is **insufficient**, due to lack of specific plans to increase the Representative Monitoring Sites (RMSs) in the monitoring network that represent water quality conditions around DACs and domestic wells and shallow groundwater elevations around GDEs and ISWs in the subbasin. These beneficial users may remain unprotected by the GSP without adequate monitoring and identification of data gaps in the shallow aquifer. The Plan therefore fails to meet SGMA's requirements for the monitoring network.[18]

Figure 7-1 through Figure 7-6 show the locations of the groundwater elevation monitoring network and wells selected for the RMS network within the Marina-Ord Area and the Corral De Tiera Area. Refer to Attachment E for maps of these monitoring sites, plotted by depth, in relation to key beneficial users of groundwater. The monitoring network that represents shallow groundwater elevations around DACs and domestic wells in the subbasin appears sufficient in terms of spatial and depth distribution.

Figure 7-17 (Locations of Wells in the Groundwater Quality Monitoring Network) shows that no water quality monitoring wells are located across portions of the subbasin near DACs and domestic wells. The monitoring network that represents water quality conditions around DACs and domestic wells in the subbasin is insufficient in terms of spatial and depth distribution. Note we were unable to create a map of water quality RMSs since Appendix 7F was not available at the time of the Draft GSP's publication.

The GSP discusses plans to install a new shallow monitoring well in the Corral de Tierra Area to assess ISWs. The GSP does not, however, discuss plans to fill data gaps for GDEs, despite acknowledging significant GDE data gaps in the GDE section of the GSP.

RECOMMENDATIONS

[18] "The monitoring network objectives shall be implemented to accomplish the following: [...] (2) Monitor impacts to the beneficial uses or users of groundwater." [23 CCR §354.34(b)(2)]

- Provide maps that overlay current and proposed monitoring well locations with the locations of DACs, domestic wells, GDEs, and ISWs to clearly identify potentially impacted areas.

- Increase the number of RMSs in the shallow aquifer across the subbasin as needed to adequately monitor all groundwater condition indicators across the subbasin and at appropriate depths for *all* beneficial users. Prioritize proximity to DACs, domestic wells, and GDEs when identifying new RMSs.

- Ensure groundwater elevation and water quality RMSs are monitoring groundwater conditions spatially and at the correct depth for *all* beneficial users - especially DACs, domestic wells, and GDEs.

- Describe biological monitoring that can be used to assess the potential for significant and unreasonable impacts to GDEs or ISWs due to groundwater conditions in the subbasin.

4. Addressing Beneficial Users in Projects and Management Actions

The consideration of beneficial users when developing projects and management actions is **insufficient** due to the failure to completely identify benefits or impacts of identified projects and management actions, including water quality impacts, to key beneficial users of groundwater such as GDEs, aquatic habitats, surface water users, DACs, and drinking water users. Therefore, potential project and management actions may not protect these beneficial users. Groundwater sustainability under SGMA is defined not just by sustainable yield, but by the avoidance of undesirable results for *all* beneficial users.

Section 9.4.3 documents the Multi-benefit Stream Channel Improvements and discusses its benefits including groundwater recharge. However, the project is described as a potential project that will be implemented on an as-needed basis and the GSP does not explicitly define a planning horizon within the SGMA process.

In Section 9.5.9 (Dry Well Notification System), the GSP states (p. 9-104): "*The GSA could develop or support the development of a program to assist well owners (domestic or state small and local small water systems) whose wells go dry due to declining groundwater elevations.*" The GSP states that the program could involve a notification system, monitoring triggered by lowered groundwater elevations, public outreach, "*...referral to assistance with short-term supply solutions, technical assistance to assess why it went dry, and/or long-term supply solutions*." However, no further specifics on a drinking water well impact mitigation program are provided.

RECOMMENDATIONS

- For DACs and domestic well owners, provide specific plans for implementation of a drinking water well impact mitigation program to proactively monitor and protect drinking water wells through GSP implementation. Refer to Attachment B for specific recommendations on how to implement a drinking water well mitigation program.

- For DACs and domestic well owners, include a discussion of whether potential impacts to water quality from projects and management actions could occur and how the GSAs plans to mitigate such impacts.

- Clarify the planning horizon of the described multi-benefit stream channel improvements to ensure that the project will proactively provide groundwater recharge, remove invasive species, and reduce streamflow impediments through GSP implementation.

- Recharge ponds, reservoirs, and facilities for managed stormwater recharge can be designed as multiple-benefit projects to include elements that act functionally as wetlands and provide a benefit for wildlife and aquatic species. For guidance on how to integrate multi-benefit recharge projects into your GSP, refer to the "Multi-Benefit Recharge Project Methodology Guidance Document".[19]

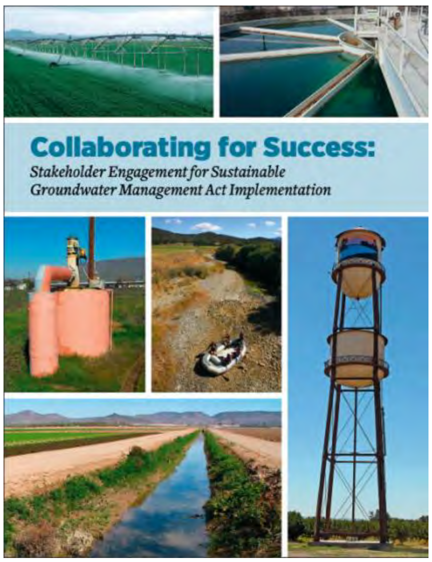
- Develop management actions that incorporate climate and water delivery uncertainties to address future water demand and prevent future undesirable results.

[19] The Nature Conservancy. 2021. Multi-Benefit Recharge Project Methodology for Inclusion in Groundwater Sustainability Plans. Sacramento. Available at: https://groundwaterresourcehub.org/sgma-tools/multi-benefit-recharge-project-methodology-guidance/

Attachment B

SGMA Tools to address DAC, drinking water, and environmental beneficial uses and users

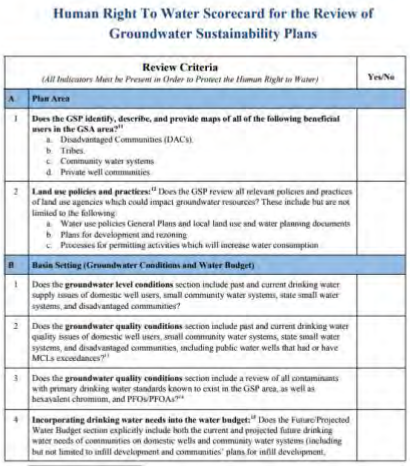
Stakeholder Engagement and Outreach



Clean Water Action, Community Water Center and Union of Concerned Scientists developed a guidance document called Collaborating for success: Stakeholder engagement for Sustainable Groundwater Management Act Implementation. It provides details on how to conduct targeted and broad outreach and engagement during Groundwater Sustainability Plan (GSP) development and implementation. Conducting a targeted outreach involves:

- Developing a robust Stakeholder Communication and Engagement plan that includes outreach at frequented locations (schools, farmers markets, religious settings, events) across the plan area to increase the involvement and participation of disadvantaged communities, drinking water users and the environmental stakeholders.
- Providing translation services during meetings and technical assistance to enable easy participation for non-English speaking stakeholders.
- GSP should adequately describe the process for requesting input from beneficial users and provide details on how input is incorporated into the GSP.

The Human Right to Water

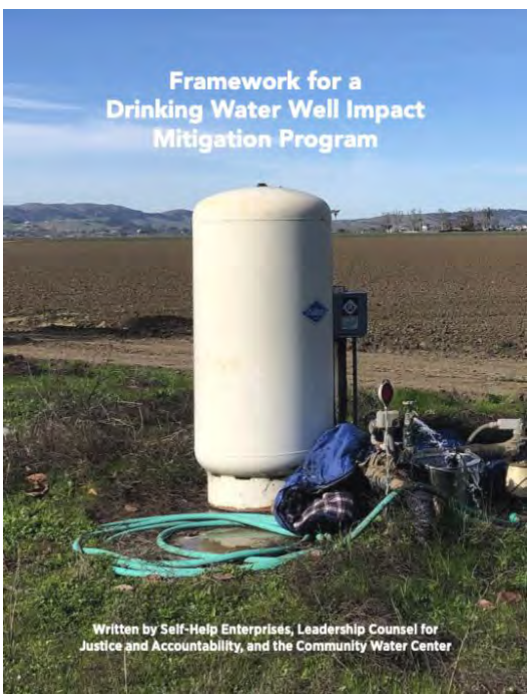


Human Right To Water Scorecard for the Review of Groundwater Sustainability Plans

	Review Criteria *(All Indicators Must be Present in Order to Protect the Human Right to Water)*	Yes/No
A	**Plan Area**	
1	**Does the GSP identify, describe, and provide maps of all of the following beneficial users in the GSA area?**[11] a. Disadvantaged Communities (DACs). b. Tribes. c. Community water systems d. Private well communities	
2	**Land use policies and practices:**[12] Does the GSP review all relevant policies and practices of land use agencies which could impact groundwater resources? These include but are not limited to the following: a. Water use policies General Plans and local land use and water planning documents b. Plans for development and rezoning c. Processes for permitting activities which will increase water consumption	
B	**Basin Setting (Groundwater Conditions and Water Budget)**	
1	Does the **groundwater level conditions** section include past and current drinking water supply issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities?	
2	Does the **groundwater quality conditions** section include past and current drinking water quality issues of domestic well users, small community water systems, state small water systems, and disadvantaged communities, including public water wells that had or have MCLs exceedances?[13]	
3	Does the **groundwater quality conditions** section include a review of all contaminants with primary drinking water standards known to exist in the GSP area, as well as hexavalent chromium, and PFOs/PFOAs?[14]	
4	**Incorporating drinking water needs into the water budget:**[15] Does the Future/Projected Water Budget section explicitly include both the current and projected future drinking water needs of communities on domestic wells and community water systems (including but not limited to infill development and communities' plans for infill development,	

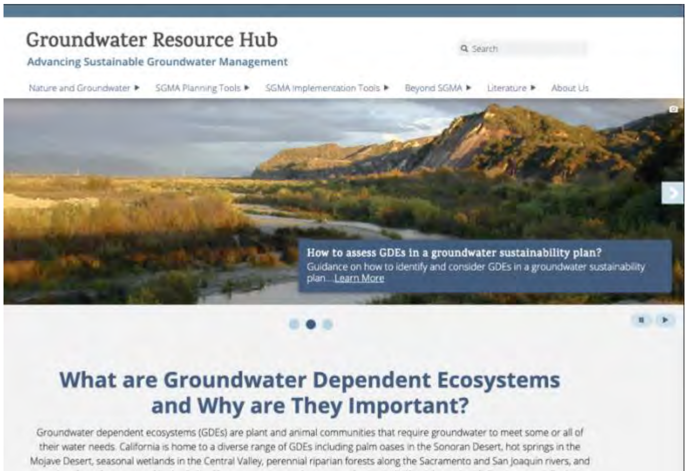
The Human Right to Water Scorecard was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid Groundwater Sustainability Agencies (GSAs) in prioritizing drinking water needs in SGMA. The scorecard identifies elements that must exist in GSPs to adequately protect the Human Right to Drinking water.

Drinking Water Well Impact Mitigation Framework



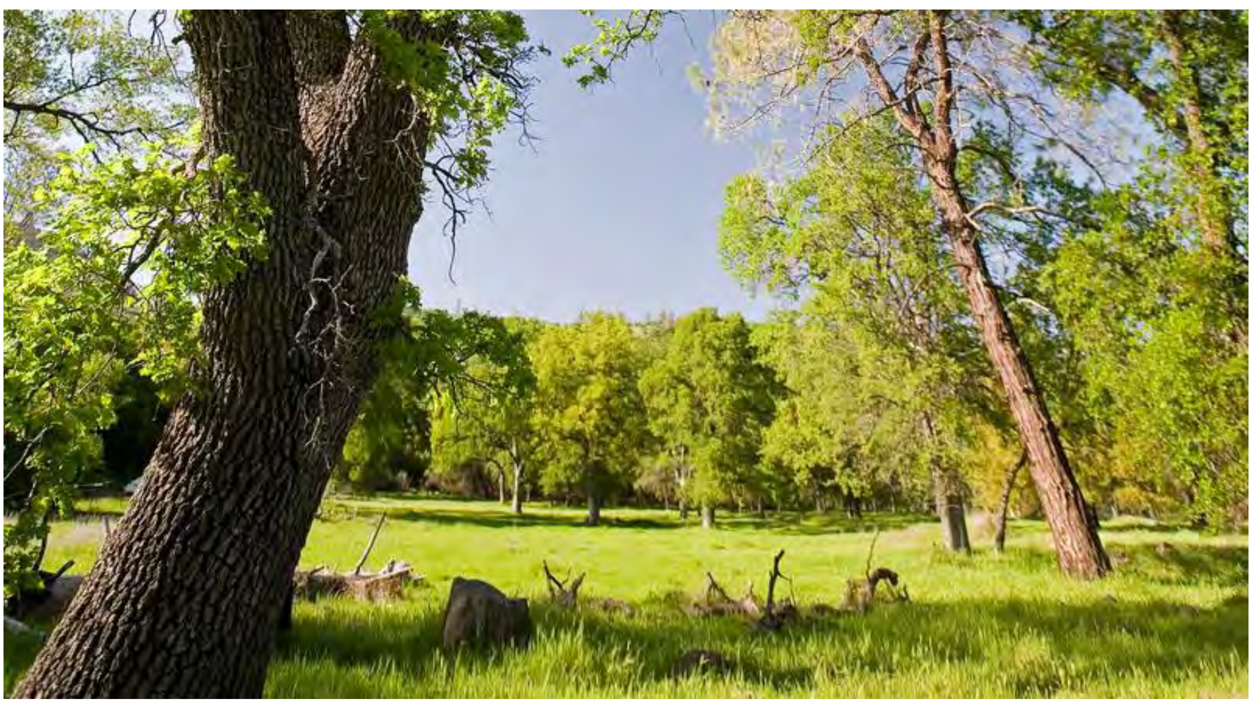
The Drinking Water Well Impact Mitigation Framework was developed by Community Water Center, Leadership Counsel for Justice and Accountability and Self Help Enterprises to aid GSAs in the development and implementation of their GSPs. The framework provides a clear roadmap for how a GSA can best structure its data gathering, monitoring network and management actions to proactively monitor and protect drinking water wells and mitigate impacts should they occur.

Groundwater Resource Hub



The Nature Conservancy has developed a suite of tools based on best available science to help GSAs, consultants, and stakeholders efficiently incorporate nature into GSPs. These tools and resources are available online at GroundwaterResourceHub.org. The Nature Conservancy's tools and resources are intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Rooting Depth Database



The Plant Rooting Depth Database provides information that can help assess whether groundwater-dependent vegetation are accessing groundwater. Actual rooting depths will depend on the plant species and site-specific conditions, such as soil type and availability of other water sources. Site-specific knowledge of depth to groundwater combined with rooting depths will help provide an understanding of the potential groundwater levels are needed to sustain GDEs.

How to use the database

The maximum rooting depth information in the Plant Rooting Depth Database is useful when verifying whether vegetation in the Natural Communities Commonly Associated with Groundwater (NC Dataset) are connected to groundwater. A 30 ft depth-to-groundwater threshold, which is based on averaged global rooting depth data for phreatophytes[1], is relevant for most plants identified in the NC Dataset since most plants have a max rooting depth of less than 30 feet. However, it is important to note that deeper thresholds are necessary for other plants that have reported maximum root depths that exceed the averaged 30 feet threshold, such as valley oak (*Quercus lobata*), Euphrates poplar (*Populus euphratica*), salt cedar (*Tamarix spp.*), and shadescale (*Atriplex confertifolia*). The Nature Conservancy advises that the reported max rooting depth for these deeper-rooted plants be used. For example, a depth-to groundwater threshold of 80 feet should be used instead of the 30 ft threshold, when verifying whether valley oak polygons from the NC Dataset are connected to groundwater. It is important to re-emphasize that actual rooting depth data are limited and will depend on the plant species and site-specific conditions such as soil and aquifer types, and availability to other water sources.

The Plant Rooting Depth Database is an Excel workbook composed of four worksheets:

1. California phreatophyte rooting depth data (included in the NC Dataset)
2. Global phreatophyte rooting depth data
3. Metadata
4. References

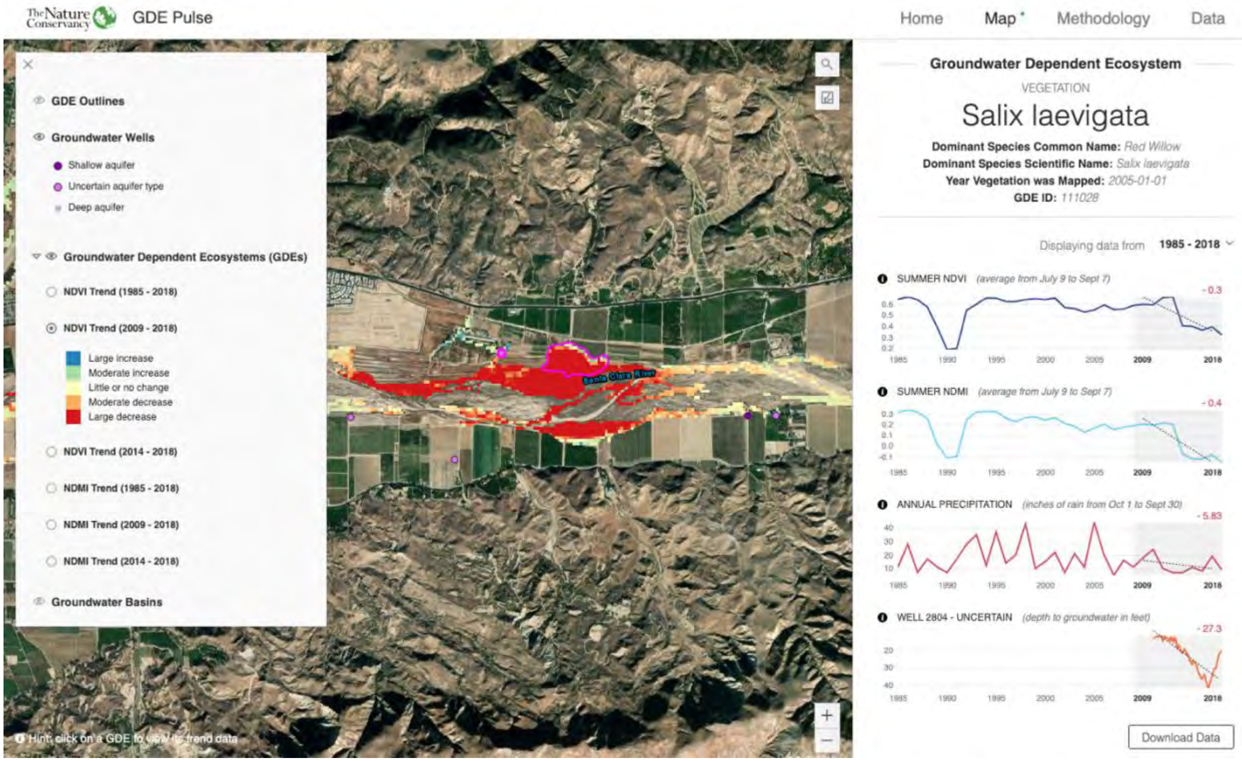
How the database was compiled

The Plant Rooting Depth Database is a compilation of rooting depth information for the groundwater-dependent plant species identified in the NC Dataset. Rooting depth data were compiled from published scientific literature and expert opinion through a crowdsourcing campaign. As more information becomes available, the database of rooting depths will be updated. Please Contact Us if you have additional rooting depth data for California phreatophytes.

---

[1] Canadell, J., Jackson, R.B., Ehleringer, J.B. et al. 1996. Maximum rooting depth of vegetation types at the global scale. Oecologia 108, 583–595. https://doi.org/10.1007/BF00329030

GDE Pulse



GDE Pulse is a free online tool that allows Groundwater Sustainability Agencies to assess changes in groundwater dependent ecosystem (GDE) health using satellite, rainfall, and groundwater data. Remote sensing data from satellites has been used to monitor the health of vegetation all over the planet. GDE pulse has compiled 35 years of satellite imagery from NASA's Landsat mission for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset. The following datasets are available for downloading:

Normalized Difference Vegetation Index (NDVI) is a satellite-derived index that represents the greenness of vegetation. Healthy green vegetation tends to have a higher NDVI, while dead leaves have a lower NDVI. We calculated the average NDVI during the driest part of the year (July - Sept) to estimate vegetation health when the plants are most likely dependent on groundwater.

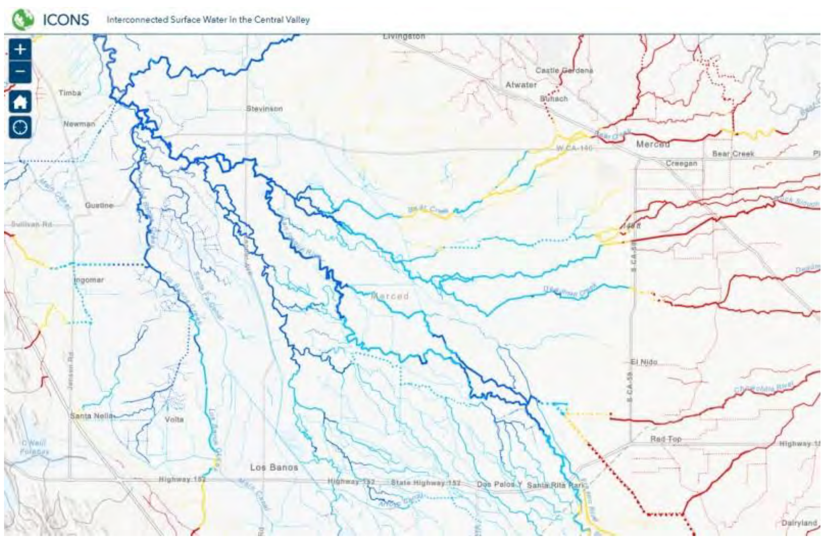
Normalized Difference Moisture Index (NDMI) is a satellite-derived index that represents water content in vegetation. NDMI is derived from the Near-Infrared (NIR) and Short-Wave Infrared (SWIR) channels. Vegetation with adequate access to water tends to have higher NDMI, while vegetation that is water stressed tends to have lower NDMI. We calculated the average NDVI during the driest part of the year (July–September) to estimate vegetation health when the plants are most likely dependent on groundwater.

Annual Precipitation is the total precipitation for the water year (October 1st – September 30th) from the PRISM dataset. The amount of local precipitation can affect vegetation with more precipitation generally leading to higher NDVI and NDMI.

Depth to Groundwater measurements provide an indication of the groundwater levels and changes over time for the surrounding area. We used groundwater well measurements from nearby (<1km) wells to estimate the depth to groundwater below the GDE based on the average elevation of the GDE (using a digital elevation model) minus the measured groundwater surface elevation.

ICONOS Mapper

Interconnected Surface Water in the Central Valley



ICONS maps the likely presence of interconnected surface water (ISW) in the Central Valley using depth to groundwater data. Using data from 2011-2018, the ISW dataset represents the likely connection between surface water and groundwater for rivers and streams in California's Central Valley. It includes information on the mean, maximum, and minimum depth to groundwater for each stream segment over the years with available data, as well as the likely presence of ISW based on the minimum depth to groundwater. The Nature Conservancy developed this database, with guidance and input from expert academics, consultants, and state agencies.

We developed this dataset using groundwater elevation data available online from the California Department of Water Resources (DWR). DWR only provides this data for the Central Valley. For GSAs outside of the valley, who have groundwater well measurements, we recommend following our methods to determine likely ISW in your region. The Nature Conservancy's ISW dataset should be used as a first step in reviewing ISW and should be supplemented with local or more recent groundwater depth data.

Attachment C

Freshwater Species Located in the Monterey Basin

To assist in identifying the beneficial users of surface water necessary to assess the undesirable result "depletion of interconnected surface waters", Attachment C provides a list of freshwater species located in the Monterey Basin. To produce the freshwater species list, we used ArcGIS to select features within the California Freshwater Species Database version 2.0.9 within the basin boundary. This database contains information on ~4,000 vertebrates, macroinvertebrates and vascular plants that depend on fresh water for at least one stage of their life cycle. The methods used to compile the California Freshwater Species Database can be found in Howard et al. 2015[1]. The spatial database contains locality observations and/or distribution information from ~400 data sources. The database is housed in the California Department of Fish and Wildlife's BIOS[2] as well as on The Nature Conservancy's science website[3].

Scientific Name	Common Name	Legal Protected Status		
		Federal	State	Other
BIRDS				
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern	BSSC - First priority
Aechmophorus clarkii	Clark's Grebe			
Aechmophorus occidentalis	Western Grebe			
Anas acuta	Northern Pintail			
Anas americana	American Wigeon			
Anas clypeata	Northern Shoveler			
Anas crecca	Green-winged Teal			
Anas platyrhynchos	Mallard			
Anas strepera	Gadwall			
Ardea alba	Great Egret			
Ardea herodias	Great Blue Heron			
Aythya americana	Redhead		Special Concern	BSSC - Third priority
Aythya collaris	Ring-necked Duck			
Aythya marila	Greater Scaup			
Aythya valisineria	Canvasback		Special	
Bucephala albeola	Bufflehead			
Bucephala clangula	Common Goldeneye			
Butorides virescens	Green Heron			
Calidris alpina	Dunlin			

[1] Howard, J.K. et al. 2015. Patterns of Freshwater Species Richness, Endemism, and Vulnerability in California. PLoSONE, 11(7). Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130710

[2] California Department of Fish and Wildlife BIOS: https://www.wildlife.ca.gov/data/BIOS

[3] Science for Conservation: https://www.scienceforconservation.org/products/california-freshwater-species-database

Calidris mauri	Western Sandpiper			
Calidris minutilla	Least Sandpiper			
Chroicocephalus philadelphia	Bonaparte's Gull			
Cistothorus palustris palustris	Marsh Wren			
Cygnus columbianus	Tundra Swan			
Egretta thula	Snowy Egret			
Fulica americana	American Coot			
Gallinago delicata	Wilson's Snipe			
Gallinula chloropus	Common Moorhen			
Himantopus mexicanus	Black-necked Stilt			
Icteria virens	Yellow-breasted Chat		Special Concern	BSSC - Third priority
Lophodytes cucullatus	Hooded Merganser			
Megaceryle alcyon	Belted Kingfisher			
Mergus serrator	Red-breasted Merganser			
Numenius americanus	Long-billed Curlew			
Numenius phaeopus	Whimbrel			
Nycticorax nycticorax	Black-crowned Night-Heron			
Oxyura jamaicensis	Ruddy Duck			
Pelecanus erythrorhynchos	American White Pelican		Special Concern	BSSC - First priority
Phalacrocorax auritus	Double-crested Cormorant			
Piranga rubra	Summer Tanager		Special Concern	BSSC - First priority
Pluvialis squatarola	Black-bellied Plover			
Podiceps nigricollis	Eared Grebe			
Podilymbus podiceps	Pied-billed Grebe			
Porzana carolina	Sora			
Rallus limicola	Virginia Rail			
Riparia riparia	Bank Swallow		Threatened	
Setophaga petechia	Yellow Warbler			BSSC - Second priority
Tachycineta bicolor	Tree Swallow			
Tringa melanoleuca	Greater Yellowlegs			
Tringa semipalmata	Willet			
CRUSTACEANS				
Linderiella occidentalis	California Fairy Shrimp		Special	IUCN - Near Threatened
FISH				
Oncorhynchus mykiss - SCCC	South Central California coast steelhead	Threatened	Special Concern	Vulnerable - Moyle 2013

HERPS				
Actinemys marmorata marmorata	Western Pond Turtle		Special Concern	ARSSC
Ambystoma californiense californiense	California Tiger Salamander	Threatened	Threatened	ARSSC
Anaxyrus boreas boreas	Boreal Toad			
Rana boylii	Foothill Yellow-legged Frog	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Rana draytonii	California Red-legged Frog	Threatened	Special Concern	ARSSC
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern	ARSSC
Taricha torosa	Coast Range Newt		Special Concern	ARSSC
Thamnophis hammondii hammondii	Two-striped Gartersnake		Special Concern	ARSSC
Thamnophis sirtalis sirtalis	Common Gartersnake			
Anaxyrus boreas halophilus	California Toad			ARSSC
Pseudacris regilla	Northern Pacific Chorus Frog			
Pseudacris sierra	Sierran Treefrog			
INSECTS & OTHER INVERTS				
Enallagma civile	Familiar Bluet			
Libellula pulchella	Twelve-spotted Skimmer			
Sympetrum corruptum	Variegated Meadowhawk			
PLANTS				
Lasthenia conjugens	Contra Costa Goldfields	Endangered	Special	CRPR - 1B.1
Alopecurus saccatus	Pacific Foxtail			
Arundo donax	NA			
Baccharis glutinosa	NA			Not on any status lists
Callitriche heterophylla bolanderi	Large Water-starwort			
Callitriche heterophylla heterophylla	Northern Water-starwort			
Callitriche marginata	Winged Water-starwort			
Calochortus uniflorus	Shortstem Mariposa Lily		Special	CRPR - 4.2
Cicendia quadrangularis	Oregon Microcala			
Cicuta maculata bolanderi	Bolander's Water-hemlock		Special	CRPR - 2B.1
Cotula coronopifolia	NA			

Crassula aquatica	Water Pygmyweed			
Crypsis vaginiflora	NA			
Datisca glomerata	Durango Root			
Elatine brachysperma	Shortseed Waterwort			
Eleocharis acicularis acicularis	Least Spikerush			
Eleocharis macrostachya	Creeping Spikerush			
Euthamia occidentalis	Western Fragrant Goldenrod			
Isoetes howellii	NA			
Isoetes orcuttii	NA			
Juncus falcatus falcatus	Sickle-leaf Rush			
Juncus phaeocephalus paniculatus	Brownhead Rush			
Juncus phaeocephalus phaeocephalus	Brown-head Rush			
Juncus rugulosus	Wrinkled Rush			
Juncus uncialis	Inch-high Rush			
Legenere limosa	False Venus'-looking-glass		Special	CRPR - 1B.1
Marsilea vestita vestita	NA			Not on any status lists
Navarretia intertexta	Needleleaf Navarretia			
Persicaria amphibia				Not on any status lists
Phacelia distans	NA			
Pilularia americana	NA			
Plantago elongata elongata	Slender Plantain			
Platanus racemosa	California Sycamore			
Pogogyne douglasii	NA			
Psilocarphus brevissimus brevissimus	Dwarf Woolly-heads			
Psilocarphus tenellus	NA			
Ranunculus lobbii	Lobb's Water Buttercup		Special	CRPR - 4.2
Rorippa curvisiliqua curvisiliqua	Curve-pod Yellowcress			
Rumex salicifolius salicifolius	Willow Dock			
Salix lasiolepis lasiolepis	Arroyo Willow			
Stachys ajugoides	Bugle Hedge-nettle			
Triglochin scilloides	NA			Not on any status lists
Typha latifolia	Broadleaf Cattail			
Veronica anagallis-aquatica	NA			
Veronica catenata	NA			Not on any status lists

Attachment D

July 2019

IDENTIFYING GDEs UNDER SGMA
Best Practices for using the NC Dataset

The Sustainable Groundwater Management Act (SGMA) requires that groundwater dependent ecosystems (GDEs) be identified in Groundwater Sustainability Plans (GSPs). As a starting point, the Department of Water Resources (DWR) is providing the Natural Communities Commonly Associated with Groundwater Dataset (NC Dataset) online[1] to help Groundwater Sustainability Agencies (GSAs), consultants, and stakeholders identify GDEs within individual groundwater basins. To apply information from the NC Dataset to local areas, GSAs should combine it with the best available science on local hydrology, geology, and groundwater levels to verify whether polygons in the NC dataset are likely supported by groundwater in an aquifer (Figure 1)[2]. This document highlights six best practices for using local groundwater data to confirm whether mapped features in the NC dataset are supported by groundwater.

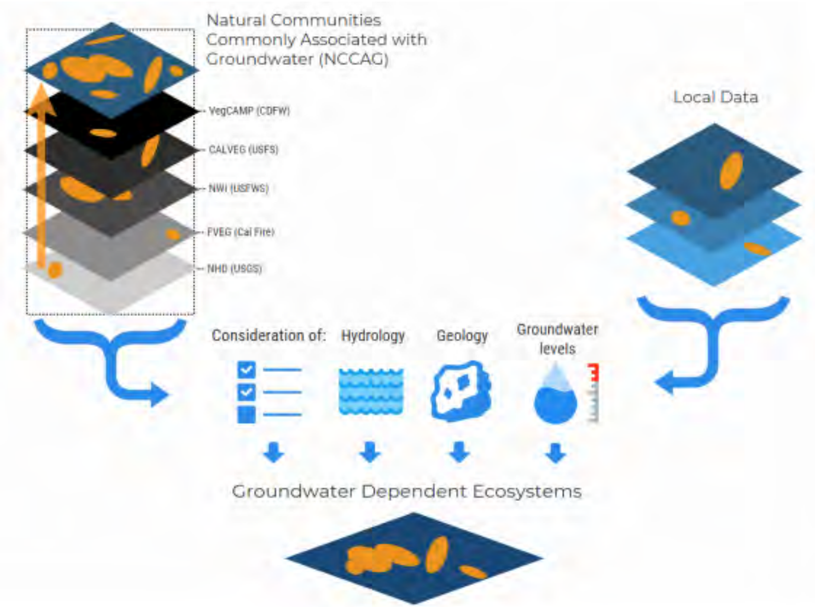


Figure 1. Considerations for GDE identification.
Source: DWR[2]

---

[1] NC Dataset Online Viewer: https://gis.water.ca.gov/app/NCDatasetViewer/

[2] California Department of Water Resources (DWR). 2018. Summary of the "Natural Communities Commonly Associated with Groundwater" Dataset and Online Web Viewer. Available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Data-and-Tools/Files/Statewide-Reports/Natural-Communities-Dataset-Summary-Document.pdf

The NC Dataset identifies vegetation and wetland features that are good indicators of a GDE. The dataset is comprised of 48 publicly available state and federal datasets that map vegetation, wetlands, springs, and seeps commonly associated with groundwater in California[3]. It was developed through a collaboration between DWR, the Department of Fish and Wildlife, and The Nature Conservancy (TNC). TNC has also provided detailed guidance on identifying GDEs from the NC dataset[4] on the Groundwater Resource Hub[5], a website dedicated to GDEs.

BEST PRACTICE #1. Establishing a Connection to Groundwater

Groundwater basins can be comprised of one continuous aquifer (Figure 2a) or multiple aquifers stacked on top of each other (Figure 2b). In unconfined aquifers (Figure 2a), using the depth-to-groundwater and the rooting depth of the vegetation is a reasonable method to infer groundwater dependence for GDEs. If groundwater is well below the rooting (and capillary) zone of the plants and any wetland features, the ecosystem is considered disconnected and groundwater management is not likely to affect the ecosystem (Figure 2d). However, it is important to consider local conditions (e.g., soil type, groundwater flow gradients, and aquifer parameters) and to review groundwater depth data from multiple seasons and water year types (wet and dry) because intermittent periods of high groundwater levels can replenish perched clay lenses that serve as the water source for GDEs (Figure 2c). Maintaining these natural groundwater fluctuations are important to sustaining GDE health.

Basins with a stacked series of aquifers (Figure 2b) may have varying levels of pumping across aquifers in the basin, depending on the production capacity or water quality associated with each aquifer. If pumping is concentrated in deeper aquifers, SGMA still requires GSAs to sustainably manage groundwater resources in shallow aquifers, such as perched aquifers, that support springs, surface water, domestic wells, and GDEs (Figure 2). This is because vertical groundwater gradients across aquifers may result in pumping from deeper aquifers to cause adverse impacts onto beneficial users reliant on shallow aquifers or interconnected surface water. The goal of SGMA is to sustainably manage groundwater resources for current and future social, economic, and environmental benefits. While groundwater pumping may not be currently occurring in a shallower aquifer, use of this water may become more appealing and economically viable in future years as pumping restrictions are placed on the deeper production aquifers in the basin to meet the sustainable yield and criteria. Thus, identifying GDEs in the basin should done irrespective to the amount of current pumping occurring in a particular aquifer, so that future impacts on GDEs due to new production can be avoided. A good rule of thumb to follow is: *if groundwater can be pumped from a well - it's an aquifer*.

[3] For more details on the mapping methods, refer to: Klausmeyer, K., J. Howard, T. Keeler-Wolf, K. Davis-Fadtke, R. Hull, A. Lyons. 2018. Mapping Indicators of Groundwater Dependent Ecosystems in California: Methods Report. San Francisco, California. Available at: https://groundwaterresourcehub.org/public/uploads/pdfs/iGDE_data_paper_20180423.pdf
[4] "Groundwater Dependent Ecosystems under the Sustainable Groundwater Management Act: Guidance for Preparing Groundwater Sustainability Plans" is available at: https://groundwaterresourcehub.org/gde-tools/gsp-guidance-document/
[5] The Groundwater Resource Hub: www.GroundwaterResourceHub.org

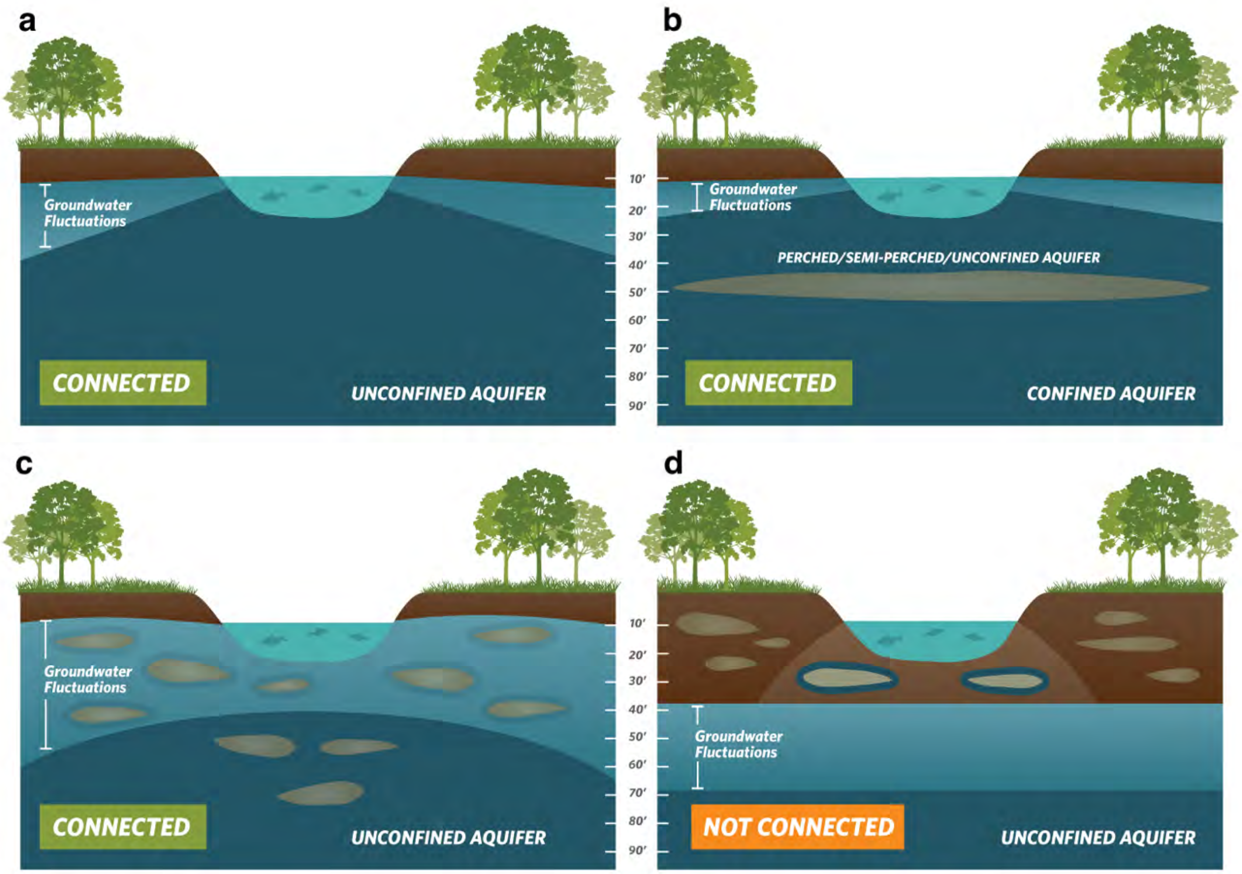


Figure 2. Confirming whether an ecosystem is connected to groundwater. Top: (a) Under the ecosystem is an unconfined aquifer with depth-to-groundwater fluctuating seasonally and interannually within 30 feet from land surface. (b) Depth-to-groundwater in the shallow aquifer is connected to overlying ecosystem. Pumping predominately occurs in the confined aquifer, but pumping is possible in the shallow aquifer. Bottom: (c) Depth-to-groundwater fluctuations are seasonally and interannually large, however, clay layers in the near surface prolong the ecosystem's connection to groundwater. (d) Groundwater is disconnected from surface water, and any water in the vadose (unsaturated) zone is due to direct recharge from precipitation and indirect recharge under the surface water feature. These areas are not connected to groundwater and typically support species that do not require access to groundwater to survive.

BEST PRACTICE #2. Characterize Seasonal and Interannual Groundwater Conditions

SGMA requires GSAs to describe current and historical groundwater conditions when identifying GDEs [23 CCR §354.16(g)]. Relying solely on the SGMA benchmark date (January 1, 2015) or any other single point in time to characterize groundwater conditions (e.g., depth-to-groundwater) is inadequate because managing groundwater conditions with data from one time point fails to capture the seasonal and interannual variability typical of California's climate. DWR's Best Management Practices document on water budgets[6] recommends using 10 years of water supply and water budget information to describe how historical conditions have impacted the operation of the basin within sustainable yield, implying that a baseline[7] could be determined based on data between 2005 and 2015. Using this or a similar time period, depending on data availability, is recommended for determining the depth-to-groundwater.

GDEs depend on groundwater levels being close enough to the land surface to interconnect with surface water systems or plant rooting networks. The most practical approach[8] for a GSA to assess whether polygons in the NC dataset are connected to groundwater is to rely on groundwater elevation data. As detailed in TNC's GDE guidance document[4], one of the key factors to consider when mapping GDEs is to contour depth-to-groundwater in the aquifer that is supporting the ecosystem (see Best Practice #5).

Groundwater levels fluctuate over time and space due to California's Mediterranean climate (dry summers and wet winters), climate change (flood and drought years), and subsurface heterogeneity in the subsurface (Figure 3). Many of California's GDEs have adapted to dealing with intermittent periods of water stress, however if these groundwater conditions are prolonged, adverse impacts to GDEs can result. While depth-to-groundwater levels within 30 feet[4] of the land surface are generally accepted as being a proxy for confirming that polygons in the NC dataset are supported by groundwater, it is highly advised that fluctuations in the groundwater regime be characterized to understand the seasonal and interannual groundwater variability in GDEs. Utilizing groundwater data from one point in time can misrepresent groundwater levels required by GDEs, and inadvertently result in adverse impacts to the GDEs. Time series data on groundwater elevations and depths are available on the SGMA Data Viewer[9]. However, if insufficient data are available to describe groundwater conditions within or near polygons from the NC dataset, include those polygons in the GSP until data gaps are reconciled in the monitoring network (see Best Practice #6).

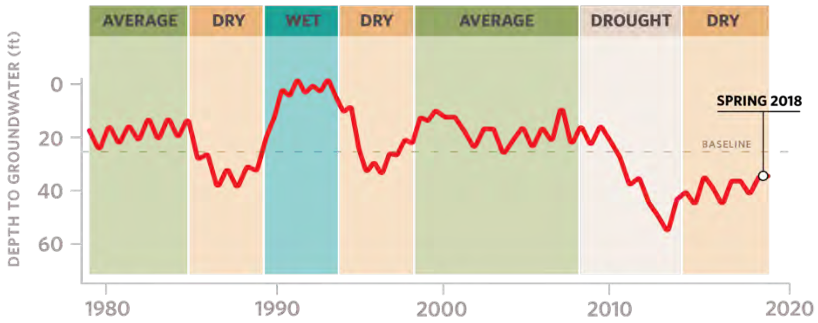


Figure 3. Example seasonality and interannual variability in depth-to-groundwater over time. Selecting one point in time, such as Spring 2018, to characterize groundwater conditions in GDEs fails to capture what groundwater conditions are necessary to maintain the ecosystem status into the future so adverse impacts are avoided.

---

[6] DWR. 2016. Water Budget Best Management Practice. Available at: https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/BMP_Water_Budget_Final_2016-12-23.pdf

[7] Baseline is defined under the GSP regulations as "historic information used to project future conditions for hydrology, water demand, and availability of surface water and to evaluate potential sustainable management practices of a basin." [23 CCR §351(e)]

[8] Groundwater reliance can also be confirmed via stable isotope analysis and geophysical surveys. For more information see The GDE Assessment Toolbox (Appendix IV, GDE Guidance Document for GSPs[4]).

[9] SGMA Data Viewer: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer

BEST PRACTICE #3. Ecosystems Often Rely on Both Groundwater and Surface Water

GDEs are plants and animals that rely on groundwater for all or some of its water needs, and thus can be supported by multiple water sources. The presence of non-groundwater sources (e.g., surface water, soil moisture in the vadose zone, applied water, treated wastewater effluent, urban stormwater, irrigated return flow) within and around a GDE does not preclude the possibility that it is supported by groundwater, too. SGMA defines GDEs as "ecological communities and species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" [23 CCR §351(m)]. Hence, depth-to-groundwater data should be used to identify whether NC polygons are supported by groundwater and should be considered GDEs. In addition, SGMA requires that significant and undesirable adverse impacts to beneficial users of surface water be avoided. Beneficial users of surface water include environmental users such as plants or animals[10], which therefore must be considered when developing minimum thresholds for depletions of interconnected surface water.

GSAs are only responsible for impacts to GDEs resulting from groundwater conditions in the basin, so if adverse impacts to GDEs result from the diversion of applied water, treated wastewater, or irrigation return flow away from the GDE, then those impacts will be evaluated by other permitting requirements (e.g., CEQA) and may not be the responsibility of the GSA. However, if adverse impacts occur to the GDE due to changing groundwater conditions resulting from pumping or groundwater management activities, then the GSA would be responsible (Figure 4).

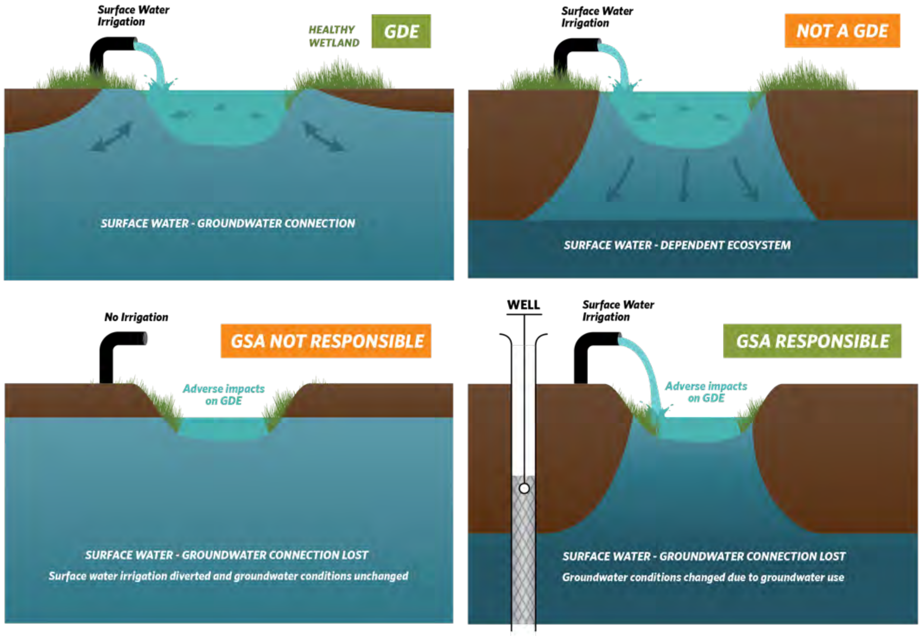


Figure 4. Ecosystems often depend on multiple sources of water. Top: (Left) Surface water and groundwater are interconnected, meaning that the GDE is supported by both groundwater and surface water. (Right) Ecosystems that are only reliant on non-groundwater sources are not groundwater-dependent. Bottom: (Left) An ecosystem that was once dependent on an interconnected surface water, but loses access to groundwater solely due to surface water diversions may not be the GSA's responsibility. (Right) Groundwater dependent ecosystems once dependent on an interconnected surface water system, but loses that access due to groundwater pumping is the GSA's responsibility.

[10] For a list of environmental beneficial users of surface water by basin, visit: https://groundwaterresourcehub.org/gde-tools/environmental-surface-water-beneficiaries/

BEST PRACTICE #4. Select Representative Groundwater Wells

Identifying GDEs in a basin requires that groundwater conditions are characterized to confirm whether polygons in the NC dataset are supported by the underlying aquifer. To do this, proximate groundwater wells should be identified to characterize groundwater conditions (Figure 5). When selecting representative wells, it is particularly important to consider the subsurface heterogeneity around NC polygons, especially near surface water features where groundwater and surface water interactions occur around heterogeneous stratigraphic units or aquitards formed by fluvial deposits. The following selection criteria can help ensure groundwater levels are representative of conditions within the GDE area:

- Choose wells that are within 5 kilometers (3.1 miles) of each NC Dataset polygons because they are more likely to reflect the local conditions relevant to the ecosystem. If there are no wells within 5km of the center of a NC dataset polygon, then there is insufficient information to remove the polygon based on groundwater depth. Instead, it should be retained as a potential GDE until there are sufficient data to determine whether or not the NC Dataset polygon is supported by groundwater.

- Choose wells that are screened within the surficial unconfined aquifer and capable of measuring the true water table.

- Avoid relying on wells that have insufficient information on the screened well depth interval for excluding GDEs because they could be providing data on the wrong aquifer. This type of well data should not be used to remove any NC polygons.

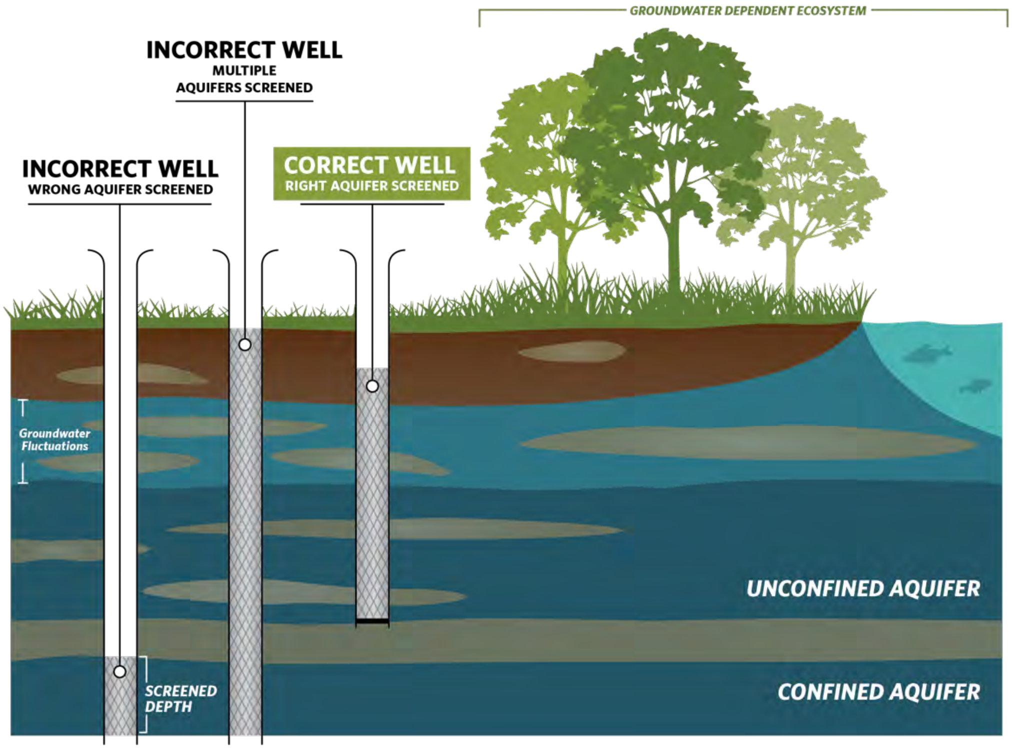


Figure 5. Selecting representative wells to characterize groundwater conditions near GDEs.

BEST PRACTICE #5. Contouring Groundwater Elevations

The common practice to contour depth-to-groundwater over a large area by interpolating measurements at monitoring wells is unsuitable for assessing whether an ecosystem is supported by groundwater. This practice causes errors when the land surface contains features like stream and wetland depressions because it assumes the land surface is constant across the landscape and depth-to-groundwater is constant below these low-lying areas (Figure 6a). A more accurate approach is to interpolate groundwater elevations at monitoring wells to get groundwater elevation contours across the landscape. This layer can then be subtracted from land surface elevations from a Digital Elevation Model (DEM)[11] to estimate depth-to-groundwater contours across the landscape (Figure b; Figure 7). This will provide a much more accurate contours of depth-to-groundwater along streams and other land surface depressions where GDEs are commonly found.

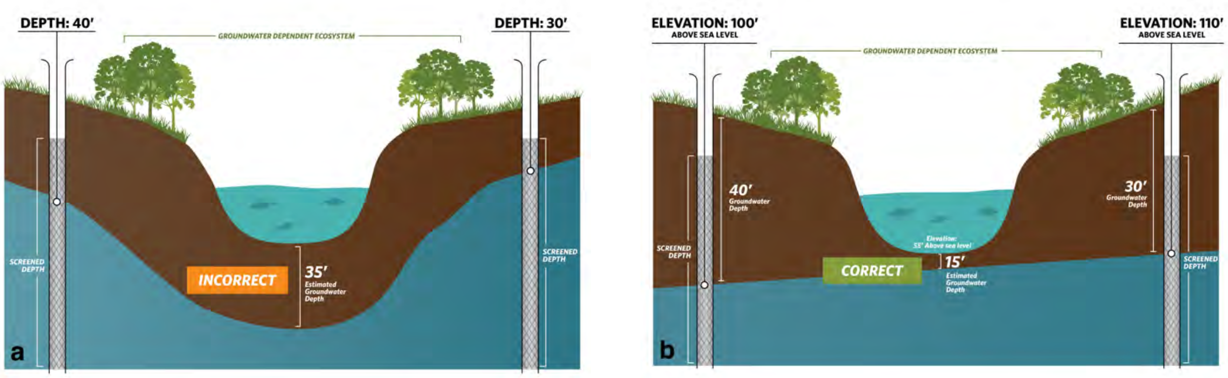


Figure 6. Contouring depth-to-groundwater around surface water features and GDEs. (a) Groundwater level interpolation using depth-to-groundwater data from monitoring wells. (b) Groundwater level interpolation using groundwater elevation data from monitoring wells and DEM data.

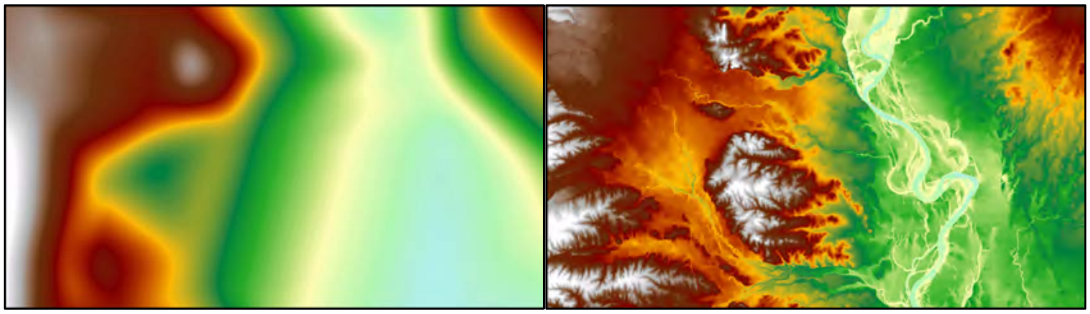


Figure 7. Depth-to-groundwater contours in Northern California. (Left) Contours were interpolated using depth-to-groundwater measurements determined at each well. (Right) Contours were determined by interpolating groundwater elevation measurements at each well and superimposing ground surface elevation from DEM spatial data to generate depth-to-groundwater contours. The image on the right shows a more accurate depth-to-groundwater estimate because it takes the local topography and elevation changes into account.

[11] USGS Digital Elevation Model data products are described at: https://www.usgs.gov/core-science-systems/ngp/3dep/about-3dep-products-services and can be downloaded at: https://iewer.nationalmap.gov/basic/

BEST PRACTICE #6. Best Available Science

Adaptive management is embedded within SGMA and provides a process to work toward sustainability over time by beginning with the best available information to make initial decisions, monitoring the results of those decisions, and using the data collected through monitoring programs to revise decisions in the future. In many situations, the hydrologic connection of NC dataset polygons will not initially be clearly understood if site-specific groundwater monitoring data are not available. If sufficient data are not available in time for the 2020/2022 plan, The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network. Erring on the side of caution will help minimize inadvertent impacts to GDEs as a result of groundwater use and management actions during SGMA implementation.

KEY DEFINITIONS

Groundwater basin is an aquifer or stacked series of aquifers with reasonably well-defined boundaries in a lateral direction, based on features that significantly impede groundwater flow, and a definable bottom. *23 CCR §341(g)(1)*

Groundwater dependent ecosystem (GDE) are ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. *23 CCR §351(m)*

Interconnected surface water (ISW) surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. *23 CCR §351(o)*

Principal aquifers are aquifers or aquifer systems that store, transmit, and yield significant or economic quantities of groundwater to wells, springs, or surface water systems. *23 CCR §351(aa)*

ABOUT US

The Nature Conservancy is a science-based nonprofit organization whose mission is *to conserve the lands and waters on which all life depends*. To support successful SGMA implementation that meets the future needs of people, the economy, and the environment, TNC has developed tools and resources (www.groundwaterresourcehub.org) intended to reduce costs, shorten timelines, and increase benefits for both people and nature.

Attachment E

Maps of representative monitoring sites in relation to key beneficial users

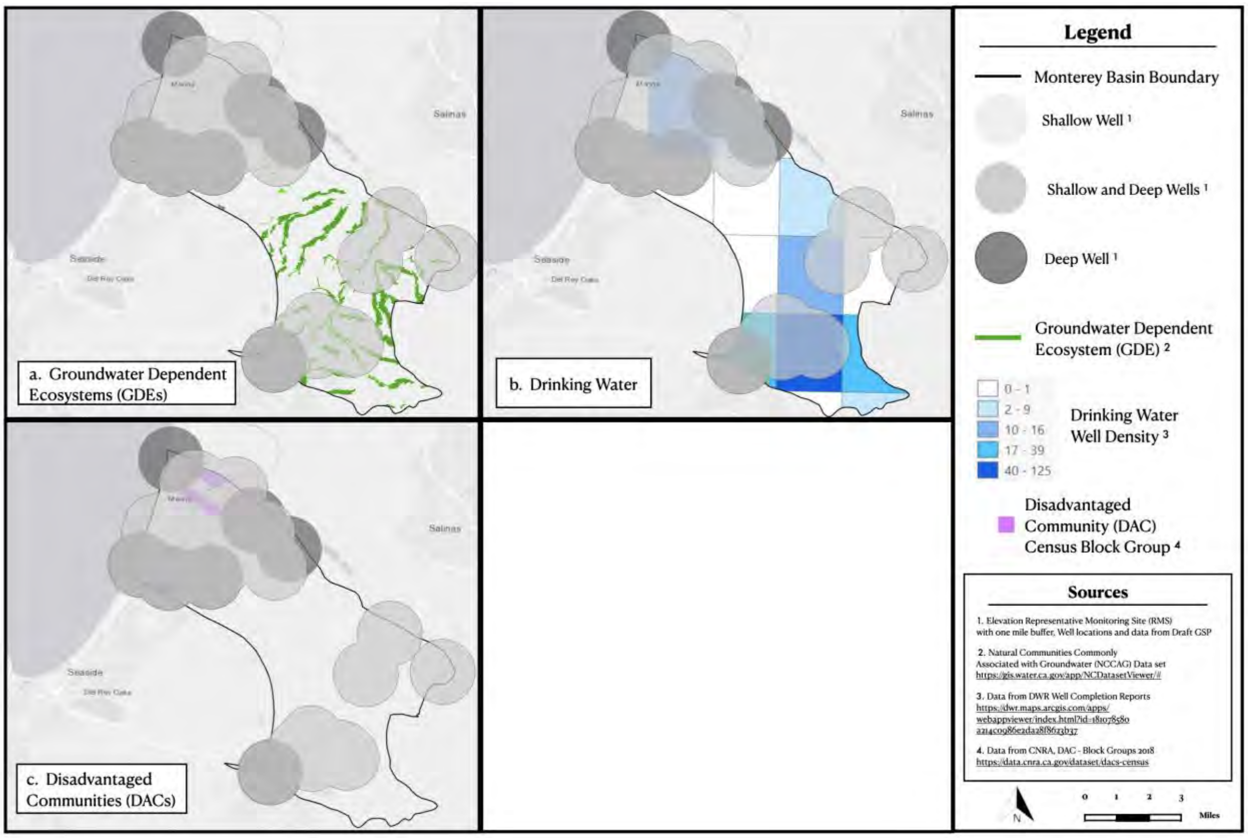


Figure 1. Groundwater elevation representative monitoring sites in relation to key beneficial users: a) Groundwater Dependent Ecosystems (GDEs), b) Drinking Water users, c) Disadvantaged Communities (DACs), and d) Tribes.

From: Mike McCullough <MikeM@my1water.org>
Sent: Thursday, November 4, 2021 3:14 PM
To: Abby Ostovar <aostovar@elmontgomery.com>; Emily Gardner <gardnere@svbgsa.org>
Cc: Alison Imamura <Alison@my1water.org>
Subject: Comments on the Monterey Subbasin GSP

Abby and Emily,

On page 9-52, the statement below reads.

In 2020, M1W completed Phase I of the AWPF that has the capacity to produce 4,300 AFY of advanced treated water. Of this water produced, 3,700 AFY is conveyed to Seaside Subbasin for IPR use as part of M1W's Pure Water Monterey project, and 600 AFY is available to MCWD. Based on current plans, the AWPF will be expanded further to produce an additional 2,250 AFY of purified water for M1W and 827 AFY for MCWD[6].

M1W's response

M1W completed its Pure Water Monterey project and MCWD's 600 AFY yield for urban irrigation in former Fort Ord project in 2020. M1W's Supplemental EIR for the Expanded Pure Water Monterey Project increased the 3,700 AFY to 5,950 AFY that is conveyed to the Seaside Subbasin for indirect potable reuse for the Monterey Peninsula (CalAm Monterey District). The expansion will continue to provide 600 AFY to MCWD.

On Page 9-54, the statement below reads.

The current operation frequency of MCWD's production wells generally ranges from 10% to 40%. These operation frequencies are low and, barring other constraints (e.g., concerns regarding seawater intrusion), could likely be increased to an operational frequency of up to 70% to capture injected water. Additional production wells might need to be constructed to provide additional extraction capacity, depending on the volume and rate of injection. The 2020 Water Supply Augmentation Study evaluated two potential production capacities for the IPR project including 973 AFY and 2,400 AFY. The project could be readily expanded to facilitate injection of additional advanced treated water as it becomes available.

M1W's response

M1W is not aware of any future projections of MCWD wastewater flows that provide for a quantity of influent water that could be used to meet the identified yield for an expanded Ord area irrigation project or an as-yet-undefined indirect potable reuse project. Current and approved expanded facilities provide for 600 AFY total yield for MCWD. RUWAP has always been described and evaluated as a water *augmentation* project; the MCWD, FORA, and M1W approvals of RUWAP all described and evaluated that the supplies from RUWAP would *augment* groundwater supplies for the redevelopment of the former Fort Ord; the project was never described as a project to replace or reduce use of groundwater. Specifically, the RUWAP project approval in 2004 (with modifications in October 2006, February 2007, and April 2016) describe the existence of rights to groundwater from zones 2 and 2A for the benefit of the former Fort Ord and that the RUWAP adds to those volumes of water available. The Pure Water Monterey Project was approved in October 2015 and that approval included no capacity for MCWD customers. In M1W's Addendum for the Proposed Capacity Expansion from 4-mgd maximum production rate to a 5-mgd maximum production rate (dated October 2017), M1W approved providing only up to 600 AFY for urban irrigation water within the former Fort Ord. Use of MCWD wastewater flows are limited to 300 acre feet during April 1 through Sept 30 plus M1W summer wastewater rights of up to 650 AFY during May 1 through August 31. Those volumes of water do not provide the flows needed to inject water per the proposed study recommendations.

Also, as noted in the first amendment to the Pure Water Delivery and Supply Project Agreement between M1W and MCWD, Section 1.03 (a) states "Because of the uncertainty resulting from the possibility that a portion of MCWD AWT Phase 2 will be used for injection, details regarding Phase 2 implementation of MCWD's AWT Phase 2 water for injection will require a separate agreement or an amendment to this agreement based upon the existing terms of the agreement."

Please let me know if you have any questions regarding these comments

Mike McCullough, MPA
Director of External Affairs
Monterey One Water
P:831-645-4618
www.MontereyOneWater.org

Monterey One Water
Providing Cooperative Water Solutions

Luhdorff & Scalmanini
Consulting Engineers

November 19, 2021

Marina Coast Water District Groundwater Sustainability Agency
11 Reservation Road
Marina, CA 93933
Attn: Patrick Breen, Water Resources Manager
Email: pbreen@mcwd.org

Salinas Valley Basin Groundwater Sustainability Agency
P.O. Box 1350
Carmel Valley, CA 93924
Attn: Emily Gardner, Deputy General Manager and Derrik Williams, GSP Project Manager
Email: gardnere@svbgsa.org; dwilliams@elmontgomery.com

SUBJECT: Comments on Monterey Subbasin Public Draft GSP Appendix 6B (Monterey Subbasin Groundwater Flow Model Documentation)

Dear Mr. Breen, Ms. Gardner, and Mr. Williams:

This letter is submitted on behalf of California American Water and provides comments on Appendix 6B (Monterey Subbasin Groundwater Flow Model Documentation) for the Public Draft Monterey Subbasin GSP updated appendices released on November 10, 2021. Detailed comments are provided along with a summary of the main comments. Overall, given the number of significant deficiencies identified in these comments, the Monterey Subbasin groundwater model as currently configured does not provide reliable model results for use in GSP implementation.

DETAILED COMMENTS

Specific comments are organized by subsection with page numbers referenced below.

Section 2 (Methodology and Approach)

- Appendix 6B states the model western boundary ends at the Pacific Ocean (section 2.2.1, p. 7). **Comment: The Principal Aquifers (180-Foot Aquifer, 400-Foot Aquifer, Deep Aquifer) extend out beneath the ocean several miles beyond the Pacific Ocean shoreline. More representative model results would be obtained by extending the model domain further out beneath the ocean.**

- Appendix 6B states the model is discretized vertically into eight layers that include Layer 3 representing the Upper 180-Foot Aquifer, Layer 4 representing the 180-Foot Aquitard, Layer 5 representing the Lower 180-Foot Aquifer (Section 2.2.3, p. 8). **Comment: While this model layering may apply in the southern part of the Monterey Subbasin in the Fort Ord area, it does not apply in the northern Monterey Subbasin or the southern 180/400 Foot Aquifer Subbasin included in the model domain, where there is no aquitard within the 180-Foot Aquifer. This comment relates to the Hydrogeologic Conceptual Model (HCM) that forms the basis of the groundwater model and**

was noted in previous Hydrogeologic Working Group (HWG) comments on GSP Chapters 4 and 5 (April 5, 2021). This incorrect portrayal of the stratigraphy in the model layering in the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin results in inaccurate model predictions in terms of groundwater levels and seawater intrusion.

- Appendix 6B states that as part of GSP development, a 3-D hydrostratigraphy model was developed to, "…provide for a more accurate representation of Principal Aquifer and Aquitard geometries and to facilitate MBGWFM grid development. The Leapfrog hydrostratigraphy model of the Basin was originally developed as part of two Airborne Electromagnetic (AEM) geophysical surveys conducted by Marina Coast Water District (MCWD) in 2017 and 2019…to help characterize seawater intrusion within the Basin." (Section 2.2.3, p. 9). **Comment: Previous HWG Comment letters (e.g., August 2018, April 2019, June 2020) have repeatedly demonstrated the significant uncertainties and flaws in the hydrostratigraphic interpretations derived from the two AEM surveys. These errors in hydrostratigraphic interpretation have been incorporated into the Monterey Subbasin groundwater model and will result in inaccurate predictions of future groundwater levels and seawater intrusion. One example of the flawed stratigraphic interpretation for the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is provided in Figure 2 of Appendix 6B 2, which displays a thick and continuous aquitard in the middle of the 180-Foot Aquifer and no Aquitard between the 180-Foot Aquifer and 400-Foot Aquifer. These two aquitards are misrepresented (and essentially reversed) in this area of the model domain.**

- Appendix 6B states, "…it is assumed the Deep Aquifer is not hydraulically connected to the Pacific Ocean." (Section 2.4.1, p. 12). **Comment: The lack of seawater intrusion in the Deep Aquifer at the present time is insufficient basis for adopting a No Flow boundary in the groundwater model. It is possible the Deep Aquifer is connected to the Pacific Ocean at the Monterey submarine canyon. At the very least, the Deep Aquifer likely extends out beneath the ocean floor for many miles offshore.**

- Appendix 6B describes the historical groundwater level measurements used as input for the general head boundaries on the northern edge of the model domain as including, "…seven wells in the Upper 180-Foot Aquifer (Layer 3), 12 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7)…". There is a footnote associated with this text that reads, "MCWRA water levels records classify wells in a grouped "Lower 180/400-Foot Aquifer" system, and thus specified heads from these wells were assigned to both Layer 5 and Layer 7 of the MBGWFM." (Section 2.4.2.1.1, p. 12). **Comment: This assignment of historical water levels to general head boundaries along the northern edge of the model domain is flawed for the reasons described above related to an inaccurate HCM stratigraphy. MCWRA maps of groundwater elevations clearly show distinct (different) groundwater elevations in the 180-Foot and 400-Foot Aquifers. The footnote relative to MCWRA category of wells in a "Lower 180/400-Foot Aquifer" system likely refers to wells screened in both aquifers and does not mean both aquifers have the same water levels as is assumed in the Monterey Subbasin groundwater model.**

- Appendix 6B states, "The final network of SGMA monitoring wells used for projected simulations includes seven wells in the Upper 180-Foot Aquifer (Layer 3), 10 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7)…" (Section 2.4.2.1.2, p. 13). **Comment: This assignment of future water levels to general head boundaries along the northern edge of the model domain is flawed for the reasons**

described above related to an inaccurate HCM stratigraphy. MCWRA maps of groundwater elevations clearly show distinct (different) groundwater elevations in the 180-Foot and 400-Foot Aquifers.

- In describing the southern model domain boundary of the Monterey Subbasin groundwater model, Appendix 6B describes notable differences in "hydrogeologic conceptualization and geometry between the two models that will result in imperfect matching of head conditions and unique estimates of cross-boundary flows. Notably, the Seaside Model defines aquifer units differently than the MBGWGM and includes a different number of layers." (Section 2.4.2.2.1, p. 15). **Comment: Although not described or acknowledged in Appendix 6B, this same issue of significantly different hydrogeologic conceptualization and geometry also applies along the northern model domain of the Monterey Subbasin groundwater model. This is due to the previously described flawed HCM and stratigraphy that served as the basis for model layering in northern Monterey Subbasin and southern 180/400-Foot Aquifer Subbasin.**

- Appendix 6B Table 2 provides a comparison of Seaside Model Layers to MBGWFM Layers (Section 2.4.2.2.1, p. 16). **Comment: A similar table showing the disagreement with the HCM and previous models of the 180/400-Foot Aquifer Subbasin are not provided. A table comparing the Monterey Subbasin groundwater model aquifer layers with the 180/400-Foot Aquifer Subbasin is provided below. This table shows the discontinuities and offset of aquifer units between the two subbasins, which is quite problematic for evaluation of groundwater levels and sea water intrusion between the two subbasins.**

Monterey Subbasin Aquifer Unit	**180/400 Foot Aquifer Subbasin Aquifer Unit**	**Comments**
Dune Sand Aquifer	**Dune Sand Aquifer and Perched "A" Aquifer**	**The Dune Sand Aquifer is perched and mounded on top of SVA and cannot be readily represented in MODFLOW. Appendix 6B does not explain how this unit was simulated.**
Upper 180-Foot Aquifer	**180-Foot Aquifer**	**The grouping of lower 180 and 400-Foot Aquifers in MBGWFM is inconsistent with all previous and existing models of the 180/400-Foot Aquifer Subbasin.**
Lower 180-Foot Aquifer And 400-Foot Aquifer	**400-Foot Aquifer**	
Deep Aquifer	**Deep Aquifer**	

- Appendix 6B describes how similar estimates of cross-boundary flows were obtained along the southern model domain boundary for both the Seaside Basin model and the Monterey Subbasin groundwater model (section 2.4.2.2.1, p. 16). **Comment: Similar cross-boundary flows were not obtained across the northern model domain boundary compared to the 180/400-Foot Aquifer Subbasin GSP, which was approved by DWR.**

- Appendix 6B states, "Various studies and projects have been proposed (see GSP Section 9) or are already being implemented by water management entities in both subbasin to better characterize and model local groundwater conditions and cross-boundary flows in the Laguna Seca area and across the entire Monterey-Seaside boundary." (Section 2.4.2.2.2, p. 17). **Comment: A similar statement regarding additional studies to address discrepancies in cross-boundary flows along the northern model domain boundary does not appear to be provided Appendix 6B or the remainder of the GSP.**

- Appendix 6B states, "More recent investigations of seawater intrusion conditions within the Basin…also indicate that the Deep Aquifer is not currently seawater intruded along the Monterey coastline. As such, GHB cells were assigned along the Pacific Ocean boundary for all layers in the MBGWFM apart from layer 8 (i.e., the Deep Aquifer), which was modeled as a no-flow boundary at the Monterey coastline."." (Section 2.4.2.3, p. 18). **Comment: The Deep Aquifer is certain to extend many miles out beneath the ocean, possibly ultimately outcropping in the submarine Monterey Canyon. While it would be best to extend the model domain extent out beneath the ocean, the next best choice is to assign a general head boundary. The selected choice to assign a no-flow boundary to the Deep Aquifer is flawed and is likely to result in erroneous predictions of future groundwater levels and seawater intrusion.**

- Appendix 6B describes texture maps based on borehole log lithologic descriptions for model layers 1, 3, 5, 7, and 8, which represent the various aquifers. (Section 2.5.1, p. 21). **Comment: It is just as important (maybe more important) to develop such texture maps for the aquitard model layers 2, 4, and 6, but apparently this was not done or is not presently described.**

<u>**Section 3 (Stresses)**</u>

- Appendix 6B states, "…it was assumed that 25% of total projected deliveries would be applied for outdoor uses between April – September, while the remainder of deliveries would be used to meet potable and non-potable indoor demands." (Section 3.1.2.3, p. 27). **Comment: While this assumption seems reasonable, it is inconsistent with the primary proposed future project of meeting 50% of future water demands with recycled water (see Table 8 on page 28 of Appendix 6B), which would require extensive indoor use of recycled water.**

- Appendix 6B states, "For both scenarios, pumping was distributed within individual MCWD wells based on historical monthly and total pumping rates at each well." (Section 3.2.2, p. 28). **Comment: As noted in the GSP Chapter 6 comment letter submitted on November 1, 2021, future pumping of MCWD wells based on historical pumping patterns does not accurately reflect pumping trends towards a greater amount of pumping from the Deep Aquifer.**

- Appendix 6B Table 8 (Projected MCWD Pumping Rates) shows total water demand in 2040 of 9,584 AFY with 5,495 AFY provided by recycled water and 4,089 of actual groundwater pumping. In addition, water demand is projected to increase from 3,367 AFY in 2020 to 6,001 AFY in 2025, with the vast majority of that increase being covered by increased groundwater pumping (Section 3.2.2, p. 28). **Comment: It is not clear how recycled water can realistically provide 57% of total water demand in 2040. Near term, an increase in groundwater pumping from 3,367 AFY to 5,401 AFY in 2025 is likely to exacerbate seawater intrusion that is already occurring with 3,367 AFY of groundwater pumping by MCWD.**

Section 4 (Calibration)

- Appendix 6B states that the discrepancy in cross boundary groundwater flow estimates between the Monterey Subbasin GSP and 180/400 Foot Aquifer Subbasin GSP is due to 180/400 Foot Aquifer Subbasin GSP estimates being made by non-modeling methods, and that the 180/400 Foot Aquifer Subbasin GSAs plan to do additional studies of cross-boundary flows for the 5-Year Update. It is noted that the estimates in the 180/400 Foot Aquifer Subbasin were derived from, "…aggregating data and analyses from previous reports and other available sources. No numerical modeling was completed to develop the historical or current water budget." (Section 4.4, p. 31)**. Comment: The implication of the Appendix 6B text is that the non-modeling methods of determining water budgets and cross-boundary flows must be wrong. However, water budgets are commonly done using non-modeling methods, even if ultimately being used as input to a numerical model from which the final water budget is determined. For example, the 180/400 Foot Aquifer Subbasin describes using stream gage data at multiple stations to determine streamflow percolation, which likely is better than a model estimate. Furthermore, the historical and current estimates of groundwater inflow/outflow for the 180/400 Foot Aquifer Subbasin are based in part on the Salinas Valley IGSM groundwater model. In addition, the 180/400 Foot Aquifer Subbasin GSP notes that future water budgets were based on the SVIHM groundwater model developed by USGS. Overall, both subbasins estimated groundwater inflow/outflow amounts using groundwater models.**

- Appendix 6B states that, "SVIHM does not accurately reflect hydrologic conditions in the Monterey Subbasin." (Section 4.4, p. 31)**. Comment: This statement is used to help justify Monterey Subbasin GSP cross-boundary groundwater flow estimates being more reliable than those provided in the 180/400 Foot Aquifer Subbasin GSP. However, as noted above in this comment letter and in the previous HWG comment letter on Monterey Subbasin GSP Chapters 4 and 5, the HCM used as the basis for the Monterey Subbasin groundwater model is flawed in the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin portions of the model domain and does not accurately reflect geologic or hydrologic conditions along the northern Monterey Subbasin groundwater model domain boundary. Thus, the basis for Monterey Subbasin GSP estimates for cross-boundary flows are likely less valid than those provided in the 180/400 Foot Aquifer Subbasin GSP that has already been approved by DWR.**

- Appendix 6B states, "SVBGSA is in the process of developing a dual density groundwater model for the coastal regions of the greater Salinas Valley Basin. This model will incorporate the MBGWFM and be used to further assess volumetric exchanges between the ocean and the Salinas Valley groundwater basin. It will also aid in evaluating flows across subbasin boundaries and will be used evaluate impacts of potential regional projects that have been proposed in this GSP and other GSPs to address seawater intrusion in the Salinas Valley groundwater basin." (Section 4.4, p. 31). **Comment: Given that the MBGWFM is expected to be expanded and have uses much greater than and beyond the scope of the Monterey Subbasin GSP, it is critical that the hydrostratigraphic misrepresentation and flawed model layering (and model boundary conditions) outlined above be addressed for this broader effort (and preferably for use in the Monterey Subbasin GSP itself).**

- Appendix 6B Table 10 indicates the Normalized RMSE for Model Layer 1 is 5.7% based on a range in elevations of 198.4 feet; and that the Normalized RMSE for Model Layer 8 is 2.9% based on a range in elevations of 728.4 feet. The text states, "A generalized rule of thumb in model calibration is that the model is considered well-calibrated when the normalized RMSE is less than 10%. The low normalized RMSEs are therefore an indicator that the model is well-calibrated as a whole and within individual layers given the range of observed data." (Section 4.7, p. 33). **Comment: Review of the hydrographs indicates the range in elevations for Model Layer 1 is not more than 115 feet, resulting in a Normalized RMSE of about 10%. Even if there were an outlier somewhere in the hundreds of hydrographs provided, it would be an extreme outlier that artificially increased the range of elevations and lowered the RMSE to 5.7 %. Overall review of hydrographs indicates the calibration of the Dune Sand Aquifer is not particularly good and is no better than previous models of the area. The extreme range in elevations of 728.4 feet for Layer 8 is apparently mixing data from near the ocean in the Marina-Ord area with the highest elevations of the Corral de Tierra area, which artificially lowers the Normalized RMSE by a large amount. A more realistic groundwater elevation range of about 95 feet for the Marina Ord area for which hydrographs show an RMSE of about 14.5 feet yields a Normalized RMSE of about 15%. There was insufficient time to do similar checks on other model layers, but results for Model Layers 1 and 8 indicate a relatively poor overall calibration for the Marina-Ord area. It is also noted that while the Monterey Subbasin modeling effort appeared to use practically all available monitoring well data for model calibration (with notable exception of MPWSP data); however, the monitoring well hydrograph for MW-OU2-29-A is missing from the dataset for the Dune Sand Aquifer, which is noteworthy because it was a particularly challenging hydrograph to match with previous models.**

- Appendix 6B provides a map (Figure 29) of calibration hydrograph locations (Section 4.7, p. 33). **Comment: It is not clear why nested monitoring well data from the Monterey Peninsula Water Management Project (MPWSP) are not being used in the model calibration. These wells are located in key data gap areas of the model domain.**

<u>**Section 5 (Sensitivity and Uncertainty Analysis)**</u>

- Appendix 6B states the final calibrated Kv of Model Layer 2 was 2 x 10^{-4} ft/d (Section 5, p. 34). **Comment: A Kv of 2 x 10^{-4} ft/d is equivalent to 7 x 10^{-8} cm/s. This is an extremely low and unrealistic Kv value for a regional clay layer. Such an unrealistically low calibrated Kv value was likely driven by trying to achieve a better calibration within the overlying Model Layer 1. Previous studies indicate that accurately representing (from a hydrogeologic standpoint) the Dune Sand Aquifer (Model Layer 1) is extremely difficult because it contains perched and mounded water on top of a sloping clay layer and numerical models have trouble accurately representing such hydrogeologic conditions. The text of Appendix 6B provides no discussion of this issue and how it was addressed in the Monterey Subbasin groundwater model. The consultants that prepared Appendix 6B are quite familiar with the issue and have critiqued previous models in the area regarding this issue, yet they provide no explanation of how the issue was addressed in their own model. Regardless, it is clear from detailed inspection of calibration hydrographs for Model Layer 1 and the use of an unrealistically low Kv value for Model Layer 2 that these model challenges for simulating the Dune Sand Aquifer remain unresolved for the Monterey Subbasin groundwater model.**

Section 6 (Model Limitations and Suggested Future Refinements)

- Appendix 6B states, "…the model calibration error is within acceptable bounds…As demonstrated by the calibration error statistics summarized in Section 4.7 the MBGWFM reasonably represents historical groundwater conditions within the Subbasin using a set of parameters that are within real-world observations and established scientific principles." (Section 6, p. 35). **Comment: As discussed previously: 1) A limited review of the calibration data indicates Model Layers 1 and 8 are poorly calibrated (time did not permit for checking calibration of other model layers); 2) the HCM forming the basis for model layering and general head boundary conditions on the northern portion of the model domain are flawed; and 3) the calibrated Kv for Model Layer 2 is unrealistically low by at least two orders of magnitude. These findings indicate the statements in Section 6 about model calibration being acceptable and the model being based on realistic model parameters are inaccurate.**

- Appendix 6B notes that, "…only a small number of wells exist in the Deep Aquifers within the 180/400 Foot Aquifer Subbasin with observed water level data spanning the full duration of the historical Period. As such, simulated Deep Aquifers heads along the northern model boundary are subject to the limitations in available data to the north of the boundary, which may impact resulting calculations of 180/400 Foot Aquifer Subbasin exchanges within the water budget." (Section 6, p. 35). **Comment: It should be noted that the same limitations on available data are equally applicable south of the boundary.**

- Appendix 6B notes that there is a lack of water level calibration data outside of certain areas such as the MCWD service area and former Fort Ord Site (Section 6, p. 36). **Comment: While this statement is generally correct, there is no explanation as to why an extensive monitoring well data set for the MPWSP is not used in the model calibration – particularly given it is located in a data gap area.**

- Appendix 6B notes there is significant uncertainty with the climate change predictions provided by DWR that are the basis for future scenarios in the GSP (Section 6, p. 37). **Comment: Given the uncertainty in climate change predictions related to precipitation, it would be more prudent for future water management to assume that groundwater recharge will not increase in the future due to climate change (as has been assumed in the GSP) and assume instead it will remain consistent with historical data.**

SUMMARY OF COMMENTS

Although limited by the available time frame for review of Monterey Subbasin GSP Appendix 6B, many detailed comments are provided above. A few of the major takeaways from this review include the following:

- The HWG previously reviewed Draft GSP Chapters 4 and 5 for the Monterey Subbasin GSP and provided comments dated April 5, 2021. While the HWG comments were acknowledged as being received by the GSA, the Public Draft versions of Chapters 4 and 5 included no significant changes to the text or figures related to the HWG comments. Furthermore, these previous comments have direct bearing on the groundwater model development documented in Appendix 6B, and it is apparent that these previous HWG comments were not considered in Monterey Subbasin groundwater model development. In particular, the HCM in northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is fatally flawed (in terms of model layering and boundary conditions) to the extent it will impact model results and lead to inaccurate future predictions of groundwater elevations and seawater intrusion in this area of the model domain.

- Although the allowed review time was insufficient to conduct a review of model calibration for Model Layers 3 through 7, review of calibration hydrographs and associated calibration statistics for Model Layers 1 (Dune Sand Aquifer) and 8 (Deep Aquifer) indicate model calibration is not within acceptable limits for the Marina Ord portion of the model domain.
- The historical challenges in achieving acceptable calibration for the Dune Sand Aquifer have not been resolved in the Monterey Subbasin groundwater model. The Kv for the underlying Model Layer 2 had to be set at unrealistically low values even to achieve the relatively poor calibration of Model Layer 1 documented in this comment letter. Utilizing a realistic Kv value for Model Layer 2 presumably would have resulted in an even worse model calibration for Model Layer 1.
- It is not clear why a No Flow boundary condition at the ocean shoreline would be used for the Deep Aquifer. This choice of boundary condition will likely lead to inaccurate future predictions of groundwater elevations and seawater intrusion.

Thank you for the opportunity to provide these comments.

Sincerely,

LUHDORFF AND SCALMANINI
CONSULTING ENGINEERS

Peter Leffler,
Principal Hydrogeologist

REFERENCES

Hydrogeologic Working Group (HWG), *HWG Comments on Technical Appendices/Attachments to Letters Submitted by MCWD and City of Marina to the CPUC and MBNMS on April 19, 2018*, Letter submitted to California Public Utilities Commission and Monterey Bay National Marine Sanctuary, August 15, 2018.

HWG, *HWG Comments on Remy Moose Manley Letter Attachments Prepared by HGC, EKI, and AGF for City of Marina Planning Commission Hearing Agenda Item #5A on MPWSP Coastal Development Permit Held on February 14, 2019*, Letter submitted to City of Marina, April 12, 2019.

HWG, *HWG Comments on AGF Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas within the Marina Coast Water District, Undated*, Technical Memorandum Submitted as an attachment to Cal Am response to City of Marina comments on 180/400 Foot Aquifer Subbasin GSP, June 26, 2020.

Appendix 2-E

Supplemental Comment Letter Responses

City Of Seaside's Comments on Draft Monterey Subbasin Groundwater Sustainability Plan

"The City of Seaside received a notice dated September 20, 2021 from the Marina Coast Water District Groundwater Sustainability Agency (MCWD GSA) that they had prepared a draft Groundwater Sustainability Plan for the Monterey Subbasin (the GSP) as required by the Sustainable Groundwater Management Act (SGMA). Staff reviewed the draft Groundwater Sustainability Plan, Monterey Subbasin prepared by EKI Water & Environment, Inc. for the Marina Coast Water District Groundwater Sustainability Agency and the Salinas Valley Basin Groundwater Sustainability Agency dated September 2021 (the GSP) download from the MCWD website on October 13, 2021 from the following link https://mcwd.org/gsa gsp.html. The following comments are submitted for your consideration."

Seaside Comments	Responses
Major Comments	
1. The City of Seaside requests to be included as stakeholder (page 28)	The City of Seaside has been added to MCWD's stakeholder list and SVBGSA's Subbasin Planning Committee. Please note that the Technical Committee is formed only between the two basin GSAs to implement the GSAs' Framework Agreement.
2. The City of Seaside is requests membership in the Technical Committee (page 8-10)	See response to Comment 1.
3. Since the Framework agreement between the MCWD GSA and the SVBGSA (the Agreement) appears to give MCWD additional jurisdiction within the City of Seaside city limits beyond the MCWD GSA boundary, the Agreement should be made available for review and comment by the City of Seaside (page 12).	A copy of the Framework Agreement will be provided to the City of Seaside. It should be noted that the subject of the Framework Agreement is the responsibility for development of GSPs for the 180/400-Foot Aquifer and Monterey Subbasins.
4. The MCWD should clarify how the Water Augmentation Project would be implemented to ensure proposed development would not cause exceedances of groundwater extraction allocations (pages 6-57 and 9-31)	The environmental and feasibility assessment of the project will include an analysis of compliance with groundwater laws and with any applicable FORA water allocations.
5. The GSP should clarify how the sustainable yield would be affected by the 180/400 & the Seaside Subbasins operated under conditions similar to current conditions or probable future conditions that do not meet MT or MO boundary conditions (page 6-59).	Given SGMA requirements which apply to the 180/400 Foot Aquifer subbasin and adjudication requirements, which apply to the Seaside Subbasin, it is reasonable to assume that these basins will operate sustainability into the Future and that the 180/400 Foot Aquifer subbasin will meet MT or MO boundary conditions through voluntary or regulatory actions. Assuming otherwise leads to an infinite set of potential future boundary conditions that cannot be evaluated in the Monterey GSP.
6. The MCWD should support the Seaside Watermaster to facilitate the development of alternative water for replenishing the Seaside Subbasin to ensure that the Seaside Subbasin is able to achieve Protective Water Levels to mitigate seawater intrusion (page 9-13)	Comment noted. MCWD is collaborating with and supporting the Seaside Watermaster's groundwater monitoring and future supply projects, including future deliveries to the golf course as well as existing Ord service area customers that overly the Seaside Subbasin.
7. The GSP should clarify if Project R2, Regional Municipal Supply, is substantially different than the Regional Project as proposed by Cal Am. If not, why is "Further analysis and scoping ... needed to determine the exact location of the desalination plant, end uses, and desalination technology [9.4.2]"? If so, how are they different? (page 9-26)	As described in Section 9.4.2, this project builds upon the Seawater Extraction Barrier Project proposed in the 180/400-Foot Aquifer Subbasin GSP. This project is substantially different from the Monterey Peninsula Water Supply Project proposed by Cal Am as to source wells and desalination plant locations.
8. In Section 9.4, the GSP should tabulate the scope of and capital costs for the proposed Seawater Extraction Barrier Project (page 9-26). The scope should clarify alternatives for discharging and/or reusing extracted brackish water (page 9-28).	The scope and capital costs of the Seawater Extraction Barrier Project can be found in the 180/400-Foot Aquifer Subbasin GSP. The GSP provides a reference to that document. As discussed in Section 9.4.2.7, "the estimated capital cost for the pipeline from the wells to

Seaside Comments	Responses
	the desalination plant and desalination plant is $309,387,000. The estimated capital cost for the distribution network ranges from $65,257,000 to $84,315,000 depending on how many communities receive water. Annual operations and maintenance are projected to cost about $13,300,000". Additional analysis and refinement of the project will be conducted during the first two years of GSP implementation should the SVBGSA Board take up this project. The Seawater Extraction Barrier Project is not included in this GSP. This GSP includes the Regional Municipal Supply Project, which would treat water from the extraction barrier and deliver it for use in municipal areas.
9. It is assumed that additional investment is required to reimburse the capital expenditures and debt servicing incurred by MCWD for producing 600 AFY of recycled water. The MCWD should clarify what this investment is (page 9-58).	Language has been modified under Project M3 regarding cost to implement recycled water for irrigation.
10. Since the GSP states that potable water could be delivered to Zone 2C by direct diversion and treatment from the Salinas River during certain months with some minor permit modifications, it should also be possible to deliver irrigation water through direct diversion. This should be explored and promoted as an alternative for providing irrigation water to supplement the more expensive treated water from Pure Water Monterey (i.e., $1,100/AF versus $1,600/AF, respectively) (page 9-22)	Comment noted. The cost/benefit, timing, and priority of the proposed projects will be further analyzed during the first two years of GSP implementation.
11. Section 10.7.1, "MCWD GSA Start-up Budget and Funding to Meet Costs," should be modified to include capital projects costs which are part of the costs for implementing the GSP over the next five years and should include an estimated cost to rate payers if no grant funding becomes available (page 10-16).	It is difficult to estimate the cost to rate payers at this time since the capital projects that will actually be implemented have not been selected, are subject to environmental and feasibility studies, and may be regional in nature. In addition, development of each capital project will depend upon then available sources of funding, including grants, loans, and other sources.
Minor Comments	
Page 12. Please add "the City of Seaside" to the definition of the Marina-Ord Management Area.	Edits made.
Page 12. Since the Framework agreement between the MCWD GSA and the SVBGSA (the Agreement) appears to give MCWD additional jurisdiction within the City of Seaside city limits beyond the MCWD GSA boundary, the Agreement should be made available for review and comment by the City of Seaside.	See response to Comment 3.
Page 28. Please confirm that the City of Seaside would be included in the stakeholder database.	See response to Comments 1 and 2.
Page 55. If the "2020 UWMP anticipates that projected water demand within the entire District would be 9,584 AFY by 2040, including 2,974 AFY within the City of Marina and 6,610 AFY for the existing and future developments within the Ord Community," why is it shown as 9,300 AFY here?	9,300 AFY is the water demand projection presented in the 2020 Master Plan. It is removed from this paragraph to avoid confusion.
Page 145. The ordinate scales on the groundwater elevation graphs are too large to confirm if a linear trend line is best fit for determining trend lines. Please clarify why linear trend lines were selected to approximate groundwater elevations in the 400-ft aquifer.	Linear trends are used to predict water levels in the SMC sections. In the absence of more detailed information, use of linear trends is appropriate and generally used for such predictions.

Seaside Comments	**Responses**
Page 149. Confusion in datum for groundwater elevations. Figure 5-12 states that it is both msl and NAVD88. These are not the same datum.	The “msl” notation is a typo and removed from the figure. The datum is at NAVD88.
Page 213. Why has the inflow from Seaside Basin increased by 45% from historic to current? Is this trend expected to continue?	The increase in groundwater inflows from Seaside Subbasin is due to recent changes in groundwater gradients observed along the Seaside-Monterey boundary. Specifically, it appears groundwater level declines observed in the 400-Foot Aquifer and Deep Aquifers during the current period contribute to increased inflows from the Seaside Subbasin into the Monterey Subbasin as rates of groundwater extraction in the Marina-Ord area have not increased. Projected Model results provide estimates of potential future inflows from the Seaside Basin into the Monterey Subbasin under variable boundary conditions at the 180/400 Foot Aquifer Subbasin boundary. MTs and MOs in the Monterey Subbasin have been established to limit increases in flows across the subbasin boundary. However, as recognized in the GSP a coordinated approach between subbasins will be required to achieve sustainability in these Subbasins.
Page 215. Was annual well pumping determined from well meters (i.e. does it include non-revenue water or leakage)? If not, then that component of leakage should be omitted from the estimated recharge.	Groundwater pumping estimates were informed by (1) metered MCWD well production for the Marina-Ord area, and (2) pumping estimates provided by SVBGSA for domestic, agricultural, and municipal supply wells within the Corral de Tierra Area (Section 6.2.2). Pumping estimates provided by SVBGSA include municipal pumping data from the four water agencies within the Corral de Tierra Area (i.e., California Water Service, CalAm Toro, Hidden Hills, and Ambler Units), which were obtained directly from the Seaside Groundwater Model (see Appendix 6B). The 5% leakage factor was only applied to municipal supply pumping from these five water agencies within the Subbasin, and does <u>not</u> include unmetered pumping from domestic and agricultural wells.
Page 233. What does the following statement mean?"... fall within the middle of the range of projected boundary conditions."	Groundwater levels specified along the 180/400-Foot Aquifer Subbasin boundary under MO boundary conditions generally fall around the mid points between groundwater levels specified under the MT and SWI boundary conditions.
Page 235. Unclear. Is the assumption that the MT or MO Boundary conditions are achieved in the short term?	As described in detail in Section 6.5.1.3 and in Appendix 6B, water levels along the 180/400-Foot Aquifer Subbasin boundary are initiated at their Fall 2018 levels for all projected scenarios, gradually adjusted over twenty years to MT/MO/SWI levels, and then held constant for the remaining 30 years of the projected simulation. For the MT scenario, water levels are adjusted linearly from Fall 2018 to MT water levels over twenty years. For the MO scenario, water levels are adjusted in five-year increments based on the interim milestones (IMs) identified in the 180/400-Ft. Aquifer Subbasin GSP.
Page 238. Why is well pumping under the "No Project" scenario shown as 8,767 AFY when the MCWD UWMP estimates that the demand would be 9,584 AFY. Applying the	The 8,767 AFY estimate reflects 50-year average projected pumping rates within the Marina-Ord Area. As described in Section 6.5.1.1. and in Appendix 6B,

Seaside Comments	Responses
5% leakage rate used in this GSP indicates future pumping should be 10,088 AFY. Please clarify.	projected MCWD pumping under the “no-project” scenario follows the projected pumping demands specified in MCWD’s 2020 UWMP, where MCWD pumping is expected to increase from 3,367 AFY in 2020 to 9,584 AFY in 2040. Demand projections provided in Table 4.6 of the 2020 UWMP include a provision for loss, which is estimated to be around 5% of total demand. Thus, total projected demand estimates listed in the 2020 UWMP serve as a reasonable proxy for total projected MCWD pumping, inclusive of non-revenue water lost to leakage.
Page 243. Could groundwater extraction along the coast mitigate the inland flow of seawater? Could modeling this scenario help?	The MBGWFM currently does not simulate variable-density groundwater flow nor does it simulate groundwater flow in adjacent subbasins, (see Appendix 6B), thus making a detailed analysis of seawater intrusion mitigation strategies is impractical. However, as described in Section 9.8.6*,* SVBGSA in coordination with MCWD plans to create a variable density model for the coastal region of the greater Salinas Valley Groundwater basin that incorporates the MBGWFM within the first 5-years of SGMA implementation. A more detailed analysis of seawater intrusion mitigation strategies will be completed upon development of this model.
Page 244. Should modeling be performed to predict scenarios, under which MCWD alters pumping regime to minimize seawater intrusion?	See response to comment re: page 243 above.
Page 245. What causes groundwater elevations to instantaneously increase by 2 feet under the no project condition?	It is a result of model simulation and likely due to that the first two years of the analog period are wet years, as can shown by the similar patterns observed around years 2038 and 2058.
Page 245. How was the MO of approximately 7-ft increase determined?	The 2004 average groundwater level was about 7 ft higher than the 2018 average groundwater level.
Page 245. How was the MT of 2-ft increase determined?	The 2015 average groundwater level was about 2 ft higher than the 2018 average groundwater level.
Page 248. Is this correct? Outflow from the 180/400 Subbasin are affecting the Monterey Subbasin?	Yes, given their demonstrated hydraulic connectivity, interactions between subbasins are affecting the sustainability of other subbasins.
Page 250. Note (c) is missing.	Reference to note (c) is a typo and is deleted.
Page 250. Table 6-5 (No Project Condition) shows outflow to 180/400 Subbasin at 3,849 AFY and 1,927 AFY for MT and MO boundary conditions, respectively. Table 6-8 (Project Condition) shows 6,833 AFY and 4,901AFY respectively. This appears to indicate that the MT and MO boundary conditions to the 180/400 Subbasin are attained at significantly different times or are different for the "No Project" and "Project" scenarios. This appears to also be the case for inter-basin transfer to the Seaside Basin. Can this be better explained?	See response to comment re: page 235 above. For all scenarios, water levels are initialized at Fall 2018 conditions along the 180/400-Foot Aquifer Subbasin Boundary, gradually adjusted to reach MT/MO/SWI levels over 20 years and are then held constant over the remaining 30 years of the simulation. Similarly, for all scenarios, water levels along the Seaside Subbasin boundary are held constant at Fall 2017 levels simulated from the Seaside Model, or at MT water levels specified for Corral de Tierra wells in the Laguna Seca area (see Section 6.5.1.3 and Appendix 6B). There are no changes in boundary condition assumptions between the “project” and “no project” scenarios. Rather, implementation of the “project” scenario results in higher water levels within the Monterey Subbasin relative to the “no project” scenario, thus impacting cross-boundary flow estimates with the adjacent subbasins.

Seaside Comments	Responses
Page 250. Table 6-5 (No Project) shows well pumping at 8,767 AFY for MT and MO boundary conditions. Table 6-8 (Project) shows 4,488 AFY for MT and MO boundary conditions. Does the model account for variability in pumping conditions since the Water Augmentation project would not come on-line for at least 6 years (see Fig. 9-6)? That is, what would cause and when would pumping exceed 4,488 AFY under the "Project" Conditions?	Yes, see slide #20 on stakeholder presentation #5.
Page 250. Do the future pumping rates shown in Table 6-8 account for leakage?	Yes.
Page 251. Are the increases in groundwater elevations shown here mostly attributed to actions performed, and MTs and MOs achieved, in adjacent subbasins?	That is correct.
Page 252. It appears that this report is stating that if the adjacent subbasins are no operated sustainably, then the Monterey Subbasin could not be managed sustainably?	Since the Monterey Subbasin is interconnected with adjacent subbasins, the sustainability of one subbasin is dependent on other basins also achieving sustainability.
Page 252. The groundwater levels appear to stabilize within the first 10 years due to assumed actions in adjacent subbasins. It could be important to consider the effects on water budget for scenarios where the adjacent subbasins are not operated under MT and MO boundary conditions.	See response in Comment #5.
Page 253. It is unclear how the range of 4,400 to 9,900 AFY was determined? Above the report states that 2,714 AFY is the lower limit of the range and Table 6-5 suggests that 8,767 AFY is sustainable if MOs are achieved.	This paragraph discusses the future sustainable yield of the Marina-Ord Area WBZ which are based on the “no project” scenario analysis (Section 6.5.4) and the “project” scenario analysis (Section 9.6.1). These results show that groundwater levels stabilize during the 30-year GSP implementation period when average rates of extraction are 4,376 AFY for the “project” scenario and 9,870 AFY for the “no project scenario”. This range of values is identified as the potential future sustainable yield of the Monterey Subbasin as MTs and in some cases MOs are achieved in RMS wells at these rates of extraction, under variable boundary conditions and climate scenarios. The projected sustainable yield is not the same as the historical sustainable yield (2,714 AFY) because it takes into account future conditions including variable climate and boundary conditions. The variable boundary conditions assume that adjacent subbasins will also achieve sustainability into the future.
Page 256. Is there a discontinuity in the modeling geometry at the interface of the Seaside Basin and MBGWFM? If so, how can this be rectified?	As described in detail in Appendix 6B, there are notable differences in hydrogeologic conceptualization and geometry between the MBGWFM and the Seaside Model that will result in imperfect matching of head conditions between the two models. As such, a few simplifying assumptions had to be made to effectively link head outputs from the Seaside Model to general head boundary cells along the Seaside boundary within the MBGWFM. This was done in a manner that results in very similar estimates of total historical cross-boundary flows between the two models (i.e., within 2% on average). MCWD encourages continued collaboration with the Seaside Basin to further rectify the discrepancies between the two models in a future

Seaside Comments	Responses
	update to the MBGWFM, and/or to integrate both models into a regional model that covers both subbasins.
Page 311. Based upon Table 6-4, it appears that sustainability goal can be achieved mostly by inter-basin coordination.	Yes
Page 312. How will Seaside Watermaster Actions be supported?	As discussed on page 311 (Section 8.2), these projects and actions are further described in Chapter 9. Please see Section 9.5.1 for further details.
Page 315. The City of Seaside or the Seaside Watermaster should consider requesting membership in the Technical Committee.	See response to Comment 2.
Page 316. Why was 2004 groundwater elevation used for this MO?	See Section 8.7.3.1.
Page 329. Are the MT and MO for the 180/400 Subbasin approximately-8 and -3.4 near Well MW-B-05-180? If not, why are -8 and-3.4 the MT and MO for this well?	As described in Section 6.1.5.3 and in Appendix 6B, MT and MO water levels were assigned to general head boundary cells along the northern MBGWFM boundary using the closest representative monitoring well (RMW) to each cell in the 180/400 Foot Aquifer Subbasin SGMA monitoring network. In the vicinity of Well MB-B-05-180, MT and MO water levels at the northern boundary were informed by RMW 14S02E27A001 in the 180/400-Foot Aquifer Subbasin. At this RMW, the MT is set at -9.9 ft msl, and the MO is set at -3.1 ft msl, which is very close to the MT/MO defined for Well MW-B-05-180. The MT and MO were set at Well MW-B-05-180 per its historical water levels using the same methodology as outlined in Section 8.7.3.1.
Page 329. 1992 to 1998 data for MW-OU2-29-180 and MW-B-05-180 seem to be skewed and may need to be ignored when determining MT and MO.	Water levels have been relatively stable in these wells and the changes since 1992 are relatively minor (i.e., within 2 ft).
Page 330. Is this one outlier determining the MT of-13.3 for MP-BW-42-295. (see MT-10 for adjacent Well MW-OU2-66-180).	The MT and MO in Well MP-BW-42-295 were set using the same methodology in Section 8.7.3.1, and the water levels at this well have been relatively stable.
Page 335. Setting the MTs to 2015 groundwater elevations seems to contradict the goal of preventing seawater intrusion.	See Section 8.7.3.1.
Page 342. Can the following statement be clarified to state whether the proposed MTs and MOs help Seaside Basin obtain its adjudication requirements: "Monterey Subbasin minimum thresholds do not prevent the Seaside basin from meeting its adjudication requirements, including the occurrence of Material Injury."	This statement was added per the request of the Seaside Watermaster. Since the Seaside Subbasin is not subject to SGMA, there are no direct SMCs established in the Seaside Subbasin that can be compared to those defined in the Monterey Subbasin. However, the GSAs will work with the Seaside Watermaster to meet
Page 392. Should a column be added to Table 9-1 for"...a description of the measurable objective that is expected to benefit from the project or management action [354.44(a)(l)"? If not, is this information given elsewhere?	The information can be found in sections “Expected Benefits and Evaluation of Benefits” under each project.
Page 394. If the extraction barrier is a necessary component of Project R2 (see Section 9.4.2.7 which states it is a precursor), should it be included here? If not, why is the seawater extraction barrier not included as a separate project in Table 9-1?	See response in Comment #8.
Page 394. Please confirm estimated cost of $172M for R1 (Section 9.4.1.7 seems to indicate $181M)	Edited to $181M.
Page 396. The costs for pilot scale modeling should be moved from Project M4 to Project M3.	The bench scale pilot testing is associated with the monitoring well(s), data gaps filling, project. Thus, the GSAs intend to keep it in Project M4.

Seaside Comments	Responses
Page 396. The demand for 1,427 AFY irrigation water at a unit production cost of $1,600/AF seems high. Section 9.4.6.7 states "MCWD's 2020 UWMP estimates that 950 AFY of landscape irrigation demand can be met by recycled water by 2030 and 1,270 AFY by 2040".	Delivering 1,427 AFY of recycled water to MCWD for irrigation will likely require an expansion of the M1W AWPF. Cost and benefits of the proposed projects will be further refined during the first two years of GSP implementation.
Page 398. Should the costs shown here only reflect costs to the MCWD GSA?	Total implementation costs are presented. In many cases, these costs reflect overall costs to both MCWD and SVBGSA.
Page 398. The Seaside Watermaster supports the construction of a facility that would allow water to be imported and injected into the Seaside Basin (see letter to M1W et al dated May 24, 2021). Can this section be clarified to state potential actions that will be implemented by the GSA to support the Seaside Watermaster desire to import water?	This level of detail is not included within the GSP, but will be identified in future updates. MCWD is collaborating with and supporting the Seaside Watermaster's groundwater monitoring and future supply projects, including future deliveries to the golf course as well as existing Ord service area customers that overly the Seaside Subbasin.
Page 399. Should the costs shown here only reflect costs to the MCWD GSA?	See response to comment re Page 398 above.
Page 399. Projects I5 and I6 appear to be the same action. Please clarify how one could be implemented without the other.	Project I5 includes a working group of multiple agencies and stakeholders to develop consensus on the current understanding of seawater intrusion, and the development of a plan to address seawater intrusion. Project I6 is being lead by the SVBGSA and MCWD and includes the development of numerical variable density groundwater model that will aid in modeling seawater intrusion within the Monterey Subbasin and the coastal regions of the Salinas Valley Groundwater basin. This model will be used to evaluate the efficacy of potential projects identified by the SWIG to address seawater intrusion.
Page 399. Please consider adding an action that supports modeling integration with Seaside Subbasin.	The numerical variable density groundwater model being developed for the coastal regions of the Salians Valley Groundwater Basin, will incorporate the Seaside Subbasin.
Page 400. Should Project I9 be modified to include wells that become non-productive due to such things as high TDS?	There are currently no domestic wells near the coast within the Monterey Subbasin.
Page 403. Section 9.4 would be more readable if the organization of project descriptions followed Table 9-1 and used the P/MA # found there.	P/MA # added to section titles.
Page 407. Does the FORA HCP have water rights and flow prescriptions for the Salinas River?	It does not.
Page 407. Since the GSP states that potable water could be delivered to Zone 2C by direct diversion and treatment from the Salinas River during certain months with some minor permit modifications, it should also be possible to deliver irrigation water through direct diversion. Should this be explored and promoted as an alternative for providing irrigation water to supplement the more expensive treated water from Pure Water Monterey (i.e. $1,100/AF versus $1,600/AF, respectively)?	See response to comment 10 under Major Comments.
Page 411. Where is the scope of work and capital costs described for the Seawater Intrusion Extraction Barrier Project?	See response to Comment 8 under Major Comments.
Page 411. Project R2 states ''The plant will produce approximately 15,000 AFY of potable water for use." Chapter 6 states that there is approx increased demand of 5,300 AFY. Why is desal plant being proposed that could provide almost 3 times the future demand?	The desalination plant is conceptualized as a regional project that may provide water to multiple subbasins including the 180/400-Foot Aquifer Subbasin and the Monterey Subbasin.

Seaside Comments	Responses
Page 411. Is Project R2 substantially different than the Regional Project as proposed by Cal Am? If not, why is "Further analysis and scoping ... needed to determine the exact location of the desalination plant, end uses, and desalination technology"? If so, how are they different?	See response to comment 7 under Major Comments.
Page 411. Table 9-1 does not include "Priority Project 6." Please clarify where this project is tabulated.	See response to Comment 8 under Major Comments.
Page 412. Please clarify how extracting an additional 35,000 AFY from the basin reduces groundwater extraction and will "either raise groundwater elevations or reduce the rate of groundwater elevation decline over time."	The Regional Municipal Supply Project (Project R2 in Chapter 9), was originally developed in the 180/400-Foot Aquifer Subbasin GSP. The purpose of extracting intruded seawater is to both prevent further intrusion as well as move the leading edge seaward by affecting the gradients in the vicinity of the extraction barrier. The extraction barrier works best in conjunction with other projects that can use the extracted and desalted water for in-lieu use, direct delivery, or injection, as described in the GSP. This GSP includes the Regional Municipal Supply Project, which would treat water from the extraction barrier and deliver it for use in municipal areas. By providing water for direct delivery, it would act as in lieu recharge through reducing the amount of groundwater that would need to be extracted. By reducing extraction, it would support raising groundwater elevations or reducing the rate of groundwater elevation decline over time.
Page 412. Please clarify if the extraction wells are extracting 100% seawater. If not, how is this project able to reduce groundwater extraction.	The exact location of the wells has yet to be determined; however, the conceptual design of this project is to draw brackish water such that it forms a hydraulic barrier to further seawater intrusion.
Page 412. Please clarify how extracting water from the basin will reduce any potential for land subsidence.	Using desalinated water instead of pumped groundwater leaves water in the ground and prevents risk for land subsidence.
Page 412. Please clarify" This would reduce groundwater extraction by that amount, increase the Subbasin's groundwater storage." Unless the extraction wells are pumping 100% seawater, there is not a one-for-one benefit for reduction in groundwater extraction	The extraction barrier and desalted water for other uses addresses seawater intruded groundwater and provides an alternative supply, thereby allowing for more groundwater to stay in the aquifers. There may not be a one-for-one benefit, but that is not the purpose or promise of the project.
Page 413. Please clarify alternatives for discharging and/or reusing extracted brackish water. If none, please clarify if there are potential cost effective alternatives to Project R2.	There are two options for the brackish water: discharge to the ocean or treat for beneficial use. The costs/benefits of various technologies and discharge options will be further analyzed during implementation should the SVBGSA Board take up this project.
Page 416. Please clarify where this cost data is derived from.	This project is still conceptual and cost estimates will be refined with further project scoping.
Page 417. Why is the seawater intrusion extraction barrier project not better described in this section?	See response to Comment 8 under Major Comments.
Page 440. Please clarify how IPR would increase groundwater elevations.	IPR provides in-lieu recharge benefits that would reduce MCWD’s groundwater pumping.
Page 440. Since Project M3 is not a supplemental water supply project, it is unclear how it would "add" water to the aquifer for future development? Please clarify.	Project M3 is a water augmentation project that does provide additional water to meet water demands within the Subbasin and reduce reliance on groundwater.
Page 443. Have all the capital expenditures been paid for the 600 AFY? If not, please clarify the investment needed to reimburse the capital expenditures and debt servicing for the 600 AFY.	Language has been modified under Project M3 regarding cost to implement recycled water for irrigation.

Seaside Comments	**Responses**
Page 443. Please clarify if the "soft costs" provided here include debt servicing. If not, whv not?	Language has been modified under Project M3 regarding cost to implement recycled water for irrigation.
Page 445. Please confirm that RUWAP pipe extends south of Coe Ave in GJM Blvd.	Yes. It extends to near South Boundary Road in GJMB but is not constructed within South Boundary Road (the portion that heads east at the southern part of the diagram). The extension of the recycled line down South Boundary road is planned but not yet constructed.
Page 487. Can the Monterey Subbasin Model be coordinated with the Seaside Basin model to simulate conditions across the subbasins?	See response to comment re: page 256 above. MCWD encourages continued collaboration with the Seaside Basin to further rectify the discrepancies between the two models in a future update to the MBGWFM, and/or to integrate both models into a regional model that covers both subbasins.
Page 491. Addressing potential overdraft could be managed by producing documents such as a monitoring and management plan and a management action plan that addresses policies and procedures to monitor and respond to water elevation concerns.	Comment noted.
Page 497. Can extraction wells be added to the monitoring network?	They can be added to the seawater intrusion monitoring network. However, extraction wells are generally not included as part of part of the groundwater elevation monitoring network, because of the variability in water levels caused by extraction.
Page 497. The annual report could also address if milestones and goals are being attained and, if necessary, potential corrective actions that may be employed to respond to deviations from goals.	Comment noted.
Page 507. What is the estimated additional costs to rate payers if no grant funding becomes available?	See response to Comment 11 under Major Comments.
Page 508. Please clarify why Administration and Legal costs are 30% of the total cost.	This category includes District staff time.

4/5/2021 – HWG COMMENTS ON DRAFT MONTEREY SUBBASIN GROUNDWATER SUSTAINABILITY PLAN, CHAPTERS 4 AND 5

The Hydrologic Working Group (HWG) was formed pursuant to a 2013 Settlement Agreement associated with California American Water Company (CalAm) Monterey Peninsula Water Supply Project (MPWSP)[1]. *The HWG consists of Mr. Martin Feeney and Mr. Tim Durbin who represent the Salinas Valley Water Coalition (SVWC) and Mr. Peter Leffler and Dr. Dennis Williams who represent CalAm*[2]*. CalAm and SVWC are parties to the Settlement Agreement*[3]*. The HWG serves as an internal peer review group to evaluate data and analyses and prepare investigation documents associated with the MPWSP.*

The MPWSP is being implemented by California American Water Company (Cal Am) to increase water supply for its customers on the Monterey Peninsula. The MPWSP includes construction of slant wells that will extract a total of approximately 15.5 million gallons per day of groundwater and seawater as part of the intake system for a desalination plant[4]. The Slant wells are located in the 180/400 Foot Aquifer Subbasin, approximately 2/3 mile north of the Monterey Subbasin. The MPWSP does not provide any water to residents or other water users within the Monterey Subbasin. Concerns have been raised by Marina Coast Water District and others that the Slant wells will extract groundwater and impact groundwater quality within the Monterey Subbasin[5]. The MPWSP is currently the subject of litigation.

As indicated above, the HWG is funded by Cal Am and the SVWC, proponents of the MPWSP. The majority of the comments provided by HWG focus on conditions in the vicinity of the MPWSP, and reflect HWG's opinions regarding conditions within the Monterey Subbasin, which support the HWG's position that the MPWSP will not withdraw or degrade groundwater quality within the Monterey Subbasin[6]. A long record of comments and responses associated with the MPWSP exist but are not included herein.

The Monterey GSP does not address the potential impacts of the MPWSP on groundwater within the Monterey Subbasin. The Monterey Subbasin GSP focuses on basin sustainability and identifying projects and management actions that will bring the basin to sustainability. Given that the MPWSP is not located within the Monterey Subbasin nor will it provide water to entities within the Monterey Subbasin it is not analyzed in the GSP. Hydrogeologic conditions in the 180/400 Foot Aquifer Subbasin and in the vicinity of the MPWSP are discussed in the two GSPs that have been prepared for the 180/400 Foot Aquifer Subbasin including:

- Salinas Valley Groundwater Basin 180/400 Foot Aquifer Subbasin Groundwater Sustainability Plan, prepared by Montgomery Associates, dated 3 January 2020 (180/400 Foot Aquifer Subbasin GSP).
- Groundwater Sustainability Plan for the Marina GSA Area of the 180/400 Foot Aquifer Subbasin, prepared for the City of Marina Groundwater Sustainability Agency Marina CA, dated January 2020 (Marina GSA Area of the 180/400 Foot Aquifer Subbasin GSP).

If the MPWSP is implemented, its impacts on groundwater quality and sustainability within the Monterey Subbasin will be assessed consistent with long-term management and monitoring conducted pursuant to the GSP. Such monitoring

---

[1] California Public Utilities Commission and Monterey Bay National Marine Sanctuary, 2018 (FEIR). CalAm Monterey Peninsula Water Supply Project, Final Environmental Impact Report/Environmental Impact Statement SCH# 200611004, dated March 2018. Appendix E3

[2] California Public Utilities Commission and Monterey Bay National Marine Sanctuary, 2018 (FEIR). CalAm Monterey Peninsula Water Supply Project, Final Environmental Impact Report/Environmental Impact Statement SCH# 200611004, dated March 2018. Appendix E3

[3] The settling parties consist of CalAm, Citizens for Public Water, City of Pacific Grove, Coalition of Peninsula Businesses, County of Monterey, Division of Ratepayer Advocates, Landwatch Monterey County, Monterey County Farm Bureau (MCFB), Monterey County Water Resources Agency (MCWRA), Monterey Peninsula Regional Water Authority (MPRWA), Monterey Peninsula Water Management District, Monterey Regional Water Pollution Control Agency, Planning and Conservation League Foundation, Salinas Valley Water Coalition (SVWC), Sierra Club, and Surfrider Foundation. FEIR, Appendix E3.

[4] This information is based on the recovery rate of 42% cited on page 3-58 of the FEIR, which also states that 24.1 MGD of source water would be required to produce 9.6 MGD of desalinated water.

[5] FEIR, Chapter 8

[6] FEIR, Chapter 8

will be critical as the FEIR did not consider the potential impacts of SGMA[7] on future basin conditions and considered any potential changes to inland hydraulic gradients, which are causing seawater intrusion within the Salinas Valley Groundwater Basin (SVGB), as "speculative". Although the life of the MPWSP is assumed to extend well beyond 2041 when sustainable groundwater basin management is required under SGMA, the California Public Utilities Commission (CPUC)[8] concluded the following when approving the MPWSP:

> *Comments assert that the Final EIR/EIS fails to consider that future groundwater projects and those proposed as part of SGMA could restore groundwater levels in the SVGB and ultimately raise groundwater levels enough to flatten or reverse the inland groundwater gradient. It would realistically require decades of groundwater management to flatten the groundwater gradient, much less reverse it, and expectations that groundwater projects would be successful in affecting the inland gradient within the life of the MPWSP would be overly optimistic. There are no reasonably foreseeable cumulative projects proposed to reduce or reverse the current landward gradients in the Dune Sands and 180-Foot aquifers at this time, and while projects under the SGMA may improve the sustainability of the SVGB -- such as a basin-wide reduction in pumping, and/or increased recharge necessary to fill the groundwater depression on the east side of Salinas, and/or projects that may involve increasing protective groundwater elevations along the coast (much like CSIP) or include extraction systems to capture incoming seawater intrusion along the coast at CEMEX (much like the proposed MPWSP) -- such actions or projects are too speculative to assume and opine about in the EIR/EIS.*

HWG Comments	Responses
Chapter 4 – Hydrogeologic Conceptual Model	
1. The GSP states, "The geology described here is based on previously published scientific reports from investigations conducted by the USGS, State of California, other consulting firms, and academic institutions."(Section 4.1.1, Geological and Structural Setting, p. 64). **HWG Comment:** We note that extensive field work conducted by the HWG between 2013 and 2018, including test slant well installation/testing, drilling of several borings and installation of an extensive monitoring well network, extensive data analyses covering the coastal southern 180/400-Foot Aquifer Subbasin and coastal northern Monterey Subbasin are documented in publicly available reports prepared by the HWG and posted on the Monterey Peninsula Water Supply Project (MPWSP) website (e.g., HWG, November 2017). These HWG	The GSP incorporates information developed as part of the Monterey Peninsula Supply Project (MPWSP), to the extent that it is relevant to the GSP. However, the 8 well clusters completed as part of the MPWSP focused on the area of the MPWSP and are all located within the 180/400 Foot Aquifer Subbasin. None of these wells are located within the Monterey Subbasin, nor is the MPWSP the focus of this GSP. The data gathering and DMS construction for the Monterey Subbasin include: • > 100,000 water level & water quality records from > 1000 wells • Lithology & well construction from > 2,000 wells • MCWD production well data (20 years) • Airborne Electromagnetic Surveys (2017 – 2019)

[7] Page 8.5-635 of the FEIR states: "Actions that may be developed or required as a function of SGMA are too speculative to opine about in the EIR/EIS. Nonetheless, as demonstrated above, substantial actions would be needed merely to arrest seawater intrusion, without consideration of more dramatic actions that would be needed to reverse such intrusion.

… the expectation that the groundwater depression on the East Side will be resolved within a reasonable timeframe and the inland gradient would be dramatically decreased is speculative for the reasons explained above, and the impact conclusion on groundwater resources remains unchanged.

[8] 12 September 2018 Memorandum RE: Responses to Comments Received after Publication of the MPWSP Final EIR/EIS to Commissioners and ALJs From: John E. Forsythe- Energy Division MPWSP CEQA/NEPA Team CPUC Legal Division. page 18.

HWG Comments	Responses
documents incorporated data from previous studies by others (many of which are cited in the Monterey Subbasin GSP), and allowed for improved hydrogeologic interpretations by incorporating both existing and new field data collected by HWG. The Monterey Subbasin GSP ignores these HWG documents and makes geologic interpretations that are inconsistent with the most recent data that has been collected. Some of the specific inconsistencies are noted in other comments in this letter.	• Numerous publicly available field studies water level/quality data/hydrogeologic investigations, ect. These data have been used in combination to develop the Geological and Structural Setting presented in the Monterey Subbasin GSP.
2. The GSP mischaracterizes the Dune Sand Aquifer in multiple instances in Chapter 4. One example is the attempt to label the Dune Sand Aquifer as a "Principal Aquifer" (Section 4.2.1, Hydrogeology in the Marina-Ord Area, Table 4-1, page 79). **HWG Comment:** The Dune Sand Aquifer is not a Principal Aquifer in the subbasin. The Draft GSP prepared by City of Marina (2019) stated the Dune Sand Aquifer, "…is not commonly used for drinking water or agricultural irrigation". The Monterey County Water Resources Agency (MCWRA), which has studied and characterized the groundwater basin for many decades, does not consider the Dune Sand Aquifer as a principal aquifer (e.g., no seawater intrusion maps are prepared for the Dune Sand Aquifer by MCWRA). The 180/400-Foot Aquifer Subbasin GSP, which the MCWD GSA adopted and submitted to DWR, also does not classify the Dune Sand Aquifer as a Principal Aquifer. The Dune Sand Aquifer is not a Principal Aquifer due in part to its lack of capability for use in groundwater production (e.g., thin saturation, groundwater quality issues related to sea water intrusion and nitrates, etc.). In addition, the Hydrogeology section for the Corral de Tierra Area in Monterey Subbasin GSP Chapter 4 states that following about the upper 120 feet of sediments, "Several small domestic wells draw groundwater from these local alluvial aquifers, but these volumes of groundwater are minimal…Since this volume of groundwater is neither economic or significant, these shallow sediments are not considered a principal aquifer…Groundwater in these sediments is hydraulically connected to the	The Dune Sand Aquifer readily meets the definition of Principal Aquifer under SGMA. The California Code of Regulations Section 351 defines a Principal Aquifer as follows: *"Principal aquifer" refer to aquifer or aquifer systems that store, transmit and yield significant or economic quantities of groundwater to wells, springs, or surface water systems*. Areal recharge is the primary source of freshwater to the Monterey Subbasin. The Dune Sand Aquifer is the upper most aquifer within the Marina Ord Area and is made up of highly permeable Older Dune Sand and Dune Sand Deposits. It extends across over 1/2 of the Marina Ord Area, where it has been identified as a Principal Aquifer (see Figure 4-2 Monterey GSP[9]). It is highly permeable and stores, transmits, and yields significant quantities of groundwater to other aquifers within the Monterey Subbasin from which groundwater is withdrawn. The absence of drinking water wells or agricultural wells within this aquifer does not diminish its importance to the Monterey Subbasin, nor preclude it from being characterized as a Principal Aquifer within the Monterey Subbasin pursuant to SGMA. The extent of surficial Dune Sand Deposits which have high recharge potential are identified on geologic and hydrologic soil group maps presented on Monterey GSP Figure 4-2 and Figure 4-7. Fort Ord Monitoring wells, shown on Figure 3-9 show that these Dune Sand Deposits are saturated over a significant portion of the Marina Ord Area and make up the Dune Sand Aquifer. The Dune Sand Aquifer does not exist in the Corral de Tierra Area as discussed in Monterey GSP Section 4.2.2, therefore references by the HWG regarding properties of this aquifer within that area appear to be

[9] Figure reference numbers and section numbers within this response to comments are based on:

- Monterey GSP Chapters 1 through 4 published draft, dated 12 January 2021, and
- Monterey GSP Chapter 5 published Draft, dated 4 January 2021

HWG Comments	Responses
small streams found in the area…" (page 111 of Chapter 4). This conclusion for the Corral de Tierra Area is inconsistent with designating the Dune Sand Aquifer, which cannot even claim to be tapped by "several small domestic wells", as a Principal Aquifer. As noted above, designation of the Dune Sand Aquifer as a Principal Aquifer is inconsistent with the 180/400-Foot Aquifer Subbasin GSP (where the Dune Sand Aquifer also is present), which specifically did not designate the Dune Sand Aquifer as a Principal Aquifer. It is also important to point out that the Dune Sand Aquifer, as defined in the Monterey Subbasin GSP, consists of two distinct aquifers – the coastal Dune Sand Aquifer that directly overlies the 180-Foot Aquifer and the perched/mounded Dune Sand Aquifer (known as the A-Aquifer in Fort Ord studies) that overlies the Fort Ord Salinas Valley Aquitard (FO-SVA) clay layer (incorrectly referred to as Salinas Valley Aquitard in the Monterey Subbasin GSP). The coastal Dune Sand Aquifer is intruded with sea water, while the perched/mounded Dune Sand Aquifer is perched in areas, has thin saturation, is impacted by nitrates, and is not developed with production wells for any significant water supply uses.	misinterpreted. Further, the Dune Sand Aquifer does extend north of the Salinas River within the 180/400 Foot Aquifer Subbasin (See Monterey GSP Figure 4-2). Therefore, it is not inconsistent or surprising that the Dune Sand Aquifer was not identified as a Principal Aquifer in 180/400 Foot Aquifer Subbasin, the majority of which lies north of the Salinas River. The geology and extent of the Dune Sand Aquifer within the Monterey Subbasin is described in detail in Monterey GSP Section 4.2.2.1. The understanding of the Dune Sand Aquifer in the Monterey Subbasin is based upon hundreds of monitoring wells installed in this aquifer and deeper aquifers across the Marina Ord Area (see Monterey GSP Figure 3-9). The majority of these wells have been installed by the Army to characterize the stratigraphy and water quality of this aquifer and facilitate remediation of chemicals historically released at Fort Ord. Over 200 Million dollars has been spent by the Army to characterize the Dune Sand Aquifer and the underlying Upper 180-Foot Aquifer and clean up chemical impacts to groundwater within these aquifers. This fact alone should highlight the importance of these aquifers. Understanding the interdependence of these aquifers with groundwater resources within the Monterey Subbasin is critical to the GSP and long-term management of the groundwater basin.
3. The GSP relies on old geologic cross-sections from 2001 (Section 4.2.1.1, Cross-Sections, pages 8085). **HWG Comment:** The cited geologic cross-section references and Figures 4-9 through 4-12 do not utilize best available science and most recent borehole and geophysical logs for wells drilled in the area, nor do they utilize the most recent geologic cross-sections developed based on these data (see HWG, November 2017). This results in mischaracterization of hydrogeologic conditions for the GSP Plan Area. Geologic cross-sections that use the latest available data and include areas within the Monterey Subbasin are provided in previously published HWG documents (HWG, November 2017; HWG et al., February 2020).	The geologic cross-sections included in the GSP are basin-wide sections that incorporate substantial data that has been developed over time within the Plan Area. These boring logs do not include information from all of the wells and borings located within the Subbasin or adjacent subbasins. The 2017 borehole and geophysical logs completed as part of the MPWSP and referenced by the HWG focus on the area of that project. The MPWSP nor these boring logs are located within the Monterey Subbasin and are not the focus of the Monterey Subbasin GSP. Information from these wells was incorporated into the GSPs prepared for the 180/400 Foot Aquifer Subbasin.
4. With regard to the Dune Sand Aquifer, the GSP states, "The aquifer is perched further away from	There is no guidance or regulation under SGMA that would suggest that a Principal Aquifer cannot be perched in some areas.

HWG Comments	Responses
the coast in areas where the SVA exists… " (Section 4.2.12, Principal Aquifers, page 86). **HWG Comment:** The HWG agrees with this GSP statement about the Dune Sand Aquifer being perched in areas where it is underlain by the SVA (more correctly referred to as the FO-SVA). However, perched aquifers should not be designated as Principal Aquifers as is being done in the Monterey Subbasin GSP.	
5. The GSP refers to an average saturated thickness of the Dune Sand Aquifer being approximately 50 feet (Section 4.2.12, Principal Aquifers, page 86). **HWG Comment:** As described above, there are two distinct aquifers being referred to collectively in the GSP as the Dune Sand Aquifer. While the coastal DSA may have a saturated thickness of 50 feet or more in some areas, the perched/mounded DSA has a saturated thickness considerably less than 50 feet.	There is only one Dune Sand Aquifer that has been defined within the Monterey Subbasin. The groundwater levels presented on Monterey GSP Figures 5-1 and 5-5 show the hydraulic gradient mapped in the Dune Sand Aquifer, which is consistent with groundwater maps and interpretations developed by the Army as part of remedial efforts at Fort Ord. The groundwater gradient presented on these maps is consistent with chemical migration patterns also monitored at Fort Ord. The saturated thickness of the Dune Sand Aquifer does vary across the Monterey Subbasin. Groundwater elevation information and estimate specific yield indicates that approximately 30,000 AF to 60,000 AF of groundwater are stored within the Dune Sand Aquifer within the Marina Ord Area (Section 8.8.3.1).
6. The GSP does not distinguish and describe the differences between the Salinas Valley Aquitard (SVA) and Fort-Ord Salinas Valley Aquitard (FO-SVA) and its significance to the perched/mounded aquifer (underlain by FO-SVA) versus the Dune Sand Aquifer and its equivalents (not underlain by FO-SVA) in many places in the document (Chapter 4). **HWG Comment:** It should be noted that the SVA and FO-SVA are not the same aquitard and FO-SVA occurs at a higher elevation; therefore, they should not be referred to as the same aquitard.	The GSP does distinguish between the FO-SVA and the SVA and describes the relationship between these aquitards. Please see discussion in Monterey GSP Section 4.2.2.1.2. Fort Ord-Salinas Valley Aquitard.
7. The GSP shows a Conceptual Site Model diagram that was developed from Fort Ord studies, and implies that the Fort Ord Conceptual Site Model diagram applies throughout the Monterey Subbasin (Section 4.2.1.2, Principal Aquifers, Figure 4-13, p.87). **HWG Comment:** Recent studies completed by the HWG demonstrate that the Fort Ord Conceptual Site	Section 4.2.2 clearly states that the conditions in the Marina-Ord Area do not extend throughout the of the Monterey GSP, and different principal aquifers are present in the Corral De Tierra Area. The Monterey GSP also does not evaluate or draw conclusions regarding conditions in the southern portion of the 180/400 Foot Subbasin. However, as shown on Figure 3-9, hundreds of wells have been installed at the northern portion of the Monterey Subbasin, which have been used to characterize conditions in this area

HWG Comments	Responses
Model does not apply in the southern portion of the 180/400 Foot Aquifer Subbasin or the northern portion of the Monterey Subbasin. In particular, the concepts of an Intermediate 180-Foot Aquitard and lack of a 180/400 Foot Aquitard do not apply outside of Fort Ord. Work completed by HWG demonstrates that the 180-Foot Aquifer is one vertically continuous aquifer and that the 180/400 Foot Aquitard is present (HWG, November 2017).	of the Marina Ord Area. The preponderance of evidence shows that this hydrogeologic conceptual model does exist in the northern portion of the Monterey Subbasin.
8. The GSP states that horizontal hydraulic conductivity in the DSA ranges from 0.14 to 120 feet/day (Section 4.2.1.2, Principal Aquifers, p.87). **HWG Comment:** It is important to distinguish the two major portions of what is referred to in the GSP as the DSA – coastal and perched/mounded. While the coastal DSA does have K values on the higher end of the cited range, perched/mounded portion of the DSA only has K values at the lower end of the cited range.	The distribution of measured hydraulic conductivities in the Dune Sand Aquifer are shown on Figure 4-20. These data are based upon specific capacity tests and aquifer testing at the identified locations and are consistent with the magnitude of hydraulic conductivity estimates presented for the Dune Sand Aquifer in the Monterey Subbasin GSP.
9. The GSP makes general statements on hydrogeologic interpretations of AEM data, including outside of the GSP Plan area (Section 4.2.1.2, Principal Aquifers, p. 88). **HWG Comment:** It is not clear why the GSP is speculating on aquifer conditions outside of the Monterey GSP Plan Area based solely on AEM data, and without consideration of geologic and well data. The GSP also provides no demonstration/evidence of how these conclusions were reached. The HWG has previously provided extensive documentation of erroneous hydrogeologic interpretations of the AEM data (HWG, November 2017, January 2018, August 2018, January 2019, March 2019, and April 2019). The HWG April 2019 document clearly demonstrates with field data that the hydrogeologic	The 2017 AEM Study[10] and 2019 AEM Study[11] for the Monterey Subbasin and surrounding area were performed by highly regarded professors of Geophysics and California Licensed Geophysicists including: • Dr. Rosemary Knight, Ph. D.: Professor of Geophysics at Stanford University, • Theodore H. Asch, CA GP#1038; California Licensed Professional Geophysicist with Aqua Geo Frameworks, LLC. • Jared D. Abraham CA GP#1089: a California Licensed Professional Geophysicist with Aqua Geo Frameworks, LLC. The 2017 AEM study has been peer reviewed[12] and has been validated against lithologic and water quality data within the Monterey Subbasin. Both studies have also been provided to California Department of Water

[10] Stanford/Aqua Geo Frameworks, 2018. *Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA*, Ian Gottschalk, Rosemary Knight, Stanford University, Stanford, CA; Ted Asch, Jared Abraham, Jim Cannia, Aqua Geo Frameworks, Mitchell, NE, dated 15 March 2018.

[11] Aqua Geo Frameworks, 2019. *Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District*, dated 14 November 2019.

[12] Gottschalk, I., Knight, R., Asch, T., Abraham, J. and Cannia, J., 2020. Using an airborne electromagnetic method to map saltwater intrusion in the northern Salinas Valley, California. Geophysics, 85(4), pp.B119-B131. https://library.seg.org/doi/full/10.1190/geo2019-0272.1

HWG Comments	Responses
interpretations of aquitard gaps from the AEM study are invalid. Furthermore, as described above, MPWSP monitoring well borehole logs demonstrate that areas of uncertain aquitard continuity identified by MCWRA (who did not have MPWSP monitoring well borehole data available to them at the time of their study) near the northern Monterey Subbasin boundary are no longer uncertain and clearly have significant aquitard material present. Furthermore, review of water level and water quality data for the MPWSP clearly demonstrate the presence and continuity of the 180/400-Foot Aquitard in this area. The Monterey Subbasin GSP does not describe the applicability of the concept of a sea water wedge (i.e., where sea water intrusion occurs, less saline water often overlies more saline water in a given aquifer) to explain the expected presence of less saline water overlying more saline water in some areas of the vertically continuous 180-Foot Aquifer. The presence of less saline water in the upper portion of an aquifer does not demonstrate the aquifer is not sea water intruded. Furthermore, given the standard of 500 mg/L chloride applied by MCWRA for defining the area of seawater intrusion, the AEM data collected in the area are not capable of distinguishing between a chloride concentration below the standard (e.g., 200 mg/L) from a chloride concentration above the standard (e.g., 600 mg/L) given inherent uncertainties in AEM data interpretation and the complicating variable of lithologic influences on AEM data.	Resources (DWR) for review as part of a large new AEM Study that is being conducted by DWR across California. One of the primary authors of the 2017 AEM study, Dr. Ian Gottschalk, Ph. D., is one of the geophysicist working on DWR's study. It is noted that members of the HWG are not California Licensed Geophysicists with expertise in AEM collection and analysis. Geophysics is a highly specialized discipline and not within the established practice areas for licensed professional geologists. The revised draft of Chapter 4 of the Monterey GSP, dated 12 January 2021 does not address the continuity of the 180/400 Foot Aquitard within the 180/400 Foot Aquifer Subbasin as it is not relevant to the understanding and characterization of conditions within the Monterey Subbasin, which is the subject of the GSP. The mechanics of seawater intrusion and the "sea water intrusion wedge" is described in Monterey GSP Section 5.3.2. The GSP does not rely solely on AEM data to characterize seawater intrusion within the Monterey Subbasin. As shown on Monterey GSP Figure 5-24, characterization of water quality in the upper 180-foot Aquifer is based on hundreds of TDS measurements collected from wells screened in this aquifer. These data have been used to confirm AEM results, which are also presented on Figure 5-24.
10. The GSP states, "South of the City of Marina, in a portion of the former Fort Ord, the 180-Foot Aquifer is separated into an "upper" zone of sandy deposits with some gravel and a "lower" zone of gravel with sand and clay lenses; the two zones are separated by a thin clay layer (Ahtna Engineering, 2013). Data collected within the former Fort Ord show that significant head differences exist between the upper and lower ones of the 180-Foot Aquifer." (Section 4.2.1.2, Principal Aquifers, p. 91). HWG Comment: The HWG agrees that the area where this conceptual model applies is in a portion of former Fort Ord to the south of the City of Marina. However, the GSP implies this conceptual	Comparison of water levels shown on: • Figure 5-2: which presents groundwater level elevations in the Upper 180-Foot Aquifer, with • Figure 5-3: which presents groundwater level elevations in the Lower 180-Foot Aquifer and 400-Foot Aquifer Zone show that water levels in the Upper 180-Foot aquifer are approximately 5 to 10 feet higher than those in the Lower 180-Foot Aquifer and 400-foot aquifer north of Reservation Road in the Monterey Subbasin. Further, as shown on Figure 5-24 and consistent with other areas in the Marina Ord, TDS concentrations in groundwater within the Upper 180-Foot Aquifer are less than 1000 mg/L north of Reservation Road; whereas, TDS concentrations in the Lower 180-Foot Aquifer and 400 foot aquifer zones range between

HWG Comments	Responses
model (illustrated in Figure 4-13) applies throughout the GSP Plan Area, including north of Reservation Road, which is not correct as documented in work by HWG that is not referenced in this GSP (e.g., HWG, November 2017).	3,000 mg/L and >10,000 mg/L in this area. These data support the hydrogeologic conceptual model presented in the Monterey GSP.
11. The GSP discussion of the "Middle (180/400) Aquitard" suggests it is not present beneath the majority of the Marina-Ord Area, and implies this conceptual model applies throughout the Monterey Subbasin as illustrated by Figure 4-13 (Section 4.2.1.2, Principal Aquifers, p. 91). **HWG Comment:** As noted above with other aspects of the conceptual model presented in Figure 4-13, the concept that the 180/400 Foot Aquitard is not present in northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is erroneous (see recent work by HWG not referenced in the GSP, as well as MCWD well logs). For example, HWG work demonstrates similar groundwater elevations in the upper and lower 180 Foot Aquifer (MW-6), and significantly different groundwater elevations and fluctuations in the 180 and 400 Foot Aquifers (multiple MPWSP monitoring wells).	See Response to Comment 7 above. Well MW-6 referenced by the HWG is not located in the Monterey Subbasin.
12. The GSP states, "The Lower 180-Foot Aquifer zone and the 400-Foot Aquifer in the vicinity of the City of Marina are functionally the same due to the missing Middle (180/400-Foot) Aquitard in this area." (Section 4.2.1.2, Principal Aquifers, p. 94). **HWG Comment:** As discussed above with other aspects of the Site Conceptual Model (Figure 4-13), this characterization does not apply to Northern Monterey Subbasin, contrary to what is stated/implied in the GSP.	See response to HWG Comment 7 above.
13. The GSP states, "Near the Monterey-Seaside subbasin boundary, a depression exists in the groundwater potentiometric surface of the 400-Foot Aquifer…These data suggest that a potential connection may exist between the 400-Foot Aquifer and the Deep Aquifer in this area." (Section 4.2.1.2, Principal Aquifers, p. 94.) **HWG Comment:** There is no geologic evidence provided in the GSP to support this statement. Preliminary review of geologic data (lithologic logs	The source of the depression is uncertain and will be identified as a data gap within the GSP. However, as discussed in Monterey GSP section 5.1.3.1 Two CASGEM wells in the southwestern portion of the Marina-Ord Area, MPWMD#FO-10 and MPWMD#FO-11, show consistent decreasing trends over the past 15-years. Additionally, groundwater elevations in these wells are significantly lower than those to the north near the City of Marina and to the south in the Seaside Subbasin. When water levels in these wells are plotted in conjunction with other 400-

HWG Comments	Responses
and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.	Foot Aquifer wells in the Marina Ord Area, they indicate the presence of in a localized depression in the groundwater potentiometric surface of the 400-Foot Aquifer. However, there is no known extraction in the Monterey Subbasin in the vicinity of these wells and groundwater elevations observed in these wells are similar to those measured in the Deep Aquifers. These data suggest that (1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells.
14. The GSP states, "As shown in Section 6 below, groundwater flow direction in the 400-Foot Aquifer is strongly influenced by groundwater pumping in the Salinas Valley Groundwater Basin, inland of the Monterey Subbasin." (Section 4.2.1.2, Principal Aquifers, p. 94) **HWG Comment:** A primary theme of this GSP here and elsewhere is that pumping in the 180/400 Foot Aquifer Subbasin is essentially solely responsible for seawater intrusion in the 180-Foot Aquifer and 400Foot Aquifer within Monterey Subbasin, and for depressed Deep Aquifer groundwater elevations in the within Monterey Subbasin. However, the history of groundwater development in the Monterey Subbasin demonstrates how groundwater production wells developed for MCWD and Fort Ord resulted in seawater intrusion in the 180-Foot Aquifer and 400-Foot Aquifers in Monterey Subbasin (for example, see quote below from Harding ESE, 2001). In addition, Deep Aquifer groundwater elevations were fluctuating around sea level prior to pumping of Deep Aquifer wells by MCWD that dropped Deep Aquifer groundwater elevations well below sea level. Thus, groundwater pumping from wells screened in the 180-Foot, 400-Foot, and Deep Aquifers within Monterey Subbasin have played a significant role in historical/current seawater intrusion and depressed groundwater elevations within Monterey Subbasin. Harding ESE (2001) states: "Seawater intrusion beneath the city of Marina was observed soon after installing several production wells in the 180-Foot Aquifer (MCWD-1, the first city well, was installed in 1956). Subsequent seawater intrusion into this area was closely related to ground water withdrawal by	Seawater intrusion within the Salinas Valley Groundwater Basin is the result of cumulative rates of groundwater extraction within the basin, which exceed freshwater recharge. However, the Monterey Subbasin water budget shows that inland cross boundary flows into the 180/400 Foot Aquifer Subbasin exceed total freshwater recharge to the Monterey Subbasin. Therefore, even if no groundwater was extracted within the Monterey Subbasin, the Monterey Subbasin would be in overdraft due to groundwater extraction from other portions of the Salinas Valley Basin. Therefore, the conclusion that groundwater extraction within other portions of the Salinas Valley Groundwater Basin (SVGB) are the primary cause of for seawater intrusion within the Monterey Subbasin is correct. Further, groundwater extracted within the Monterey subbasin does not exceed areal recharge to the subbasin. Additional information regarding the water budget for the Monterey Subbasin will be presented in Monterey GSP Chapter 6.

HWG Comments	Responses
the city of Marina and former Fort Ord. Deteriorating water quality forced the city of Marina to discontinue pumping most of its 180-Foot Aquifer wells by the late 1970's and install water-supply wells in the 400-foot (MCWD-8, -8a, and -9) and Deep Aquifers (MCWD-10, -11, and-12)."	
15. The GSP states with respect to the Deep Aquitard (otherwise known as 400 Foot/Deep Aquitard), "There is no analysis available for its spatial occurrence or geologic composition." (Section 4.2.1.2, Principal Aquifers, p. 95). **HWG Comment:** The GSP could have conducted the "missing" analysis of the aquitard for the Monterey Subbasin given that several MCWD production wells (e.g., MWCW 10, 11, 12) and other wells (e.g., USGS deep nested monitoring well, agricultural wells) have available lithologic and geophysical logs. Such an analysis would demonstrate the presence of a 200 to 300 foot thick clay layer (i.e., 400/Deep Aquitard) between the 400-Foot Aquifer and uppermost Deep Aquifer Zone. The lack of seawater intrusion in the Deep Aquifer, which has groundwater elevations on the order of 50 to 100 feet below sea level in the northern Monterey Subbasin area and a strong vertically downward gradient from the 400-Foot Aquifer, combined with high salinity in the 400-Foot Aquifer within and surrounding the northern Monterey Subbasin also shows the strong integrity of the aquitard between the 400-Foot Aquifer and Deep Aquifer. The large difference in water levels between the 400-Foot Aquifer and Deep Aquifers also provides evidence of a thick/tight aquitard separating these aquifer zones.	Boring logs from MCWD production wells MCWD-10, -11 and -12 and the USGS monitoring well informed cross sections on Figures 4-8, 4-9, and 4-11 Boring logs of MCWD-11 and MCWD-12 do show a 200 to 300 foot thick clay layer between the 400-Foot Aquifer and the Deep Aquifers. However, other wells within the subbasin (e.g. MCWD-10), show a series of thinner clay deposits between the 400 Foot Aquifer and the Deep Aquifer. The vertical gradients observed between the 400 Foot aquifer and Deep Aquifers, indicate that the series of clay deposits between these aquifer zones create substantial barriers to vertical flow.
16. The GSP describes the Reliz Fault as displaced the Monterey Formation, which is the base of the Deep Aquifer, shifted downward on the northeast side by 1,000 feet. It then states the fault does not appear to impede groundwater flow within the Dune Sand Aquifer, 180-Foot Aquifer, or 400-Foot Aquifers (Section 4.2.1.3, Structural Restrictions to Flow, p. 98). **HWG Comment:** The GSP does not comment on the possibility of the Reliz Fault altering groundwater flow within the Deep Aquifer.	There is insufficient data to evaluate the extent to which the Reliz Fault may alter flow within the Deep Aquifers. However, available water level data suggests that groundwater flows readily between the Monterey and 180/400 Foot aquifer Subbasin within the Deep Aquifer zones near the Reliz fault as shown on Figures 5-4 and 5-8. Therefore, if it does alter flow, the impacts appear to be localized.

HWG Comments	Responses
17. This section of the GSP begins, “This Section presents a general discussion of the natural fresh groundwater quality in the Marina-Ord Area, focusing on general geochemistry (Section 4.2.1.4, General Water Quality, p. 98). **HWG Comment:** Given the significance of historical and ongoing seawater intrusion in the Dune Sand Aquifer, 180-Foot Aquifer, and 400-Foot Aquifer in the Marina-Ord Area, it is unclear why this section would only describe the fresh water within the Marina-Ord Area.	As stated in the 2nd sentence of this Section 4.2.1.4, “The distribution and concentrations of specific constituents of concern, including seawater intrusion, are discussed in Chapter 5. Consistent with SGMA guidance, seawater intrusion is assessed independently from other water quality parameters within the GSP, as it is one of the six “Undesirable Results” designated under SGMA.
18. With regard to the Dune Sand Aquifer, the GSP states, “Groundwater in this aquifer is primarily fresh; minimal seawater intrusion has occurred in this aquifer (Section 4.2.1.4, General Water Quality, p. 98). **HWG Comment:** The coastal Dune Sand Aquifer is intruded by seawater, as demonstrated by monitoring wells at the MCWD office on Reservation Road (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996, 2001) and in the vicinity of the CEMEX site (HWG, November 2017).	Current groundwater data from over 20 monitoring wells and AEM data have been used to evaluate the extent of seawater intrusion within the Dune Sand Aquifer in 2017 (See Figure 5-24) within the Monterey Subbasin. Historical data collected from over 25 years ago has not been included in the GSP, nor is data collected from the CEMEX site which is located in the 180/400 Foot Aquifer Subbasin.
19. The GSP states, “The Dune Sand Aquifer contributes recharge to the 180-Foot Aquifer…” (Section 4.2.1.4, General Water Quality, p. 98). **HWG Comment:** It should be noted that this recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is minimal (likely on the order of a few hundred acre-feet per year). This recharge has not stopped seawater intrusion from occurring in this area.	Areal recharge is the primary source of freshwater recharge to the Monterey Subbasin. Given that the Dune Sand aquifer overlies approximately 1/2 of the Marina Ord Area, Recharge to the Dune Sand Aquifer is one of the most significant sources of freshwater recharge to this portion of the Monterey Subbasin. As shown on Monterey GSP Figure 5-24 the fresh water exists in both the Dune Sand Aquifer and the Upper-180 Foot aquifer, which is recharged by the Dune Sand Aquifer across the Marina Ord Area. Further, although seawater intrusion exists within the Lower 180- Foot Aquifer and 400-Foot Aquifer in the northern portion of the Marina Ord Area, the southern portion of the Monterey Subbasin has not been seawater intruded (see Monterey GSP Figure 5-28), and is supported by recharge from the Dune Sand Aquifer. These facts support the conclusions presented in the Monterey GSP. Groundwater elevation information and estimate specific yield indicates that approximately 80,000 AF to 160,000 AF of groundwater exist within the Dune Sand and upper 180-foot aquifer (Section 8.8.3.1). Water quality and AEM data indicate that this groundwater is fresh.
Chapter 5 – Groundwater Conditions	

HWG Comments	Responses
1. The GSP notes data sources used in the GSP, which includes documents/data for Monterey Peninsula Landfill (Section 5.1.1, Data Sources, p. 6). **HWG Comment:** We note that Monterey Peninsula Landfill (MPL) is not located within Monterey Subbasin. In addition, if data from Monterey Peninsula Landfill are being used, why are data from MPWSP monitoring network not being used. Notably, later in Chapter 5, the GSP uses AEM data outside of Monterey Subbasin and within the area of MPWSP monitoring network data, yet there is no use of MPWSP data that contradicts the hydrogeologic interpretation of AEM data provided in the GSP.	The GSP incorporates information developed as part of the Monterey Peninsula Supply Project (MPWSP), to the extent that it is relevant to the GSP. However, the 8 well clusters completed as part of the MPWSP are located in the immediate vicinity of the MPWSP and are all located within the 180/400 Foot Aquifer Subbasin. None of these wells are located within the Monterey Subbasin, nor is the MPWSP the focus of this GSP.
2. The GSP states that the Dune Sand Aquifer is a Principal Aquifer and that the 180-Foot Aquifer contains two distinct layers, known as the upper- and lower- 180-Foot Aquifer (Section 5.1.2.1, MarinaOrd Area, p.7). **HWG Comment:** The Dune Sand Aquifer should not be designated as a Principal Aquifer, and is in conflict with the 180/400 Foot Aquifer Subbasin GSP in this regard. Furthermore, the splitting of the 180-Foot Aquifer into two distinct aquifers only applies in the Fort Ord area, and does not apply in northern Monterey Subbasin (HWG, November 2017). While the entire thickness of the 180-Foot Aquifer is intruded by seawater near the coast and for a significant distance inland, the presence of less saline water within the upper portion of the 180-Foot Aquifer further inland is merely a function of the nature of seawater intrusion wedges, and not a function of the presence of an intermediate aquitard within the 180-Foot Aquifer in northern Monterey Subbasin.	See response to HWG Chapter 4 Comment 5.
3. The GSP describes groundwater flow conditions in the 180-Foot Aquifer, and states, "…inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion." (Section 5.1.2.1, Marina-Ord Area, p.8). **HWG Comment:** Any groundwater flow that may occur from the Perched/Mounded portion of the inland Dune Sand Aquifer to the underlying 180-Foot Aquifer has historically not prevented seawater	There are hundreds of wells located in the upper 180-foot aquifer that show that TDS concentrations are below 1,000 mg/L. See Monterey GSP Figure 5-24.

HWG Comments	Responses
intrusion from occurring within the 180-Foot Aquifer, which has been and remains heavily intruded with seawater. Any claims to the contrary, such as in this referenced statement from the Monterey Subbasin GSP, are incorrect. As noted above, there are not geologically distinct Upper and Lower 180 Foot Aquifers in northern Monterey Subbasin. The amount of recharge from the Dune Sand Aquifer to the 180-Foot Aquifer is small, as can easily be demonstrated by calculation of the amount of precipitation recharge in the Dune Sand Aquifer within the area west of the groundwater divide that has potential to recharge the 180-Foot Aquifer (e.g., on the order of a few hundred AFY, before subtracting Ford Ord remedial pumping). Furthermore, in order to dilute incoming seawater to a fresh water concentration, there would need to be over 30 times more fresh water than seawater in the mixing zone to create a net fresh water condition. Thus, a few hundred AFY of fresh water can effectively only dilute about 10 to 20 AFY of incoming seawater.	
4. The GSP states, "…the lower 180-Foot Aquifer is hydraulically connected to the 400-Foot Aquifer in the Marina-Ord Area due to the discontinuous nature of the 180/400-Foot Aquitard within this region…As such, groundwater elevation and gradients in the lower 180-Foot Aquifer are similar to those in the 400-Foot Aquifer in the Marina Ord Area of the Subbasin…" (Section 5.1.2.1, Marina-Ord Area, p.8). **HWG Comment:** This characterization of the discontinuous nature of the 180-400 Aquitard is not applicable to the northern portion of the Monterey Subbasin. Groundwater levels in the 180-Foot Aquifer and 400-Foot Aquifer are clearly different and distinct in the northern half of Monterey Subbasin and in the adjacent 180/400-Foot Aquifer Subbasin (HWG, November 2017). The Monterey Subbasin GSP does not demonstrate the similarity or difference in groundwater elevations to justify its characterization.	See response to HWG Chapter 4 Comment 7.
5. Figures 5-1 and 5-5 show the western extent of the FO-SVA north of Monterey Subbasin as extending to MPWSP MW-3.	These figures will be modified to remove the estimate extent of the FO-SVA outside of the Monterey Subbasin, as this is information is not relevant to the Monterey GSP.

HWG Comments	Responses
HWG Comment: The extent of FO-SVA shown on the maps is outdated and also does not incorporate more recent data and analyses based on the MPWSP borehole/well data. We also note that groundwater elevation figures for all units except the Dune Sand Aquifer extend northward across the Monterey Subbasin/180-400 Foot Aquifer Subbasin boundary, even though many Dune Sand Aquifer well locations are available and shown on the figures for the MPWSP and MPL monitoring networks. In addition, there are several monitoring wells located at the MCWD District office headquarters and treatment plant on Reservation Road near the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996 and 2001).	
6. In describing groundwater elevations in the 400-Foot Aquifer the GSP states, "A local groundwater depression exists just north of the Monterey-Seaside Subbasin boundary where a potential connection between the 400-Foot Aquifer and the Deep Aquifers may be located ." (Section 5.1.2.1, Marina-Ord Area, p.8). **HWG Comment:** The GSP provides no geologic evidence for a potential connection at this location between the two aquifers. The GSP only cites to HLA (2001) for cross-sections in this area, but other geologic cross-sections are available to consider from previous reports (e.g., HWG, 2017; Yates et.al., 2005). The location of this depression, which is more centrally located within Monterey Subbasin than described in the GSP text, is only about 1.5 miles south of MCWD Deep wells where a thick (i.e., 200 to 300 feet) aquitard exists between the 400 Foot Aquifer and Deep Aquifer.	See response to HWG Chapter 4 Comment 13.
7. GSP Figures 5-1 and 5-5 (Groundwater Level Contours in the Dune Sand Aquifer – Fall 2017 and Spring 2018) show locations of MPWSP and MPL wells, but do not use the data to prepare groundwater level contours. **HWG Comment:** It is not clear why the GSP maps would show these MPWSP/MPL well locations but not use the data. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or to develop an understanding of the geologic conditions	Groundwater levels for the Dune Sand Aquifer have not been extended into the 180/400 Foot Aquifer Subbasin, as they do not affect the conclusions or projects included in this GSP.

HWG Comments	Responses
for the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data.	
8. GSP Figures 5-2 and 5-5 (Groundwater Level Contours in the 180-Foot Aquifer – Fall 2017 and Spring 2018) show locations of only three of the MPWSP wells (MW-6, MW-8, and MW-9), and do not use data from MW-8 and MW-9. **HWG Comment:** It is not clear why the GSP maps only show selected MPWSP well locations and do not use most of the data from the selected wells that are shown on the maps. We also note that geologic and borehole geophysical data from these wells are not used in developing geologic cross-sections or in developing an understanding of the geologic conditions underlying the HCM. This is particularly noteworthy in that the GSP Chapter 5 later uses hydrogeologic interpretations from the AEM data in lieu of actual borehole/well data to derive different conclusions regarding the HCM that are not supported by borehole/well data. We also note that groundwater is indicated to flow inland from the ocean to a pumping center in the north central portion of Monterey Subbasin.	The Monterey GSP focuses on wells located in the Monterey Subbasin and wells located immediately adjacent to the subbasin within the 180/400 Foot Aquifer subbasin to provide continuity with water levels in that subbasin.
9. Figures 5-3 and 5-7 (Groundwater level Contours in the 400-Foot Aquifer – Fall 2017 and Spring 2018) show a +10 feet MSL contour as the shoreline in Marina Subbasin. **HWG Comment:** There is no well control to support this +10 feet MSL contour line, or even the zero contour line. We note that groundwater elevations in the 400-Foot Aquifer for MPWSP MW-3 (very close to the shoreline) ranged from 0 to -15 feet NAVD88 during this time period. We also note that groundwater is indicated to flow inland from the ocean to a depressed area in the south central portion of Monterey Subbasin. The Fall 2017 groundwater levels show that the pumping depression in the southern central area of Monterey Subbasin contributes to a broader depression that extends to the 180/400 Foot Aquifer Subbasin. Spring 2018 groundwater levels appear to indicate	The revised draft of Chapter 5 of the Monterey GSP does not show a +10 feet contour on Figures 5-3 and 5-7.

HWG Comments	Responses
occurrence of a temporal groundwater divide around the MCWD well field.	
10. The GSP states, "…water levels in the Dune Sand Aquifer increase and decrease during extended wet and dry periods." This statement is apparently in reference to Figure 5-11: Representative Groundwater Elevation Hydrographs in the Dune Sand Aquifer (Section 5.1.3.1, Long-Term Groundwater Elevation Trends, Marina-Ord Area, p. 21). **HWG Comment:** The seven hydrographs shown in Figure 5-11 do not appear to respond to wet and dry periods. The only short-term response observed is around the year 2000 in the hydrograph for MW-OU2- 05-A. This apparent stability of groundwater levels in the Perched/Mounded portion of the Dune Sand Aquifer is quite unlike the seasonal fluctuations that occur in response to pumping in the underlying aquifers, and further confirms that the DSA is undeveloped and essentially undevelopable as a water supply and therefore not a Principal Aquifer.	See response to HWG Chapter 4 Comment 2.
11. The GSP states, "Groundwater elevations in the Lower 180-Foot Aquifer are generally equivalent to those observed in the 400-Foot Aquifer…" (Section 5.1.3.1, Long-Term Groundwater elevation Trends, 180-Foot Aquifer, Lower 180-Foot Aquifer, p. 21). **HWG Comment:** The GSP provides no evidence that groundwater elevations in the Lower 180-Foot Aquifer are equivalent to those in the 400-Foot Aquifer. In addition, no geologic evidence is provided that defines distinct Upper and Lower 180-Foot Aquifers in terms of a continuous intermediate aquifer throughout the Monterey Subbasin. MPWSP monitoring well MW-6 is a nested well cluster with separate wells in the upper and lower 180-Foot Aquifer and shows essentially identical groundwater elevations and fluctuations – it is located along Blanco Road on the border of the Monterey Subbasin with the 180/400-Foot Aquifer Subbasin.	As shown in Figure 5-13, the two multi-completion wells (MP-BW-37 and MP-BW-41) screened from 286 ft bgs to 460 ft bgs showed identical water levels, suggesting that the groundwater elevations in the Lower 180-Foot Aquifer are equivalent to those in the 400-Foot Aquifer.
12. The GSP states that groundwater elevation data for MPWMD#FO-10 and MPWMD#FO-11	See Response to HWG Chapter 4 Comment 13.

HWG Comments	Responses
suggest, "…(1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells." (Long-Term Groundwater Elevation Trends, 400-Foot Aquifer, p. 22). **HWG Comment:** Insufficient evidence is provided to make the stated conclusions; for example, no geologic evidence is provided to support these claims. In addition, more groundwater elevation data are needed to evaluate the gradient and flow direction in this portion of the aquifer. Preliminary review of geologic data (lithologic logs and Elogs) by HWG for MPWMD FO-10 and FO-11 indicate presence of sufficient thicknesses of clay layers to serve as aquitard layers between the 400-Foot and Deep Aquifers at this location.	
13. GSP Figure 5-15 shows groundwater hydrographs for Deep Aquifer wells near the Monterey Subbasin and 180/400-Foot Aquifer Subbasin boundary. Figure 5-16 shows Deep Aquifer groundwater pumping over time. In reference to the adjacent 180/400-Foot Aquifer Subbasin, the GSP states that, "…groundwater elevations in wells located near Cooper Road and Blanco Road have declined more than 5 ft/year over the past 15 years." **HWG Comment:** We note that the three wells in the 180/400-Foot Aquifer Subbasin have data through about 2020 and generally show fluctuating but overall stable groundwater elevations from about 2015 to 2020. Several of the MCWD wells within the Monterey Subbasin shown in the figure are lacking data from about 2017 to 2020, but the overall trend from available data appears to be declining groundwater elevations within Monterey Subbasin from 2015 to 2020. We note that Figure 5-16 shows significant increases in both agricultural and urban pumping from the Deep Aquifer after 2013, with urban pumping comprising approximately half of the total Deep Aquifer pumping over that time period. Figure 5-16 shows a doubling of urban pumping between 2013 and 2018, but no discussion/explanation of the sharp jump in urban pumping is provided in the text. Overall, the characterization of recent Deep Aquifer	Figure 5-15 shows significant declining groundwater trends in the deep aquifers in the Monterey and 180/400-Foot Aquifer Subbasins. A comparison of MCWD pumping in the deep aquifer has been added to Figure 5-16, which has been stable since the 1990s.

HWG Comments	Responses
groundwater elevation trends between the two subbasins in the text appears to be inaccurate based on review of the figures.	
14. The GSP states, "These downward vertical gradients are caused by areal surface recharge, groundwater extraction from deeper aquifers, and laterally extensive aquitards, which exist in the Marina-Ord Area." (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, pp. 31-32). **HWG Comment:** We note that the GSP references the presence of laterally extensive aquitards separating Principal Aquifers throughout Monterey Subbasin, a statement that we agree with, and yet the conceptual model described in GSP Chapters 4 and 5 provides for essentially no aquitard between the 180-Foot and 400-Foot Aquifers and a big hole in the thick aquitard between the 400-Foot Aquifer and Deep Aquifers.	The conceptual model presented in Chapters 4 and 5 does not imply that extensive aquitards do not exist in the Marina Ord Area. However, the data does indicate that the aquitard that is observed between the 180- and 400-foot aquifers in the 180/400 Foot Subbasin is not as prevalent in the Marina Ord Area. Further, the conceptual site model does state that a series of aquitards exist between the 400 Foot Aquifer and the Deep Aquifers, which significantly reduce vertical groundwater migration. The available data do not suggest that it is one thick continuous aquitard across the Marina Ord area.
15. The GSP states that in the central Marina-Ord Area the groundwater elevations in the upper 180-Foot Aquifer are 70 feet lower than in the Dune Sand Aquifer (Section 5.1.4, Vertical Hydraulic Groundwater Gradients, p. 32). **HWG Comment:** This 70 foot difference in groundwater elevation almost certainly reflects the presence of perched aquifer conditions in the Dune Sand Aquifer at this location, which is why the HWG refers to the portion of the so-called Dune Sand Aquifer overlying the FO-SVA as the Perched/Mounded Aquifer. This observation also begs the question of why the Dune Sand Aquifer is being classified as a Principal Aquifer in this GSP, when much of it is a thinly saturated perched aquifer.	See response to HWG Chapter 4 Comment 2.
16. The GSP states, "Within the Monterey Subbasin, seawater intrusion has been documented in the northern portion of the lower 180-Foot and 400-Foot Aquifers." (Section 5.3, Seawater Intrusion, p. 36). **HWG Comment:** As discussed other HWG comments in this letter, the designation of a geologically distinct lower 180-Foot Aquifer does not apply in the northern portion of the Monterey Subbasin. The entire thickness of the 180-Foot Aquifer is intruded at the coast and for some	See responses to: HWG Chapter 4 comments 5 and 7, and HWG Chapter 5 comment 3

HWG Comments	Responses
distance inland, with a seawater wedge having formed further inland (i.e., less saline water overlying more saline water due to density differences).	
17. The GSP describes data sources used in their analysis of seawater intrusion for the GSP, which include two airborne electromagnetic (AEM) surveys (Section 5.3.1, Seawater Intrusion, Data Sources, p. 36). **HWG Comment:** We note that the GSP utilizes an AEM profile entirely within the 180/400-Foot Aquifer Subbasin that passes through/near several MPWSP boreholes/wells, yet the GSP does not use the readily available MPWSP borehole/well data in its analysis. Furthermore, the HWG has conclusively demonstrated in previous documents (e.g., HWG, April 2019) that hydrogeologic interpretations derived from AEM data are flawed and inconsistent with borehole/well data.	Figures 5-26 and Figures 5-27 provide insights regarding the vertical profile of seawater intrusion within the Monterey Subbasin. These profiles include AEM Data, logged borehole data, and water quality data from each of the borings identified. As such, the reader can see how all of these sources of data correlate. The premise that that water quality data from well MW-7 is inconsistent with AEM data, is not correct. Detailed review of Cross Section A-A, which presents both AEM data and water quality data from well M-7, shows that TDS concentrations detected in groundwater samples collected from each well screen, reflect an average of the AEM profile that intersects the screen interval. As stated in Monterey Section 5.3.3: Cross-Section A-A', which is located immediately north of the Monterey Subbasin has been included in the GSP, to provide insight regarding the vertical delineation of seawater intrusion within the coastal areas of the Monterey Subbasin. AEM data along Cross Section B-B, which is located in the Subbasin, is sporadic due to the absence of AEM data in urban areas where high density of utilities interferes with AEM data collection.
18. The GSP devotes several pages and two figures (5-26 and 5-27) to describing AEM surveys, primarily a profile entirely outside of the Monterey Subbasin (Section 5.3.1.2, Geophysical Data, pp. 36-38, 41-42, and 45-46). **HWG Comment:** It is not clear why the GSP relies so heavily on AEM data (primarily outside the Monterey Subbasin) in its discussion of seawater intrusion (and disregards borehole/well data for the same area) – especially given the flaws in the hydrogeologic and groundwater quality interpretations made using AEM data previously described in multiple HWG documents (e.g., January, March, April 2019). The hydrostratigraphy shown on the AEM profiles (Figures 5-26 and 5-27) is incorrect; particularly with regard to its depiction of aquitards (i.e., the presence of a continuous intermediate aquitard within the 180-Foot Aquifer and absence of a 180/400 Aquitard). In essence, the GSP is inappropriately trying to apply the Fort Ord	See responses to: HWG Chapter 5 Comment 17 above.

HWG Comments	Responses
hydrogeologic conceptual model (developed for a limited area south of Reservation Road) throughout the northern Monterey Subbasin and into the adjacent 180/400 Foot Aquifer Subbasin. Field borehole/well data demonstrate that application of the Fort Ord HCM to northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is incorrect. There is no evidence/basis to support the stratigraphic interpretations in Figures 5-26 and 5-27 related to the presence (or absence) of aquitards between various aquifers. We note that there are no control points for the majority of the cross-section in Figure 5-26, yet the figure implies an abundance of fresh water. Field water quality data from MW-7M do not match that indicated on the profile. The two profiles are inconsistent; where control points exist with a TDS color coded legend the profiles are not shaded accordingly; however, where no control points exist to validate AEM water quality the profiles are shaded.	
19. In describing the purpose of the AEM surveys, the GSP states, "The studies' goal was to evaluate the understanding of the hydrostratigraphy in the study area and to interpret that distribution of groundwater quality indicated by available well data." (Section 5.3.1.2, Geophysical Data, p. 37). **HWG Comment:** While this statement references "available well data", it does not actually cite or use available well data. Rather, the GSP interpretations of hydrostratigraphy and seawater intrusion in this section are based primarily on interpretations of AEM data that are at odds with well data (see various HWG documents such as January 2019, March 2019, and April 2019).	Well data are presented on all cross-sections and areal maps that include AEM Data within the GSP. The AEM data aid in the understanding the extent of seawater intrusion and hydrostratigraphy, however, all conclusions presented in the GSP are supported by actual well data.
20. The GSP describes how AEM data (i.e. electrical resistivity) are dependent on, "…the amount of clay, the amount of water, and/or the salinity of the water…" (Section 5.3.1.2, Geophysical Data, p. 37). **HWG Comment:** While we agree with this statement, these facts also point out the high level of uncertainty associated with interpretation of AEM	See response to HWG Chapter 5 Comment 19.

HWG Comments	Responses
data in this coastal seawater intruded setting where multiple variables are impacting recorded AEM (resistivity) values. This allows for multiple non-unique interpretations of AEM data to be made in such settings, which creates more uncertainty in those hydrostratigraphic and groundwater quality interpretations. The GSP itself acknowledges that water quality interpretation is "difficult to discern" for a wide range of AEM resistivity values. The GSP does not acknowledge that geochemical interpretation of AEM resistivity values even outside of the cited large range are still subject to uncertainties related to variation in lithologic/saturation conditions.	
21. The GSP states, "The AEM surveys have found that high salinity groundwater as a result of seawater intrusion exists within the lower 180-Foot Aquifer and 400-Foot Aquifers of the Monterey Subbasin. This volume of high salinity groundwater is overlain by fresh groundwater in the Dune Sand and upper 180-Foot Aquifers. The results of the AEM study are consistent with water quality data collected within the Subbasin (EKI, 2019)." (Section 5.3.1.2, Geophysical Data, p. 38). **HWG Comment:** Both the AEM data and borehole/well data demonstrate that the coastal Dune Sand Aquifer and essentially the entire thickness of the 180-Foot Aquifer are seawater intruded from the ocean shoreline to approximately one mile inland. At that point, the coastal Dune Sand Aquifer begins to transition to the Perched/Mounded Aquifer that overlies of FO-SVA that is generally not seawater intruded because it is an elevated thinly saturated perched aquifer further inland, and the fully seawater intruded area of the 180-Foot Aquifer transitions to a seawater intrusion wedge with less saline water overlying more saline water due to density differences. While the results of the AEM survey may be consistent with the primarily Perched/Mounded Aquifer groundwater quality data cited in EKI (2019), the AEM survey based hydrostratigraphic and groundwater quality interpretations are inconsistent with the groundwater quality data collected for the MPWSP	See responses to HWG Chapter 4 comments 5 and 7, and HWG Chapter 5 Comments 3 and 19.

HWG Comments	Responses
(e.g., HWG, April 2019) and key MCWD and Seaside Basin wells.	
22. The GSP presents an analysis (Figure 5-23) that demonstrates the definition of 500 mg/L chloride as the threshold for defining seawater intrusion is equivalent to a TDS of 1,000 mg/L. The GSP also cites the State of California upper Secondary Maximum Contaminant Level of 1,000 mg/L for TDS (Section 5.3.2, Defining Seawater Intrusion, p. 40). **HWG Comment:** We concur with the use of 500 mg/L chloride (although a good argument can be made for use of 250 mg/L chloride as a better indicator) and 1,000 mg/L TDS as an appropriate standards/thresholds for drinking water and seawater intrusion. We note that the AEM studies (study authors and study proponents) continue to argue for a drinking water and seawater intrusion threshold of 3,000 mg/L TDS, but this is at odds with GSP stated seawater intrusion and drinking water standards/thresholds of 500 mg/L and 1,000 mg/L TDS. Furthermore, due to the significant uncertainties in AEM groundwater quality interpretations, the AEM studies primarily attempt to differentiate groundwater above and below 3,000 mg/L TDS. The use of AEM data with a lower cutoff value (e.g., 1,000 mg/L TDS) results in even greater uncertainty in interpreted results than are achieved using the already uncertain AEM interpretations based on a cutoff of 3,000 mg/L TDS. We note that the GSP adopts a double standard by saying seawater intrusion has occurred when TDS exceeds 1,000 mg/L or chloride exceeds 500 mg/L in the Deep Aquifer, yet concentrations of 3,000 mg/L TDS and over 1,000 mg/L chloride represent low-TDS groundwater that is considered a source of drinking water supply in the AEM studies cited in the GSP.	The GSP selects 500 mg/L chloride to estimate the extent of seawater intrusion within the Subbasin. However, as discussed in Section 3.2.2.6, beneficial use criteria for the Subbasin are established pursuant to Water Quality Control Plan for the Central Coastal Basin, (Basin Plan) (State Water Resources Control Board (SWRCB), 2017). The Basin plan lists beneficial users, describes the water quality which must be maintained to allow those uses, provides an implementation plan, details SWRCB and Central Coast Regional Water Quality Control Board plans and policies to protect water quality and a statewide surveillance and monitoring program, as well as regional surveillance and monitoring programs. The SWRCB's Sources of Drinking Water Policy, adopted in Resolution No. 88-63 and incorporated in its entirety in the Basin Plan, provides that water with TDS less than or equal to 3,000 mg/L is considered suitable or potentially suitable for drinking water beneficial uses. As discussed in the Response to HWG Chapter 5 Comment 19: Well data are presented on all cross-sections and areal maps that include AEM Data within the GSP. The AEM data aid in the understanding the extent of seawater intrusion and hydrostratigraphy, however, all conclusions presented in the GSP are supported by actual well data.
23. In reference to the AEM profiles shown in Figures 5-26 and 5-27, the GSP states, "TDS and AEM data shown on these cross-sections confirm that seawater intrusion in the Monterey Subbasin primarily exists in the lower 180-Foot Aquifer and 400-Foot Aquifer, whereas groundwater in the Dune Sand and upper 180-Foot Aquifers remains	See Response to HWG Chapter 5 Comment 17.

HWG Comments	Responses
fresh." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41). **HWG Comment:** While the statement refers to Monterey Subbasin, it should be noted that the Figure 526 is located entirely outside (north of) Monterey Subbasin, and Figure 5-27 contains very little data for the AEM profile within Monterey Subbasin. Furthermore, we have previously commented (in this letter and previous documents) on the flaws in the hydrostratigraphic and water quality interpretations shown on these AEM profiles (e.g., HWG, April 2019). Actual borehole/well data show the coastal Dune Sand Aquifer and entire thickness of the 180-Foot Aquifer are heavily intruded with seawater at the coast and for a significant distance inland. We recommend that AEM data only be used where results can be clearly validated with actual lithologic and water quality data. By not using this approach, the groundwater conditions are being misrepresented.	
24. In reference to the 180-Foot and 400-Foot Aquifers, the GSP states, "It appears that seawater intrusion in these two aquifers forms a unified intrusion wedge, due to the discontinuity of the 180/400 Foot Aquitard near the coast." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 41). **HWG Comment:** The HWG has previously demonstrated the flaws and inaccuracies in the hydrostratigraphic/water quality interpretations from AEM data inherent in this statement (i.e., absence of 180/400 Aquitard) (see HWG, April 2019).	See Response to HWG Chapter 5 Comment 17.
25. The GSP states, "Based on available TDS and AEM data, Figure 5-28 depicts the estimated extent of seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and CrossSections, p. 41). **HWG Comment:** The area covered by Figure 5-28 does not include the AEM profile shown in Figure 5-26 and the AEM profile in Figure 5-27 provides very little data for the mapped area in Figure 5-28. Therefore, Figure 5-28 presumably is based essentially exclusively on TDS data. Furthermore,	See Response to HWG Chapter 5 Comment 17.

HWG Comments	Responses
the area covered by Figure 5-28 has separate 180-Foot and 400-Foot Aquifers separated by an aquitard, so one map is mixing data from different aquifers and should be revised to be two separate figures as is done by the MCWRA.	
26. The GSP states, "…the 180-Foot Aquifer in the Subbasin is divided by an intermediate aquitard into an upper zone and a lower zone. There is no observed seawater intrusion in the upper portion of the 180-Foot Aquifer." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42). **HWG Comment:** As discussed previously in this letter, the area covered by Figure 5-28 does not have a continuous intermediate aquitard in the 180-Foot Aquifer, does have a 180/400-Foot Aquitard, and seawater intrusion is present in a significant zone along (and inland of) the ocean throughout the entire thickness of the 180-Foot Aquifer (see HWG, 2017; Staal, Gardner & Dunne, 1992; Fugro West 1996 and 2001).	See responses to HWG Chapter 4 comments 5 and 7, and HWG Chapter 5 Comments 3 and 19.
27. In reference to Figure 5-28, the GSP states, "The figure shows that depressed groundwater elevations in the 180/400 Foot Aquifer Subbasin are creating inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin." (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, pp. 41-42). **HWG Comment:** It should be noted that there are also depressed groundwater elevations from groundwater pumping within the Monterey Subbasin that are contributing to inland groundwater gradients that are contributing to seawater intrusion within the Monterey Subbasin. In fact, the groundwater elevation contour map provided in Figure 5-28 indicates flow lines from the ocean end in a groundwater depression within the Monterey Subbasin. Furthermore, much greater historical pumping from Fort Ord and MCWD wells within the Monterey Subbasin created seawater intrusion within the Monterey Subbasin. Once seawater intrusion occurs, it requires many decades of maintaining seaward gradients to flush saline water back out of the aquifers.	See Response to HWG Chapter 4 Comment 14.

HWG Comments	Responses
28. GSP Figure 5-24 purports to show TDS concentrations and the extent of seawater intrusion in Monterey Subbasin (Section 5.3.3 Seawater Intrusion Maps and Cross-Sections, p. 43). **HWG Comment:** The dark blue zone in the Dune Sand Aquifer map extending approximately 0.5 miles inland from the shoreline suggests presence of fresh water coastal Dune Sand Aquifer, which is attributed to the 2018 AEM Survey report according to the map legend. The light blue zone that presumably attempts to define TDS concentrations below 1,000 mg/L includes a lobe that extends west of the FO-SVA extent that is not supported by any well data. On the contrary, available well data from the MCWD office site on Reservation Road for the Dune Sand Aquifer shows significant seawater intrusion has occurred in the area the AEM Survey report shown to be fresh water in the Dune Sand Aquifer along the coast (Staal, Gardner & Dunne, 1991 and 1992; Fugro West, 1996a and 1996b; Fugro West, 2001).	See Response to HWG Chapter 4 Comment 18.
29. The GSP states, "…seawater continues to flow across the area that is intruded towards the 180/400 Foot Aquifer Subbasin, while there is minimal migration of seawater intrusion to inland areas of the Monterey Subbasin. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 48.) **HWG Comment:** While the title of this GSP section refers to "Historical Progression of Seawater Intrusion", it fails to actually discuss the historical progress of seawater intrusion within Monterey Subbasin. As indicated in seawater intrusion maps prepared by MCWRA (Appendix 5B), a significant lobe of seawater intrusion into the 180-Foot Aquifer and 400-Foot Aquifer solely within Monterey Subbasin occurred south of Reservation Road in the 1970's and 1980's. This initial seawater intrusion into Monterey Subbasin occurred as a result of groundwater pumping from MCWD and Fort Ord wells screened in the 180-Foot Aquifer and 400-Foot Aquifer production zones, which were sequentially abandoned and moved inland and/or deeper as seawater intrusion moved inland in response to pumping of MCWD and Fort Ord production wells (Harding ESE, 2001). Most of the saline water that	See Response to HWG Chapter 4 Comment 14.

HWG Comments	Responses
was induced to flow into Monterey Subbasin in the 1970s and 1980s still resides in Monterey Subbasin aquifers, and remains part of the overall area of seawater intrusion that exists today.	
30. Figure 5-29 of the GSP (Total Dissolved Solid Concentration Trends in the Lower 180-Foot, 400-Foot Aquifer) shows historical and recent TDS concentrations in various wells, including MCWD Wells MCWD-29 and MCWD-31. (Section 5.3.4, Historical Progression of Seawater Intrusion, p. 49). **HWG Comment:** Figure 5-29 indicates TDS concentrations of approximately 400 mg/L during 2019 in MCWD-29 and MCWD-31. Review of the 2019 AEM Survey Report Table 4-1 shows that AEM based TDS concentrations in the zone screened by these wells is estimated to be greater than 1,000 mg/L (about three times the field measured concentrations). Based on analysis (AEM data is a major data source of mapping sweater intrusion in the GSP) and relationships between chloride and TDS established in the GSP (e.g., chloride concentrations of 500 mg/L equate to TDS concentrations of approximately 1,000 mg/L), it seems that MCWD wells MCWD-29 and MCWD-31 should be included within the area of mapped seawater intrusion. In fact, this discrepancy demonstrates how interpretation of AEM data with regard to water quality can result in significant errors relative to field measured data. Interpreted AEM data has also been shown to significantly underpredict TDS/chloride concentrations (e.g., HWG, April 2019) is some areas.	A comparison of AEM data and water quality data from wells MCWD-29, MCWD-30 and MCWD-31 is presented on Figure 5-27. As shown on these figures, the AEM data and water quality data from these wells is very consistent and show that these wells are primarily screened within zones that have TDS concentrations < 500 ug/L. Some of the deeper screens from these wells do extend into areas where resistivity estimates are in the moderate range and could be indicative of higher salinity groundwater or higher amounts of clay. This phenomenon is also observed at MCWD-34, where groundwater extracted from this well has lower TDS concentrations than AEM data suggest. As stated in section 5.3.1.2 Geophysical Data: "Stanford study found that very high resistivity (greater than 25 ohm/cm) or very low resistivity (smaller than 5 ohm/cm) are indicative of fresh groundwater and high salinity groundwater and, respectively. Moderate AEM resistively in the range of 5 to 25 ohm/cm can be indicative of either higher salinity or higher amount of clay in subsurface materials, thus the exact water quality associated with these resistivity values is more difficult to discern." Due to this limitation, AEM data is better at detecting areas of fresh groundwater and can over predict salinity in some areas due to the presence of clay sediments. However, as previously discussed, significant groundwater quality data exists within the Monterey Subbasin, which supports AEM results. All of these data have been integrated to develop the hydrogeologic conceptual model and map the extent of seawater intrusion within the Subbasin.
31. The GSP relies on a study conducted by WRA Environmental (2020) to conclude that 19.51 acres of aquatic and upland biological communities at six ponds are dependent upon groundwater (Section 5.7.1, Groundwater Dependent Ecosystems, Coastal Vernal Ponds within the City of Marina, p. 68). **HWG Comment:** We note that the five authors of the report by WRA Environmental are all biologists, with no apparent contribution from a hydrogeologist to help evaluate groundwater conditions and dependence of the plant communities on	The Marina ponds have been identified in DWR's NC Dataset as potential GDEs (https://gis.water.ca.gov/app/NCDatasetViewer/). Based on information from the WRA study and the NC dataset, the GSP has reasonably identified these ponds as GDEs or potential GDEs. Pursuant to the *Nature Conservancy's Best Practices for Using the NC Dataset* (dated July 2019), "The Nature Conservancy strongly advises that questionable polygons from the NC dataset be included in the GSP until data gaps are reconciled in the monitoring network." Per the Identifying GDEs

HWG Comments	Responses
groundwater. The only investigation of groundwater in the report was digging a hole to 14 inches in depth to look for soil saturation; however, these field efforts are inadequate to determine groundwater conditions at the sites because there may be shallow fine-grained sediment layers supporting perched/saturated soils in the upper few feet of soil. The WRA report also cites the fact that their field efforts were conducted in June 2020, well after the end of the rainy season, and water was still observed in most of the ponds (implying it must be groundwater). However, review of monthly precipitation data for the 2019 and 2020 water years indicates the 2019 year was very wet (133% of normal) and the 2020 water year was wet (105% of normal). In addition, heavy rainfall occurred in March and April 2020 (about 6.5 inches or close to half the average annual rainfall) with smaller amounts of rainfall in May and June; therefore, it would be expected that surface runoff remained in the ponds with near surface saturation at the time of WRA's June 2020 site visits. We also note that the WRA Report relies on other studies such as Formation Environmental (April 2020) and the draft City of Marina GSA GSP (2020). The HWG has previously commented on these studies, and Geoscience/AECOM conducted the most recent study on the vernal pools (HWG, November 2019; Geoscience and AECOM, August 18, 2020). Summary Geoscience/AECOM comments on the Formation Environmental TM included: 1) very limited use of available groundwater data from MPWSP MW-4 and MW-7 to one point in time without considering entire record and impact of agricultural irrigation return flows in immediate vicinity; 2) relies solely on ET data to justify conclusion that Armstrong Ranch Ponds are groundwater dependent without consideration of alternative water sources such a seasonal surface water from rainfall; 3) failure to account for perched aquifer conditions underlying area; 4) failure to account for effects of urbanization surrounding six ponds in city of Marina that caused ponds to become primarily reliant of surface water runoff and leading to ponds becoming perennial. Furthermore, all six ponds in the Marina area are not hydraulically connected to the coastal Dune Sand Aquifer (thus, pumping from coastal Dune Sand Aquifer will not	under SGMA – Best Practices for Using the NC Dataset dated July 2019 provided by the Nature Conservancy.

HWG Comments	Responses
affect them); and all ponds received surface discharge from storm drains that empty into the ponds. Several ponds were found to have hardpan layers beneath them that limit percolation and likely account for WRA observations of shallow saturation. In addition, water quality data suggest that ponds are more influenced by stormwater runoff than groundwater from the perched aquifer system. Overall, it was found that the Formation Environmental study is fundamentally flawed , misrepresents potential impacts on ponds from pumping in the coastal Dune Sand Aquifer, and does not consider all available evidence concerned the nature of these pond resources and potential impacts to them from pumping. HWG comments on the City of Marina GSA Draft GSP state, "the fact that nearby GDEs are seasonally flooded and have a seasonal nature to them (and are associated with "a lens of less pervious soil") suggests a surface water source is most likely sustaining vegetation in these areas. The GSP evaluation to determine if potential GDEs are actual GDEs did not consider that shallow groundwater in these nearby potential GDE areas is saline or the likelihood that fresh surface water is the primary sustaining factor for these areas and (which means they are not GDEs)."	
32. We note that the City of Marina Draft GSP stated the following with regard to pumping from Marina Coast Water District Deep Aquifer wells, "The combined extraction from these wells was approximately 1,823 AFY in 2015, and is forecast to increase to 3,905 AFY by 2035…" (Section 3.1.8, page 3-17). **HWG Comment:** While the Monterey Subbasin GSP comments on the impacts of increasing pumping from the Deep Aquifer in the adjacent 180/400-Foot Aquifer Subbasin, it is silent on the issue of increased pumping from existing (and potential future new) MCWD Deep Aquifer wells. The cited MCWD Deep Aquifer pumping numbers represent a greater than doubling of the amount of current MCWD pumping from the Deep Aquifer, a pumping amount that already results in Deep Aquifer water levels within Monterey Subbasin on the order of 50-100 feet below sea level. Such increased pumping from the Deep Aquifer by MCWD and others is likely not sustainable.	Impacts of potential future groundwater extraction will be included in the Water Budget Chapter of the GSP.

HWG Comments	Responses
33. We note that the City of Marina Draft GSP stated, "In the Monterey Subbasin, groundwater demand from the Deep Aquifer by MCWD to supply the City of Marina is expected to increase….however, the increase is projected to be within MCWD's allocated pumping rights." (Section 3.3.10.4, page 3-69). **HWG Comment:** Regardless of the validity of allocated pumping rights (which is yet to be determined), it remains unclear if the proposed MCWD increase in pumping from the Deep Aquifer is sustainable. In addition, the increased pumping from the Deep Aquifer to the east to support agricultural expansion is based on overlying rights, not allocated (paper water) pumping rights, and are thereby presumably superior to MCWD rights.	Impacts of potential future groundwater extraction will be included in the Water Budget Chapter of the GSP. SGMA does not establish groundwater rights. HWG's apparent legal opinion regarding the MCWD's pumping rights is not relevant to the GSP.
Monterey Subbasin GSP Comment Log (Prepared by SVBGSA)	
1. In Comment 41 (dated 1/7/21) Tina Wang states, "…There is one thing we pointed out in that chapter, is the dune sand aquifer and the upper 180 foot aq is not SWI intruded, it is fresh." **HWG Comment:** As pointed out in our comments on GSP Chapters 4 and 5, the Fort Ord Site Conceptual Model (i.e., continuous intermediate aquitard within 180-Foot Aquifer and lack of a 180/400-Foot Aquitard) does not apply in northern Monterey Subbasin. Furthermore, available field data indicate that the Dune Sand Aquifer and upper portion of the 180-Foot Aquifer are seawater intruded (chloride greater than 500 mg/L) for a significant distance inland from the coast in the northern Monterey Subbasin and Southern 180/400-Foot Aquifer Subbasin. We also note that EKI's (and others) definition of fresh water in many previous documents related to the MPWSP has been TDS up to 3,000 mg/L; however, HWG have shown such levels of TDS also have greater than 1,000 mg/L chloride in the area, which is far in excess of the 500 mg/L standard applied by MCWRA for seawater intrusion. The Monterey Subbasin GSP uses AEM data outside of Monterey Subbasin (i.e., in southern 180/400-Foot Subbasin) to claim the presence of this so-called fresh water, yet actual field data show seawater intrusion has occurred at the coast and for	See responses to HWG Chapter 4 comments 5 and 7, and HWG Chapter 5 Comments 3 and 19.

HWG Comments	Responses
a significant distance inland in this area (see HWG, 2017).	
2. In Comment 44 (dated 1/7/21) Derrik Williams responds to the commenter (Bob Jaques) that, "We have discussed the AEM data with some members of the blue ribbon panel…the didn't have too many concerns.' **HWG Comment:** If the commenter is referring to the Hydrogeologic Working Group, this statement by Derrik Williams is incorrect. The HWG has many concerns about the hydrogeologic interpretation of the AEM data and has documented our concerns in numerous documents (e.g., HWG, 2017; HWG, 2018; HWG, January 2019; HWG, March 2019; HWG, April 2019; HWG, June 2020).	See response to HWG Chapter 4 comment 9.

11/1//2021 – Comments on Monterey Subbasin Public Draft GSP Chapter 6

"This letter is submitted on behalf of California American Water and provides comments on Chapter 6 (Water Budget) for the Public Draft Monterey Subbasin GSP Chapter 6 released on September 3, 2021. It also includes a brief review of how previous comments by the Hydrogeologic Working Group (HWG) on Monterey Subbasin GSP Chapters 4 (HCM) and 5 (Groundwater Conditions), which are attached to this comment letter, were not addressed in the recently released Public Review Draft versions of these chapters. Detailed comments are provided along with a summary of the main comments."

SUMMARY OF COMMENTS

The Monterey Subbasin GSP emphasizes in several places that subbasin sustainability is dependent on adjacent subbasins becoming sustainable. While there is some interdependence between subbasins that may impact the sustainability of adjacent subbasins, the GSAs in the Monterey Subbasin should focus on their role in making the Subbasin sustainable. This is best achieved by comparing groundwater recharge (just the vertical components of flow from the soil moisture balance, not including subsurface inflows form adjacent subbasins) in the Marina-Ord Area to groundwater pumping in the Marina-Ord Area. In addition, there needs to be excess groundwater recharge over and above total pumping for significant outflow to the ocean to prevent seawater intrusion.

A summary of several other major Chapter 6 comments includes:

- Groundwater model documentation is key to understanding the water balance, but is not included in available Public Draft GSP documents made available for review;
- Soil moisture budget accounting model documentation is key to understanding the water balance, but is not included in available Public Draft GSP documents made available for review;
- The surface water system water budget required under SGMA is not provided;
- There is a major inconsistency in estimated net subsurface inflow between the Monterey Subbasin and the 180/400 Foot Aquifer Subbasin presented in the GSPs for the two subbasins (i.e., 12,500 AFY vs. 3,000 AFY);
- The extent of seawater intrusion within the Monterey Subbasin has expanded over the historical period covered by the GSP, which is in contrast to statements/assumptions in the GSP;
- Some of the boundary conditions used in the groundwater model for future project scenarios are not realistic and are inconsistent with the 180/400 Foot Aquifer Subbasin GSP;
- The GSP Marina-Ord Area water balance indicates that increases in groundwater pumping for the future project scenario are not realistic and are not sustainable, because they exceed Marina-Ord Area groundwater recharge and do not allow for outflow to combat seawater intrusion;
- Future project scenarios should be more conservative and should not assume groundwater recharge will increase in the future by 10 to 20% due to climate change;
- Groundwater model results indicate that MTs and MOs will likely not be achieved in the Monterey Subbasin if realistic boundary conditions are applied; and
- The sustainable yield estimate of 4,400 to 9,900 AFY for the Marina-Ord Area is significantly overestimated, and will likely have detrimental impacts on adjacent subbasins (i.e., the Seaside Basin and the 180/400 Foot Aquifer Subbasin)."

<u>Please see responses below for details.</u>

LSCE Comments	Responses
Section 6.1 (Water Budget Method)	
1. The GSP states that the water budget information is based on use of a groundwater flow model developed for the subbasin (p. 6-8). **Comment:** The model documentation (Appendix 6B) was not provided for review; thus, it is not possible to provide complete comments on the water balance without being able to review documentation for the model used to produce the water balance. Without the supporting documentation, stakeholders and the public are not able to adequately comment on the relevant issues.	Appendix 6B, which contains the model documentation, has been made available. It was uploaded to MCWD's website on 11/10/2021.
2. The GSP states that a soil moisture budget (SMB) accounting model is used to estimate groundwater recharge (p. 6-10). **Comment:** While Appendix 6-A provides some tables with output data from the SMB, no model documentation is provided. Thus, it is not possible to provide complete comments on the water balance without being able to review documentation for the SMB model used to provide key input to the groundwater model and water balance. Without the supporting documentation, stakeholders and the public are not able to adequately comment on the relevant issues.	Appendix 6B, which contains the model documentation, has been made available. It was uploaded to MCWD's website on 11/10/2021.

3. The GSP states, "As discussed in Appendix 6B, the MBGWFM has been calibrated against 30,354 historical water level measurements to achieve normalized calibration error statistics of less than 2% and thus adequately represents the historical conditions of the Basin. Therefore, it is appropriate to use the MBGWFM to estimate water budgets for the Monterey Subbasin." (p. 6- 10). **Comment:** Appendix 6B was not provided for review. While good calibration to water levels is important, it does not in and of itself validate use of the model for producing a valid water balance. Other key considerations include the fact that simulated water levels and subsurface inflows/outflows can be highly variable depending on boundary conditions. Thus, various combinations of recharge, discharge, aquifer parameters, and boundary conditions can produce similarly good model calibrations to water levels (i.e., models are non-unique). For example, a groundwater model with less vertical recharge could produce a good calibration to groundwater levels with a different set of aquifer parameters and/or boundary conditions. Therefore, additional justification is needed for use of the model for water balance output, such as comparison to adjacent subbasin water balances and the amount of vertical recharge (e.g., precipitation recharge, excess irrigation recharge) per acre. For example, the 180/400-Foot Aquifer Subbasin historical water budget has vertical recharge amounting to 0.22 ft/acre compared to the Monterey Subbasin historical water budget with vertical recharge of 0.33 ft/acre, or 50% greater vertical recharge than the immediately adjacent 180/400-Foot Aquifer Subbasin.	Appendix 6B, which contains the model documentation, has been made available. It was uploaded to MCWD's website on 11/10/2021. There is inherent uncertainty in any basin water balance, especially in basins where multiple aquifers exist and where significant cross-boundary flows are known to occur between adjacent, hydraulically connected subbasins. Similarly, nearly all numerical groundwater flow models are considered to be "non-unique", as they are based on imperfect information regarding aquifer parameters and their spatial distribution, time-varying boundary conditions, and spatiotemporal stresses such as recharge and pumping. Uncertainties and limitations of the MBGWFM are described in detail in Section 6.7 and Appendix 6B. With this in mind, significant effort was expended to ensure that aquifer parameters (e.g., hydraulic conductivities and storage coefficients) were calibrated to measured values and that estimated recharge rates were consistent with other models developed for the Monterey Subbasin and surrounding areas. Section 4 of the model documentation (Appendix 6B) details the methodologies and datasets used to inform model calibration. It is unreasonable to directly compare recharge estimates from the MBGWFM to estimates provided in the 180/400-Foot Aquifer GSP because: (1) land use conditions are substantially different between the two subbasins (e.g., the Monterey Subbasin is predominantly undeveloped and low-density residential land except for in the City of Marina, whereas the 180/400-Foot Aquifer Subbasin has a large agricultural and urban footprint); (2) precipitation rates differ substantially between the two subbasins; and (3) the recharge estimates were developed using entirely different methodologies and, notably, water budgets presented in the 180/400-Foot Aquifer GSP were not informed by a numerical model (see reply to comment 6 below). As part of MBGWFM calibration, recharge rates output from the soil moisture balance model (SMB) were compared to analogous estimates produced for the Monterey Subbasin by the Farm Package of the Salinas Valley Integrated Hydrologic Model (SVIHM), which is being used to develop

LSCE Comments	Responses
	updated water budget estimates for the 180/400-Foot Aquifer Subbasin GSP. Comparison between the SMB and SVIHM indicates that average Basin-wide recharge rates calculated from the SMB are +12% higher than those calculated from the SVIHM over like timeframes. However, when looking at normalized recharge rates, it appears that the SMB and SVIHM track very closely in most areas of the Basin. For example, the SMB calculated ~25.3% of total precipitation and applied water as contributing to recharge in the Corral de Tierra Management Area, compared to ~25.6% calculated from the SVIHM. The most significant difference between the two models is within urban areas, where the SMB calculates ~11.6% recharge of precipitation and applied water compared to ~5.8% calculated from SVIHM. This discrepancy may in part be explained by the fact that SVIHM does not account for deliveries from municipal water suppliers or leakage from water conveyance systems within urban areas of the basin in its recharge calculations. Therefore, it appears the discrepancy in Basin-level recharge between the two models can be primarily explained by differences in input datasets and assumptions between the two models rather than fundamental differences in recharge calculation methodologies. See Appendix 6B for a more detailed description of the SMB and comparison of estimated recharge rates to other existing models.
4. The GSP states, "To quantify all required water budget components as specified in the GSP Emergency Regulations (CCR § 354.18(b)), this GSP presents results from both the SMB for the land surface system and the MBGWFM for the groundwater system." (p. 6-11). **Comment:** The GSP Emergency Regulations (CCR § 354.18(b.1)) require, "Total surface water entering and leaving a basin by water source type." A surface water budget is not provided in Chapter 6; this would include total streamflow and any imported water entering and leaving the Monterey Subbasin.	Comment noted. An updated version of Chapter 6 will be provided that includes a tabular summary of total surface water entering and leaving a basin by water source type over the historical and current water budget period.
Section 6.2 (Water Budget Components)	
5. The GSP states that inter-basin cross-boundary flows (e.g., between the Monterey Subbasin and the 180/400 Aquifer Subbasin) are based on model general head boundary conditions (p. 6-15). **Comment:** The details of the general head conditions used (i.e., heads, conductance) are not provided and cannot be reviewed. Presumably such details would be provided in the Model Documentation in Appendix 6B if it were made available for public review.	Appendix 6B, which contains the model documentation, has been made available. It was uploaded to MCWD's website on 11/10/2021.
Section 6.4 (Historical and Current Water Budget)	

LSCE Comments	Responses
6. GSP Table 6-1 provides historical and current groundwater water budget results (p. 6-20). **Comment:** The historical and current Monterey Subbasin water budgets show net subsurface outflows of 12,265 to 12,565 AFY to the 180/400-Foot Aquifer Subbasin. Review of the DWR-approved GSP for the 180/400-Foot Aquifer Subbasin shows historical and current water balance net subsurface inflows from the Monterey Subbasin of 3,000 AFY. Thus, there is a large discrepancy between the two GSPs regarding subsurface cross-boundary flows. If the Monterey Subbasin GSP cross- boundary flows are correct, the difference between inflows and outflows for the historical groundwater budget for the 180/400-Foot Aquifer Subbasin GSP changes from -12,900 AFY to -3,635 AFY, which has significant implications for the 180/400-Foot Aquifer Subbasin GSP. In general, this uncertainty in cross-boundary flows also points out that subbasin sustainability should be based (primarily) on balancing the vertical components of recharge and discharge. This eliminates the uncertainty regarding cross-boundary flows (and associated dependency) in evaluating projects/management actions needed to achieve sustainability.	As discussed in the Monterey GSP, a lot of care was taken to assess cross boundary flows and accurately represent conditions in adjacent subbasins. Estimated cross boundary flows between the Monterey Subbasin and the 180/400-Foot Aquifer Subbasin are significantly higher than those presented in the 180/400-Foot Aquifer GSP. This discrepancy is well founded. Due to time constraints, historical and current water budgets presented in the 180/400-Foot Aquifer GSP were developed based on data and analyses aggregated from previous reports and other available sources. No numerical modeling effort was completed to develop the historical or current water budget. The limitations of the historical water budget analyses included in the 180/400-Foot Aquifer GSP are well acknowledged within the GSP, and additional analyses are being conducted as part of the 5-year review process. In fact, as noted in the 180/400-Foot Aquifer GSP, the estimated inflow from the Monterey Subbasin of 3,000 AFY/year was taken from a Montgomery Watson document produced in 1997. This document generally looks at data that pre-dates the Historical Period evaluated in the Monterey GSP (i.e., water years 1999 through 2018). It is based on a very limited dataset and does not reflect conditions within these subbasins over the last 15 years. The MCWD GSA and SVBGSA collaborated on development of the MBGWFM including boundary conditions along the boundary of the 180/400-Foot Aquifer Subbasin and beneath the Salinas River. Additional information and documentation of collaborate efforts between the agencies as part of MBGWFM development has been added to the water budget section and as Appendix 6C.

LSCE Comments	Responses
7. A footnote to Table 6-1 states, "All seawater inflows from the ocean are presumed to leave the Monterey Subbasin across the 180/400 Foot Aquifer Subbasin boundary, as evidenced by no observed expansion of the seawater intrusion front in the Monterey Subbasin over the historical time period." (p. 6-20). This issue is also discussed in the first bullet at the top of page 6-23, and first bullet at the top of page 6-24. **Comment:** Review of seawater intrusion maps prepared by MCWRA indicates this statement/conclusion is not correct – the seawater intrusion front in Monterey Subbasin has expanded over the historical time period.	As discussed in Chapter 5, no evidence of expansion of the seawater intrusion front has been observed in the Monterey Subbasin during the historical period (2004 to 2018). MCWRA maps are developed on the basis of chloride data which is collected intermittently from a limited number of wells (see Figure 5-27 for locations of wells with post-2015 chloride data). As part of the Monterey GSP effort, specific conductance and TDS data collected from Fort Ord Wells was analyzed and utilized to evaluate the seawater intrusion front. As presented in Appendix 5A, a very high correlation exists between TDS, chloride and specific conductance in groundwater within this subbasin.
8. GSP Figure 6-4 (p. 6-21) indicates subsurface flow occurs from the Corral de Tierra Area to the Marina Ord Area. **Comment:** Review of topography and studies by others (e.g., Geosyntec, 2007) indicates essentially no flow between the two Areas, but rather subsurface flow from the Corral de Tierra Area strictly to the 180-400 Foot Aquifer Subbasin. The water balance for Marina-Ord Area assumes such subsurface inflow amounts to 1,544 AFY, but this is likely not the case.	As indicated by the Geosyntec study, significant groundwater flow from the Corral de Tierra Area to the 180/400 Foot Aquifer Subbasin exists. The Monterey Subbasin Groundwater Flow Model estimates that, on average, approximately 3,632 AFY of groundwater flows from the Corral De Tierra Area WBZ to the 180/400 Foot Aquifer Subbasin over the historical period. Groundwater gradient map developed as part of the GSP show that some groundwater flows between the Coral De Tierra Area and the Marina-Ord Area, which is estimated at 1,544 AFY over the historical period. However, as discussed in the GSP, there are few wells along the boundaries between the Corral De Tierra Area and the 180/400 Foot Aquifer Subbasin and the Marina Ord Area. The absence of such data has been identified as a data gap. Additional wells are planned in these areas to further assess these cross-boundary flows.
9. The GSP states that outflows to the ocean occur from the Dune Sand Aquifer (p. 6-22). **Comment:** The HCM and groundwater elevation contour maps indicate that the Dune Sand Aquifer and 180- Foot Aquifer merge inland of the coast where the FO-SVA aquitard pinches out and the combined groundwater flow moves inland. The GSP presents no evidence of outflow to the ocean.	As shown on Figures 5-1 and 5-2, water levels in the Dune Sand Aquifer are above mean sea level. Although much of the water from the Dune Sand aquifer returns to the subbasin via the Upper 180-Foot aquifer as illustrated in Figure 4-19, it is anticipated that some discharge to the ocean occurs. However, the freshwater/ocean water interface is highly complex in this heterogenous environment and dual density modeling has not been conducted. The modeling that has been conducted focuses on larger basin water budget issues that are the focus of the GSP. Although relevant to the California American Water Monterey Peninsula Water Supply Project, the intricacies of this freshwater/seawater interface are not explored as part of this GSP.

LSCE Comments	Responses
10. The GSP notes that estimated net annual inflows/outflows between the Monterey Subbasin and the Seaside Subbasin are consistent with the estimates from the Seaside Basin Groundwater Flow Model. However, this same statement of consistency is not made by the GSP for estimated net annual inflows/outflows between the Monterey Subbasin and the 180/400 Foot Aquifer Subbasin. **Comment:** As noted above, there is a major discrepancy between the 3,000 AFY of net inflow to the 180/400 Foot Aquifer Subbasin from the Monterey Subbasin estimated in the 180/400 Foot Aquifer Subbasin GSP versus the 12,365 AFY of net inflow to the 180/400 Foot Aquifer Subbasin estimated in the Monterey Subbasin GSP.	See Response to Comment 6.
11. The GSP notes that the Dune Sand Aquifer has seaward gradients that result in 534 AFY of net outflow to the ocean (p. 6-23). **Comment:** The groundwater elevation contour maps presented in Chapter 5 do not include data points near the coast and provide no evidence of outflow to the ocean. In fact, other data indicate there is no outflow to the ocean from the Dune Sand Aquifer as described above.	See response to comment 9.
12. The GSP states that groundwater elevations in the 180/400 Foot Aquifer Subbasin are 40 feet below mean sea level (MSL) in the 180 and 400-Foot Aquifers and 100 feet below MSL in the Deep Aquifer (p. 6-24). **Comment:** It should also be noted here that groundwater elevations in the Monterey Subbasin are 20 to 30 feet below MSL in the 180 and 400-Foot Aquifers and 50 to 70 feet below MSL in the Deep Aquifer.	This information is presented on the figures of the GSP. The purpose of this statement is to note that water levels in the 180/400 Foot aquifer subbasin are lower than those in the Monterey Subbasin, which is consistent with the HCM and cross-boundary flow estimates presented in the GSP.

LSCE Comments	Responses
13. Figure 6-5 (p. 6-27) shows an area of seawater intrusion in Monterey Subbasin with arrows showing groundwater flow directions in this area. The text describes these arrows as, "…the general direction of presumed freshwater and seawater cross-boundary flows…" (p. 6-28). The GSP also states, "…it is difficult to predict if seawater inflows from the ocean will continue to pass through the Monterey Subbasin into the 180/400 Foot Aquifer subbasin as they did during the historical period." (p. 6-42). **Comment:** The area of seawater intrusion does not match the sea water intrusion maps prepared by MCWRA and does not distinguish seawater intrusion in the 180-Foot Aquifer vs. 400-Foot Aquifer as done by MCWRA. In addition, the groundwater flow direction arrows within the zone of seawater intrusion are incorrect and do not correlate with the groundwater elevation contours included on the map, which indicate a portion of the groundwater within the seawater intrusion zone flowing towards the middle inland portion of Monterey Subbasin. It is not clear why the groundwater flow directions shown are based on "presumed" directions rather than the flow arrows that would be derived based on actual groundwater elevation contour lines shown on the figure.	See response to comment 7.
14. The GSP states, "…pumping in the Corral de Tierra Area is estimated using the known data, and may be missing a significant amount of pumping." (p. 6-33). **Comment:** If a significant amount of pumping is not accounted for in the Corral de Tierra Area, then subsurface outflow is significantly overestimated.	This comment is correct. As stated in the GSP, the magnitude of pumping in the Coral De Tierra has been identified as a data gap and additional information will be obtained as part of ongoing GSP efforts. Such information will be incorporated into future model updates and cross-boundary flows will be reevaluated.
Section 6.5 (Projected Water Budget)	
15. Projected water demands for the MCWD service area are estimated to increase from 3,367 to 8,314 AFY, and it is assumed that increased pumping would be divided evenly between the 180 and 400 Foot Aquifers and the Deep Aquifer based on historical MCWD operations (pp. 6-37 and 6-38). **Comment:** Given the evolution of MCWD pumping distribution between the Deep Aquifer and shallower aquifers to the point where Deep Aquifer pumping has apparently increased to become more than two-thirds of total MCWD pumping in recent years, it is apparent that the 180 and 400 Foot Aquifers cannot accommodate the proposed future pumping increases stated in the GSP. The future model scenario should assign all future increases in pumping to the Deep Aquifer. This pumping distribution will likely have a major effect on future scenario model results.	Where additional pumping will occur is unknown. Simplifying assumptions have been made in the GSP. GSP updates will evaluate the impacts of additional pumping as it is proposed.

LSCE Comments	Responses
16. The GSP states that model boundary conditions used in future scenarios include: minimum thresholds (MT), measurable objectives (MO), and seawater intrusion protective boundary conditions (p. 6-38). **Comment:** The seawater intrusion protective boundary conditions are not defined in terms of what they are or how they were derived, or how likely they are to occur. Since they are not provided in GSPs for adjacent subbasins as likely to occur, they do not seem appropriate to use.	As described in Chapter 6 of the GSP, seawater intrusion protective boundary conditions represent minimum groundwater levels that would be required to stop seawater intrusion within the 180/400 Foot Aquifer subbasin, in the absence of an extraction or injection barrier. The seawater intrusion protective heads have been calculated on the basis of the Ghyben-Herzberg Relation described in Section 5.3.2 of the GSP. The actual value for each aquifer and climate scenario varies based upon the average depth of the aquifer and the estimated value of mean sea level under the assumed future climate scenario. The detailed description of freshwater equivalent heads was included in Appendix 6B. Given that groundwater extraction or injection barriers will require hundreds of millions of dollars to construct, it is very conceivable that they will not be completed and pumping reductions and in lieu recharge will used to reach sustainability. Such projects and management actions are also identified in the 180/400 Foot Aquifer Subbasin GSP Measurable Thresholds for seawater intrusion established in the 180/400 Foot Aquifer Subbasin GSP, do not allow expansion of the seawater intrusion front. As such, in the absence of injection/extraction barriers groundwater levels will need to be raised to seawater protective levels to stop further seawater intrusion and meet Measurable Thresholds for seawater intrusion in the 180/400 Foot Aquifer Subbasins. Such groundwater levels would be achieved through pumping reductions and/or in lieu recharge which are included as potential projects and management actions in the 180/400 Foot Aquifer GSP. As such, this scenario provides insights regarding the impacts of such potential future boundary groundwater conditions on the Monterey Subbasin.

LSCE Comments	Responses
17. The GSP states that for the MT Boundary Conditions in the projected model scenario run, "Groundwater levels in RMS wells located near the Monterey Subbasin are raised from 2018 model predicted values to water level MTs established in the 180/400 Foot Aquifer GSP…" (p. 6-38). **Comment:** Review of water level data from MCWRA indicates that 2015 to 2016 water levels were generally lower than 2018 water levels. The 180/400-Foot Aquifer Subbasin GSP set MTs one foot above 2015 water level elevations. Thus, it is not clear why model-predicted 2018 water levels in boundary condition areas would need to be raised to be at MT levels established in the 180/400-Foot Aquifer Subbasin unless model-predicted groundwater elevations for 2018 were substantially lower than observed values. If model-predicted values are substantially lower than observed values in boundary condition areas, the model would likely significantly overestimate groundwater outflow from the Monterey Subbasin to the 180/400-Foot Aquifer Subbasin.	Comment noted. In all cases, water levels at general head boundary cells along the northern MBGWFM boundary were <u>adjusted</u> from Fall 2018 levels to MT levels defined at 180/400-Foot Aquifer RMS wells. For certain wells, this may result in an increase in water levels relative to Fall 2018 conditions, while in other wells this may result in a decrease in water levels relative to Fall 2018 conditions. This sentence has been reworded to clarify that water levels "are <u>adjusted</u> from 2018 model predicted values to water level MTs established in the 180/400-Foot Aquifer GSP."
18. The GSP states that seawater intrusion protective elevations are, "…consistent with the MTs for seawater intrusion established in the 180/400 Foot Aquifer GSP." (p. 6-39). **Comment:** Based on this statement, it is not clear how seawater intrusion protective elevations differ from MT elevations. Several figures in the GSP suggest seawater intrusion protective elevations are much higher than MT elevations.	See response to comment 16.
19. The GSP Project Scenario calls for increased use of recycled water from 600 AFY in 2023 to 5,495 AFY in 2040, with total demand in 2040 and beyond of 10,955 AFY. **Comment:** This Project scenario assumes that recycled water can provide 50% of total water demand for MCWD, which is likely unrealistic. In addition, other documents (MCWD Urban Water Master Plan, MCWD Water Supply Master Plan) indicate future recycled water use would be limited to no more than 1,500 AFY.	This project consists of using purified recycled water for indirect potable reuse (IPR). As discussed on page 9-54 under "IPR in Monterey Subbasin", IPR includes injecting non-potable water into a groundwater aquifer for later recovery. This generates potable water that can meet a larger portion of MCWD's demand beyond irrigation needs.
20. The GSP states, "…the projected water budget results indicate that the climate scenarios have a much smaller impact on changes in storage and groundwater levels within the subbasin than the identified boundary conditions." (p. 6-43). **Comment:** While this statement may be true relative to horizontal groundwater flows, it is not true with regard to vertical groundwater recharge that increases substantially (about 10 to 20%) under future climate change scenarios. Additional projected model runs should be made using historical groundwater recharge amounts due to the significant uncertainty in future groundwater recharge increases.	Results for model runs for 2030 and 2070 climate scenarios are included in the GSP. See Chapter 6 and Appendix 6B.

LSCE Comments	Responses
21. GSP Table 6-5 (Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Boundary Conditions and 2030 Climate Condition, Marina-Ord Area WBZ) shows 8,767 AFY of groundwater pumping versus 6,823 AFY of total groundwater recharge (p. 6-45). **Comment:** Under these scenarios groundwater pumping exceeds groundwater recharge by approximately 2,000 AFY and is not sustainable.	As discussed in the GSP under the future No Project Scenario, groundwater pumping does exceed groundwater recharge and the GSP concludes that MTs will likely not be met under this scenario. Potential projects have been identified to meet MTs and MOs within the groundwater subbasin under increased demands. The authors premise that groundwater recharge is equivalent to the sustainable yield of a groundwater subbasin is a reasonable argument, but is not articulated under SGMA.
22. The GSP states, "…ocean inflows into the basin also decrease as water levels at this boundary increase from MTs, to MOs, and to SWI protective elevations…However, there is little reduction in net ocean inflows between the historical water budget and the projected baseline water budgets under MT boundary conditions or MO boundary conditions." (p. 6-48). **Comment:** This statement would seem to indicate that ocean inflows are driven by Monterey Subbasin groundwater elevations.	This comment seems to ignore the fact that water levels in the Monterey Subbasin are impacted by water levels in the adjacent 180/400-Foot Aquifer subbasin, and vice-a-versa. While net ocean inflows are similar between the historical and projected baseline scenario water budgets, the projected baseline scenario water budget also assumes an average pumping rate of 8,767 AFY in the Marina-Ord area, compared to 4,346 AFY in the historical model. This indicates that, if the 180/400-Foot Aquifer Subbasin were able to maintain MT or MO water level conditions, MCWD could pump at least twice as much from its subbasin without causing further increases in ocean inflows as this additional pumping would instead be offset by decreased outflows to the 180/400-Foot Aquifer Subbasin.
23. The GSP states, "…projected water budgets also indicate that substantial groundwater outflows from Monterey Subbasin continue to occur into the 180/400-Foot Aquifer Subbasin under MT and MO boundary condition scenarios." **Comment:** It should be determined how much of this groundwater outflow across Subbasin boundaries is due to sea level rise.	The MBGWFM currently does not include a dual-density groundwater flow component to explicitly simulate seawater intrusion in the Basin (see Appendix 6B), thus making a detailed analysis of projected seawater intrusion rates and spatial migration patterns impractical. However, as described in Section 9.8.6, MCWD and SVBGSA plan to coordinate to convert the MBGWFM into a seawater intrusion model within the first 5-years of SGMA implementation. A more detailed analysis of seawater intrusion rates and spatial trends, including an analysis of sea level rise impacts on cross-boundary flows, will be completed upon development of this model.
24. With respect to the Marina-Ord Area, the GSP states, "…these projected water budget results indicate that this management area will not be in overdraft if adjacent basins are managed sustainably and SMCs are achieved." (p. 6-50). **Comment:** Given that pumping exceeds recharge by 2,000 AFY in in the Marina-Ord Area per Table 6-5, it is not clear how this Area can be considered to not be in overdraft under projected future conditions.	See response to comments 21 and 19.

LSCE Comments	Responses
25. The GSP states, "…it is difficult to predict if…changes in boundary conditions and increased extraction in the subbasin could cause saline groundwater from the 180/400 Foot Aquifer subbasin or ocean to flow further inland within the Monterey subbasin. It is noted that MCWD has significant operational flexibility regarding rates of extraction from its wells and could potentially modify the location and depth at which groundwater is extracted to limit such impacts." (p. 6-50 to 6-51). **Comment:** The groundwater model should be able to provide some indication of the potential for saline water from the ocean to flow further inland within the Monterey Subbasin. As discussed in other comments, MCWD does not appear to have operational flexibility on depth of extraction and additional pumping is likely to occur from the Deep Aquifer.	See response to Comment 16.
26. In reference to Figure 6-8, the GSP states, "This figure indicates that variable climate conditions have limited impacts on projected water levels in RMS wells relative to boundary condition scenarios." (p. 6-51). **Comment:** This figure and the associated statement here are misleading with regard to the impacts of variable climate conditions assumed in the future scenario. The future climate change assumptions result in an increase in groundwater recharge ranging from 10 to 20%, which is highly uncertain. A better approach would be to assume groundwater recharge in the future will be similar to historical groundwater recharge. The assumption of increased future groundwater recharge may exacerbate overdraft that is already predicted to occur even with the assumed increased in groundwater recharge (see Table 6-5 where groundwater pumping exceeds future groundwater recharge by approximately 2,000 AFY).	Per GSP regulations 23-CCR §354.18(e), *"Each Plan shall rely on the best available information and best available science to quantify the water budget for the basin in order to provide an understanding of historical and projected hydrology, water demand, water supply, land use, population, <u>climate change</u>, sea level rise, groundwater and surface water interaction, and subsurface groundwater flow"*. As further described in Appendix 6B, EKI utilized the methodology and datasets provided in DWR's *Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development* (DWR, 2018) to estimate climate change impacts to ET and precipitation, which directly informed corresponding estimates of projected recharge rates under the 2030 and 2070 climate change scenarios. This comment's suggestion to use historical recharge rates for projected water budgets does not constitute best available information and science and does not meet the requirements of a GSP outlined by 23-CCR §354.18.

LSCE Comments	Responses
27. The GSP states, "…these results suggest that projects and/or management actions may be required to consistently maintain water levels above MTs and to achieve MOs within the Marina-Ord Area unless SWI protective boundary conditions are achieved in the adjacent subbasins." (p. 6-51). **Comment:** The 180/400 Foot Aquifer Subbasin GSP is approved by DWR with the MO/MT included in the GSP. It is not reasonable to evaluate/assume boundary conditions could be at the apparently much higher "SWI protective boundary conditions". Thus, it should be assumed that projects/management actions will be required in Monterey Subbasin to maintain water levels above MTs and achieve MOs within the Marina-Ord Area.	See response to comment 16.
28. GSP Figure 6-8 indicates that Monterey Subbasin does not meet its MT when using MT boundary conditions for adjacent basins and does not meet its MO when using MO boundary conditions for adjacent basins in future project model runs for "No Project" conditions (p. 6-52). **Comment:** These results demonstrate that projects/management actions will be necessary to meet MT and MO in Monterey Subbasin. The GSP Project with water supply augmentation by recycled water of 5,500 AFY far exceeds any other current projections of available recycled water (less than 1,500 AFY in MCWD UWMP).	See response to Comments 16 and 19.
Section 6.6 (Historical, Current, and Projected Overdraft and Sustainable Yield)	
29. The GSP presents three methods of calculating sustainable yield of the Marina-Ord Area (p. 6-59 to 6-60). **Comment:** Two of the three methods are based on comparing historical and current overdraft to groundwater pumping during these time frames, with resulting sustainable yield ranging from 2,714 to 3,294 AFY, or an average of approximately 3,000 AFY. This estimate is likely reasonable given that historical and current pumping amounts ranging from 3,503 to 4,346 AFY have resulted in groundwater basin overdraft and seawater intrusion. The third method of calculating sustainable yield in the GSP erroneously concludes that the projected water budget results support an estimated sustainable yield of 9,870 AFY, which is three times the amount of groundwater pumping that has already resulted in overdraft and seawater intrusion. Furthermore, this sustainable yield estimate is on the order of 50% greater than total groundwater recharge. While the GSP claims a sustainable yield of up to 9,900 AFY, it is clear from historical and current data that the sustainable yield of the Marina-Ord Area is likely no greater than about 3,000 AFY.	It should be noted that on average -9,307 AFY of groundwater flowed inland from the Monterey subbasin into the 180/400 Foot Aquifer Subbasin in Water Year 2015-2018 where groundwater levels are well below sea level and lower than the Monterey Subbasin. The projected water budget analysis is also based on data inputs that best reflects future conditions, including climate change and boundary conditions assuming adjacent subbasin would achieve sustainability under SGMA.

LSCE Comments	Responses
30. The GSP states that under the "no project" scenario RMS well groundwater levels "…are generally higher than MTs during non-drought periods under all identified boundary conditions and climate scenarios…" and that RMS well groundwater levels "…reach MOs if SWI protective boundary conditions are achieved in adjacent subbasins." (p. 6-60). **Comment:** Review of Figure 6-7 indicates that groundwater levels are below the MTs more than 50% of the time after 2040 under MT boundary conditions, which is contrary to statements in the GSP. In addition, the DWR-approved 180/400 Foot Aquifer Subbasin GSP does not propose to achieve SWI protective groundwater levels; therefore, Monterey Subbasin RMS wells will not achieve proposed MOs.	See response to Comment 16.
31. The GSP states that the future projected sustainable yield ranges between 4,400 and 9,900 AFY if adjacent subbasins are managed sustainably and the 180/400 Foot Aquifer Subbasin reaches its SMCs (p. 6-60). **Comment:** While there is some interdependence between subbasins that may impact the sustainability of adjacent subbasins, each subbasin in the Salinas Valley needs to be managed sustainably on its own to make the entire Salinas Valley sustainable. The 180/400 Foot Aquifer Subbasin GSP has been approved by DWR as doing its part to achieve sustainability. Seaside Basin has been adjudicated and is doing its part to be sustainable. Monterey Subbasin cannot rely on inflows from other subbasins (e.g., from Seaside Basin) nor simply blame other subbasins (e.g., the 180/400 Foot Aquifer Subbasin) for its own inability to reach sustainability. The Monterey Subbasin should do its part to become sustainable by balancing its vertical inflows and outflows (i.e., do not include adjacent subbasin inflows and outflows), including a sufficient allowance for outflows to the ocean to avoid seawater intrusion. Alternatively, Monterey Subbasin GSAs may choose to work with the adjacent 180/400 Foot Aquifer Subbasin to develop other means of achieving sustainability such as by implementing a coordinated groundwater extraction barrier to address seawater intrusion.	Estimated groundwater recharge in the Monterey Subbasin is approximately 10,055 AFY, which far exceeds historical estimated rates of groundwater extraction (i.e., 5,274 AFY), yet the subbasin is in overdraft. If all subbasins were held to the criteria proposed by the author (i.e. simply by balancing its vertical inflows and outflows), the Monterey Subbasin would not be in overdraft and would not require that an extraction barrier be built.
32. The GSP states with regard to the projected sustainable yield range for the Marina-Ord Area of 4,400 to 9,900 AFY, that that ability to conduct this amount of pumping without inducing seawater intrusion needs to be verified (p. 6-60). **Comment:** It is not clear why pumping amounts in excess of historical pumping amounts that induced seawater intrusion would be proposed in a GSP without first verifying that they would not be expected to induce seawater intrusion. The groundwater model developed for the GSP should be applied to address this issue.	Seawater intrusion is the result of the combined effects of groundwater pumping within the greater Salinas Valley Groundwater Basin. As articulated in the GSP, a coordinated approach is required to reach sustainability in the Monterey Subbasin and other subbasins in the greater Salinas Valley Groundwater Basin.

LSCE Comments	Responses
Other General Comments	
33. The HWG previously reviewed Draft GSP Chapters 4 and 5 for the Monterey Subbasin, and provided comments dated April 5, 2021 (attached to this letter). While the HWG comments were acknowledged as being received by the GSA, the Public Draft versions of Chapters 4 and 5 include no significant changes to the text or figures related to the HWG comments. Furthermore, unlike responses provided to other comments submitted on the draft GSP chapters, there have been no responses to the HWG comments. Given that GSP development is a public process that is required include substantial public and stakeholder participation, and given that GSPs must be based on the best available science, the GSP should be revised to address the HWG's comments and the comments set forth herein. If the GSAs disagree with any of the subject comments, the GSAs should at the very least provide responses to the comments as they did for other comments.	Responses to these comments will be provided in the final draft of the GSP scheduled to be published on December 13, 2021.
33. Chapter 6 of the GSP makes several references to details of the groundwater model being described in Appendix 6B; however, Appendix 6B had not been provided for review as of October 29, 2021, and comments were due on November 1, 2021. Given that the entire Chapter 6 is essentially based on the groundwater model developed for the GSP, the GSAs' failure to provide this model documentation precludes stakeholders and the public from being able to adequately review and comment on a foundational element of the entire GSP. The GSP cannot undergo adequate review until a sufficient review period is provided for Appendix 6B Model Documentation, and additional time should be provided to comment on Appendix 6B once it is provided to the public.	Appendix 6B, which contains the model documentation, has been made available. It was uploaded to MCWD's website on 11/10/2021.

11/19/2021 – Comments on Monterey Subbasin Public Draft GSP Appendix 6B (Monterey Subbasin Groundwater Flow Model Documentation)

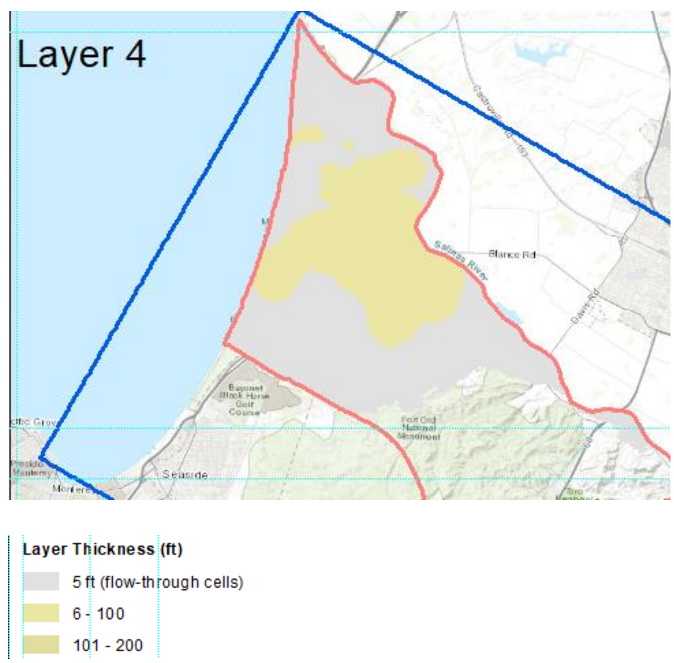
"This letter is submitted on behalf of California American Water and provides comments on Appendix 6B (Monterey Subbasin Groundwater Flow Model Documentation) for the Public Draft Monterey Subbasin GSP updated appendices released on November 10, 2021. Detailed comments are provided along with a summary of the main comments. Overall, given the number of significant deficiencies identified in these comments, the Monterey Subbasin groundwater model as currently configured does not provide reliable model results for use in GSP implementation."

SUMMARY OF COMMENTS

Although limited by the available time frame for review of Monterey Subbasin GSP Appendix 6B, many detailed comments are provided above. A few of the major takeaways from this review include the following:

- The HWG previously reviewed Draft GSP Chapters 4 and 5 for the Monterey Subbasin GSP and provided comments dated April 5, 2021. While the HWG comments were acknowledged as being received by the GSA, the Public Draft versions of Chapters 4 and 5 included no significant changes to the text or figures related to the HWG comments. Furthermore, these previous comments have direct bearing on the groundwater model development documented in Appendix 6B, and it is apparent that these previous HWG comments were not considered in Monterey Subbasin groundwater model development. In particular, the HCM in northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is fatally flawed (in terms of model layering and boundary conditions) to the extent it will impact model results and lead to inaccurate future predictions of groundwater elevations and seawater intrusion in this area of the model domain.
- Although the allowed review time was insufficient to conduct a review of model calibration for Model Layers 3 through 7, review of calibration hydrographs and associated calibration statistics for Model Layers 1 (Dune Sand Aquifer) and 8 (Deep Aquifer) indicate model calibration is not within acceptable limits for the Marina Ord portion of the model domain.
- The historical challenges in achieving acceptable calibration for the Dune Sand Aquifer have not been resolved in the Monterey Subbasin groundwater model. The Kv for the underlying Model Layer 2 had to be set at unrealistically low values even to achieve the relatively poor calibration of Model Layer 1 documented in this comment letter. Utilizing a realistic Kv value for Model Layer 2 presumably would have resulted in an even worse model calibration for Model Layer 1.
- It is not clear why a No Flow boundary condition at the ocean shoreline would be used for the Deep Aquifer. This choice of boundary condition will likely lead to inaccurate future predictions of groundwater elevations and seawater intrusion.

LSCE Comments	Responses
Section 2 (Methodology and Approach)	
1. Appendix 6B states the model western boundary ends at the Pacific Ocean (section 2.2.1, p. 7). **Comment:** The Principal Aquifers (180-Foot Aquifer, 400-Foot Aquifer, Deep Aquifer) extend out beneath the ocean several miles beyond the Pacific Ocean shoreline. More representative model results would be obtained by extending the model domain further out beneath the ocean.	There is very limited data and information available regarding principal aquifer depths/geometry, aquifer properties, and historical water level observations to support extending the active model domain offshore of the Monterey coastline at this time. As described in Appendix 6B, general head boundary (GHB) cells were assigned along the coastline to simulate subsurface exchange with the Pacific Ocean. Freshwater equivalent sea levels were assigned to GHB cells based on estimated offshore distances and depths at which principal aquifers contacted the seafloor, which were informed by previous hydrogeologic investigations (*Feeney, 2003*).

LSCE Comments	Responses
2. Appendix 6B states the model is discretized vertically into eight layers that include Layer 3 representing the Upper 180-Foot Aquifer, Layer 4 representing the 180-Foot Aquitard, Layer 5 representing the Lower 180-Foot Aquifer (Section 2.2.3, p. 8). **Comment:** While this model layering may apply in the southern part of the Monterey Subbasin in the Fort Ord area, it does not apply in the northern Monterey Subbasin or the southern 180/400 Foot Aquifer Subbasin included in the model domain, where there is no aquitard within the 180-Foot Aquifer. This comment relates to the Hydrogeologic Conceptual Model (HCM) that forms the basis of the groundwater model and was noted in previous Hydrogeologic Working Group (HWG) comments on GSP Chapters 4 and 5 (April 5, 2021). This incorrect portrayal of the stratigraphy in the model layering in the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin results in inaccurate model predictions in terms of groundwater levels and seawater intrusion.	See response to comments 7, 10, 11, and 15 of the HWG Chapter 4 comment letter (dated 04/05/2021). The MBGWFM <u>does</u> represent a gap in the 180-Foot Aquifer in the northwestern and central portions of the Monterey Subbasin and in the southwestern portion of the 180/400-Foot Aquifer Subbasin. In these areas, Layer 4 cells are assigned a thickness of 5 feet and parameterized using the aquifer properties from Layer 3 such that they function as "flow-through" cells and allow for hydraulic connectivity between Layers 3 and 5. This approach was used to avoid a no-flow condition in Layer 4 cells with zero thickness, as MODFLOW-NWT cannot directly simulate pinched out layers (see Section 2.2.3 of Appendix 6B for further details). However, we have noticed an error in Figure 6 that does not correctly show the "flow-through" portions of Layer 4 as described above. This error has been corrected and will be reflected in the final MBGWFM documentation. A screenshot of Layer 4 thickness is provided below, where "flow-through" cells are delineated in light grey: 

LSCE Comments	Responses
3. Appendix 6B states that as part of GSP development, a 3-D hydrostratigraphy model was developed to, "…provide for a more accurate representation of Principal Aquifer and Aquitard geometries and to facilitate MBGWFM grid development. The Leapfrog hydrostratigraphy model of the Basin was originally developed as part of two Airborne Electromagnetic (AEM) geophysical surveys conducted by Marina Coast Water District (MCWD) in 2017 and 2019…to help characterize seawater intrusion within the Basin." (Section 2.2.3, p. 9). **Comment:** Previous HWG Comment letters (e.g., August 2018, April 2019, June 2020) have repeatedly demonstrated the significant uncertainties and flaws in the hydrostratigraphic interpretations derived from the two AEM surveys. These errors in hydrostratigraphic interpretation have been incorporated into the Monterey Subbasin groundwater model and will result in inaccurate predictions of future groundwater levels and seawater intrusion. One example of the flawed stratigraphic interpretation for the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin is provided in Figure 2 of Appendix 6B 2, which displays a thick and continuous aquitard in the middle of the 180-Foot Aquifer and no Aquitard between the 180-Foot Aquifer and 400-Foot Aquifer. These two aquitards are misrepresented (and essentially reversed) in this area of the model domain.	See response to comment 2 above.
4. Appendix 6B states, "…it is assumed the Deep Aquifer is not hydraulically connected to the Pacific Ocean." (Section 2.4.1, p. 12). **Comment:** The lack of seawater intrusion in the Deep Aquifer at the present time is insufficient basis for adopting a No Flow boundary in the groundwater model. It is possible the Deep Aquifer is connected to the Pacific Ocean at the Monterey submarine canyon. At the very least, the Deep Aquifer likely extends out beneath the ocean floor for many miles offshore.	Representation of the Pacific Coast as a no-flow boundary within the Deep Aquifer (Layer 8) is consistent with previous numerical models developed for the region, including the Seaside Model and SVIGSM. Boundary condition assumptions within the Deep Aquifer will be revisited in a future model update (e.g., for the seawater intrusion model currently under development) as more information becomes available.

LSCE Comments	Responses
5. Appendix 6B describes the historical groundwater level measurements used as input for the general head boundaries on the northern edge of the model domain as including, "…seven wells in the Upper 180-Foot Aquifer (Layer 3), 12 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7)…". There is a footnote associated with this text that reads, "MCWRA water levels records classify wells in a grouped "Lower 180/400-Foot Aquifer" system, and thus specified heads from these wells were assigned to both Layer 5 and Layer 7 of the MBGWFM." (Section 2.4.2.1.1, p. 12). **Comment:** This assignment of historical water levels to general head boundaries along the northern edge of the model domain is flawed for the reasons described above related to an inaccurate HCM stratigraphy. MCWRA maps of groundwater elevations clearly show distinct (different) groundwater elevations in the 180-Foot and 400-Foot Aquifers. The footnote relative to MCWRA category of wells in a "Lower 180/400-Foot Aquifer" system likely refers to wells screened in both aquifers and does not mean both aquifers have the same water levels as is assumed in the Monterey Subbasin groundwater model.	We recognize that MCWRA does not explicitly distinguish between the Upper 180-Foot and Lower 180-Foot Aquifers within most of the Salinas Valley Basin. However, within the Monterey Subbasin, the Upper 180-Foot Aquifer and Lower 180-Foot Aquifer are defined as distinct Principal Aquifer Units due to notable differences in water levels caused by the local presence of the 180-Foot Aquitard. Along most of the northern MBGWFM boundary, the 180-Foot Aquitard is present while the 180/400-Foot Aquitard is absent (see Figures 6 & 7 of Appendix 6B). Historical water level observations collected in this area indicate that groundwater elevations within the Lower 180-Foot Aquifer closely resemble water levels in the 400-Foot Aquifer along the northern basin boundary. Furthermore, water level contour maps for the Lower 180-Foot Aquifer created by EKI closely resemble MCWRA contour maps of the 400-Foot Aquifer along the boundary. As such, we chose to assign heads to GHB cells in MBGWFM Layers 5 and 7 using water levels collected from MCWRA wells characterized in the "180/400-Foot Aquifer." We agree there is considerable uncertainty in water level conditions within each Principal Aquifer unit along the northern MBGWFM boundary and have committed to coordinate with SVBGSA in revisiting northern boundary condition assumptions in a future model update as more information becomes available.
6. Appendix 6B states, "The final network of SGMA monitoring wells used for projected simulations includes seven wells in the Upper 180-Foot Aquifer (Layer 3), 10 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7)…" (Section 2.4.2.1.2, p. 13). **Comment:** This assignment of future water levels to general head boundaries along the northern edge of the model domain is flawed for the reasons described above related to an inaccurate HCM stratigraphy. MCWRA maps of groundwater elevations clearly show distinct (different) groundwater elevations in the 180-Foot and 400-Foot Aquifers.	See response to comments 2 and 5 above.

LSCE Comments	Responses
7. In describing the southern model domain boundary of the Monterey Subbasin groundwater model, Appendix 6B describes notable differences in "hydrogeologic conceptualization and geometry between the two models that will result in imperfect matching of head conditions and unique estimates of cross-boundary flows. Notably, the Seaside Model defines aquifer units differently than the MBGWGM and includes a different number of layers." (Section 2.4.2.2.1, p. 15). **Comment:** Although not described or acknowledged in Appendix 6B, this same issue of significantly different hydrogeologic conceptualization and geometry also applies along the northern model domain of the Monterey Subbasin groundwater model. This is due to the previously described flawed HCM and stratigraphy that served as the basis for model layering in northern Monterey Subbasin and southern 180/400-Foot Aquifer Subbasin.	See response to comments 2 and 5 above.
8. Appendix 6B Table 2 provides a comparison of Seaside Model Layers to MBGWFM Layers (Section 2.4.2.2.1, p. 16). **Comment:** A similar table showing the disagreement with the HCM and previous models of the 180/400-Foot Aquifer Subbasin are not provided. A table comparing the Monterey Subbasin groundwater model aquifer layers with the 180/400-Foot Aquifer Subbasin is provided below. This table shows the discontinuities and offset of aquifer units between the two subbasins, which is quite problematic for evaluation of groundwater levels and sea water intrusion between the two subbasins.	See response to comments 2 and 5 above.

Table from Comment 8:

Monterey Subbasin Aquifer Unit	180/400 Foot Aquifer Subbasin Aquifer Unit	Comments
Dune Sand Aquifer	Dune Sand Aquiferand Perched "A"Aquifer	The Dune Sand Aquifer is perched and mounded on top of SVA and cannot be readily represented in MODFLOW. Appendix6B does not explain how this unit was simulated.
Upper 180-Foot Aquifer	180-Foot Aquifer	The grouping of lower 180 and 400-Foot Aquifers in MBGWFM is inconsistent with all previous and existing models of the 180/400-Foot Aquifer Subbasin.
Lower 180-Foot Aquifer And 400-Foot Aquifer		
	400-Foot Aquifer	
Deep Aquifer	Deep Aquifer	

LSCE Comments	Responses
9. Appendix 6B describes how similar estimates of cross-boundary flows were obtained along the southern model domain boundary for both the Seaside Basin model and the Monterey Subbasin groundwater model (section 2.4.2.2.1, p. 16). **Comment:** Similar cross-boundary flows were not obtained across the northern model domain boundary compared to the 180/400-Foot Aquifer Subbasin GSP, which was approved by DWR.	See response to comment 6 of LSCE comment letter #1 (dated 11/1/2021)

LSCE Comments	Responses
10. Appendix 6B states, "Various studies and projects have been proposed (see GSP Section 9) or are already being implemented by water management entities in both subbasin to better characterize and model local groundwater conditions and cross-boundary flows in the Laguna Seca area and across the entire Monterey-Seaside boundary." (Section 2.4.2.2.2, p. 17). **Comment:** A similar statement regarding additional studies to address discrepancies in cross-boundary flows along the northern model domain boundary does not appear to be provided Appendix 6B or the remainder of the GSP.	Comment noted. A statement will be added to Appendix 6B.
11. Appendix 6B states, "More recent investigations of seawater intrusion conditions within the Basin…also indicate that the Deep Aquifer is not currently seawater intruded along the Monterey coastline. As such, GHB cells were assigned along the Pacific Ocean boundary for all layers in the MBGWFM apart from layer 8 (i.e., the Deep Aquifer), which was modeled as a no-flow boundary at the Monterey coastline.".'' (Section 2.4.2.3, p. 18). **Comment:** The Deep Aquifer is certain to extend many miles out beneath the ocean, possibly ultimately outcropping in the submarine Monterey Canyon. While it would be best to extend the model domain extent out beneath the ocean, the next best choice is to assign a general head boundary. The selected choice to assign a no-flow boundary to the Deep Aquifer is flawed and is likely to result in erroneous predictions of future groundwater levels and seawater intrusion.	See response to comments 1 and 4.
12. Appendix 6B describes texture maps based on borehole log lithologic descriptions for model layers 1, 3, 5, 7, and 8, which represent the various aquifers. (Section 2.5.1, p. 21). **Comment:** It is just as important (maybe more important) to develop such texture maps for the aquitard model layers 2, 4, and 6, but apparently this was not done or is not presently described.	Interval-based lithology data collected from borehole logs are generally insufficient in detail to assign spatial texture classifications to the aquitard units using the method described in Appendix 6B. Typically, aquitards are identified from borehole logs based on the presence of relatively consistent fine-grained deposits. Therefore, assigning a "coarse fraction" to aquitard units is impractical using the lithology interval data alone, as it will almost always result in a 0% coarse fraction throughout the entirety of the aquitard. Rather, the MBGWFM accounts for local variations in aquitard transmissivity by assigning unique thicknesses and extents to each aquitard layer at a cell level. Where gaps or missing sections of the aquitards are known to occur, these are represented in the MBGWFM using a "flow-through" cell approach to allow for direct exchange between overlying and underlying model layers. See response to comment 2 and Section 2.3.3. of Appendix 6B for further details.
Section 3 (Stresses)	

LSCE Comments	Responses
13. Appendix 6B states, "…it was assumed that 25% of total projected deliveries would be applied for outdoor uses between April – September, while the remainder of deliveries would be used to meet potable and non-potable indoor demands." (Section 3.1.2.3, p. 27). **Comment:** While this assumption seems reasonable, it is inconsistent with the primary proposed future project of meeting 50% of future water demands with recycled water (see Table 8 on page 28 of Appendix 6B), which would require extensive indoor use of recycled water.	The author is correct. Recycled water would be used to meet indoor as well as outdoor demands. This would be accomplished through IPR (injection of recycled water into the aquifer) as described in in GSP Section 9.4.6 (project M3) cited in Appendix 6B, Section 3.2.2
14. Appendix 6B states, "For both scenarios, pumping was distributed within individual MCWD wells based on historical monthly and total pumping rates at each well." (Section 3.2.2, p. 28). **Comment:** As noted in the GSP Chapter 6 comment letter submitted on November 1, 2021, future pumping of MCWD wells based on historical pumping patterns does not accurately reflect pumping trends towards a greater amount of pumping from the Deep Aquifer.	See response to comment 15 of LSCE comment letter #1 (dated 11/1/2021).
15. Appendix 6B Table 8 (Projected MCWD Pumping Rates) shows total water demand in 2040 of 9,584 AFY with 5,495 AFY provided by recycled water and 4,089 of actual groundwater pumping. In addition, water demand is projected to increase from 3,367 AFY in 2020 to 6,001 AFY in 2025, with the vast majority of that increase being covered by increased groundwater pumping (Section 3.2.2, p. 28). **Comment:** It is not clear how recycled water can realistically provide 57% of total water demand in 2040. Near term, an increase in groundwater pumping from 3,367 AFY to 5,401 AFY in 2025 is likely to exacerbate seawater intrusion that is already occurring with 3,367 AFY of groundwater pumping by MCWD.	See response to Comment 13. Groundwater monitoring will be used to verify that SMCs are met.
Section 4 (Calibration)	

LSCE Comments	Responses
16. Appendix 6B states that the discrepancy in cross boundary groundwater flow estimates between the Monterey Subbasin GSP and 180/400 Foot Aquifer Subbasin GSP is due to 180/400 Foot Aquifer Subbasin GSP estimates being made by non-modeling methods, and that the 180/400 Foot Aquifer Subbasin GSAs plan to do additional studies of cross-boundary flows for the 5-Year Update. It is noted that the estimates in the 180/400 Foot Aquifer Subbasin were derived from, "…aggregating data and analyses from previous reports and other available sources. No numerical modeling was completed to develop the historical or current water budget." (Section 4.4, p. 31). **Comment:** The implication of the Appendix 6B text is that the non-modeling methods of determining water budgets and cross- boundary flows must be wrong. However, water budgets are commonly done using non-modeling methods, even if ultimately being used as input to a numerical model from which the final water budget is determined. For example, the 180/400 Foot Aquifer Subbasin describes using stream gage data at multiple stations to determine streamflow percolation, which likely is better than a model estimate. Furthermore, the historical and current estimates of groundwater inflow/outflow for the 180/400 Foot Aquifer Subbasin are based in part on the Salinas Valley IGSM groundwater model. In addition, the 180/400 Foot Aquifer Subbasin GSP notes that future water budgets were based on the SVIHM groundwater model developed by USGS. Overall, both subbasins estimated groundwater inflow/outflow amounts using groundwater models.	See response to comment 6 of LSCE comment letter #1 (dated 11/1/2021).
17. Appendix 6B states that, "SVIHM does not accurately reflect hydrologic conditions in the Monterey Subbasin." (Section 4.4, p. 31). **Comment:** This statement is used to help justify Monterey Subbasin GSP cross-boundary groundwater flow estimates being more reliable than those provided in the 180/400 Foot Aquifer Subbasin GSP. However, as noted above in this comment letter and in the previous HWG comment letter on Monterey Subbasin GSP Chapters 4 and 5, the HCM used as the basis for the Monterey Subbasin groundwater model is flawed in the northern Monterey Subbasin and southern 180/400 Foot Aquifer Subbasin portions of the model domain and does not accurately reflect geologic or hydrologic conditions along the northern Monterey Subbasin groundwater model domain boundary. Thus, the basis for Monterey Subbasin GSP estimates for cross-boundary flows are likely less valid than those provided in the 180/400 Foot Aquifer Subbasin GSP that has already been approved by DWR.	See response to comments 2 and 5 above, and comment 6 of LSCE comment letter #1 (dated 11/1/2021).

LSCE Comments	Responses
18. Appendix 6B states, "SVBGSA is in the process of developing a dual density groundwater model for the coastal regions of the greater Salinas Valley Basin. This model will incorporate the MBGWFM and be used to further assess volumetric exchanges between the ocean and the Salinas Valley groundwater basin. It will also aid in evaluating flows across subbasin boundaries and will be used evaluate impacts of potential regional projects that have been proposed in this GSP and other GSPs to address seawater intrusion in the Salinas Valley groundwater basin." (Section 4.4, p. 31). **Comment:** Given that the MBGWFM is expected to be expanded and have uses much greater than and beyond the scope of the Monterey Subbasin GSP, it is critical that the hydrostratigraphic misrepresentation and flawed model layering (and model boundary conditions) outlined above be addressed for this broader effort (and preferably for use in the Monterey Subbasin GSP itself).	See response to comments 2 and 5 above, and comment 6 of LSCE comment letter #1 (dated 11/1/2021).

LSCE Comments	Responses
19. Appendix 6B Table 10 indicates the Normalized RMSE for Model Layer 1 is 5.7% based on a range in elevations of 198.4 feet; and that the Normalized RMSE for Model Layer 8 is 2.9% based on a range in elevations of 728.4 feet. The text states, "A generalized rule of thumb in model calibration is that the model is considered well-calibrated when the normalized RMSE is less than 10%. The low normalized RMSEs are therefore an indicator that the model is well-calibrated as a whole and within individual layers given the range of observed data." (Section 4.7, p. 33). **Comment:** Review of the hydrographs indicates the range in elevations for Model Layer 1 is not more than 115 feet, resulting in a Normalized RMSE of about 10%. Even if there were an outlier somewhere in the hundreds of hydrographs provided, it would be an extreme outlier that artificially increased the range of elevations and lowered the RMSE to 5.7 %. Overall review of hydrographs indicates the calibration of the Dune Sand Aquifer is not particularly good and is no better than previous models of the area. The extreme range in elevations of 728.4 feet for Layer 8 is apparently mixing data from near the ocean in the Marina-Ord area with the highest elevations of the Corral de Tierra area, which artificially lowers the Normalized RMSE by a large amount. A more realistic groundwater elevation range of about 95 feet for the Marina Ord area for which hydrographs show an RMSE of about 14.5 feet yields a Normalized RMSE of about 15%. There was insufficient time to do similar checks on other model layers, but results for Model Layers 1 and 8 indicate a relatively poor overall calibration for the Marina-Ord area. It is also noted that while the Monterey Subbasin modeling effort appeared to use practically all available monitoring well data for model calibration (with notable exception of MPWSP data); however, the monitoring well hydrograph for MW-OU2-29-A is missing from the dataset for the Dune Sand Aquifer, which is noteworthy because it was a particularly challenging hydrograph to match with previous models.	This comment appears to make a generalized statement about MBGWFM calibration by focusing on a subset of wells and layers within a local area of the model domain that is of particular interest to CalAm. There is no actionable recommendation provided in the comment. As mentioned in previous replies, the focus of MBGWFM is to provide a reasonably calibrated, Basin-level model of the Monterey Subbasin that serves as a starting point for coordinated regional model development and/or refinements. Appendix 6B demonstrates that model calibration, both within individual layers and as a whole, falls within acceptable performance criteria and reasonably recreates Basin-level groundwater conditions. Model performance within CalAm's area of interest in the Basin was not a primary focus of MBGWFM development or calibration.
20. Appendix 6B provides a map (Figure 29) of calibration hydrograph locations (Section 4.7, p. 33). **Comment:** It is not clear why nested monitoring well data from the Monterey Peninsula Water Management Project (MPWSP) are not being used in the model calibration. These wells are located in key data gap areas of the model domain.	MPWSP monitoring wells were installed in 2015. Therefore, data from these wells begins in year 18 of the 20 year historical calibration period which extends from (WY 1999 through WY 2018). As such, they were not selected for incorporation into the calibration data set for the historical period. However, data from these wells will be incorporated into future model updates that focus on future time periods.
Section 5 (Sensitivity and Uncertainty Analysis)	

LSCE Comments	Responses
21. Appendix 6B states the final calibrated Kv of Model Layer 2 was 2 x 10-4 ft/d (Section 5, p. 34). **Comment:** A Kv of 2 x 10-4 ft/d is equivalent to 7 x 10-8 cm/s. This is an extremely low and unrealistic Kv value for a regional clay layer. Such an unrealistically low calibrated Kv value was likely driven by trying to achieve a better calibration within the overlying Model Layer 1. Previous studies indicate that accurately representing (from a hydrogeologic standpoint) the Dune Sand Aquifer (Model Layer 1) is extremely difficult because it contains perched and mounded water on top of a sloping clay layer and numerical models have trouble accurately representing such hydrogeologic conditions. The text of Appendix 6B provides no discussion of this issue and how it was addressed in the Monterey Subbasin groundwater model. The consultants that prepared Appendix 6B are quite familiar with the issue and have critiqued previous models in the area regarding this issue, yet they provide no explanation of how the issue was addressed in their own model. Regardless, it is clear from detailed inspection of calibration hydrographs for Model Layer 1 and the use of an unrealistically low Kv value for Model Layer 2 that these model challenges for simulating the Dune Sand Aquifer remain unresolved for the Monterey Subbasin groundwater model.	A Kv value of 2E-4 ft/d is well within the range of hydraulic conductivity values for clay layers presented in relevant literature, and in most cases, represents the upper limit of the range. For example, *Freeze and Cherry, 1979* presents a range in hydraulic conductivity of 8E-13 m/s (2E-7 ft/d) to 2E-9 m/s (6E-4 ft/d) for unweathered marine clays. For silt/loess, the range is higher, from 1E-9 m/s (2E-4 ft/d) to 2E-5 m/s (5.7 ft/d). Furthermore, the calibration metrics presented in Appendix 6B indicate the model is reasonably well calibrated in Layer 1, with RMSE of 11.5 ft (5.7%) and a mean residual of -0.4 ft. The model was set up with the properties of the Dune Sand and underlying Salinas valley aquitard (SVA) in mind. As indicated above, the SVA model layer 2 was parameterized to reflect the low permeability associated with marine layer deposits. The model is also set up to be fully convertible in each layer to allow representation of varying degrees of confinement and saturation within each aquifer unit. It also allows for rewetting to accommodate situations where certain layers and/or cells go dry during the simulation.
Section 6 (Model Limitations and Suggested Future Refinements)	
22. Appendix 6B states, "…the model calibration error is within acceptable bounds…As demonstrated by the calibration error statistics summarized in Section 4.7 the MBGWFM reasonably represents historical groundwater conditions within the Subbasin using a set of parameters that are within real- world observations and established scientific principles." (Section 6, p. 35). **Comment:** As discussed previously: 1) A limited review of the calibration data indicates Model Layers 1 and 8 are poorly calibrated (time did not permit for checking calibration of other model layers); 2) the HCM forming the basis for model layering and general head boundary conditions on the northern portion of the model domain are flawed; and 3) the calibrated Kv for Model Layer 2 is unrealistically low by at least two orders of magnitude. These findings indicate the statements in Section 6 about model calibration being acceptable and the model being based on realistic model parameters are inaccurate.	See responses to comments 2, 5, 19, and 21 above.

LSCE Comments	Responses
23. Appendix 6B notes that, "…only a small number of wells exist in the Deep Aquifers within the 180/400 Foot Aquifer Subbasin with observed water level data spanning the full duration of the historical Period. As such, simulated Deep Aquifers heads along the northern model boundary are subject to the limitations in available data to the north of the boundary, which may impact resulting calculations of 180/400 Foot Aquifer Subbasin exchanges within the water budget." (Section 6, p. 35). **Comment:** It should be noted that the same limitations on available data are equally applicable south of the boundary.	Comment noted.
24. Appendix 6B notes that there is a lack of water level calibration data outside of certain areas such as the MCWD service area and former Fort Ord Site (Section 6, p. 36). **Comment:** While this statement is generally correct, there is no explanation as to why an extensive monitoring well data set for the MPWSP is not used in the model calibration – particularly given it is located in a data gap area.	See response to comment 20 above.
25. Appendix 6B notes there is significant uncertainty with the climate change predictions provided by DWR that are the basis for future scenarios in the GSP (Section 6, p. 37). **Comment:** Given the uncertainty in climate change predictions related to precipitation, it would be more prudent for future water management to assume that groundwater recharge will not increase in the future due to climate change (as has been assumed in the GSP) and assume instead it will remain consistent with historical data.	See response to comment 26 of LSCE comment letter #1 (dated 11/1/2021).

LANDWATCH COMMENTS ON DRAFT MONTEREY SUBBASIN GROUNDWATER SUSTAINABILITY PLAN, CHAPTER 8

"I write on behalf of LandWatch Monterey County to comment on draft Chapter 8 of the Monterey Subbasin Groundwater Sustainability Plan (GSP).

The sustainable management criteria (SMCs), including the minimum threshold (MT) and measurable objective (MO) for chronic lowering of groundwater levels for the Monterey Subbasin may suffer from the same defect as in the 180/400-Foot Aquifer

Subbasin Groundwater Sustainability Plan. That defect is that the groundwater level SMCs are not supported by consideration of their effects on other sustainability indicators, in particular, seawater intrusion. There appears to be no evidence that the groundwater level SMCs and their associated interim milestones will support attainment of the seawater intrusion threshold, particularly since the interim milestone would permit continued declines in historic groundwater levels and would not reach the SMCs for almost 20 years.

Furthermore, setting Corral de Tierra subarea groundwater level SMCs at historic levels would cause chronic lowering of groundwater levels in the neighboring Seaside Subbasin. According to the Seaside Basin Watermaster, pumping reductions and groundwater level increases are required in the Corral de Tierra subarea to remedy falling groundwater levels in the Laguna Seca Subarea.

Finally, the water quality sustainable management criteria should not be limited to effects caused by "direct GSA action" through GSA projects. The GSA must also limit excessive third party extractions that cause undesirable water quality results."

LandWatch Comments	Responses
Chapter 8 – Hydrogeologic Conceptual Model	
A. Groundwater level sustainable management criteria and interim milestones fail to support the seawater intrusion criteria.	
1. The groundwater level minimum threshold must support the seawater intrusion minimum threshold. SGMA requires that each minimum threshold must avoid each undesirable result because SGMA requires that "basin conditions at each minimum threshold will avoid undesirable results for each of the sustainability indicators." (23 CCR § 354.28(b)(2), emphasis added.) For example, the groundwater level minimum threshold must be "supported by" the "[p]otential effects on other sustainability indicators." (23 CCR 354.28(c)(1)(B), emphasis added.) This means that each minimum threshold, especially the groundwater level minimum threshold, must be coordinated to ensure that all undesirable results are avoided.	The Monterey Subbasin GSP contains groundwater level minimum thresholds that support the seawater intrusion minimum thresholds. As described in Landwatch comment number 4 below. Chap. 8, p. 8-29 states: The observed lateral extent of seawater intrusion within the Subbasin appears to have been generally stable within the 180- and 400-Foot Aquifers between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient. (Chap. 8, p. 8-29.)

LandWatch Comments	Responses
	As stated by LandWatch ("LW") in Comments 2, 3, and 4 the Monterey GSP calls for no further seawater intrusion and identifies sustainable management criteria based upon historical conditions to meet this measurable objective. Although the GSP allows for interim declines in water levels in the 400-foot aquifer in inland portions of the subbasin, it does not allow declines in wells located along the known seawater intrusion front within the northern portion of the subbasin (see response to LW comment 5). It also calls for installation of additional wells in the southern portion of the subbasin to better track water levels and seawater intrusion in this portion of the subbasin. This new data will be used to identify appropriate SMCs and interim milestones for groundwater levels in this area. Annual induction logging is also proposed to assess vertical migration of the seawater intrusion front between the 400-foot aquifer and the Deep Aquifers, where no seawater intrusion has been detected to date. These data will be reviewed, and interim milestones will be adjusted if needed. MCWD has significant flexibility to change extraction rates between in its production wells and increase water levels in selected areas in the event that seawater intrusion is identified. Annual and 5-year reports required under SGMA will be used to identify changes to water level SMCs and interim milestones if required. The interim milestones included in the Monterey GSP reflect the reality that it will take time to implement projects and management actions to stop groundwater levels from falling. As discussed in the GSP, rates of groundwater extraction within the Monterey Subbasin are significantly lower than total recharge, and large volumes of groundwater are flowing into the 180/400 foot groundwater basin. As such, sustainability with the Monterey Subbasin will require the implementation of both local and regional projects and management actions to reach sustainability. Such regional solutions will inevitably take time to implement. The Monterey GSP is consistent with SGMA, which acknowledges this reality and allows 20 years to reach sustainability. Further, in the event that such monitoring indicates expansion of the seawater intrusion

LandWatch Comments	Responses
	front, prior to reaching SMCs local projects such as IPR could be implemented to raise water levels in selected areas through injection of recycled water (i.e., IPR project) or in lieu recharge as identified in Chapter 9 . In the event that monitoring data indicate rapid vertical downward migration of the seawater intrusion front, interim water level SMCs may be adjusted to address this issue. Annual and 5 year reports required under SGMA will be used to identify such changes if required.
2. The proposed seawater intrusion SMCs do not permit any additional intrusion. The draft Monterey Subbasin Chapter 8 sets the MT and MO for seawater intrusion for the "lower" 180-Foot Aquifer and the 400-Foot Aquifer at the line of advancement as of 2015. (Monterey Subbasin GSP, draft Chap. 8 ("Chap. 8."), p. 8-55 to 8-56.) Chapter 8 sets the MT and MO for seawater intrusion to the Deep Aquifers at Highway 1, based on the observation that there is limited intrusion in these aquifers. (Id., pp. 8-51, 8-55 to 856.) In effect, Chapter 8 commits the GSP not to permit any additional seawater intrusion in these aquifers. This is a proper goal in light of the clear impacts to beneficial users.	As stated in LW Comment 2, the proposed seawater intrusion SMCs identified in Chapter do not permit any expansion of the seawater front.
3. The groundwater level SMCs and groundwater level interim milestones are set based on their effects on seawater intrusion. The draft Monterey Subbasin Chapter 8 acknowledges that the MT and MO for groundwater levels must support attainment of the seawater intrusion MT and MO because it identifies the primary consideration in setting the groundwater level MT and MO is the effect on seawater intrusion: As discussed in Section 3.1.6, groundwater use within the Marina-Ord Area is almost exclusively limited to generation of municipal supplies by MCWD. Groundwater elevations are significantly higher than municipal production well screen elevations in all aquifers in the Marina-Ord Area, and there is limited concern regarding the potential dewatering of groundwater production wells. Therefore, groundwater levels that could cause undesirable results associated with other locally relevant sustainability indicators, such as the lateral or vertical expansion of the existing seawater intrusion extent and/or eventual migration of saline	As stated in LW Comment 3, the intent of Chapter 8 is to establish MTs and MOs for groundwater levels that support attainment of the seawater intrusion MTs and MOs.

LandWatch Comments	Responses
water into Deep Aquifer wells, have been used to define groundwater level minimum thresholds in the Marina-Ord Area. (Chap. 8, p. 8-16, emphasis added.) Chapter 8 also provides that . . . undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion and other locally relevant sustainability indicators. These sustainability indicators have been considered when defining groundwater level minimum thresholds in the Marina-Ord Area. (Chap. 8, p. 8-18, emphasis added.)	
4. Setting the groundwater level SMCs at historic 1995-2015 conditions is purportedly justified by the stability of the lateral extent of seawater intrusion in the Monterey Subbasin during that historic period. Chapter 8 contends that setting the groundwater level MT and MO for the 180- and 400Foot Aquifers on the basis of the 1995 to 2015 groundwater levels is justified because the lateral extent of seawater intrusion in the Monterey Subbasin has been "generally stable" in that period: As discussed in the preceding sections, the potential effects of undesirable results caused by chronic lowering of groundwater levels in the Marina-Ord Area are primarily associated with the expansion of seawater intrusion. The observed lateral extent of seawater intrusion within the Subbasin appears to have been generally stable within the 180- and 400-Foot Aquifers between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers.. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient. (Chap. 8, p. 8-29.)	As stated in LW comment 4, and GSP chapter 8 "available data indicate that the lateral extent of seawater intrusion front in the 180/400 Foot Aquifer in Monterey Subbasin has been stable between 1995 and 2015. As such, minimum thresholds have been set based upon minimum groundwater elevations observed between 1995 and 2015 in the 180- and 400 Foot aquifers. Seawater intrusion is additionally monitored and managed pursuant to seawater intrusion SMCs (Section 8.9 below) to verify seawater intrusion does expand within the Subbasin due to sea-level rise and/or changes in the groundwater gradient."
5. The "stability" rationale for setting groundwater level SMC's based on historic conditions is undercut by Chapter 8's projections that groundwater levels will	In order to limit migration of the seawater intrusion front; MT, MO, and <u>interim milestones</u> in 180/400 Foot aquifer RMWs located near the

LandWatch Comments	Responses
actually continue to decline and remain below historic conditions and by the interim milestones that permit such declines. First, the contention that groundwater level SMCs are justified by historic conditions ignores the GSP's own projection that groundwater levels will continue to decline until at least 2033 and will not attain the MO until 2042. Chapter 8 documents and projects in its "Example Trajectory for Groundwater Elevation Interim Milestones" that groundwater levels for a Marina-Ord well fell below the MT in 2019, will continue to fall until 2033, will not rise above the MT until 2039, and will not attain the MO until 2042. (Chap. 8, pp. 8-40 to 8-41, Figure 8-12.) The interim milestones for wells in the 400-Foot Aquifer and the Deep Aquifers assume and permit that groundwater levels will remain below historic levels and the MT for most of the next 20 years: Within the Monterey Subbasin, for wells in the 400-Foot Aquifer, Deep, and El Toro Primary Aquifer System Aquifers where groundwater levels have been declining, groundwater elevation interim milestones are defined based on a trajectory informed by current (fourth quarter of 2020) groundwater levels, historical groundwater elevation trends [footnote], and measurable objectives. This trajectory allows for and assumes a continuation of historical groundwater elevation trends during the first 5-year period of GSP implementation, a deviation from that trend over the second 5-year period, and a recovery towards the measurable objectives in the third and fourth (last) 5- year period. (Chap. 8, p. 8-40.) The proposed interim milestones for wells in the 180-Foot and Deep Aquifers permit substantial declines in groundwater levels from 2020 conditions in the years 2027 and 2032. (Id., p. 8-43, Table 8-3.) Allowing groundwater levels to fall below historic levels is purportedly justified because "there are large volumes of freshwater in the Subbasin that provide additional time and flexibility to reach identified SMCs while projects and management actions are implemented." (Id.) However, the draft GSP provides no evidence to suggest that groundwater levels that fall and remain below the historic conditions in the Marina-Ord area will not induce further seawater intrusion in the interim,	seawater intrusion front have all been set at minimum groundwater elevations observed between 1995 and 2015. These RMWs include: MCWD-29, 30, and 31, MPWMD#FO-10S and 11S, MW-12-12-180L, MW-BW-04-180, MW-OU2-07-400, MW-OU2-66-180, TEST2, and two multi-completion wells (MP-BW-42* and MP-BW-50*). No interim water level decreases in these wells are incorporated in the interim milestones for these RMWs. Nor is any interim decrease in water levels included in the proposed interim milestones for Dune Sand RMWs near the coast, where seawater intrusion is most likely to occur. Interim declines in water levels have been incorporated into SMCs for inland 400-foot wells and Deep Aquifer Zone wells, where no seawater intrusion has been observed to date. As such, proposed declines in interim milestones at these locations are not inconsistent with Seawater SMCs. The need for additional wells and monitoring to further assess the potential for lateral and vertical migration of seawater are proposed in Section 7.5.2 of the GSP: This work includes: 1. The completion of an additional 400-foot aquifer monitoring well in the southern portion of the Monterey Subbasin between the coast and wells FO-10 and FO-11, where water levels are falling. This well will be used to further evaluate the extent of if seawater intrusion in this area and evaluate groundwater levels. SMCs in this additional RMW will be established accordingly. 2. Annual induction logging at Deep Aquifer monitoring wells to assess potential vertical migration of seawater from the 400 Foot Aquifer into the Deep Aquifer. Data from these additional investigations will be utilized to inform future annual and 5-year reports to the GSP. If needed, groundwater level interim milestones and/or SMCs may be modified to achieve the Seawater intrusion SMCs.

LandWatch Comments	Responses
resulting in a failure to meet the seawater intrusion SMCs. The historic "stability" rationale cannot be extrapolated to claim that groundwater levels well below the historic record will continue to result in a stable areal extent of seawater intrusion. It makes no sense to contend that setting the MT and MO on the basis of historic conditions will not result in seawater intrusion when the GSP would effectively fail to maintain those historic conditions for the next twenty years during which the GSP is supposed to attain sustainability. The historic stability rationale also ignores the fact that Deep Aquifer groundwater levels began dropping in 2014, have continued to drop, and are projected to continue to drop due to increased levels of extractions. MCWRA reported in 2020 that Deep Aquifer groundwater levels have been falling since 2014, are well below sea-level, and that induced vertical migration of contaminated water to the Deep Aquifers themselves is in fact occurring: As is the case with the 180-Foot and 400-Foot Aquifers, groundwater levels in the Deep Aquifers are predominantly below sea level. Beginning around 2014, groundwater levels in the Deep Aquifers began declining and are presently at a deeper elevation than groundwater levels in the overlying 400-Foot Aquifer based on comparisons of multiple well sets at selected locations, meaning that there is a downward hydraulic gradient between the impaired 400-Foot Aquifer and the Deep Aquifers (Figure 16 and Figure 17). This decrease in groundwater levels coincides with a noticeable increase in groundwater extractions from the Deep Aquifers (Figure 16 and Figure 17). The potential for inducing additional leakage from overlying impaired aquifers is a legitimate concern documented by previous studies and is something that would be facilitated by the downward hydraulic gradient that has been observed between the 400-Foot Aquifer and Deep Aquifers. Seawater intrusion has not been observed in the Deep Aquifers. However, the Agency has documented the case of one well, screened in the Deep Aquifers, that is enabling vertical migration of impaired groundwater into the Deep Aquifers. The	

LandWatch Comments	Responses
Agency is working with the well owner on destruction of this well.[12] In addition to the threat to contaminate the Deep Aquifers, the induced vertical migration of upper aquifer groundwater to the Deep Aquifers aggravates seawater intrusion in those upper aquifers. A 2003 study for MCWD concluded that increasing pumping of the Deep Aquifers from the 2002 baseline level of 2,400 AFY to just 4,000 AFY would (1) induce further seawater intrusion into the upper aquifers (the 180-Foot and 400-Foot Aquifers), which were vertically connected, and (2) risk contamination of the Deep Aquifers themselves.[3] Deep Aquifer pumping is now in excess of 10,000 AFY.[4] And, in fact, Chap 8 admits that falling groundwater levels in the Deep Aquifer threatens to contaminate the Deep Aquifers and to induce seawater intrusion in the upper aquifers: Seawater intrusion has not been observed in the Deep Aquifer to date. However, groundwater elevations have been declining and are significantly below sea level. The declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPMWD#FO-10S and MPMWD#FO-11S). Although there is some uncertainty whether the Deep Aquifer is subject to seawater intrusion from the ocean, continued decline of groundwater elevations in the Deep Aquifers could increase the risk of seawater intrusion and may eventually cause vertical migration of saline water from overlying aquifers into the Deep Aquifers. As such, minimum thresholds for the Deep Aquifers are set to historically observed minimum groundwater	

[1] Monterey County Water Resources Agency (MCWRA), Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin:
[2] Update, May 2020, p. 31, https://www.co.monterey.ca.us/home/showdocument?id=90578

[3] WRIME, Deep Aquifer Investigative Study, May 2003, pp. 4-7, 4-11 to 4-12, pdf available upon request.
[4] Monterey County Water Resources Agency (MCWRA), Well Permit Application Activities Update, prepared for May 17, 2021 MCWRA Board of Directors meeting, https://monterey.legistar.com/View.ashx?M=F&ID=9381226&GUID=34ED34CD3A39-4851-87A3-298BE70D383C

LandWatch Comments	Responses
elevations between 1995 and 2015, which is equivalent to the groundwater elevations observed in 2015 for most Deep Aquifer wells. (Chap. 8, p. 8-40.) Again, setting the groundwater level MT and MO to historic levels but then allowing 20 years to pass before the interim milestones actually require attainment of these historic levels cannot demonstrably ensure that there is no further advancement of seawater intrusion. However, that is precisely what is required by the seawater intrusion MT and MO.	
6. Chapter 8 fails to assess the effects on other subbasins of setting groundwater level SMCs based on historic conditions or allowing groundwater levels to decline further through relaxed interim milestones. As Chapter 8 acknowledges, the interconnectivity between the 180/400-Foot Aquifer Subbasin and the Monterey Subbasin requires coordination of the sustainable management criteria for both subbasins. (Id., p. 8-35.) Coordination is required in order to meet SGMA's requirement that the SMC's for one subbasin do not prevent another subbasin from meeting its sustainability goal. Setting the groundwater level MT and MO at historic levels and then effectively ignoring these criteria through use of relaxed interim guidelines for 20 years may very well impair attainment of the seawater intrusion criteria for the 180/400-Foot Aquifer GSP, which are also set at a level that permits no further advancement of the seawater intrusion front. However Chapter 8 provides no analysis of that possibility. Chapter 8 proposes to defer the assessment of the impact of the Monterey Subbasin's groundwater level MTs on the Deep Aquifers in the neighboring 180400-foot Aquifer Subbasin until after completion of the long-delayed Deep Aquifers Study and the eventual establishment of Deep Aquifer SMCs for the 180400-foot Aquifer Subbasin. The Deep Aquifer Study, recommended almost four years ago, has neither been funded nor initiated. Furthermore, there is no reason that an assessment of the effects of the Monterey Subbasin's groundwater level MTs should be limited to its effects on the Deep Aquifers in the 180/400-Foot Subbasin. The assessment should also include an assessment of the effects of the	As discussed in the GSP, rates of groundwater extraction within the Monterey Subbasin are significantly lower than total recharge, and large volumes of groundwater are flowing into the 180/400-foot groundwater basin. As such, sustainability with the Monterey Subbasin will require the implementation of both local and regional projects and management actions to reach sustainability. Such regional solutions will inevitably take time to implement and will require coordination with adjacent subbasins and of SMCs. The Monterey GSP is consistent with SGMA, which acknowledges this reality and allows 20 years to reach sustainability.

LandWatch Comments	Responses
Monterey Subbasin's groundwater level MTs on seawater intrusion of each of the principle aquifers in that neighboring subbasin. The Monterey Subbasin GSP argues that pumping in the 180/400-Foot Aquifer Subbasin has caused seawater intrusion in the Monterey Subbasin. In turn, the Monterey Subbasin GSP must assess the reciprocal effects of its own pumping, SMCs, and interim milestones on the 180/400-Foot Aquifer Subbasin. SGMA's mandate to use the best available science is not an invitation to let the perfect be an enemy of the good pending completion of the Deep Aquifer study. Chapter 8 must use the whatever science is now available to provide some discussion and assessment of the effect on the neighboring subbasins of allowing continued reductions in Monterey Subbasin groundwater levels below historic conditions through relaxed interim thresholds. Again, it is not reasonable to extrapolate beyond the historic data to assume that lower than-historic groundwater levels in the Monterey Subbasin will not impair adjacent basins. The purported stability of the lateral extent of seawater intrusion in the Monterey Subbasin from 1995 to 2015 was certainly not matched in the 180/400-Foot Aquifer Subbasin. Chapter 8 provides no evidence to justify the assumption that allowing lowerthan-historic groundwater levels in the Monterey Subbasin will not contribute to the continuing seawater intrusion in the neighboring subbasin.	
7. Finally, the Monterey Subbasin GSP must also evaluate and address the effects of reduced groundwater levels in the Corral de Tierra Subarea on the Seaside Subasin. Again, there is no evidence in the record that merely maintaining historic groundwater levels is sufficient to support groundwater levels in the Seaside Subbasin. To the contrary, comments by the Seaside Basin Watermaster indicate that chronic lowering of groundwater levels in the Laguna Seca Subarea of the Seaside Subbasin can only be corrected by reducing existing pumping in the Corral de Tierra, i.e., increasing groundwater levels above historic levels. (Robert Jacques, PE, email to Sarah Hardgrave, et al., March 22, 2021.) Setting Monterey Subbasin groundwater level SMC's at historic levels violates SGMA because it will prevent attainment of groundwater level objectives in the adjacent Seaside Subbasin.	SVBGSA and the Seaside Watermaster are in close coordination to monitor, model, and discuss water levels in the Corral de Tierra area for SMC and GSP development. While the hydrologic connection is clear, the future impacts as predicted by modeling are less clear. Modeling teams are in close contact to resolve discrepancies and develop improved predictions that meet the needs of all stakeholders.

LandWatch Comments	Responses
B. Water quality sustainable management criteria should not be limited to effects caused by "direct GSA action;" the GSP must also limit extractions that cause undesirable results.	
Chapter 8 purports to limit significant and unreasonable conditions related to groundwater quality degradation to "[l]ocally defined significant and unreasonable changes in groundwater quality resulting from direct GSA action." (Chap. 8, p. 8-56, italics added.) Thus, Chapter 8 contends that the GSP need only address water quality degradation that is a "direct result of projects or management actions conducted pursuant to GSP implementation:" For the Subbasin, any groundwater quality degradation that leads to an exceedance of MCLs or SMCLs in potable water supply wells or a reduction in crop production in agricultural wells that is a direct result of GSP implementation is unacceptable. Some groundwater quality changes are expected to occur independent of SGMA activities; because these changes are not related to SGMA activities they do not constitute an undesirable result. Therefore, the degradation of groundwater quality undesirable result is: Any exceedances of minimum thresholds during any one year as a direct result of projects or management actions conducted pursuant to GSP implementation is considered as an undesirable result. (Id., underlining added.) This language does not define what constitutes "a "direct result" of GSP implementation or "direct GSA action." Elsewhere, Chapter 8 gives three examples of conditions that may lead to an undesirable result and that the GSA is presumably prepared to address: • Required Changes to Subbasin Pumping. If the location and rates of groundwater pumping change as a result of projects implemented under the GSP, these changes could alter hydraulic gradients and associated flow directions, and cause movement of constituents of concern towards a supply well at concentrations that exceed relevant standards. • Groundwater Recharge. Active recharge of imported water or captured runoff could modify groundwater gradients and move constituents	The water quality SMC primarily focuses on a 'do no harm' approach, whereby groundwater management implemented by SVBGSA will be evaluated for negative impacts to water quality, but no groundwater management implementation will not be evaluated for negative impacts. The phrase 'direct GSA action' has been removed, and replaced with different language after consulting with legal counsel. Existing water quality programs and standards are included in the GSPs to highlight partnership and authority over different groundwater management aspects.

LandWatch Comments	Responses
of concern towards a supply well in concentrations that exceed relevant limits. • Recharge of Poor-Quality Water. Recharging the Subbasin with water that exceeds an MCL, SMCL, or level that reduces crop production could lead to an undesirable result. (Chap. 8, p. 8-57.) Significantly, none of these three conditions that might trigger GSA action include excessive pumping by other parties that may cause water quality degradation; each condition includes only the secondary effects of the GSA's own projects. The GSA's failure to take management action, e.g., its failure to restrict excessive extractions, may also cause water quality degradation. Chapter 8 should be revised to acknowledge that the GSA has both the authority and duty to address groundwater quality degradation caused by excessive pumping. Chapter 8 contends that because other agencies have authority over groundwater quality, the GSA's role is somehow limited: The powers granted to GSAs to effect sustainable groundwater management under SGMA generally revolve around managing the quantity, location, and timing of groundwater pumping. SGMA does not empower GSAs to develop or enforce water quality standards; that authority rests with the SWRCB Division of Drinking Water and Monterey County. Because of the limited purview of GSAs with respect to water quality, and the rightful emphasis on those constituents that may be related to groundwater quantity management activities. Therefore, this GSP is designed to avoid taking any action that may inadvertently move groundwater constituents already in the Subbasin in such a way that the constituents have a significant and unreasonable impact that would not otherwise occur. (Id., pp. 8-59 to 8-60.) The fact that the County and the RWQCB also have authority and responsibility to address water quality degradation demonstrates that the statutory scheme does not rely on the regulatory actions of any single agency. Nothing in SGMA's mandate that the GSP address water quality degradation permits the GSA to consider only the direct effect of GSA projects and only those projects that move pollutants. The GSP	

LandWatch Comments	Responses
must also address the effects of its regulatory omissions, including omissions that move or concentrate existing pollutants by permitting excessive extractions. DWR has made it clear in its imposition of corrective actions on the 180/400-Foot Aquifer Subbasin GSP that "groundwater management and extraction" may result in degraded water quality: RECOMMENDED CORRECTIVE ACTION 5 Coordinate with the appropriate groundwater users, including drinking water, environmental, and irrigation users as identified in the Plan, and water quality regulatory agencies and programs in the Subbasin to understand and develop a process for determining if groundwater management and extraction is resulting in degraded water quality in the Subbasin. Accordingly, the GSP cannot limit its concern to the effects of its own projects without taking responsibility for the effects of unregulated extractions on water quality degradation. For example, if, in the Corral de Tierra Subarea, there is evidence that arsenic concentrations are increased by excessive extractions, then the GSP must manage extractions to avoid undesirable results from increased concentrations. Chapter 8 cannot simply state that "no clear correlation that can be established between groundwater levels and groundwater quality at this time" as if that disposes of the matter. (Chap. 8, p. 8-57.) Indeed, at the July GSA Board meeting, staff acknowledged that lowering groundwater levels could cause water quality degradation, specifically referencing Corral de Tierra. The GSA must investigate, apply the best available science, and manage the resource to prevent undesirable contaminant concentrations caused by excessive extractions.	

Responses to Seaside Watermaster's Comments on the Monterey Subbasin Groundwater Sustainability Plan

Comments Provided on 17 November 2020

Comments from Georgina King of Montgomery & Associates on behalf of the Seaside Watermaster

"I have reviewed and plotted up the water quality data and parts of reports EKI provided. I also looked at MCWRA's recent maps of seawater intrusion (2017). I have pasted some maps and charts into a Word document Essentially, what we see is that:"

Comments	Responses
1. There is Salinas Valley seawater intrusion quite far south and into the Seaside Basin in the 180 ft aquifer equivalent to formations shallower than the Shallow Aquifer (Paso Robles) in the Seaside Basin. But we know this from the induction logs in the northern Sentinel Wells. The data available and included on our map is from Fort Ord monitoring – all of which is very shallow (180-ft aquifer) and not in our Shallow (Paso Robles) aquifer. As reference for depth, the FO-9 shallow aquifer in the Paso Robles is screened from 610-650 ft below ground.	As discussed in the GSP, available data indicates that there is no observed seawater intrusion in the upper portion of the 180-Foot Aquifer. Therefore, MCWRA's maps are only consistent with data collected from the lower 180-Foot Aquifer.
2.The 400 ft aquifer which is equivalent to the Shallow Aquifer (Paso Robles) in the Seaside Basin has a similar southern extent to what we have included in the SIAR mostly because there is no data/wells available to update the extent. There has been considerable inland advancement. <u>There are no 400-foot Fort Ord monitoring wells that have data more recent than 2008. Perhaps we should find out if some of these wells can start being sampled by the GSA in that area? [Underline text are the items that Seaside Watermaster would like the GSP to address.]</u>	There is a large amount of total dissolved solids (TDS) data that was collected from Ford Ord monitoring wells in 2018 that has been used in the seawater intrusion analysis in Chapter 5 (Figure 5-28). As discussed in Chapter 5, there is a high correlation between TDS and chloride results in groundwater in the subbasin, and therefore TDS measurements are a good indicator of seawater intrusion. As discussed in Chapter 7, the area between MCWD-09 and MPMWD#FO-10S remains a data gap. MCWD plan to fill the data gap during GSP implementation by drilling a new well.
<u>3. FO-10 shallow and deep have had almost 15 feet of groundwater level drop over the past 11 years, most of which has been since the start of the drought in 2012. There must be some pumping in this area that is causing this. I do not have the data to help me figure this out. The GSA is going to have to address this.</u>	The decline in groundwater levels in FO-10 is discussed in the GSP. Two possible explanations for the decline are identified in the GSP since there is no identified pumping in this area: (1) these wells are screened within sediments that connect directly to the Deep Aquifers where groundwater levels are declining; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells.
4. To concude, <u>the lack of data available for the 400-ft aquifer (equivalent to Paso Robles aquifer) means we still have a large data gap between the</u>	The GSP identifies this as a data gap and plans to address the data gap by either utilizing an existing well or drilling a new one.

Comments	Responses
400-ft aquifer seawater intrusion and the Seaside Basin.	

Comments Provided on 8 January 2021

Chapter 5 comments

Comments	Responses
1. There are a huge number of acronyms in this Chapter. Please include near the front of the Chapter a list of acronyms and their meanings.	An abbreviations list is provided in the front of the GSP.
2. I am confused by the many names given to the various aquifers. For example in the Seaside Basin we have 3 aquifers: Aromas Sands, Paso Robles, and Santa Margarita. In the adjacent Monterey Subbasin Marina Management Area there are the upper and lower 180' and 400', the Dunes Sands, and the Deep Aquifers. In the Monterey Subbasin Corral de Tierra Management Area there are the El Toro Principle aquifers. I'm sure many of these are hydrogeologically interconnected and thus, in essence, the same aquifer. Near the front of this Chapter please include a table that gives the corresponding name of the aquifers in each of the Management Areas and the adjacent Seaside Subbasin and the 180/400-foot Subbasin, and a cross-section figure that graphically depicts the aquifers across each of these Management Areas and Subbasins.	Text added under Section 4.2.2.
3. Page 7 - This para includes language indicating that there is a data gap in the southern portion of the Marina-Ord area Dune Sand Aquifer. Language should be added to say that this data gap needs to be filled as part of the GSP.	As discussed in Chapter 4, the SVA pinches out in the southwestern portion of the Marina-Ord Area and therefore the Dune Sand Aquifer is likely hydraulicly connected to the underlying aquifers there. The GSAs' near-term plan to fill-in these data gaps is to install monitoring wells in the 400-Foot and Deep Aquifers in this area, as discussed in Section 7.3.2 and Section 10.2.3.1.
4. Page 8 – This para states that the Dune Sand Aquifer protects the upper 180' aquifer from SWI. Please elaborate on how this protection is provided.	See discussion in Section 5.1.2.1: "Groundwater elevations are near sea level at the coastline and are below sea level further inland. This inland gradient allows high salinity water to flow into the Subbasin (see Section 5.3 Seawater Intrusion). However, inflow from the Dune Sand Aquifer protects the upper 180-Foot Aquifer from seawater intrusion."

Comments	Responses
5. Page 8 – Please explain what is causing the local groundwater depression just north of the boundary between the Seaside Subbasin and the Marina-Ord area. The Watermaster is very concerned that we are starting to see increasing chloride levels in our monitoring well FO-10 which is in that area and also in our monitoring well FO-9 which is inside the Seaside Subbasin not too far south and west of FO-10. For more detail on this please refer to page 33 of the Watermaster's 2020 Seawater Intrusion Analysis Report (SIAR) which is posted at this link: http://www.seasidebasinwatermaster.org/Other/2020%20Seawater%20Intrusion%20Analysis%20Report%20Final%2012-3-20.pdf	The local depression is explained in Section 5.1.3 on page 22, which states: "Two CASGEM wells in the southwestern portion of the Marina-Ord Area, MPWMD#FO-10 and MPWMD#FO-11, show consistent decreasing trends over the past 15-years. Additionally, groundwater elevations in these wells are significantly lower than those to the north near the City of Marina and to the south in the Seaside Subbasin. When water levels in these wells are plotted in conjunction with other 400-Foot Aquifer wells in the Marina Ord Area, they indicate the presence of in a localized depression in the groundwater potentiometric surface of the 400-Foot Aquifer. However, there is no known extraction in the Monterey Subbasin in the vicinity of these wells and groundwater elevations observed in these wells are similar to those measured in the Deep Aquifers. These data suggest that (1) these wells are screened within sediments that connect directly to the Deep Aquifers; or (2) leakage is occurring from the 400-Foot Aquifer into the Deep Aquifers in the vicinity of these wells." MCWD will collect additional data in the vicinity of FO-10 and FO-11 during GSP implementation to future understand the cause of groundwater declines and potential seawater intrusion in this area.
6. Figure 5-3 – The depression referred to on page 8 is clearly shown in this Figure so the response to the comment above about this should also refer to this Figure.	See response above.
7. Figure 5-7 – The groundwater contours for the 400-foot aquifer shown in this Figure extend into the Seaside Subbasin. We do not have a 400-foot aquifer in the Seaside Subbasin. Presumably this is either the Paso Robles or the Santa Margarita aquifer, so the legend of this Figure should make that clarification.	The 400-Foot Aquifer in the Monterey Subbasin is likely connected to the Paso Robles Aquifer in the Seaside Subbasin. Note added to figure for clarification.
8. Figure 5-8 – The groundwater contours for the Deep Aquifers shown in this Figure extend into the Seaside Subbasin. We do not have a Deep Aquifer in the Seaside Subbasin, and the aquifers	The Deep Aquifers in the Monterey Subbasin are likely connected to the Santa Margarita Aquifer in the Seaside Subbasin. Note added to figure for clarification.

Comments	Responses
we do have, with the exception of the Aromas Sands, are all much deeper than the contours that are shown.	
9. Figures 5-9 and 5-10 – There are groundwater level contours in the Laguna Seca Subarea of the Seaside Subbasin that should also be plotted on this Figure, since they correspond to the same aquifers that are part of the El Toro Primary Aquifer. Those contours are contained in the Watermaster's 2017 Seawater Intrusion Analysis Report on pages 54 and 55. For 2017 the link to the SIAR is: http://www.seasidebasinwatermaster.org /Other/2017%20Seawater%20Intrusion%20 Analysis%20Report_Final.pdf	The data and groundwater level contours will be included in future versions of the GSP. Groundwater level data from the Laguna Seca wells are included in the creation of the Corral de Tierra contours. Future maps will extend these contours in this portion of the Corral de Tierra into the Laguna Seca as both an acknowledgement of the hydrogeological connectivity, as well as the importance of collaboration regarding cross-boundary flows..
10. Page 21 – The word "the" is missing in the first sentence of this bulleted para, right before the word "large".	Updated.
11. Page 23 – When the term "El Toro Primary Aquifer System" is first introduced please describe the aquifers that comprise it, and if they are not the Paso Robles and Santa Margarita aquifers, explain how they correspond to those aquifers, which are the ones we monitor in the Laguna Seca Subarea of the Seaside Subbasin.	Addressed in the text. The term El Toro Primary Aquifer System is initially defined in Chapter 4, and includes the Paso Robles Formation, the Santa Margarita Sandstone, and the Aromas Sands (if/where they occur in the Corral de Tierra area). The principal aquifers in the Monterey Subbasin, and neighboring subbasins are derived from the same geologic materials. In the Seaside Subbasin, the principal aquifers are named based on the Paso Robles and Santa Margarita geologic Formations. These two geologic formations are grouped together to form the El Toro Primary Aquifer System in the Corral de Tierra area as many wells are screened across both formations. The hydraulic connection between the Corral de Tierra area and the Laguna Seca area is relatively well established with production wells screened in the Paso Robles and Santa Margarita Formations with "shallow" designations generally correlating to wells completed in the Paso Robles formation and "deep" designations generally correlating to wells completed in the Santa Margarita formation.
12. Figure 5-13 – The plots in this Figure of MPWMD#FO-10 and MPWMD#FO-11S show	See response to Comment 5.

Comments	Responses
falling groundwater levels, whereas the other plots in this Figure should stable levels. The reason for the falling levels in these wells, which are in the southwestern portion of the Marina-Ord area, should be explained in the text.	
13. Figure 5-14 – This Figure shows groundwater levels in the Deep Aquifers. The plot for MPWMD#FO-10D shows groundwater levels in the Santa Margarita aquifer, not the Deep Aquifer. I am not sure, but the same may be true of MPWMD#FO-11D.	As discussed in Section 4.2.2.1.7 Deep Aquifers (page 35 of Chapter 4): "Within the Monterey Subbasin, the Deep Aquifers comprise the middle and lower portions of the Paso Robles Formation, the Purisima Formation and the Santa Margarita Sandstone (Hanson et al., 2002; Yates, 2005). The Deep Aquifers are also likely connected to the deep Santa Margarita aquifer in Seaside Subbasin (Yates, 2005)." Therefore, groundwater levels in MPWMD#FO-10D and MPWMD#FO-11D are plotted with other Deep Aquifers within the Monterey Subbasin.
14. Figure 5-18 – The text should discuss the dramatic decline in groundwater elevations occurring since 1998, and a trend line for that portion of the data would be helpful to highlight the rate of decline.	The average rate of decline in groundwater levels in these wells will be added to figure.
15. Figure 5-20 – There is considerably more groundwater level measurement data in the Seaside Subbasin than is depicted in this Figure. That data is available in the Watermaster's annual SIARs and should be added to this Figure, just as the data in the 180/400-foot Aquifer Subbasin is shown.	Noted. The GSP focuses on creating contours for the Monterey Subbasin, and therefore this map only includes wells located in the portion of the Seaside Subbasin that is adjacent to the Monterey Subbasin.
16. Page 37 – A paragraph should be added within the discussion of the AEM data describing the comments and concerns about the reliability of the AEM data which were raised by the Blue Ribbon Panel that reviewed the Cal Am Slant Well reports.	The 2017 AEM Study[1] and 2019 AEM Study[2] for the Monterey Subbasin and surrounding area were performed by highly regarded professors of Geophysics and California Licensed Geophysicists including: • Dr. Rosemary Knight, Ph. D.: Professor of Geophysics at Stanford University,

[1] Stanford/Aqua Geo Frameworks, 2018. *Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA*, Ian Gottschalk, Rosemary Knight, Stanford University, Stanford, CA; Ted Asch, Jared Abraham, Jim Cannia, Aqua Geo Frameworks, Mitchell, NE, dated 15 March 2018.

[2] Aqua Geo Frameworks, 2019. *Final Report on the 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District*, dated 14 November 2019.

Comments	Responses
	• Theodore H. Asch, CA GP#1038; California Licensed Professional Geophysicist with Aqua Geo Frameworks, LLC. • Jared D. Abraham CA GP#1089: a California Licensed Professional Geophysicist with Aqua Geo Frameworks, LLC. The 2017 AEM study has been peer reviewed and has been validated against lithologic and water quality data within the Monterey Subbasin[3]. Both studies have also been provided to California Department of Water Resources (DWR) for review as part of a large new AEM Study that is being conducted by DWR across California. One of the primary authors of the 2017 AEM study, Dr. Ian Gottschalk, Ph. D., is one of the geophysicist working on DWR's study.
17. Page 41 (Next to last para) – A sentence should be added at the end of this para stating that there is also a data gap in the southwestern portion of the Marina-Ord area, which prevents knowing the location of the SWI front in that area as well.	Two Fort Ord monitoring wells that screen the 400-Foot Aquifer near the seawater intrusion front in Figure 5-28 were sampled for total dissolved solids and chloride in 2018, which indicates no sign of seawater intrusion. Thus, data gap in the southwestern portion of the Marina-Ord area was not discussed here. However, Chapter 7 identifies this area as data gap to monitor future seawater intrusion, and this data gap will be filled during GSP implementation by either identifying an existing well in each area that meets the criteria for a valid monitoring well, or drilling a new well in each area, as further described in Chapter 10.
18. Figure 5-24 – In the legend the "Note" pertaining to the Groundwater with TDS <1,000 mg/L is missing.	Note 2 is updated in the latest figure.
19. Figure 5-28 – The text where it discusses this Figure should note that the Watermaster's Sentinel Well SBWM-1, which is located next to the coast just north of the Seaside-Marina-Ord boundary has not shown any indication of SWI in any of the aquifers that it penetrates, which include the Paso Robles and Santa Margarita	Although water quality results from SBWM-1 did not indicate seawater intrusion, its well screens are located greater than 1,000 ft bgs. Induction logs from SBWM-1 showed low resistivity and possible seawater intrusion around 400-700 ft bgs which corresponds to the approximately depth of the 400-foot aquifer and the depths of

[3] Gottschalk, I., Knight, R., Asch, T., Abraham, J. and Cannia, J., 2020. Using an airborne electromagnetic method to map saltwater intrusion in the northern Salinas Valley, California. Geophysics, 85(4), pp.B119-B131. https://library.seg.org/doi/full/10.1190/geo2019-0272.1

Comments	Responses
aquifers. Therefore, it is not clear why the extent of the "Area of Known Seawater Intrusion" is shown going into that area. Due to the lack of monitoring well data in that area (as mentioned in some of the comments above) it is not clear how the extent of the SWI front can be accurately depicted in that part of the Marina-Ord area. This is supported by the MCWRA SWI mapping in Appendix 5B which has "???" shown in that area due to lack of data. This comment also applies to Figure 5-29 which also shows the "Area of Known Seawater Intrusion".	the inland MPMWD#FO-10S well screen (650 ft bgs). These data indicate that seawater intrusion potentially exists in the 400-Foot Aquifer (or shallow Paso Robles Aquifer) at this location. The seawater intrusion extent for the remainder of the Subbasin is drawn based on data shown on this figure, including a 2018 sampling event conducted by MCWD from FO monitoring wells to fill data gaps, in addition to wells that are regularly monitored by MCWD and MCWRA.
20. Page 48 – Next to last para - A sentence should be added at the end of this para stating that Wells MPWMD#FO-9 and FO-10 have also been showing increasing TDS levels in recent years.	The following text has been added: "One CASGEM well in the southwestern portion of the Marina-Ord Area, MPWMD#FO-10, showed a recent increase in TDS concentration in 2020. Induction logging at this well suggested that the increase in TDS concentration was no due to casing leakage. However, the exact cause of the elevated TDS/chloride concentration is unknown. The GSAs will collect additional data in the vicinity of this well during GSP implementation in collaboration with the Seaside Basin Watermaster. "
21. Page 48 – Last Para - Provide a para here that discusses the apparent migration of SWI from the Marina-Ord area, south toward the Seaside Subbasin, as discussed in the Watermaster's 2020 SIAR.	See response above. The GSA is making a priority to conduct future investigation of the seawater intrusion extent in the southern portion of the Marina-Ord Area, west of FO-10S.
22. Figure 5-29 – Add an inset plot of TDS levels from well MPWMD#FO-9 to this Figure	Per the Geophysical Investigation Fort Ord Monitoring Wells FO-9 and FO-10 – Preliminary Findings Memo provided by the Seaside Basin Watermaster on April 22, 2021, recent water quality results from MPWMD#FO-09 were impacted by a structural flaw in the casing, which suggests that the samples taken in recent years are not representative of the in-situ aquifer water from the screened interval at this well.
23. Page 50 – Add MPWMD and the Watermaster as entities from which data was collected.	Added.

Comments Provided on 22 April 2021

Monitoring Well FO-10 Induction Logging Results and Request

Comments	Responses
1. Attached is the Tech Memo prepared by Martin Feeney after the recent completion of induction logging of monitoring wells FO-9 and FO-10. As his Memo reports, he does not have an explanation for the findings in FO-10 in which the logging showed high conductivity over nearly the entire depth of the well, whereas the E-log from the original construction of this well did not show this. One theory, that there is leakage in this casing just as is believe to be the case in the casing of FO-9, does not bear out, since there are clearly different water level readings in the different depth wells at FO-10. That indicates that these wells are not cross-connected through casing leakage. Our TAC asked that you please include investigating the cause of these findings in the GSP for this portion of the Monterey Subbasin, and developing any response action that the investigation finds should be taken.	Additional language has been added to the latest draft, under Section 5.3.4 Historical Progression of Seawater Intrusion.
2. With regard to FO-9 Shallow, MPWMD plans to video inspect this well to confirm the suspected casing leakage in FO-9 Shallow and to determine the structural integrity of FO-10 Shallow. They plan to do that work in the next couple of weeks and I will share with you the results of that inspection. If it is found that the casing in FO-9 Shallow is leaking, and that it is not feasible to repair it, MPWMD said that as the owner of the well they plan to destroy it to avoid having it be a cross-aquifer contamination source. Since water level and water quality data from that part of the Seaside Basin is important not only to the Watermaster and MPWMD, but also to MCWD to provide information for your development of the Monterey Subbasin GSP, if the well needs to be destroyed we would like to discuss with you a cost-sharing arrangement to have a replacement monitoring well installed near that location. "One correction. The District is planning to video FO-09 shallow and deep and not FO-10."	Noted.

Comments Provided on 10 May 2021

Comments on Chapter 7

Comments	Responses
1. Section 7.3 – This section states in part "The sustainability indicator for chronic lowering of groundwater levels is evaluated by monitoring groundwater elevations in designated monitoring wells." The list of entities that monitor the 39 wells mentioned here does not include the Watermaster. The Watermaster has numerous wells that are adjacent to the Corral de Tierra subarea, and some that are adjacent to the Marina- Ord subarea. Those should be included in order for the GSP to be able to see how its management actions are affecting the adjacent subbasin.	The 39 wells identified in Chapter 7 are Representative Monitoring Site (RMS) wells. As described in Section 7.1.2, RMSs are a subset of the monitoring network and are focused on monitoring groundwater condition relative to SGMA compliance. The GSAs are required to limit RMS to wells located within the Monterey Subbasin. However, groundwater level data from the wells outside the Monterey Subbasin are included in the creation of the GSP's analysis, e.g. groundwater elevation contours, and development of the basin numerical model. MCWD GSA and SVBGSA will continue coordinating with the Seaside Basin Watermaster to monitor groundwater elevations and water quality in the Seaside Subbasin. These data will be included in future version of the GSP and in annual reporting. Chapter 7 focuses on discussing monitoring network within the Monterey Subbasin. Clarifying language has been added to Section 7.1.
2. Section 7.3 – The 3rd bullet on this page states "RMS wells should facilitate monitoring along the existing seawater intrusion front to verify that water levels in these areas are not declining and increasing the risk of seawater intrusion." Monitoring Well FO-9 is within the Seaside subbasin, just south of the boundary with the Monterey subbasin, and is near the known seawater intrusion front. Therefore, it should be included as an RMS well.	See response to Comment 1.
3. Figure 7-12 and Figure 7-13 – Figures 7-4 and 7-5 should include Monitoring Well FO-9 Shallow and/or FO-9 Deep for the reasons stated above.	See response to Comment 1.
4. Figure 7-6 – Figure 7-6 should include adjacent monitoring wells in the eastern portion of the Laguna Seca subarea of the Seaside subbasin to see how Corral de Tierra management actions are affecting the adjacent subbasin. Montgomery &	The data and groundwater level contours will be included in future versions of the GSP. The groundwater level data from the Laguna Seca wells are included in the creation of the Corral de Tierra contours. Future maps will extend these

Comments	Responses
Associates has maps showing the names and locations of those wells.	contours in this portion of the Corral de Tierra into the Laguna Seca as both an acknowledgement of the hydrogeological connectivity, as well as the importance of cross-boundary collaboration.
5. Section 7.3.2 – The statement from one of the reports cited in this section that 0.2 to 10 wells per 100 square miles is the recommended monitoring well density is ridiculous for purposes of performing any type of reliable groundwater modeling. Far greater well density is necessary for that purpose.	The current monitoring network include 35 wells in the Marina-Ord Area and 13 wells in the Corral de Tierra Area, which is at far greater density than what the reports suggested.
6. Section 7.3.2 – On this page there is the statement "…additional wells are necessary to provide additional groundwater elevation data near the ocean in areas subject to sea water intrusion." It also states that the generalized locations for monitoring wells was based on "Demonstrating conditions at Subbasin boundaries." For the reasons stated above Monitoring Well FO-9 should be included.	See response to Comment 1.
7. Section 7.3.2 – On this page it states "A higher density of monitoring wells is recommended near residential areas or other locations where groundwater withdrawal is significant" and that this is the case in the Corral de Tierra subarea. Per the comment above on page 7-14 the adjacent monitoring wells in the Laguna Seca subarea should be included.	The data and groundwater level contours will be included in future versions of the GSP. The groundwater level data from the Laguna Seca wells are included in the creation of the Corral de Tierra contours. Future maps will extend these contours in this portion of the Corral de Tierra into the Laguna Seca as both an acknowledgement of the hydrogeological connectivity, as well as the importance of cross-boundary collaboration. The Laguna Seca Monitoring wells will be included in the monitoring network, but will not be included in the RMS network, which must use wells within the subbasin boundaries.
8. Figure 7-7 – Although not within the area identified on Figure 7-7 as a "data gap" area, Monitoring Well FO-9 Shallow should be included to help fill that gap.	See response to Comment 1.
9. Figure 7-8 – Although not within the area identified on Figure 7-8 as a "data gap" area, Monitoring Well FO-9 Deep should be included to help fill that gap.	See response to Comment 1.
10. Figure 7-9 – Per the comment above on page 7-14, the adjacent monitoring wells in the Laguna Seca subarea should be included in Figure 7-9.	See response to Comments 4 and 7.

Comments	Responses
11. Section 7.3.3 – In the top para on this page it appears that the word “parallel” should be “perpendicular.” In the 2nd para after the words “…Monterey Subbasin…” the words “…or into any adjacent subbasins…” should be inserted. In that same para the word “southeastern” should be replaced with the word “southern.” In the last para on this page, after the words “Monterey Subbasin” the words “…and in the adjacent Seaside Subbasin…” should be inserted.	Latest draft has been updated per this comment except replacing the word “parallel” with “perpendicular”. As shown on Figure 5-28 in Chapter 5, the current hydraulic gradient and groundwater flow direction is parallel to the seawater intrusion front. Therefore, only minimal migration of seawater intrusion within the Monterey Subbasin was observed during the past two decades.
12. Figure 7-10 – In Figure 7-10 in the Legend this is a symbol for “Area of Potential Seawater Intrusion.” It would be helpful to discuss in the text how that area was determined.	Figure 7-10 shows the same extent as Figure 5-28, please see Chapter 5 for details. A note was added to Figure 7-10 for clarification.
13. Section 7.5 – In the top para the words “…and the Seaside Groundwater Basin Watermaster…” should be added after the word “MPWMD.” In that same para it states “Additional sites are added to the RMS network to facilitate monitoring of significant and unreasonable groundwater conditions…” This supports the need to add monitoring wells in the adjacent Seaside subbasin.	Language added, and see response to Comment 1.
14. Section 7.5 – The Seaside Groundwater Basin Watermaster should be added to the list of monitoring agencies on this page. Per comments above Monitoring Well FO-9 Shallow should be added to Figure 7-15. Per comments above Monitoring Well FO-9 Deep should be added to Figure 7-16. Per comments above Monitoring Wells FO-9 Shallow and Deep should be added to Table 7-4.	See response to Comment 1.
15. Section 7.5 (Page 7-37) – Sentinel MW#1 is also monitored by the Seaside Groundwater Basin Watermaster via induction logging and datalogger groundwater elevation monitoring.	Noted and added to the latest draft.
16. Section 7.5.1 – In the 2nd bullet in this section correct the wording to read “The Seaside Basin Watermaster Monitoring and Management Program…”	Updated.
17. Section 7.5.2 – In the 1st and 2nd bullets in this section add that Monitoring Well FO-9 should be included.	See response to Comment 1.
18. Section 7.6 (Figure 7-17) – In Figure 7-17 monitoring wells in the eastern portion of the	See response to Comments 4 and 7.

Comments	Responses
Laguna Seca subarea should be added to the wells in the groundwater quality monitoring network.	
19. Section 7.6.2 – The statement that the network cannot be expanded by drilling new wells (i.e. monitoring wells) does not make sense.	This sentence was rephrased.

Comments Provided on 13 July 2021

Comments on Chapter 8

Comments	Responses
1. Section 8.4 – The 3rd para on this page talks about SMCs in this subarea and their potential to impact SMCs in adjacent subbasins (in this case the Seaside subbasin). It goes on the say that SMCs for the Monterey subbasin will be set so as to be consistent with SMCs in those adjacent subbasins, so that adjacent subbasins will be able to be sustainable. For this reason it would be appropriate (as mentioned in other comments below) for the monitoring network of the Monterey subbasin to include some monitoring and/or production wells in the Seaside subbasin that are near the border between the two subbasins. Data from those wells can be provided to the SVBGSA at no cost, so the SVBGSA can determine what impact the Monterey subbasin's SMCs are having on the Laguna Seca subarea of the Seaside subbasin, which is the portion of the Seaside subbasin that abuts the Corral de Tierra subarea. This para also mentions that modeling will be one of the means of determining the impacts of the Corral de Tierra SMCs on the adjacent subbasin. The Monterey subbasin model being developed for the MCWDGSA by its consultant EKI should incorporate modeling information from the Seaside Watermaster's Seaside Basin Model (prepared by HydroMetrics) to ensure that the two models are consistent at the boundary between the subbasins.	The data and groundwater level contours are included in the Monterey Subbasin Model, and future data from the Laguna Seca area will continue to refine the model during implementation, as well as for monitoring over the GSP planning period. The GSP has been developed in coordination with vested stakeholders, including those in neighboring basins. Projects have been developed, and will be included in future modeling scenarios and as implementation data are collected. Modelers are continuing to collaborate to improve the understanding of the relationship between Laguna Seca and the Corral de Tierra. As described in detail in Appendix 6B, there are notable differences in hydrogeologic conceptualization and geometry between the MBGWFM and the Seaside Model. a few simplifying assumptions had to be made to effectively link head outputs from the Seaside Model to general head boundary cells along the Seaside boundary within the MBGWFM. The basin GSAs will continue to collaborate with the Seaside Subbasin to further rectify the discrepancies between the two models in a future update to the MBGWFM, and/or to integrate both models into a regional model that covers both subbasins.
2. Table 8-1 – The Corral de Tierra area MT and MO groundwater elevations (2015 and 2008) are believed, based on modeling performed for the Watermaster by HydroMetrics, to be so low that they are causing water to (1) be drained out of	The current model shows approximately 400 AF/yr. flowing from the Corral de Tierra area into the Laguna Seca area.

Comments	Responses
the Seaside subbasin's Laguna Seca Subarea by creating an eastward sloping hydraulic gradient and/or (2) preventing the natural westward flow of groundwater from replenishing the Laguna Seca Subarea, resulting in falling groundwater levels in that subarea. The GSP should mention this and ensure that its SMCs prevent this adverse condition from continuing.	It is important to note that multiple projects need to be implemented in the Corral de Tierra area in order to meet the sustainability goals. Declining water levels have been observed in this area since the early 1990's. The effort to raise groundwater levels in the Corral de Tierra area and neighboring Laguna Seca area will be a sustained and coordinated effort among managers and stakeholders. Additionally, modelers are continuing to collaborate to improve the understanding of the relationship between Laguna Seca and the Corral de Tierra areas. The modeling performed by HydroMetrics in 2016 has a different set of assumptions and boundary conditions than the modeling performed by EKI. These models will be revised through a series of meetings with the modelers to better align assumptions, boundary conditions, and predictions over time.
3. Section 8.7.1 – Reword the first bullet on this page to read "Groundwater elevations at or below those observed in 2015. Lower groundwater elevations could lead to inadequate water production in a significant number of domestic and small water system wells, <u>not only in the Corral de Tierra subarea but also in the Laguna Seca subarea of the adjacent Seaside subbasin.</u>	Updated.
4. Section 8.7.1 – This Section discusses a minimum threshold of 20% exceedances of groundwater levels. As mentioned in the comment above on page 8-8, some monitoring wells in the Laguna Seca subarea, which is directly impacted by groundwater levels in the Corral de Tierra subarea, should be included in Representative Monitoring Sites for the Corral de Tierra subarea when making the 20% calculation.	The Seaside data and groundwater level contours will be included in future versions of the GSP. The groundwater level data from the Laguna Seca wells are included in the development of the Corral de Tierra contours. Future maps will extend these contours in this portion of the Corral de Tierra into the Laguna Seca as both an acknowledgement of the hydrogeological connectivity, as well as the importance of cross-boundary collaboration. The Laguna Seca Monitoring wells will be included in the monitoring network, but will not be included in the RMS network, which must use wells within the subbasin boundaries. The effort to monitor groundwater levels in the Corral de Tierra area and neighboring Laguna

Comments	Responses
	Seca area will be a sustained and coordinated effort among managers and stakeholders.
5. Section 8.7.2.3 – The bottom para on this page mentions undesirable results caused by chronic lowering of groundwater levels within the Corral de Tierra subarea. The following language should be inserted at the appropriate place in this para "These same undesirable effects will occur in the adjacent Laguna Seca subarea from chronic lowering of groundwater levels in the Corral de Tierra subarea."	Language added with modifications.
6. Section 8.7.2.3 – The top para on this page mentions the term "clustering". A better explanation of what would constitute "clustering" should be added to this para, since this is apparently going to be one of the criteria to determine if a significant and unreasonable effect is occurring.	Comment noted.
7. Table 8-2 – Many of the wells in this table also have common names which appear on maps in various reports that have been prepared for the Corral de Tierra and Laguna Seca subareas. A column should be added to this Table titled "Well Common Name" to include that information for the reader's ease of knowing which well in located at the Monitoring Site. Also, as mentioned in the comment above on page 8-8, some monitoring wells in the Seaside subbasin should be included in this Table. Suggested wells for inclusion are: MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-6D, Seca Place, MPWMD#FO-9S, MPWMD #FO-9D,	Table 7-1 in Chapter 7 contains the common name of the RMS wells. This table lists SMCs established in RMS wells pursuant to SGMA. The Seaside monitoring wells will be included in the monitoring network, but not be included in the RMS network, which must use wells within the subbasin boundaries. MCWD GSA and SVBGSA will continue coordinating with Seaside Basin Watermaster to monitor groundwater elevations and water quality in the Seaside Subbasin and will include data from Seaside monitoring wells in annual reporting. The long-term sustainability goal strives to raise water levels and not adversely impact the Seaside Subbasin.
8. Figures 8-4 and 8-5 – The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-9S and MPWMD #FO-9D) should be added to these figures to monitor the effectiveness of the SMCs in the Marina-Ord subarea on preventing seawater intrusion from flowing into the Seaside Subbasin.	See response to Comment 7.
9. Figure 8-6 – The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-	See response to Comment 7.

Comments	Responses
6D, and Seca Place) should be added to these figures to monitor the effectiveness of the SMCs in the Corral de Tierra subarea on preventing chronic lowering of groundwater levels in the Seaside Subbasin.	
10. Section 8.7.3.1 – The next to the last para on this page states "The declining groundwater elevations in the Deep Aquifer may be causing groundwater elevations to fall within the 400-Foot Aquifer in the southwestern portion of the Marina-Ord Area (i.e., near wells MPWMD#FO-10S and MPWMD#FO-11S)." An explanation to support this hypothesis should be included as this is not intuitively apparent.	This is discussed under Section 5.3.1 (see response to Comment 5 for Chapter 5, provided on January 8, 2021). Additional languages were included in the GSP to provide clarification.
11. Section 8.7.3.1 – In the top two paras there are two small typos to correct: (1) in the first para the word "elevations" should be singular; (2) in the second para the last sentence should be reworded in part to read "…Deep Aquifer's wells as well as…"	Updated.
12. Section 8.7.3.1 – The second bullet on this page mentions historical groundwater elevation data from wells monitored by MCWRA. This language should be expanded to include historical groundwater elevation data from wells monitored by the Seaside Basin Watermaster.	Updated.
13. Section 8.7.3.5 – Add at the end of the first sentence at the top of this page the following wording "…including the occurrence of "Material Injury" (as defined in the Seaside Basin adjudication decision) in the Laguna Seca subarea due to lowered groundwater levels."	Updated.
14. Section 8.7.4.1 – Correct "MPWMD" to read "MPWMD" for the wells mentioned in this Section and the footnote at the bottom of this page. Also, update the language in the footnote to read as follows: "Chloride concentration measured from MPWMD#FO-10S and MPWMD#FO-09S in September 2020 were 89.9 mg/L and 90.4 mg/L, respectively. <u>An investigation performed by MPWMD into the cause of this in mid-2021 concluded that there was leakage in the upper portion of the casing that was allowing salty shallow dune sand water to flow downward in this well, thus causing these increases in chloride readings.</u> As part of	"MPWMD" has been corrected. It is our understanding that the leakage in the casing was only confirm in MPWMD#FO-09, and the cause for elevated chloride in MPWMD#FO-10 was still unknown.

Comments	Responses
GSP implementation, the Subbasin GSAs intend to investigate possible seawater intrusion near the southwestern portion of the Marina-Ord Area in collaboration of the Seaside Watermaster.”	
15. Section 8.7.4.2 – In the 2nd para on this page there is discussion about groundwater elevation trends continuing to fall in the early part of the implementation period and then recovering in the latter part of that period. It would helpful to the reader to have an explanation included as to how the rate of recovery of the fallen groundwater levels was determined, and what the level of confidence is in these projections. In other words, is it certain that the projects that will be included in Chapter 9 of the GSP will be able to bring groundwater levels up as shown in the figures in Appendix 8B?	The interim milestones for wells with declining groundwater elevations are determined based on the anticipation that time will be required to implement these projects and management actions. The GSA plans implement projects and management actions, including those listed in Chapters 9 and 10, to achieve these goals. As shown by the water budget and projected groundwater elevation change results in Sections 6.5 and 9.6. As such, a coordinated and sustained approach to sustainable groundwater management will be required between subbasins within the Salinas Valley Basin.
16. Section 8.8.3.1 – There is a table showing estimated groundwater storage in the Marina-Ord area, but I did not see a similar table for the El Toro area.	SVBGSA has chosen to leave this out and focus instead on working towards/attaining the SMC in the GSP. An estimation of groundwater storage may distract from the work on sustainability, and does not include the nuance of accessible groundwater storage.
17. Section 8.8.3.4 – This para discusses the setting of minimum thresholds to avoid dropping below recent levels of storage. The existing groundwater levels in the Corral de Tierra subarea are already causing a loss of groundwater in the Laguna Seca subarea of the Seaside subbasin. Therefore, the Corral de Tierra groundwater levels need to be raised, not just kept from falling further.	The long-term sustainability goal strives to raise water levels and not adversely impact the Seaside Subbasin. The minimum thresholds were set by the Subbasin Committee. The effort to raise groundwater levels in the Corral de Tierra area and neighboring Laguna Seca area will be a sustained and coordinated effort among managers and stakeholders. The long-term sustainability goal will strive to raise water levels and not adversely impact the Seaside Subbasin.
18. Sections 8.10.1 and 8.10.2 – Question: If a water quality problem already exists and therefore the affected part of the subbasin is not sustainable as a potable water supply due to that problem (example of arsenic) doesn’t SGMA require GSPs to include projects and management actions to remedy the problem in order to achieve sustainability?	Based on inputs collected from stakeholders including those from the Corral de Tierra committee, current water quality conditions in the Subbasin have not be determined as significant and unreasonable. In addition, SGMA does not require addressing water quality impacts that existed prior to the establishment of SGMA, such as the arsenic issues mentioned here.

Comments	Responses
19. Section 8.10.3.1 – Small typo to correct in the first para of this Section: put a comma rather than a period after "Monterey County" and make the word "because" not be capitalized.	Updated.
20. Section 8.10.3.1 – Under the "Public water system supply wells regulated by the SWRCB DDW" shouldn't the smaller private systems that are not regulated by DDW, of which there are many in the Corral de Tierra subarea, also be included in the development of the SMCs because of their cumulative impact on the subbasin?	The pumping for *de minimis* and small system wells was approximated based on number of households using land use type, acreage, and parcels.
21. Figure 8A-9 and 8A-10 in Appendix A – The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-9S and MPWMD #FO-9D) should be added to these figures to monitor the effectiveness of the SMCs in the Marina-Ord subarea on preventing seawater intrusion from flowing into the Seaside Subbasin.	See response to Comment 1.
21. Figure 8A-11 and 8A-12 in Appendix A – The wells suggested for inclusion in the comment on page 8-21 (MPWMD#FO-5S, MPWMD#FO-5D, MPWMD#FO-6S, MPWMD#FO-6D, and Seca Place) should be added to this figure to monitor the effectiveness of the SMCs in the Corral de Tierra subarea on preventing chronic lowering of groundwater levels in the Seaside Subbasin.	See response to Comment 7.

Comments Provided on 30 July 2021

Draft Chapter 8 – Supplemental Comments from Seaside Basin Watermaster 7-30-21

These are comments provided by the Watermaster's hydrogeologic consultant, Montgomery & Associates. They supplement the Watermaster's comments dated 7-13-21.

Comments	Responses
1. Figure 8-6 – The Robley wells are the ones to focus on to understand what would happen in the Seaside Basin than the wells on Figure 8-6 that are much farther away from the Seaside Basin. The minimum threshold for the Robley wells are just above record lows in 2020 on the hydrographs (levels this year are undoubtedly going to be even lower!). The GSA has 20 years to get levels at or above the minimum threshold, so levels can still fall lower than they are now between now and 2042.	Comment noted.
2. Figures 8-9 and 8-10 – We don't find the contours on Figures 8-10 and 8-11 very useful because we don't have contours generated the same way for the Seaside Basin (i.e., based on an assumed future condition). The flow direction from the contours is similar to current conditions (see Chapter 5, Figures 5-9 and 5-10) so there is no expected change in flow directions to what has happened in the past. What I found more informative was Figure 8-6 which shows historical hydrographs for the Robley wells together with minimum threshold (elevation that they should not really be going below) and the measurable objective (elevation where they would like to be). Note that the measurable objective is not enforceable but the minimum threshold is.	Comment noted.
3. Figure 8-12 – The example well in Figure 8-12 shows a continuing drop in groundwater levels, with levels only increasing to measurable objectives after 2030 when project benefits are projected to kick in.	The interim milestones included in the Monterey GSP reflect the reality that it will take time to implement projects and management actions to stop groundwater levels from falling and increase levels. As discussed in the GSP, rates of groundwater extraction within the Monterey Subbasin are significantly lower than total recharge, and large volumes of groundwater are flowing into the 180/400-Foot Aquifer Subbasin. As such, sustainability with the Monterey Subbasin will require the implementation of both local and regional projects and management actions to reach sustainability. Such regional solutions will inevitably take time to implement.

Comments	Responses
	The Monterey GSP is consistent with SGMA, which acknowledges this reality and allows 20 years to reach sustainability.
4. Table 8-3 – Table 8-3 provides interim milestone every five years to show how they project levels will eventually meet measurable objectives. This all indicates that groundwater levels in the Laguna Seca subarea will continue to fall for at least the next 10 years.	See response to Comment 3. The long-term sustainability goal will strive to raise water levels and not adversely impact the Seaside Subbasin.
5. Section 8.7.3.5 – Effect of Minimum Thresholds on Neighboring Basins and Subbasins is an important section to look at – I do not feel they have adequately addressed effects on the Seaside Basin from the minimum thresholds. They do not mention the ongoing declines in the Laguna Seca subarea and what the minimum thresholds will do for that nor the impacts that will occur when levels are allowed to fall lower than the minimum threshold over the next 10 years. There is only one sentence addressing Seaside Basin and it reads "The Seaside Subbasin is an adjudicated basin and not subject to SGMA. The subbasin GSAs have and will continue to coordinate closely with the Seaside Watermaster to ensure that the Monterey Subbasin minimum thresholds do not prevent the Seaside basin from meeting its adjudication requirements."	See response to Comments 3 and 4.
6. There is still the ongoing issue in the Coral de Tierra subarea of poor pumping records. This means they still don't understand exactly what is causing the ongoing declines. Derrik mentioned that they are talking about expanding the County groundwater extraction monitoring (GEMS) into the Corral de Tierra subarea, but that section of the GSP has not been posted yet (probably Chapter 10).	Corral de Tierra groundwater pumping demands were estimated for small water systems and domestic wells by SVBGSA using extraction reported to MCWRA and SWRCB where available, and approximated based on number of households to account for small water systems connections and *de minimis* pumpers using land use type, acreage, and parcels. During Implementation, the GEMS program will be expanded and enhanced to collect more data. This data will continually be refined over the implementation period.

Comments Provided on 23 August 2021

Draft Chapter 9 – Comments from Seaside Basin Watermaster 8-23-21

Comments	Responses
1. Section 9.1 – In the next to last sentence in the first para of this Section please insert after the words “Corral de Tierra Management Areas” the words “and the adjacent Seaside Subbasin”.	“Chronic lowering of groundwater levels sustainability indicator” is a term for the SGMA Act, and since MCWD SGA and SVBGSA do not have the authority to monitor wells located in the Seaside Subbasin, the proposed language will not be added to this paragraph. However, MCWD GSA and SVBGSA will continue coordinating with Seaside Basin Watermaster to monitor groundwater elevations and water quality in the Seaside Subbasin and will include data from MPWMD#FO-9 in the annual reporting.
2. Table 9-1 – Multi-basin project R3 states that multi-basin benefits have not been quantified. Without some indication of the level of benefit a Project may be able to provide, decision-makers will not know which ones are the most desirable projects to pursue.	Though the multi-basin benefits have not been quantified in Table 9-1, Section 9.4.3.2 quantifies benefits including evapotranspiration reduction and additional recharge from four recharge basin. Additional benefits would be quantified through further investigation.

3. Table 9-1 – General comment and recommendation: Many of the Projects and Management Actions do not have estimated Costs or estimated Unit Costs provided for them. Recognizing that some projects are essentially only conceptual at this point, nevertheless, an effort should be made, even if it is as simple as "rule of thumb," to estimate what the range of unit costs might be for each project. Without estimated costs it will be impossible for an operating budget for the GSP to be developed, or for fees or water-use related charges to be developed. As was commented on, and I believe correctly so, by some in the SWIG when Derrik presented a summary of the comments received from the TAC for the SWIG when they discussed various projects that would help mitigate seawater intrusion, it is appropriate to do a "reality check" on projects in terms of getting a sense of how financially feasible they may be. Something like a cost-benefit ratio for example. Without sufficient estimated costs and benefits for each project, time and effort will be wasted evaluating projects that have such high cost-to-benefit ratios that they should be dropped out of the Project list early-on. As a corollary, years ago when projects that could help to solve the water-shortage problem of the Monterey Peninsula were being discussed, and no project was supposed to be rejected out-of-hand even if it seemed extremely unlikely, a project to tow icebergs from the Arctic to Monterey Bay so the water could be melted and used as a water supply for the Peninsula was proposed. Time and effort was spent coming to the conclusion that it was simply economically and/or logistically infeasible. The same can be said about a number of the proposed projects which have very high implementation costs and very little water-savings benefit, resulting in very high unit costs. I recommend that a separate table showing just: • P/MA # • Project Name • Quantity of water that will be saved from being pumped • Implementation and O&M costs • Unit Cost	Comment noted. Cost for all projects and management actions are estimated under each of the project descriptions and summarized in Table 9-1 under the "cost" column, including capital costs, O&M costs, and unit costs if applicable. Project benefit and capacity are summarized under the "Project Benefits / Quantification of Benefits" column. As further discussed in Section 10.5, the basin GSAs will further assess project benefit and feasibility during the first two years of GSP implementation. The GSAs will continue to collaborate with the Seaside Watermaster and key agencies during that process.

• A priority ranking column (which would be filled in by the GSP Committee based on the data in the other columns of this table)	
4. Table 9-1 – The Pumping Allocation and Control Management Action will almost certainly be an action/project that will have to be implemented to achieve Corral de Tierra subbasin sustainability. This Management Action will have to achieve the greatest amount of pumping reduction, since all of the other Projects and Management Actions combined, especially after those that are financially infeasible are eliminated, will fall far short of achieving the necessary pumping reduction. Therefore, instead of saying "Decreased extraction; range of potential benefits" in the "Project Benefits/ Quantification of Benefits" column, an amount of pumping reduction should be shown for this Management Action, so the reader can see clearly the magnitude of pumping allocation and control that will be needed.	A "No Pumping" Project scenario was run with the model, and is described along with the results in Section 9.9.2. This project scenario shows that even if all pumping were replaced with alternative supplies and pumping was eliminated, the Corral de Tierra Area would still need recharge projects to reach sustainability. The quantification of benefits for decreased extraction are dependent on the degree of pumping reductions or allocations. As the GSP is implemented, these benefits will be further analyzed and quantified based on the actions taken by the GSAs in coordination with other partner entities and local stakeholders.
5. Section 9.3.4 (page 9-18) – In the last para of this Section it mentions that capital costs were annualized over 25 years. The interest rate for this calculation should be stated, and for what revenue source(s) that rate pertains.	Several of the project scenarios have cost explanations in Appendix 9X, and they show their respective, assumed interest rates.
6. Section 9.4.2.2 (page 9-27) – The first sentence of this Section states that 15,000 AFY of desalinated water could be produced for the "Salinas Valley," and the Section goes on to say that a portion of this would go to the Monterey Subbasin. Since the Seaside Subbasin is also part of the Salinas Valley Groundwater Basin, and since this Section is discussing a "Regional Municipal Supply Project," language should be added saying that a portion of the water supply might also go to the Seaside Subbasin which is also in need of a supplemental water source to achieve sustainability.	The text was reworded into "The proposed plant would produce up to 15,000 AFY of desalinated water for the Salinas Valley. A portion of that would go to the Monterey Subbasin, while others would go to other Subbasin within the Salinas Valley Basin." The GSAs would like to focus on Monterey Subbasin in the text.

7. Section 9.4.6 (page 9-51 to 9-54) – This Section discusses the use of recycled water. Thought needs to be given to the limitation on the volume of recycled water that M1W's Salinas Valley Reclamation Plant or its Pure Water Monterey AWT Plant can produce. The feedwater source for both of those plants is M1W's Regional Treatment Plant, and its flow is currently only about 19 MGD. Water conservation and other factors have nearly eliminated increases in wastewater flows to that plant in recent years. With the CSIP being proposed for expansion in the 180/400-foot Aquifer Subbasin's GSP, with a Pure Water Monterey Expansion Project being proposed for the Seaside Subbasin, and now with the Monterey Subbasin GSP proposing obtaining recycled water from M1W, there appears to be a real risk that the amount of recycled water that can be produced may be over-subscribed.	As described on page 9-53, first paragraph, "MCWD's sewer flows will increase over time as MCWD's water demand increases and could be used as source water for a MCWD expansion of the AWPF." The indirect potable use (IPR) option of this project includes a proposed expansion to the M1W Advanced Treatment Purification Facility that could utilize future sewer flow generated by MCWD.
8. Section 9.4.6 (page 9-52) – The PWM Project currently is only sized to deliver 3,500 AFY to the Seaside Subbasin, not 3,700 AFY as stated in the 4th para on this page. Also on this page it states that the AWPF will be expanded. The word "may" should be used in lieu of the word "will" as there are still obstacles to the proposed expansion project.	Clarification added. The AWTF and regional transmission pipeline was constructed with a capacity of 3,700 AFY for the PWM project to deliver 3,500 AFY to the Seaside Subbasin.
9. Section 9.4.6 (page 9-53 to 9-54) – On these pages it mentions "a MCWD expansion of the AWPF." That should read "a M1W expansion of the AWPF."	Updated.
10. Section 9.4.6 (page 9-54) – The last para in this Section on this page starts out with "The current operation frequency of MCWD's productions generally ranges from 10% to 40%." Please clarify what this statement means.	Text was updated to "The current operation frequency of MCWD's production wells generally ranges from 10% to 40% (i.e., these wells are being operated 10% to 40% of the time)."
11. Figure 9-7 – The RUWAP pipeline is shown extending down General Jim Moore Boulevard clear through Del Rey Oaks and then easterly into Ryan Ranch. Please verify that this pipeline has already been constructed that far. I was of the understanding that it only went part of the way down General Jim Moore and not even as far as South Boundary Road.	The pipeline extends to near South Boundary Road in GJMB but is not constructed within South Boundary Road (the portion that heads east at the southern part of the diagram). The extension of the recycled line down South Boundary road is planned but not yet constructed.

12. Section 9.4.8 (page 9-65) – The para in the middle of this page states in part "…if pumping needs to be reduced to meet sustainable yield…". It is not "if" but simply "will" need to be reduced. Calculations in earlier GSP chapters identify the estimated sustainable yield, and the amount of overpumping that will have to be eliminated to achieve sustainable yield. In addition, sustainability will also necessitate raising groundwater levels in this Subbasin, not just having extractions equal natural replenishment. The reader should clearly be informed that pumping reductions will be necessary, and not misled into thinking that somehow the other Management Actions and Projects will achieve sustainability. In this Section (or elsewhere in this Chapter) there should be a discussion of how users will be able to achieve the necessary level of pumping reduction and still meet the water demands of their customers. This is a problem already being faced in the Seaside Subbasin, specifically with the City of Seaside's Municipal Water System. That System's only source of water is groundwater from the Seaside Subbasin. If further pumping reductions affecting that Water System were to be imposed, it would be unable to supply its customers water needs.	Text described this type of allocation structure, not the current conditions of the Corral. However, to address the comment text has been edited to say "To reduce pumping to meet the sustainable yield, all users would reduce water usage by the same percentage, except for de minimis users." Even though this is a preferred method to reach sustainability, since it is only one of the options for reaching sustainability, this is not the place to discuss the necessity of pumping reductions. A section has been added to the end of Chapter 9 that discusses project scenarios with modeling to assess the need to meet sustainable yield requirements for the Subbasin. Within this section, the following text has been added that specifically addresses this comment: "This project scenario shows that even if all pumping were replaced with alternative supplies and pumping was eliminated, the Corral de Tierra Area would still need recharge projects to reach sustainability."
13. Section 9.4.8 (page 9-65) – In the bottom para on this page it states in part "If the sustainable yield is lower than current extraction…". Earlier chapters in this GSP have clearly shown that current extractions exceed the estimated sustainable yield. So it is not "if" the sustainable yield is lower than current extraction. This sentence should be rewritten to correct this misstatement, and to not leave the reader with the impression that pumping reductions may not be necessary.	See response to Comment 12.
14. Section 9.4.8.2 (page 9-66) – The second para in this Section states that the network of monitoring wells is monitored by MCWRA. The Seaside Basin also monitors wells which my earlier comments (on Chapter 8) recommended be included in the monitoring well network for the Corral de Tierra Subbasin. Language should be added here to point this out.	MCWD GSA and SVBGSA will include monitoring data from Seaside Subbasin in the future annual reporting as appropriate. Since similar language has been added to Chapter 8, the GSAs intend to focus on Monterey Subbasin in Chapter 9.

15. Section 9.4.8.8 (page 9-67) – The word "Subbasin" is missing after the word "Monterey" in the first sentence of the para at the bottom of this page.	Update has been made.
16. Section 9.4.9 (page 9-68) – I commented at one of the earlier GSP Committee meetings that any reduction in flows in any of the creeks in the Corral de Tierra Subbasin that flow westward toward the Seaside Subbasin might reduce the natural replenishment of the Seaside Subbasin. This needs to be pointed out in this Section, and that a hydrogeological evaluation of the impacts of any such projects be prepared to determine if such reductions would adversely impact the Seaside Subbasin.	There is currently no knowledge of westward flowing creeks from the Corral de Tierra Area towards the Laguna Seca area. The Canyon Del Rey watershed overlaps small portions of the western edge of the Corral de Tierra area, however previous reports indicate the majority of the runoff that may occur in this watershed come from the southern boundary of the watershed, south of Highway 68. Additionally, previous reports indicate this watershed has high infiltration of precipitation due to soils composition. During implementation, as data are collected, more analysis will be included to determine surface water relationships between the Corral de Tierra Area and the Laguna Seca area.
17. Section 9.4.11 (page 9-78) – The second sentence in this Section on this page states in part "This water will be disinfected tertiary levels…". It would be clearer and more correctly stated that "This water will be treated to a tertiary level…".	Update has been made.
18. Section 9.5.6 (page 9-102) – The last sentence in the first para on this page mentions effects on groundwater levels in the Monterey Subbasin. Wording should be added to this sentence that effects on groundwater levels in the adjacent Seaside Subbasin should also be evaluated using this model.	Text was updated to "It is anticipated that this model may be expanded to include the coastal area of the 180/400 Foot Subbasin and will aid in evaluating the potential effects of regional projects on seawater intrusion and groundwater levels in the Monterey Subbasin and adjacent subbasins including Seaside and 180/400 Foot Aquifer Subbasins."

19. Section 9.5.7 (page 9-103) – This Section includes a statement that "SGMA does not allow metering of de minimis well users…". SGMA Section 5202 states that the requirement to file an annual report of groundwater extraction does not apply to de minimis extractors. It says nothing about "not allowing metering", nor does it say anything that would prevent a jurisdiction, such as Monterey County or the Monterey County Water Resources Agency, from imposing such a reporting requirement separate from the requirements of SGMA. This language should be corrected to more accurately state what SGMA says. Section 10730(a) of SGMA states in part "A groundwater sustainability agency shall not impose a fee…on a de minimis extractor unless the agency has regulated the users pursuant to this part." It is not clear to me what "regulated the users pursuant to this part" means. It would be good to have a legal review made of the issue of imposing a requirement for de minimis extractors to file annual extraction reports to see if such reporting could be required and not be in conflict with SGMA. This could be very helpful in managing the Subbasin, since there are so many de minimis extractors.	~~The SVBGSA will solicit further legal advice early during GSP implementation and potentially partner with MCWRA and/or the County on addressing *de minimis* extraction.~~ A GSA may not require de minimis users (as defined) to meter or otherwise report annual extraction data. Other public agencies such as the County or Water Resources Agency may have such authority. SGMA allows a GSA to implement regulations to achieve sustainability, including the regulation of extractions, even from de minimis users. If the GSA implements such regulations applicable to de minimis users, it can charge a fee to the de minimis user if the fee is imposed as required by SGMA. The SVBGSA will consult with the County and the Water Resources Agency on addressing the issue of reporting by de minimis users, as they each may have such authority.

Comments Provided on 6 September 2021

Draft Chapter 6 – Comments from Seaside Basin Watermaster 9-6-21

Comments	Responses
1. Section 6 – Just above the bullet list on this page it states there are Three budget time periods, however the chart below the bullet list shows Four time periods. I did not see the value of showing the "Historical Model" bar in the chart since it seemed like only the 15-Year Historical bar was used. Also, I did not understand footnote number 2 on this page – please clarify what is meant by a "five-year equilibration period".	Please see the footnote below the bar chart for details. The five-year equilibration period (WY 1998-2003) allows the model to stabilize from initial conditions, prior to simulations during the 15-year historical period (WY 2004-2018). Please see Section 6.1 for the model calibration discussion.
2. Section 6.1 – The last bullet on this page discusses pumping from various wells. Wouldn't pumping from wells in the Seaside Basin affect ground water levels, and therefore need to be included in the MBGWFM due to the hydrogeologic interconnection between the Seaside Basin and both subareas of the Monterey Subbasin?	The current MBGWFM does not expand to the Seaside Subbasin; however, the boundary condition should have captured the effects of pumping in the Seaside Subbasin. MCWD will continue to with the Seaside Basin to further rectify the discrepancies between the two models in a future update to the MBGWFM, and/or to integrate both models into a regional model that covers both subbasins.
3. Section 6.1.1 – Same comment as on page 6-10 (Comment 2) pertaining to <u>Pumping Records</u>.	See response in Comment 2.
4. Section 6.2.2 – Same comment as on page 6-10 (Comment 2) pertaining to <u>Groundwater pumping</u>.	See response in Comment 2.
5. Section 6.3.3 – Don't understand why there are three bullets shown on this page with each bullet saying the same thing.	The three "analog periods" were created from 20 years-worth of historical information (WY 1999-2018), which maintained the long-term average hydrologic conditions on average. The first two periods, analog years 1-20 and 21-40, repeats hydrology of actual years 1999-2018; while the third period, analog years 41-50, repeats hydrology of the 10-year period 1999-2008.
6. Table 6-1 – Footnote (a) would be good to add to each of the tables in the Appendix in which water budgets are shown, to clarify what a positive or negative value means.	Updated

7. Figures 6-4 to 6-6, and Tables 6-4, 6-6, and 6-7 – Under future anticipated pumping conditions, the outflow from the Corral de Tierra subarea into the Laguna Seca Subarea of the Seaside Subbasin shown in these Figures and discussed in these Sections is projected to start reversing in the future as groundwater levels in the Corral de Tierra continue to fall. The reversal would result in water starting to flow out of the Laguna Seca Subarea and into the Corral de Tierra subarea. This was the finding of Watermaster modeling performed by HydroMetrics in 2016 in their Technical Memorandum dated January 27, 2016 titled "Groundwater Flow Divides within and East of the Laguna Seca Subarea." That report is contained in Attachment 12 of the Watermaster's 2016 Annual Report which can be viewed and downloaded at this URL: http://www.seasidebasinwatermaster.org/Other/2016%20 Final%20Annual%20Report%2012-8-16a.pdf. This should be discussed and addressed in Chapter 6 of the GSP.	Seaside, MCWDGSA, and SVBGSA modelers have begun collaborating to collaborate to improve the understanding of the relationship between Laguna Seca and the Corral de Tierra. The modeling performed by HydroMetrics in 2016 has a different set of assumptions and boundary conditions than the modeling performed by EKI. The MBGWFM does not show that the groundwater flow will reverse and flow out of the Laguna Seca area under future conditions. These models will be revised through a series of meetings with the modelers to better align assumptions, boundary conditions, and predictions over time.
8. Section 6.4.1.1.2 – In the 2nd para of this Section the typo "and" should be corrected to read "an."	Updated
9. Section 6.4.1.1.3 – In the upper bullet of the group of bullets in the center of this page it mentions an inflow from the Seaside Subbasin into the Monterey Subbasin, the majority of which is between the Seaside Subbasin and the Marina-Ord subarea of the Monterey Subbasin. There is a flow divide between that subarea and the Seaside Subbasin which I understood would prevent this. That should be discussed in this Section. This comment also pertains to Table 6-2, Also in this same para the typo "and" should be corrected to read "an."	The magnitude of inflow from the Seaside Subbasin into the Monterey Subbasin is consistent with prior water budgets prepared for the Seaside Subbasin, such as those presented in CH2M (2004) and Yates (2005). As discussed in 6.2.2, this inflow is calculated by the MBGWFM based on modeled groundwater head outputs at the Seaside boundary from the historical Seaside Basin Groundwater Flow Model (Hydrometrics 2009 & 2018) and lateral hydraulic conductivities at boundary cells. Typo had been corrected.

10. Section 6.4.3.1.2 – In this Section there are typos in the 3rd sentence which does not make sense. The statement in this Section regarding a significant amount of pumping data being missing because *de minimis* pumpers do not have to report pumping data provides support to my comment made on the Comment website and at the August 25th GSP Committee meeting that a legal look should be made into whether/how *de minimis* pumping reporting could be required.	The SVBGSA will partner with MCWRA to develop a plan to address *de minimis* extraction.
11. Section 6.5.2.2 – An explanation is warranted regarding the statement in this Section that "No project scenarios were run for the Corral de Tierra area at this time."	Since this comment, a 'project' scenario was run for the Corral de Tierra and added to Section 9.9, as it relates to projects and management actions.
12. Section 6.5.3 – The top para on this page discusses the potential for expansion of the seawater intrusion front in the Monterey Subbasin. This should be considered a significant concern and should be discussed in the Plan Implementation Chapter 10.	This paragraph discusses that change in the magnitude or direction of inter-basin flows could cause expansion of the seawater intrusion front in the Monterey Subbasin. Therefore, MCWD GSA has established a set of wells to monitor the protective groundwater gradient as described in Section 7.3.3. Section 10.2.4.2 states "Spatial data gaps within the seawater intrusion monitoring network in the Marina-Ord Area are located in the same general area as the data gaps identified within the groundwater elevation network. Therefore, the aforementioned new monitoring wells to be constructed in the Marina-Ord Area will be monitored for both groundwater elevation and seawater intrusion." The GSAs plan to monitor seawater intrusion closely by installing monitoring wells, gathering water quality data, and completing an annual report.
13. Section 6.5.5 – In the 1st sentence of the 2nd para of this Section the word "scenario" should be inserted after the word "project."	Updated.

14. Section 6.6.1 – I concur with the discussion on this page that "…simply reducing pumping to within sustainable yield is not proof of sustainability under SGMA, which must be demonstrated by avoiding undesirable results for all 6 sustainability indicators." I also agree with the statement at the bottom of this page that "…confirmation that these quantities could be extracted without inducing seawater intrusion has to be verified." To augment this discussion it would be good to add some language explaining that in order to prevent inducing seawater intrusion, ground water levels near the coast need to be at or above protective elevations. This may necessitate replenishing a basin in order to raise its groundwater levels, not just pumping at the estimated sustainable yield level to stabilize groundwater levels if they would still be below sea level.	The groundwater elevation MTs are set at historic groundwater elevation in the intruded 180-Foot and 400-Foot Aquifers as there has been no observed expansion of the seawater intrusion front over the historical period. This criteria is consistent with the Minimum Thresholds established for the 180/400-Foot Aquifer Subbasin, where a seawater intrusion barrier is considered. In the absence of an injection/extraction barrier, groundwater elevation may need to raise to seawater protective levels to stop further seawater intrusion and meet Measurable Thresholds for seawater intrusion. The basin GSAs will continue to monitor seawater intrusion and fill data gaps in the seawater intrusion monitoring network. In the event that monitoring indicates expansion of the seawater intrusion front, local projects such as IPR could be implemented to raise water levels in selected areas through injection of recycled water (i.e., IPR project) or in lieu recharge as identified in Chapter 9. In the event that monitoring data indicate rapid vertical downward migration of the seawater intrusion front, SMCs may be adjusted to address this issue. Annual and 5 year reports required under SGMA will be used to identify such changes if required.

15. Section 6.6.2 – I concur with the discussion on this page that "…simply reducing pumping to within sustainable yield is not proof of sustainability under SGMA, which must be demonstrated by avoiding undesirable results for all 6 sustainability indicators." I also agree with the statement at the bottom of this page that "Further analysis is necessary to refine estimates of where pumping should be reduced to address all sustainability indicators." To augment this discussion it would be good to add some language explaining that in order to enable the adjacent Seaside Subbasin (specifically the Laguna Seca subarea thereof) to achieve sustainability it will be necessary for ground water levels in the Corral de Tierra subarea to be raised, not just stabilized at 2008 levels. This would necessitate replenishing that subarea of the Monterey Subbasin in order to raise its groundwater levels, not just pumping at the estimated sustainable yield level to stabilize groundwater levels.	The long-term sustainability goal is to raise water levels and maintain them to both meet the objectives of the GSP as well as not adversely impact the Seaside Basin. These objectives will be met through a combination of projects and management actions described in Chapter 9.
16. Section 6.7 (Page 6-64) – My comment on page 6-33 also pertains to the discussion in the top bulleted para on this page. Comment on Page 6-33: "In this Section there are typos in the 3rd sentence which does not make sense. The statement in this Section regarding a significant amount of pumping data being missing because *de minimis* pumpers do not have to report pumping data provides support to my comment made on the Comment website and at the August 25th GSP Committee meeting that a legal look should be made into whether/how *de minimis* pumping reporting could be required."	See response to Comment 10.
17. Section 6.7 (Page 6-64) – With regard to the language in the 2nd bulleted para on this page, my understanding is that the Deep Aquifer is not present in the Seaside Subbasin.	The Deep Aquifers are not in the Seaside Basin, but the geologic formations that comprise the Deep Aquifers are present in the Seaside Basin. This bulleted paragraph highlights the differences in the conceptualization of principal aquifers in the Seaside model versus the MBGWFM.

18. Section 6.7 (Page 6-65) – In the next-to-last bulleted para on this page there is mention of monitoring network expansion in the Corral de Tierra subarea. In previous comments I have asked that the monitoring network be expanded to include some of the near-boundary monitoring wells in the Laguna Seca subarea of the Seaside Subbasin. Including those wells should be mentioned in this para.	Laguna Seca wells will be included in the monitoring network, with revised maps being developed post-DWR submittal. They will not be included in the RMS network.

Draft Chapter 10 – Comments from Seaside Basin Watermaster 9-6-21

Comments	Responses
1. Section 10.2 (Page 10-5) – In the 3rd sentence of the top para on page 10-5 the wording "as well" is repeated. In the 3rd para there is discussion of data collection by other agencies. The Seaside Basin Watermaster should also be listed as it collects monitoring well data that will be useful.	These two comments were addressed.
2. Section 10.2.2 (Page 10-6) – In the 2nd para of this Section there is discussion of data collection by other agencies. MPWMD and the Seaside Basin Watermaster should also be listed as they collect monitoring well data that will be useful.	Updated.
3. Section 10.2.4.5 – There is the statement in this Section that "…monitoring wells outside the Monterey Subbasin cannot be included in the Subbasin's monitoring well network…" I believe thisis an incorrect statement. I could find no such prohibition anywhere in SGMA. Also in this Section there is discussion regarding monitoring well FO-9 shallow. That language should be edited to read as follows: *Within the Seaside Subbasin, ~~the Watermaster is proposing to replace~~ monitoring well FO-09 Shallow where casing leakage has been identified is likely to be replaced. The monitoring well is located nearthe coastline just south of the Seaside-Monterey Subbasin boundary. It is used to (a) monitor groundwater levels relative to seawater intrusion protective groundwater elevations and (b) monitor ~~chloride concentrations~~ water quality in groundwater to detect occurrences of seawater intrusion into both Subbasins*	Per the DWR document (Draft Best management Practices for the Sustainable Management of Groundwater – Sustainable Management Criteria Dated November 2017), "Representative monitoring sites are a subset of a basin's complete monitoring network, where minimum thresholds, measurable objectives, and interim milestones are set." Thus, only wells within the Monterey Subbasins are selected for RMS wells. This section has been edited accordingly.
4. Section 10.2.5 (Page 10-10) – In the next-to-last bullet on this page the word "the" should be inserted before the word "boundary."	Updated
5. Section 10.3 (Page 10-11) – In the first para of this Section "the Seaside Basin Watermaster" should be inserted just before the word "other."	Rephrased it to state "In addition, the basin GSAs have and will continue to coordinate with other entities (including the Seaside Basin Watermaster) on water management efforts that involve the larger Salinas Valley Basin."

6. Section 10.5 (Page 10-12) – At the end of the 3rd para in this Section the words "and the Seaside Basin Watermaster's Seaside Basin Model" should be added. In the 4th para in this Section please clarify what is meant by the words "standing up" as it pertains to the Dry Well Notification System.	Updated. It is a typo which has been corrected.
7. Table 10-1 – My comment on page 10-9 about including monitoring wells outside of the Monterey Subbasin seems to be addressed in the line-item titled "Voluntary monitoring of non-RMS wells." Please clarify in the text if that is correct.	This item, as described in the "Assumptions" column, primarily includes specific conductivity monitoring of non-RMS monitoring wells within the Subbasin. However, as described in Section 10.2.4.5, the Seaside monitoring wells will be included in the monitoring network and will inform future SGMA-related analyses.
8. Table 10-1 – In the line-item titled "Improving Monitoring Networks" the same language that is contained in Table 10-2 on page 10-21 "Add Seaside Subbasin wells to monitoring GWL network" should be added.	See response to Comment 7.
9. Figure 10-1 – Is there a statutory allowance of 2 years for DWR to review GSPs? This seems inordinately long and could cause problems for the GSAs if DWR took that look to provide its feedback.	Yes, the DWR has two years to review the submitted GSP. *GSP Regulations Sec 355.2(e) The Department shall evaluate a Plan within two years of its submittal date and issue a written assessment of the Plan, which shall be posted on the Department's website.*

Appendix 2-F

SVBGSA Subbasin Committee Comment Table

COMMENTS RECEIVED FROM JULY 7, 2020 to December 13, 2021										
Number	**Chapter**	**Table**	**Page**	**Figure**	**Comment Type**	**Date**	Commenter	**Comment**	Response	**Action**
1					Meeting	7/7/2020	Bob Jaques	Will you please say something about Seaside Subbasin?	Emily: Yes, the other 6 generally fall under the SVBGSA jurisdiction. Seaside does not because it is adjudicated.	Meeting comment - noted.
2					Meeting	7/7/2020	Bob Jaques	When do you anticipate releasing the initial set of draft chapters?	Emily: As soon as we're ready. We are reviewing and will release them as soon as humanly possible.	Meeting comment - noted.
3					Meeting	7/7/2020	Janet Brennan	Will those elements you mention be a part of each GSP? So we will be looking to do something similar as the 180/400?	Emily: Yes	Meeting comment - noted.
4					Meeting	7/7/2020	Sarah Hardgrave	With respect to the chapters and topics, given that we're coordinating with MCWD, will there be a single description of the plan area and the HCM? Or will there be two separate descriptions?	Emily: I will defer to Derrik Williams. We are still figuring out how to put this together. We will end up with one GSP, but how the chapters will look is yet to be determined. DW: As Emily points out, we will write one GSP, so the description will be for one basin. If we decide on management areas, there will be those descriptions. However, these additional descriptions need to add up to one basin. I went over the regulations this morning, and we're still working this out.	Meeting comment - noted.
5					Meeting	7/7/2020	Sarah Hardgrave	Patrick will you have separate stakeholder engagement outreach? Will we be	Patrick Breen: We are planning on having separate stakeholder meetings for the Marina-Ord area, and we will send out notice soon. Patrick: It will be a separate group, but it will be a public meeting so everyone here is welcome to join. We are working it out this month. Donna: We are working under a framework agreement. We have our own process, but we are very much coordinating and working under the framework agreement.	Meeting comment - noted.
6					Meeting	7/7/2020	Sarah Hardgrave	Is that framework agreement posted?	We can send it to the subcommittee	Meeting comment - noted.
7					Meeting	7/7/2020	John Farrow	I was interested in hearing about the coordination with MCWD. I think the framework agreement should be posted for the public to view.		Meeting comment - noted.
8					Meeting	7/7/2020	Bob Jaques	I think it would be important to include the Seaside Model developed by HydroMetrics, in addition to the SVIHM and SVOM listed.		Meeting comment - noted.
9					Meeting	7/7/2020	Sarah Hardgrave	Are these workshops meant to be for all subbasins?	Emily: Yes they are. Bob, we have talked about your suggestion. We are planning for the Monterey Subbasin to have a specific Seaside meeting, possibly early in the process (Aug, Sept). Could we cover the model in that meeting? Bob: I think that's a good idea, and I'd like to make a presentation. I spoke with M&A, September is looking good and I think it would fit in well with GSP development. Sarah H: I think that's a good plan.	Meeting comment - noted.
10					Meeting	7/7/2020	Jon Farrow	First, want to make sure there's an opportunity for comment on the drafts; I assume you will proceed similar to 180/400 and post the chapters on the website. 2nd, I'm interested in how you'll coordinate with 180/400 subbasin. Coordination with projects and water charges framework. Not clear to me how that coordination will work out, especially with the integrated plan. Third, you mentioned there would be an opportunity for this committee to provide steering on the drafts before the drafts are written. The SMCs presentation describes options, but how to pick which option will be more suitable. I see the recommendations are not planned for September, but you won't in fact be seeking guidance or in the workshop later this month, on how to focus on one option or another. Those options need to be informed by data and information which is not available yet.	Emily: As the draft chapters are available, they will be included in the agenda packets and posted on the website. They will be very accessible. To the third question about when we will seek input, it's scheduled for September, but we can push it depending on if we're ready. Today is mainly informational. Donna: We will be tracking all the subbasin planning efforts against the 180/400. The 180/400 is kind of the foundational GSP, and was required by the state to be completed first due to its condition. The ISP committee will be looking at the technical aspects of each GSP to see how they will work. The SWIG had its first meeting this month, filled with technical experts and various agencies and groups. The SWIG is looking at developing agreement and how to define SWI and conditions. As we move through the planning process we will look at the integrative parts as well. This integrative planning will be more available at the Adv Committee and BOD meetings.	Meeting comment - noted.
11					Meeting	7/7/2020	Janet Brennan	It was recommended that we use a consensus process to make decisions for the GSP plans. This is a different process than what we used in the 180/400. Can you explain this?	Emily: This process of finding consensus is what Gary intended as well, since I used his slides. What we'll be asking for is strategic direction. The board will look at accepting the plan. We need strategic direction from you.	Meeting comment - noted.
12					Meeting	7/7/2020	Sarah Hardgrave	You did identify we would be making motions and taking votes. There is a goal to achieve consensus, but we will be making motions and taking votes also?	Emily: Exactly. If there is a wide variety of opinions, we'll document that too.	Meeting comment - noted.
13					Meeting	7/7/2020	Janet Brennan	Will each GSP go to the board for approval?	Emily: Our plan is for the comments we receive to be incorporated into the drafts and then go to the board.	Meeting comment - noted.

14					Meeting	7/7/2020	Sarah Hardgrave	With the MCWD agreement, will they have their own committee member for the ISP?	Donna: For the ISP Committee, we would have one represenative from this subbasin committee. The goal is to have one representative from each subbasin. Emily: This is the next agenda item. Within the framework agreement, there are several subcommittees; our committee here, the MCWD committee, a technical committee, a steering committee which will include the GSA manager from each GSA and will provide another layer of alignment to create one GSP. We're looking for one person on this committee to volunteer to be on the ISP and one person for the steering committee	Meeting comment - noted.
15					Meeting	7/7/2020	John Farrow	I have a question about how the technical and steering committees relate to the ISP.	Emily: Technical committee is really to do the work, and make sure the GSP is done in a coordinated fashion with the nuts and bolts of the plan. The steering committee will (as defined in framework agreement) review daft chapters and elevate issues to advisory committee. Any issues to be worked out between the two GSAs will happen here. Donna: To clarify, the genesis of the technical and steering committees really come out of 2018 framework agreement. As each GSA does its work, we wanted to be clear and create as much coordination and communication as possible.	Meeting comment - noted.
16					Meeting	7/7/2020	Gary Peterson	As we think about techical committee, M&A and EKI are meeting to work through technical issues, and the plan is aligned on a technical level. The framework agreement is now 3 years and one GSP old; may be revised. We didn't know what it all would look like when we started it. We can adjust as we go.		Meeting comment - noted.
17					Meeting	7/7/2020	Janet Brennan	I don't understand the hierarchy. Do technical and steering committees provide input? What decisions will these committees be making in relation to how our committee makes recommendations.	Donna: The BOD ultimately has approval over the plan. The technical committee works on technical information, will run through our committee. The technical committee work will come through some of the workshops, and we will discuss these items with you also. Steering committee is related to utilizing BOD member and general managers from each GSA and will keep BOD updated, utilized in slightly different way. ISP Planning committee, fairly clear.	Meeting comment - noted.
18					Meeting	7/7/2020	Janet Brennan	Good overview of recent history. Going back a little bit, seems the Monterey Subbasin used to be a part of the 180/400 subbasin where there is a 3,500 AFY SWI. Why is this subbasin not a part of the 180/400? Why is this subbasin not critically over drafted?	Gary: This is a DWR question. The subbasin determinations were set by DWR.	Meeting comment - noted.
19					Meeting	7/7/2020	Janet Brennan	As part of our subbasin planning, will we address the Deep Aquifer which is a part of this subbasin?	Gary: I would say SWIG will look at that, and it includes City of Marina and MCWD representatives and Bob Jaques, seaside watermaster	Meeting comment - noted.
20					Meeting	7/7/2020	Janet Brennan	Does the Monterey subbasin include all of the Corral de Tierra subbasin?	Leslie Girard: Yes, DWR made corrections to include all of Corral de Tierra.	Meeting comment - noted.
21					Meeting	7/7/2020	Janet Brennan	It seems like there are two distinct subbasin with very different water issues. How are we going to come up with single criteria for the subbasin? Are we going to come up with separate criteria for separate areas?	DW: The criteria, depends on which you're talking about, will be set differently for different areas. However, they must tell a single integrated story. The can be separate, but have to be coordinated. Storage is an example of a single basin criteria. One area cannot prevent another area from reaching sustainability.	Meeting comment - noted.
22					Meeting	7/7/2020	Janet Brennan	That suggests that the area with the greatest problem will be the one that sets the standard.	DW: Not necessarily. It comes down to negotiation between the areas. What is significant and unreasonable in each area. What is a future condition we can reasonably achieve.	Meeting comment - noted.
23					Meeting	7/7/2020	Margaret Anne	Very impressed with the job you've all been doing.		Meeting comment - noted.
24					Meeting	7/7/2020	John Farrow	Not clear if there will be a single GSP to cover both areas. Will it be drafted by this committee or MCWD or the BOD? Do all GSAs need to approve the GSP? Are the jurisdictional areas where they have annexed? Or where there services areas are? Seems to have been given large area. I'm wondering if MCWD representative sought the boundary changes and not DWR, could the MCWD representative give more background? Seems like it has created a complex problem with coordination and the SWIG.	Gary: [map] the green areas are the expanded annexed areas. On left, corral de tierra area. The Ord area in the middle. Leslie Girard: Under SGMA the jurisdictional boundaries of MCWD are its boundaries. That means a GSA cannot impose fees on areas outside of those boundaries. They are service provider for much of the area outside of their jurisdictional boundary. They cannot impose a fee outside of their jurisdictional boundary. DWR allowed for management outside their jurisdictional boundary (MCWD) and SVBGSA will manage the corral area. Patrick Breen: Have nothing to add. We will work together as Leslie Girard described.	Meeting comment - noted.

25					Meeting	7/7/2020	Sarah Hardgrave	Special request for special meeting to have discussion about the edges of the Monterey subbasin. Especially with respect to Laguna Seca area and impact to Seaside, and how SMC apply to adjacent subbasins and coordination actions with neighboring subbasins, like 180/400 subbasin.	DW: Happy to add that in.	Meeting comment - noted.
26					Special Meeting	7/17/2020	Sarah Hardgrave	Is subsidence data reflecting only groundwater impacts, or other sources of change?	DW: Yes. Possibly seeing subsidence due to faults in the area. InSAR data is satellite data, if you till field and move land surface, will show up on InSAR. We will add caveats to text, and explain must be due to lowering groundwater levels.	Meeting comment - noted.
27					Special Meeting	7/17/2020	Janet Brennan	It seems like it would be helpful to have the same subsidence [SMC] as the 180/400.	DW: Great point, SGMA requires us to not cause adverse effects to our neighbors. If we say, can allow 8in drop and they say 0in drop, they can say 'you are preventing us from reaching sustainability.' This is my opinion, if subsidence is not a problem for you, choose 'subsidence is 0 subsidence. There's a right answer and a wrong answer. Yes the 180/400 is zero subsidence.	Meeting comment - noted.
28					Special Meeting	7/17/2020	Janet Brennan	Lacking data, do we have the possibility of simulation?	DW: I suppose the question is really, how accurate are the simulations? They will probably have used that USGS gage for part of the simulation. Make assumptions that the data is 'good enough'. There will be uncertainty, and we can talk about that uncertainty. We can incorporate the uncertainty by including conservative approaches to depletion, or shallow GW levels.	Meeting comment - noted.
29					Special Meeting	7/17/2020	Janet Brennan	Doesn't GDE and ISW require monitoring?	DW: SGMA discusses the rate of depletion, not the flow in a stream or level in a lake. We're measuring our *impact* on SW bodies through GW management.	Meeting comment - noted.
30					Special Meeting	7/17/2020	Janet Brennan	I don't understand how you can do that without being able to measure your impact.	DW: I'll go over more what we did in the 180/400, and talk about some recommended approaches. What we're looking at, historically, has our pumping cause an undesirable effect on the SW? The easiest one to understand is, is there a flow requirement for fish in the river? Has the current rate of pumping caused you to fail to meet that flow requirement? This is about meeting legal obligations with current rates on depletion. This is not the same as knowing what the flow is at any given time.	Meeting comment - noted.
31					Special Meeting	7/17/2020	Sarah Hardgrave	Regarding the model, how it is designed, especially with respect to the relationship between SW and GW. I think a lot of these are intermittent streams which flow during the rainy season. Does the model account for that kind of input from streamflows?	DW: Yes it does. The model has a series of stream inputs. Since it is a GW model, the stream inputs are a little rougher than if this was a stream model.	Meeting comment - noted.
32					Special Meeting	7/17/2020	Sarah Hardgrave	Does it estimate the quantities for different size storm events?	DW: Not in the GW model, but there is a watershed model that is able to estimate runoff. There is a tool that can feed into this and estimate runoff from storms.	Meeting comment - noted.
33					Special Meeting	7/17/2020	Sarah Hardgrave	Can you explain how much water is expected to be in a stream?	DW: For the calibrated period, a period of time where we have data, those data will be in the model. We can say, ok it's doing a reasonable job of estimating the amount of water in the stream. So when they simulate future scenarios, they will be able to say if it's a reasonable estimate. The question is, how important is El Toro creek with connection to GW. This is something we'll be looking for feedback on. Is this really driving sustainability or not. We could say, current conditions are unreasonable or not? El Toro creek may be a good one to look at due to less stratification to aquifers.	Meeting comment - noted.
34					Special Meeting	7/17/2020	Margaret Ann Copernall	Are going to consider the impact on Sea Water Rise?	DW: I will get into it in 3 metrics. Sea Level Rise is an interesting question, and I'll come back to that with sea water intrusion.	Meeting comment - noted.
35					Special Meeting	7/17/2020	Harold Wolgamott	How are we going to write a caveat? This is depletion of GW level. If there is no GW level, we can't control precipitation, how to we write a caveat to explain that?	DW: I don't know if we do write caveats for GW levels? One of the questions that come up is about when there is a drought? The point of these metrics is we are managing a 50yr plan, long-term averages, towards an objective. We try to account for droughts. DWR understands there will be droughts, and people will fall off their plans. We can write a drought caveat.	Meeting comment - noted.
36					Special Meeting	7/17/2020	Bab Jaques	You mention if there's a lack of data on GW levels in the Corral area, ideally, even before you establish the SMC, you would want to obtain more data. I don't know if there's time during GSP development to do that, or if you will be using Seaside Model data. What would be the most effective way to handle that?	DW: You're getting to an important distinction. If we say GW levels in 2015 are significant and unreasonable. We can look at what wells we have, set our SMCs there, then say, we don't have enough wells. During implementation, we can look for more wells. Before we have all data, we will set what we consider significant and unreasonable. We can find new monitoring wells in the future.	Meeting comment - noted.

37					Special Meeting	7/17/2020	Bob Jaques	I understand the GSA received grant money to develop GSP. Can some of that money be used for looking for data?	DW: Ms. Gardner would know more Emily: You do have to have a good grasp on where your data gaps occur so you can provide the missing information. You don't have to have submitted the GSP, but far enough in the process to know where you don't have data	Meeting comment - noted.
38					Special Meeting	7/17/2020	Janet Brennan	I assume, based on the relationship to domestic wells, 1ft above 2015 levels, accounts for these criteria. They are not mutually exclusive. The GDEs, the domestic well issue, we should be able to address these with one threshold. The relationship of GW levels 1ft above the 2015 levels, whether or not that is consistent with Seawater Intrustion concerns.	DW: two good questions. First, you're correct, these options are not mutually exclusive, and you can set the SMCs that way. You can combine the ideas of GDE and groundwater levels. Second, for Seawater Intrustion, there are a couple ways to look at this. Each of the SGMA 6 sustainability indicators, we have to avoid undesirable results simultaneously. No matter what we say, we have to stop SWI. If we don't use GW elevations to stop SWI, that's ok, find another way. You can define everything separately. Some people have tried to address everything all together, stitched together with a GW elevation map. It kind of assumes you already know your projects and actions ahead of time. You have SGMA 6 undesirable results to avoid simultaneously. You can be well above your GW elevation mininimum thresholds for SWI, and meet both.	Meeting comment - noted.
39					Special Meeting	7/17/2020	Janet Brennan	Because our approach to Seawater Intrusion is more to stop the Seawater Intrustion and not related to Groundwater levels, are they compatible?	DW: Say there are two ways to approach this: raise all GW levels and push it back, or drill wells and draw the water down. We may not want to predicate it all together. Things can change in the future. It is a complicated topic.	Meeting comment - noted.
40					Special Meeting	7/17/2020	Sarah Hardgrave	Do we have data in the Corral subarea in terms of the number of wells and kinds of wells they are? I understand domestic wells serving 1-2 households are not regulated, considered de minimis under the law. I understand these wells are the primary types of wells in the Corral area. Can the de minimis users be considered cumulative?	DW: You are correct, we have some data from the Corral area. I will point out we are missing some data from this area. It is a data gap we have to fill, and it will cause us a problem to implement a threshold. You're right, any well that serves a household, no crop, less than 2AFY, de minimis. We cannot force domestic well owners to report to pumping to the GSA or to DWR. I believe we can include them in the management structure, both individually and collectively, but I don't know how just yet. Marina P: We can ask Les Girard to help clarify.	Meeting comment - noted.
41	`				Special Meeting	7/17/2020	Sarah Hardgrave	Without understanding the number of wells, their depths, and how much they're pumping, it seems hard to manage. I am aware for the CALAM managed systems, Ambler and Toro, they have a water quality question with regard to arsenic.	DW: Yes good to know that it should be one of the drivers of our groundwater elevations.	Meeting comment - noted.
42					Special Meeting	7/17/2020	Janet Brennan	I assume this does not address the deep aquifer?	DW: It will include the deep aquifer. It doesn't show up in the whole basin. If we set the total pumping, it will include the Deep aquifer.	Meeting comment - noted.
43					Special Meeting	7/17/2020	Janet Brennan	How did we address it in the 180/400?	DW: We do not set this aquifer by aquifer, we address it as a whole basin. So, this will include the deep aquifer.	Meeting comment - noted.
44					Special Meeting	7/17/2020	Sarah Hardgrave	Because the SWI is occuring in the MCWD management area, what roll does this committee play in working with MCWD in setting this SMC? Will we have the opprtunity to weigh in? Will that be done solely by MCWD then negotiated?	DW: There is a good working relationship right now between the GSAs. The decision-making details have not been worked out. We will continue working coooperatively.	Meeting comment - noted.
45					Special Meeting	7/17/2020	Beverly Bean	I was under the impression that MCWD has already written a GSP and when can we see it?	DW: We are writing a single GSP with EKI.	Meeting comment - noted.
46					Special Meeting	7/17/2020	Beverly Bean	Does their GSP cover the 400 acres?	Gary: The City of Marina has written their GSP. We have read it and commented.	Meeting comment - noted.
47					Special Meeting	7/17/2020	Beverly Bean	Will we be looking at that plan as this committee moves forward? I suggest we look at it to incorporate all available input.	Gary: Derrik is well aware of the plan	Meeting comment - noted.
48					Special Meeting	7/17/2020	Beverly Bean	Is our GSP to replace the plan that Marina wrote?	Sarah: I don't believe so, that area is not in our subbasin. It's in the 180/400 DW: We are not replacing their GSP, it's not in this subbasin Gary: That plan was for an area within the 180/400 subbasin and does not impact our subbasin or GSP	Meeting comment - noted.
49					Special Meeting	7/17/2020	Tamara Voss	I'm with MCWRA, and I'm with group that creates the SWI maps. The area to the south in both the 180' and 400' SWI maps are areas where there is a large data gap. We put a gray band with black question marks to denote the missing data on our maps. I want to make sure everyone knows this is an area with missing data.		Meeting comment - noted.
50					Special Meeting	7/17/2020	Tina Wang	I want to tack on, there is a limited number of wells along the coast for data. There are the sentinel wells put in by the Seaside watermaster and we will look in to those wells.		Meeting comment - noted.

51					Special Meeting	7/17/2020	Bob Jaques	The Salinas Valley Integrated model is going to be used for modeling purposes for all Salinas Valley GSPs. How will that be coordinated with the Seaside GW Model, especially with respect to the Corral area? Do you envision any model runs during Corral GSP developmetn? Or will that be after the GSP approval and implementation.	DW: I believe the USGS has the Seaside model and will incorporate it. There may not be significant differences, but we'll have to negotiate out the differences if they are important. We will run the model during development, several simulations to work out projects and actions.	Meeting comment - noted.
52					Special Meeting	7/17/2020	Sarah Hardgrave	I observed a discussion of the Seaside watermaster and the area where there is a data gap along Fort Ord and to the Coast. I would like to have a conversation about how the monitoring network can be expanded because I don't think we can rely on existing data.		Meeting comment - noted.
53	3	Table 3-2 Existing Well Types			JotForm	7/16/2020	Heather Lukacs	We request that this table include all Monterey County regulated drinking water systems and clearly distinguish between type of drinking water system. Local small water systems serve 2-4 connections, state small water systems serve 5-14 connections, private domestic wells serve 1 connection. In addition this table should list agricultural and industrial users as separate well types. This distinction is made in Figure 3-6 but not in this Table. It is important to distinguish between well type here in order to set the stage for good water budget estimates, for the monitoring network, and throughout the plan. This data is all readily available to the public and GSA.	Submission Received	Table 3-2 was made using DWR's OSWCR database, and it does not provide information on the amount of agricultural and industrial wells so these categories have to be combined into the production category. The parcel data used to make Figure 3-6 came from Monterey Country, not from DWR so it is unlikely that these two data sources match up exactly.
58					Meeting	9/4/2020	Beverly Bean	Have any of the recommendations from the GeoSyntec been implemented?	DW: The Zone B8 overlay still only covers the area between the boundary between the subbasins to the Ambler Park area. This overlay says "this is an area of limited water supply". It has not been expanded per the recommendation.	Meeting comment - noted.
59					Meeting	9/4/2020	Beverly Bean	Who would be responsible for implementing those recommendations?	DW: The county planning department would be in charge of the zoning.	Meeting comment - noted.
60					Meeting	9/4/2020	Sarah Hardgrave	Who commission the GeoSyntec report?	Beverly Bean: The County Board of Supes asked for it because of problems with people's wells:	Meeting comment - noted.
61					Meeting	9/4/2020	Janet Brennan	Will the cutbacks in the Seaside Basin be met this year?	Bob Jaques: Yes, through conservation and other measures, they've been able to keep pumping below the 3,000AFY. I anticipate we'll be able to meet that.	Meeting comment - noted.
62					Meeting	9/4/2020	Janet Brennan	CalAm is required to replenish the seaside basin over time. Is that related to the cutbacks?	Bob Jaques: It pays back the basin from the 2007 decision time, by in-lieu replenishment of the basin. By further reducing their pumping by 700 AFY additional, they would pay back what they've pumped since the decision was made.	Meeting comment - noted.
63					Meeting	9/4/2020	Janet Brennan	I think It would be important to know what the demand is in the Corral de Tierra area. That will speak to the kind of projects we need to look at.	DW: We will address that in some upcoming discussions today.	Meeting comment - noted.
64					Meeting	9/4/2020	Sarah Hardgrave	I was involved in the early years of implementation, and have worked with Bob and Derrik. Helpful to see all the work done over time. As you've developed your modeling for the watermaster, can you distinguish the natural safe yield as determined by the court versus the true sustainable yield?	Bob Jaques: Natural safe yield is very simplistic, you look at inputs and outputs at all boundaries. If outputs exceed inputs, you're exceeding the natural safe yield. For sustainable yield, you look at the whole basin. One area can experience drawdown while the whole basin can be sustainable. Our board considered a sustainable yield analysis, but it's very costly. We're waiting to see how the GSP is developed, and then do that analysis with additional information.	Meeting comment - noted.

65					Meeting	9/4/2020	Sarah Hardgrave	Thank you, that is helpful to know. Another observation, the boundaries of the adjudicated area were more political than hydrogeological. The issues between the Eastern Laguna Seca area and the Corral area may be reflective of that. Maybe there isn't a physical division between the subbasins.	Georgina King: You're completely correct, there is no physical boundary there. Parts of the boundary were delineated by flow divides, but we all know those divides change. The boundary shown on the map was actually the incorrect boundary. The correct one was more based on the geology. But yes, you're correct the boundary is more political. DW: Yes, that flow divide was more reflective in the marina area. This corner of the basin was an extension of that line. There really is no difference between managing the Laguna Seca area and managing the Toro/Corral area.	Meeting comment - noted.
66					Meeting	9/4/2020		Subsidence SMC: Motion to accept Option 1: Any subsidence anywhere in the Subbasin is significant and unreasonable using the metric of InSAR data.	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
67					Meeting	9/4/2020	Sarah Hardgrave	Re: Groundwater Storage SMC: I would assume that sustainable yield for the Corral Area would include adequate groundwater flow to the Laguna Seca area.	Abby Ostovar: Yes, through SGMA, you cannot impair your neighbor from reaching sustainability.	Meeting comment - noted.
68					Meeting	9/4/2020		Groundwater Storage SMC: Motion to accept Option 1: Pumping in excess of the sustainable yield leads to significant and unreasonable impacts.	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
69					Meeting	9/4/2020		Seawater Intrusion SMC: Motion to accept Option 2. Existing SWI is significant and unreasonable, and SVBGSA chooses to improve SWI. Goal is to push back seawater intrusion.	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
70					Meeting	9/4/2020	Eric Tynan	I appreciate what you're doing. What's going on in Castroville is it's within 2000 feet of our wells, and we're losing well 3. We've been taking measures, so unless we start pushing it back now, we're in a bad spot. I know it's not close to you, but I appreciate what you're doing.	comment received	Meeting comment - noted.
71					Meeting	9/4/2020	Bob Jaques	Your comment about arsenic being naturally occuring, I have friends on a CWS with arsenic levels worsening over time. They have to put in a remediation system	DW: These are the thresholds we're setting. When we talk about undesirable results, degraded water quality as a result of GSA actions is undesirable. In the case of the arsenic that has already been degrading over time, that wasn't caused by a direct action of the GSA, we would not be responsible for that. Abby Ostovar: Even with Option 1, it doesn't prevent you from taking actions that have the additional benefit of improved quality.	Meeting comment - noted.
72					Meeting	9/4/2020	Janet Brennan	My question is related to Option 3. It would appear that it would not be interferring with other agencies?	Abby Ostovar: . We can come back on who is responsible and for what. My understanding is that this hasn't really played out with SGMA yet. It's still unclear. DW: You're right, it's still not very clear. Many other places in the state are taking the "do no harm" approach. You want to work with partners, but not overstep their bounds with regard to partners.	Meeting comment - noted.

73					Meeting	9/4/2020	Justine Massey	We think about water quality from the perspective from individual, domestic wells. They are the least protected and regulated, but are very important to those who rely on them. I agree with comments on how GSAs engage with water quality is not very clear. However, water quality is one of the six undesirable results. We would like to encourage taking care to explore what the situation is for the domestic wells. That would mean not just using deep supply wells, but measuring what the quality is in shallow wells. We support Option 3 here, we think there is a role for GSAs to address water quality. Even if you go with Option 1, we have more sugestions such as DW mitigation program. To reiterate, we think there are many opportunities for partnerships and multi-benefit projects to mitigate the impacts.	Sarah Hardgrave: Thank you for your comments.	Meeting comment - noted.
74					Meeting	9/4/2020	Bob Jaques	On discussion to move on Option 1. I would vote no. I move for Option 3. My friends on a small water system would want to see someone try to do something. You can start with that, and revise it if you see it's not working.	comment received	Meeting comment - noted.
75					Meeting	9/4/2020	Sarah Hardgrave	That raises the question as to whether we can have split criteria for different parts of the subbasin. Arsenic issues may be more of a concern in the Corral area. Can we consider different criteria for different areas, with part of Option 3 as well?	Abby Ostovar: There is still the conversation about management areas and the whole subbasin. We haven't reached out to DWR. There is a question about different options for different aquifers as well. This may be an area to get your input now, not make a decision, but bring back more information.	Meeting comment - noted.
76					Meeting	9/4/2020	Beverly Bean	Regarding arsenic: Different areas have different issues. I don't believe quality is the job of the GSA, it's the job of other agencies. I believe our job is to make the amount of pumping sustainable. If you get the pumping under control, many quality issues resolve themselves.	Comment received	Meeting comment - noted.
77					Meeting	9/4/2020	Janet Brennan	Actions as wtihin other areas, like pumping, will indirectly benefit quality. I still support Option 1.	Comment received	Meeting comment - noted.
78					Meeting	9/4/2020	Bob Jaques	My experience with regulatory agencies is, they will notify you of the problem but they will not take over and solve it for you.	Comment received	Meeting comment - noted.
79					Meeting	9/4/2020	Sarah Hardgrave	One final comment, whether overpumping is exacerbating quality issues needs to continue to be discussed.	Abby Ostovar: Yes, this gives us direction on how to begin writing the GSP, and how to engage with MCWD. We will certainly continue to have these discussions. Donna Meyer: We have initiated conversations with Monterey County Health and we see them as a valuable partner in this. We are learning more about how we can develop the responsibilities and relationship. We're also reaching out to regional board and other agencies to learn more about jurisdictional responsibilities.	Meeting comment - noted.
80					Meeting	9/4/2020		Water Quality SMC: Motion to accept Option 1: Degraded groundwater quality resulting from direct GSA actions is significant and unreasonable as measured by the number of supply wells.	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
81					Meeting	9/4/2020	Janet Brennan	Re: Groundwater Levels SMC: The relationship of this threshold with SWI, comments were made for the 180/400 that setting it at the 2015 level was not consistent with the requirement to address SWI. Maybe it's not as important in this subbasin. Can we have a discussion about that here?	DW: Janet is correct. And here, we are setting SMCs mainly for the Corral area. In the 180/400 we said we will set SMCs for SWI and we would meet them. What we didn't do is incorporate all our SMCs into GW levels. We said we have 6 different things to meet at the same time. What happens is that one of the SMCs will become the dominant driver of how we manage the GW system. They don't have to absolutely integrate. For example if we say we want to stop SWI by injecting water. Our GW levels will rise above the Min Thresh and it meets the requirements. If we say we want to stop SWI by pumping SWI out, our GW levels will drop and we will have to make some adjustments. At this point, we probably don't want to integrate the objectives just yet because we don't know what our projects will be to meet the SMCs.	Meeting comment - noted.

82					Meeting	9/4/2020	Sarah Hardgrave	I did have some thoughts about data needs for the Corral area and GW levels, and what makes the subbasin unique in terms of the proportional share of pumping for omestic purposes versus ag purposes. Looking at what the 180/400 selected, their water demands and purpose are different than in this area. I think our committee primarily selecting an emphasis on shallow domestic wells is reflective of the primary users in this area. I would like more information on the amount of domestic wells and regulated systems compared to the amount of pumping for ag purposes. I see some reason for having different criteria on the GW levels.	Abby Ostovar: Again, this is an iterative process. Other subbasins also came against this where they need more information. We can get initial direction and still come back with more information.	Meeting comment - noted.
83					Meeting	9/4/2020	Janet Brennan	Groundwater Level SMC: Motion to accept Option 4: Impacting shallow, domestic wells is signficant and unreasonable.	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
84					Meeting	9/4/2020	Beverly Bean	Depletion of Interconnected Surface Water SMC: Motion to accept Option 3: The current rate of surface water depletion is not unreasonable (although it may be significant).	Motion was passed by Committee and will be incorporated into GSP.	This will be incorporated into GSP development as a strategic comment. See memo for further discussion.
85					Meeting	9/4/2020	Sarah Hardgrave	Re: Projects and Management Actions: Pumping reductions question: If domestic wells are de minimus users under SGMA, what ability do we have to do pumping restrictions or a water charges framework?	DW: We will include an analysis of that in our data packet. One question we've talked about internally, we don't have reg authority to meter wells, can there be a voluntary system? We'll look into those options as well.	Meeting comment - noted.
86					Meeting	9/4/2020	Janet Brennan	Seems to me the first priority is not to make the problem worse. So, that means no new wells in the area, that's where we begin.	DW: You did point out earlier about Zone B8 overlay. But if it's the suggestion of this committee, we can propose it is expanded and go to the county as the GSA.	Meeting comment - noted.
87					Meeting	9/4/2020	Sarah Hardgrave	I think it would be helpful if you brought back the recommendations of the GeoSyntec report.	Comment received	Meeting comment - noted.
88					Meeting	9/4/2020	Beverly Bean	I agree. We spent $300,000 on that report and we have those recommendations. We may not have the power to implement those, the county does. We don't need to reinvent the wheel, and I think we have enough to go on. If the Country Club is not recycling their water, we can have the county require that they do. Generally speaking, upper Corral area has better supply and quality than lower Corral area well. Is there a way to purchase, pump and store in those areas?	Comment received	Meeting comment - noted.
89					Meeting	9/4/2020	Margaret Anne Copernall	With respect to the SWI, there has been new information on sea level rise being higher than initially thought and the impacts on GW will be severe.	DW: I am familiar with that recent study. We are planning on developing GW models to address these issues specifically. However, we will be making decisions before the results of those models are available. But we will address it.	Meeting comment - noted.
90					Meeting	9/4/2020	Janet Brennan	Are most of the residents on septic systems or sewer? Requiring community sewage collection systems and recycling water could be an approach if there are enough residences on septic. I raise this as a brainstorm possibility.	Comment received	Meeting comment - noted.
91					Meeting	9/4/2020	Sarah Hardgrave	I want to add on. In the Toro Park subdivisions, they are on a wastewater system. It's not exactly a benefit directly to our subbasin. I recall in the Ferini Ranch there was a discussion to connect to Monterey OneWater to get more flow. For the Country Club, I don't think they have a recycled water source for irrigation, but it may be a good idea for an in lieu recharge situation.	Comment received	Meeting comment - noted.
92					Meeting	9/4/2020	Bob Jaques	A couple things, I know Toro Village is sewered to the Toro area treatment plant near the Highway 68 bridge. I think that system was expanded and extended to pick up a little more, not all the way to the Corral area. Looking at the GeoSyntec recommendations, one was more monitoring wells. This would help M&A to calibrate the model so you're not making too many assumptions. Under the GSP, one was to install more monitoring wells. Even though you can't require de minimis wells to report/monitor, but you can ask them and maybe the GSA could get funding for meters. In Seaside we were able to require some wells to provide pumping data.	DW: Yes, for de minimis users we cannot require metering. One question that has come up in other basins is, can we require users to verify they are de minimis users, so they can account for their water use? This is a possible option, but we need a legal opinion if it falls under SGMA abilities or not.	Meeting comment - noted.

93					Meeting	9/4/2020	Sarah Hardgrave	Any sort of recharge project could be expensive. If in the future, the alternative project to desalinate brackish water pumped from the SWI extraction barrier wells was to come to fruition, if aquifer recharge could happen on the southern end of SWI line, if you were trying to mound treated water in the 180/400, if that would have the benefit of mitigating further SWI? And speaking of water gradients, on the other side we may have water leaving this subbasin to the 180/400 aquifer. Would there be benefit to freshwater recharge at those boundary areas?	Comment received	Meeting comment - noted.
94					Meeting	9/4/2020	Janet Brennan	It seems that addressing some of the problems in the Laguna Seca area would also benefit the Corral area. I don't know what kind of projects those would be, but the inter-relationship should be something to consider.	DW: Would you like us to look at what the shortest pipeline runs might be? From CalWater? Or Monterey OneWater? What is the smallest pipe run possible, and how to get water in the pipe?	Meeting comment - noted.
95					Meeting	9/4/2020	Sarah Hardgrave	I think it depends on what projects MCWD would be developing. I think the shortest route is along Reservation Road. Looking at some sort of recharge/injection in the Laguna Seca area, then along a different route. In addition to providing freshwater and recharge, thinking about if it would also have the benefit of halting SWI.	Comment received	Meeting comment - noted.
96					Meeting	9/4/2020	Janet Brennan	Do we have any idea of water consumption at the residential level, such that recommending conservation measures would be a worthwhile approach?	DW: We don't have specific data. The value used in the 180/400 plan was 0.39 AFY per living unit to be used across the basin. It does not include landscaping use, or differentiate large living units and landscaping.	Meeting comment - noted.
97					Meeting	9/4/2020	Janet Brennan	We could extrapolate use from Carmel Valley or Pebble Beach. Those data are available.	Comment received	Meeting comment - noted.
98					Meeting	9/4/2020	Beverly Bean	I think this data could easily be collected. There are several small systems that keep these record, we just need to do the asking.	Comment received	Meeting comment - noted.
99					Meeting	9/4/2020	Sarah Hardgrave	I would like to see a quantification of the water systems (all sizes) and residential connections.	Comment received	Meeting comment - noted.
100					Meeting	11/6/2020	Bob Jaques	Re: Action Minutes for Subbasin Committee Meeting: I find the action minutes for the meetings not to be satisfactory in the sense that there is so little information provided about what the discussions were at the meeting.	Emily and staff: Action minutes are a particular type of minutes which primarily record meeting motions and votes. Comments from Committee members are recorded in the Comment table and the meetings are also recorded. Chair Hardgrave: We have comments captured in the comment table and we have the technical memorandum that provides additional information about motions. My feeling is that we have the comments captured and the information available to support the minutes if needed.	Meeting comment - noted.
101					Meeting	11/6/2020	Sarah Hardgrave	Re: Draft Chapters: I have a question about the two management areas, and coordination with the two GSAs. First question is around the federal lands, and the importance of GSA coverage, combined with statement that SGMA doesn't apply to federal lands. Could you say more about this issue?	Emily Gardner: It's a grey area we don't yet have clarity on. SGMA doesn't apply to fed lands. However, when a GSP is analyzed, they look at if the whole subbasin is covered. We're trying to find the best approach to this grey area. DW: We have received different feedback from different members at DWR. What is more accurate is, we can't tell people on federal lands what they can and cannot do with their water. We do need to cover all the land, including federal land, with the GSP. We just can't tell them what to do. The safest approach is to cover all the land with a GSA. That is what is being done everywhere else.	Meeting comment - noted.
102					Meeting	11/6/2020	Sarah Hardgrave	In the areas in the middle, BLM land, they probably don't have much GW extraction. I'm interested in the federal lands in the north. Like Presidio Monterey. Will those lands be transferred to local agencies?	Patrick Breen: My understanding is that everything has been transferred that will be transferred, and those areas that you are asking about will not be tranferred and will remain federal.	Meeting comment - noted.
103					Meeting	11/6/2020	Sarah Hardgrave	Are those federal areas served by Marina Coast?	Patrick Breen: Yes, under a contract with the Army.The water use will be captured within MCWD's numbers.	Meeting comment - noted.
104					Meeting	11/6/2020	Sarah Hardgrave	It might be worth considering inviting the presidio as a stakeholder.	Comment received	Meeting comment - noted.
105					Meeting	11/6/2020	Sarah Hardgrave	I have a question about the water charges framework for the Corral de Tierra area, if that will apply to the 300 domestic wells you've identified. It may be a future agenda item.	DW: It's something we've talked about internally, and what are our legal options to do that. That's a great future discussion we will have. Abby Ostovar: You'll see in the project and management actions, it is part of pumping controls, and will be a conversation after the allocations workshop. It's very much on our mind, but not something we've worked on and are prepared to talk about today.	Meeting comment - noted.

106					Meeting	11/6/2020	Sarah Hardgrave	There was a difference in the discussion about the deep aquifer. The staff report left out a few statements about pumping from the deep aquifer. I assume this discussion would be included in another spot in the document.	Abby Ostovar: It's something we'll work with MCWD on. It's a difference of where we talk about it. Some chapters include it in the principal aquifer discussion, but we might have moved it to the water budget chapter.	Meeting comment - noted.
107					Meeting	11/6/2020	Sarah Hardgrave	Comment about the piper diagrams that were included in one version and not in another. For the lay person who may not understand piper diagrams, perhaps include them in an appendix. That way the information is available for the technical experts, but it's not in the draft and weighing down the draft chapter for the lay person. If they are included, more explanation of what they are depicting. This comment goes for the cross section diagrams as well.	Comment received	Meeting comment - noted.
108					Meeting	11/6/2020	Beverly Bean	Re: ISW Input: We have other people who have extensive knowledge, Mike Weaver has extensive knowledge.	Abby Ostovar: Local knowledge would be great. Sarah Hardgrave: I agree	Meeting comment - noted.
109					Meeting	11/6/2020	Sarah Hardgrave	You may want to consider talking with representatives from CalAm. They have some facilities near Toro Creek, but I don't know the depth of their wells in those locations.	Abby Ostovar: I think CalAm's wells are much deeper.	Meeting comment - noted.
110					Meeting	11/6/2020	Beverly Bean	Re: Domestic Wells: As a former active person in our local domestic water system, the Monterey County Health Dept. closely monitors us. They have considerable information about the small water systems. The reports we have to complete every year were very complete. Have you considered them as a source?	Abby Ostovar: We have reached out to them, we have not heard back. Emily Gardner: We took this approach because getting this information from the Health Dept. was a complex process. They have a lot of the information, but only some files have all the information we need like well logs. It's a variable data source, much of it is in PDF form, and we have to open each file and read it individually. We've spoken with the Health Dept, and we've taken this approach first before we go down that route.. We can do that, if that's the direction you prefer. Abby Ostovar: We have a number of well logs and that's how we've located which aquifer these wells are in.	Meeting comment - noted.
111					Meeting	11/6/2020	Tamara Voss	We've been working together to get you data. We have a bit of a well log library. If you had APNs, we could make another go at it. Either APN or quarter section. Maybe there's something we can batch give you. I can't guarantee if it could easily be matched to the map. Isn't there someone on the SWIG? Have you reached out to Roger?	Emily Gardner: Roger and Sheryl Sandoval have both reached out back to us, they're willing collaborate. We have to be focused on our ask, and we have to be prepared to go through the documents and figure out how to match them to the dots on our map.	Meeting comment - noted.
112					Meeting	11/6/2020	Beverly Bean	I just want to reiterate the health department does inspect each new well. You'll have current information. These older wells, pre-1995, many are not functional. The health department does inspect when each new well comes online. They do have this information, and it's current. I know it's a lot of work, but it's current.	Abby Ostovar: They continue to inspect the wells? Emily Gardner: You mean taking water quality samples? (Bev: Yes) Abby Ostovar: Do they take water level information? (Emily: No) (Bev: They know how deep they are, and the water level from when it was drilled.)	Meeting comment - noted.
113					Meeting	11/6/2020	Janet Brennan	It looks like there's no problem in Corral de Terra based on your data? Am I reading this correctly? Also, you use many acronyms in your slide. It would be helpful for you to be more descriptive in your presentations.	Abby Ostovar: This is the best we've been able to do with the data we've got. Have you heard of a lot of wells going dry that aren't reflective of what is here?	Meeting comment - noted.
114					Meeting	11/6/2020	Sarah Hardgrave	You're asking, what year would be a good year to set the baseline to measure GW elevations for SMC?	Abby Ostovar: Yes, we're looking at what year were the impacts on domestic wells minimal? DW: Of the wells we know about, there are 50 on this chart. In 2015 and 2017, we think these wells were operable. We would have to have much lower water levels to have impacts in those wells. Is 2015 or 2017 a safe place to set our water levels? We're looking for feedback from this group that 2015 or 2017 are safe enough? Or do you think there were more wells we don't have data to really say?	Meeting comment - noted.
115					Meeting	11/6/2020	Sarah Hardgrave	I'm not sure if Cal Water Service has any comments since they have such a large base of customers, and they have the most familiarty with their well operations during these years. I don't feel able to answer the question about how many wells were impacted. My impression from your chart was that the	Abby Ostovar: I think 2017 is often considered an average year in the valley? DW: It was a little wet, and 2015 being extremely dry.	Meeting comment - noted.
116					Meeting	11/6/2020	Janet Brennan	The Corral de Tierra is in a B8 Zone which limits pumping. These data seem to contradict the B8 designation. Am I reading this incorrectly?	Beverly Bean: The B8 only applies to certain parts of Corral de Tierra and it doesn't restrict pumping. I don't think you legally can restrict pumping. It simply prevents subdivision of legal lots because that is indirectly a way to reduce pumping. Sarah: Yes, B8 zoning is a land use zoning, not necessarily an effort to limit pumping with existing users. Beverly: Specifically the B8 area, is where the GeoSyntec found the most impact from wells.	Meeting comment - noted.

117					Meeting	11/6/2020	Beverly Bean	These well levels relate directly to the drought years. I agree with Sarah. The driest years are the ones you should be measuring from. Also, when I'm talking about wells, I'm talking about small domestic wells and small mutual water systems, when these drought years come and their well goes dry, they just drill another deeper well.	Abby Ostovar: This doesn't capture if one well went dry, and they drilled another. We'd have both records. These are the domestic wells.	Meeting comment - noted.
118					Meeting	11/6/2020	Sarah Hardgrave	This is a sustainability criteria that is based on the domestic wells. This captures a portion of the domestic wells constructed since 1995, the more	Abby Ostovar: We can update this in the future. Abby Ostovar: So I understand the MT recommendation is 2015.	Meeting comment - noted.
119					Meeting	11/6/2020	Bob Jaques	Re: Wallace Group Memo. It says the purpose was to estimate water extractions, and to estimate available recyled water. It seems like they didn't really complete the task. At the end they talk about information gaps that prevented them from getting handles on those numbers. I have a few ideas. Looking at page 6 and 7, they talk about Cal Utility Service. It seems the Regional Water Board would have waste discharge reports because they all have to be permitted. I've been able to get this information. I would encourage looking at that. Second, on page 7, they have a table of estimated WW flows, the figure for residential indoor domestic use looks awfully high to me. The water reuse on that same page, Las Palmas, there may be additional waste water that could be used from that plant elsewhere in Corral de Tierra.	Abby Ostovar: You're right, the WW is high and the Projects document has the updated number.	Meeting comment - noted.
120					Meeting	11/6/2020	Sarah Hardgrave	Re: Wallace Group Memo: Las Palmas is within the County service area and they are in the process of updating some of the reports. I think the county will have more information available for the WW capacity for that system in the next few months because of a development proposed in that area and they are reporting to the Regional Board. I can ask county staff to provide that.	Comment received	Meeting comment - noted.
121					Meeting	11/6/2020	Janet Brennan	Re: Projects and Management Actions: In terms of use of GW from the Upper Corral Canyon, who would do that? I don't understand who would be doing that? Are we talking about the public water agencies?	Abby Ostovar: The GSA could take actions, we have to figure out who would finance them. I don't know, since it's outside the subbasin boundaries. We could always partner with somebody. Les: The GSA has independent authority to do a variety of things. There are other agencies which have authority. We could form more JPAs, and there are many ways to partner with other entities that have authority.	Meeting comment - noted.
122					Meeting	11/6/2020	Beverly Bean	Re: Projects and Management Actions: Encouraging domestic conservation. In my experience, the people who have small systems or their own wells are not amenable to conservation. During the drought, we observed in our group that we were the only ones that reduced our water use. No one else did. Conservation has been successful on the peninsula because they can reduce your water pressure way down. How can we enforce conservation?	Les: In my opinion, the GSA can regulate extractions of de minimis users, but we can't make them report their extractions. MCWRA can regulate extractions, they have never done so, but they have that authority. Monterey County can also regulate extraction under certain circumstances.	Meeting comment - noted.
123					Meeting	11/6/2020	Les Girard	The GeoSyntec report was commissioned by Monterey County Resource Management Agency, not MCWRA. And the B8 Zone was adopted from that which is a limitation on development.	Beverly Bean: The B8 overlay was in effect since 1992, the GeoSyntec report supported it and allowed it to continue.	Meeting comment - noted.
124					Meeting	11/6/2020	James Sang	I'm really interested in water recharge. I like the use of recycled water instead of GW. It would be dependent on what the residents feel about it. I think it's a good source of water. The use of GW from upper areas, requires a lot of money to build pumps and piping and tanks. Re domestic conservation, I agree with Beverly that people are not willing to do it. I don't like pumping limitations. I like the idea of recharge, but I would like to know exactly where the water is coming from that people are using. If it's coming from wells, we should do collection and recharge around that well.	Comment received	Meeting comment - noted.

125					Meeting	11/6/2020	Sarah Hardgrave	This exercise and this presentation really reinforced the challenge of this particular area, in terms of options for recharge in particular. I was concerned about seeing more details on the limitations and the physical geology of the area, being limiting factors. The decentralized recharge areas and basins, I think there are opportunities for that, but it will be a drop in the bucket. It wouldn't provide as much as benefit, would not have a significant effect in terms of GW levels. This is a rural residential area, so there isn't infrastructure in place for bioswales and that intentional, "Slow it, Sink it, Spread it concept". It also didn't seem like it would result in a lot of recharge to the aquifers. The recharge from runoff is pretty minimal. I think it would be worth it to look at extensive educational program with homeowners. This area is not part of the county's municipal stormwater program. There is extensive materials and information out there with the county RMA, for collaborative efforts in this area, but I'm not fully convinced it would have big bang for the buck.	Comment received	Meeting comment - noted.
126					Meeting	11/6/2020	Beverly Bean	I support what you're saying about recharge. Most of the small users' wells are already at 300-400 feet. Recharge would not be very successful at that depth. The golf course just drilled a new well at 800 feet deep. My strong feeling is enforcing pumping limitations is the only way forward. Legally, we can do it, how do you implement it? I would like to see more details on the last item (pumping limits).	Comment Received	Meeting comment - noted.
127					Meeting	11/6/2020	Sarah Hardgrave	I think at this point in time, I would recommend not taking anything off the table entirely. None of these is a silver bullet. There are a lot of challenges. I would like to see how we can incentivize conservation. Maybe now with the GSA, there is more authority to enforce it and maybe we can approach it differently.	Comment Received	Meeting comment - noted.
128					Email	11/6/2020	Bob Jaques	Re: Project Ideas: Programs and Actions should include: "Coordinate with Seaside Basin Watermaster to mitigate lowering of groundwater levels in the Laguna Seca Subarea" To meet SMC measurable objectives, should include addressing overdraft in the Seaside Basin Laguna Seca Subarea.	Comment received.	
130					Meeting	1/7/2021	Sarah Hardgrave	Are you going to develop a long-term sustainable yield for the two management areas or for the subbasin as a whole?	Abby Ostovar: We have to calculate overdraft as a subbasin, but still need to discuss with MCWD. If only for informational puporses, we will do this for each management area, but we haven't discussed how this all works yet. Have to check what's in the regs, what we can do legally and well as what we want to do. For this conversation, focused on the corral de tierra area. I'm not asking you to make decisions today, this is just to inform you and get you thinking. This is an intermediary step.	Meeting comment - noted.
131					Meeting	1/7/2021	Sarah Hardgrave	It seems like allocations are more easily applied in areas where there are more ag/irrigation users, and not as easily in areas that are predominantly rural and residential areas. Are the Cal-Water and Cal-Am in the Corral area service systems considered municipal systems?	Abby Ostovar: I'm pretty sure, I'll check on it. They would be different than mutual water systems, not overliers.	Meeting comment - noted.
132					Meeting	1/7/2021	Janet Brennan	I think addressing this issue depends on if a pumping allocation system can even be implemented in this area. It seems that a large portion of the water users are beyond the regulatory process.	Abby Ostovar: We can regulate de minimis users. You can regulate them, you just can't meter them. Tricky because you don't know what they are actually pumping.	Meeting comment - noted.
133					Meeting	1/7/2021	Janet Brennan	How do you know they're meeting their allocation?	Abby Ostovar: If there was a connection basis, you could have a set amount per connection. Say you have 1000 AFY and you have 500 connections, and 100 are de minimis users. You could count them as connections and that would be their slice of the pie. It's an approximation.	Meeting comment - noted.
134					Meeting	1/7/2021	Janet Brennan	I guess the question in terms of percentage of users, what percentage are de minimis, what percentage are overliers?	Abby Ostovar: I don't have the percentages here. Do you want to treat municipal systems different than mutual water systems? You can, you don't have to.	Meeting comment - noted.
135					Meeting	1/7/2021	Janet Brennan	Why would you differentiate?	Abby Ostovar: The categories the state uses are overliers and non-overliers. But mutual and municipal are both for domestic use.	Meeting comment - noted.

136					Meeting	1/7/2021	Sarah Hardgrave	It seems that the municipal systems, the Cal-Water service and Cal-Am are serving neighborhoods or developments that are more akin to a medium density residential area, whereas the mutual water systems may serve larger lot property owners. I'm not sure you could treat them equally. Those larger lot owners may have horses, or a small vineyard on their property that may account for more water use. I think that's something we need to consider. In the B8 Zone, the recently adopted county regs for accessory dwelling units do not allow ADUs within the B8 Zone area. So that is not a consideration for future demand, within that B8 portion of the management area. Not all of the management area is in the B8 Zone. In the B8 zone, there's no further subdivision according to the zoning. I don't know how much subdivision potential there is outside of the Zone, but I think it's probably limited. I recommend looking at the county land use plan for the Toro area for an indication of potential growth to use for the calculation of a set aside. I don't think it will be a substantial amount.	Comment received.	Meeting comment - noted.
137					Meeting	1/7/2021	Beverly Bean	Question about the difference between municipal as those being served by Cal-Am or Toro water, compared to the mutual systems formed from residential users. Water source. Mutual water systems pump from wells close to their properties. Where are the wells used by Toro and Cal-Am?	Abby Ostovar: We know where some of the wells are. As far as overlying rights, the mutual water systems' wells are right there, and they can't move that water. We can look at how far away the wells are of the municipal water systems. My guess is that it isn't that far, so it won't make that much of a difference.	Meeting comment - noted.
138					Meeting	1/7/2021	Beverly Bean	You believe they're all within the Corral de Tierra subbasin?	Abby Ostovar: I believe so. We will look at those along the edge.	Meeting comment - noted.
139					Meeting	1/7/2021	Jon Lear	I just want to say as far as Cal-Am pumping in this area and pumping in the Laguna Seca area, there is going to be a change in the Laguna Seca area because the most recent general rate case has CalAm building an intertie to their main system, so there will be an overall reduction in the Laguna Seca area. The corral de tierra area, still plan to have that area pumped. No plan to tie-in to larger system.	Comment received.	Meeting comment - noted.
140					Meeting	1/7/2021	James Sang	I wanted to know exactly how it is being determined you're in overdraft. Are you going to different wells and just judging by how far you reach the water? And in the future, if you're able to get enough progress to bring the water level up, how does that affect the pumping allocation? Last November, we discussed some projects but they didn't seem to really be able to increase the GW supply. I think there are other projects that can be recommended. In Langley, they recommended rooftop water harvesting. I think that's good for anyone that's on a well to reduce their pumping. There are some people who have 5,000 gal tanks. On a 15inch rainfall year on a 1,000 sq ft roof, you can get 9,000 gal. I think it's possible to harvest rainwater and get it into the GW but using the slopes. You could do it by trenching the surface of the hills to collect more of the rainwater, and prevent it from being evaporated and allow it to sink into the soil in the hill and allow it to sink into the ground. How do you determine overdraft?	Abby Ostovar: We use a groundwater model. We're actively working on it. They're very complex models, you have to take in the stratigraphy and climate. We're working on it. We're hoping to have a budget for you soon. For recharge projects, if you put more in the ground, you can take more out. However, there are not great recharge options in this area. There isn't a steady supply of surface water in the area. We're working on scoping a larger recharge project. We've looked at scoping decentralized rainwater harvesting. It will be very challenging to meet the sustainable yield just with those types of projects. There are over 300,000 gal in an AF. The amount you collect on an individual house may help that house, but getting enough homeowners to participate is a very challenging task. We want to pursue it, but we have to look at the numbers to see if we can meet sustainable yield. For a larger recharge project, there is also the question about how to pay for it. Pumping allocations, even if not used for reductions in pumping, could be a way to allocate the financing structure to pay for these kinds of projects.	Meeting comment - noted.
141					Meeting	1/7/2021	Sarah Hardgrave	Given land use in the area, and the residential areas, has there been much fluctuation in pumping over time, or has it been fairly consistent?	Abby Ostovar: One of my staff has looked more at this, but it only goes back to 2013.	Meeting comment - noted.
142					Meeting	1/7/2021	Beverly Bean	I would say the majority of development has happened in the last 50 years or less. I've been here for the last 40 years, and growth was unchecked from the 70s and 80s on, and with the flimsiest ideas of where the water would come from. Historically speaking, I don't know what time frame you're talking about. The growth since the 60's and 70's has been steady. The number of people living here has steadily increased. The groundwater levels are steadily decreasing.	Abby Ostovar: We don't have data for water systems prior to 2013. We could take an average between 2013 and 2018 but that includes a drought. For individual households, we don't have that data, but we could look at the number of households.	Meeting comment - noted.
143					Meeting	1/7/2021	Janet Brennan	If you use historical pumping as the basis of an allocation system, historical pumping has created the problem. So is it historical pumping minus a percentage?	Abby Ostovar: The historical pumping would basically say, 2013-2018, average water use sets up the pie. Your sustainable yield determines the size of the pie. Could be smaller. It just sets the basis for the overall allocation.	Meeting comment - noted.
144					Meeting	1/7/2021	Janet Brennan	Historical pumping seems to be a fair way to allocate water use. I mean, it reflects actual use for all systems, except for de minimis.	Abby Ostovar: The argument against historical is that it rewards those who have caused the problem.	Meeting comment - noted.

145					Meeting	1/7/2021	Janet Brennan	If you have an allocation based on historical use, how does it increase water use?	Abby Ostovar: If you have 2 neighbors, and one has been pumping and irrigate all their land, and the other hasn't, how much they've been pumping determines how much they use in the future. The one who has pumped a lot can continue to pump, and the one who has conserved cannot. Emily Gardner: It would have to be changed proportionally. Abby Ostovar: Right, if you've always used less, you will always use less.	Meeting comment - noted.
146					Meeting	1/7/2021	Beverly Bean	In terms of this historical pumping, if you've caused problems in the past, why should you be allowed to continue that? In my mutual system, we have an allocation of basic use of 30,000 gal per quarter per household. If you go over that, you are punished by a severely higher rate. Maybe those kinds of numbers are the way you need to look at this. If you go by household, what's a reasonable number and if you go over that, you have exceeded your allocation.	Abby Ostovar: There are two more options, by household/building structure or connections. Net acreage would be another one. Sarah mentioned that some people have other uses, like horses. How do you deal with that in your mutual water company?	Meeting comment - noted.
147					Meeting	1/7/2021	Beverly Bean	Having horses is a choice. If you can do it within your allocation, you can do it. The problem is with affluent people, I'm not sure the cost is a deterrent. We don't make special circumstances for what people do on their property. If you use more you pay more. I'm not sure that is a sufficient deterrent.	Comment received.	Meeting comment - noted.
148					Meeting	1/7/2021	Janet Brennan	Could have allocation based on households plus acreage, a hybrid, to account for people who have horses.	Abby Ostovar: It's a fair point that there are other uses than just domestic use.	Meeting comment - noted.
149					Meeting	1/7/2021	Sarah Hardgrave	Some people have swimming pools and other household activities.	Abby Ostovar: The question is "what's fair", does each household get the same? Should allocation be based on acreage and use?	Meeting comment - noted.
150					Meeting	1/7/2021	Sarah Hardgrave	If you fly over this area, there is a quite a bit of variation in size of houses. There's probably some houses over 10,000 ft^2 and other houses that are 2,000 ft^2. That's a challenge in this area to consider. I think that's where a hybrid that considers the lot size might be appropriate.	Abby Ostovar: Would you weigh those equally?	Meeting comment - noted.
151					Meeting	1/7/2021	Sarah Hardgrave	I feel we don't have enough information to weigh in at this point. It would take some better understanding from the land use perspective to propose a hybrid.	Abby Ostovar: If you're in overdraft, this will be one of the ways to meet sustainability. Post GSP there will be more of a process, more stakeholder discussions. Here, this is the foundation. The more input we have now, the better we can come back. When it comes to overliers vs non overliers, should those have a similar metric and allocation or should we have something distinct for those?	Meeting comment - noted.
152					Meeting	1/7/2021	Janet Brennan	I'm not sure why we would want to differentiate between municipal systems and overliers. We should use the same approach for both.	Comment received.	Meeting comment - noted.
153					Meeting	1/7/2021	Sarah Hardgrave	I would agree with you, Janet, because the areas served by Municipal systems, Toro Park, Las Palmas, those are more suburban density neighborhoods, so if you're using some sort of lot size or acreage, that would be reflected. Or those areas would be more likely to have the 0.4 AF househole usage versus someone higher up in corral who has a 10-acre property.	Comment received.	Meeting comment - noted.
154					Meeting	1/7/2021	James Sang	On this issue, what this program is dealing with is if you're getting in overdraft or not. If Cal-Am or Cal-Water has their water source far away, I don't think they should be included unless their source of water is connected to this aquifer.	Sarah Hardgrave: These are satellite systems that are operated by these two utilities that draw their supply in this system. They are neighborhood scale systems that have the source of supply in area.	Meeting comment - noted.
155					Meeting	1/7/2021	Beverly Bean	These dormant overliers, if these are what we call legal lots of record, aren't they entitled to water? We're just counting them in so we can make a water budget?	Abby Ostovar: Theoretically, you can just say they don't get any. She cautioned against that. Either you account for them when they start using, or you set aside part of the pie.	Meeting comment - noted.
156					Meeting	1/7/2021	Beverly Bean	Are these legal lots of record? Simple enough to find out who they are and how many there are.	Comment received.	Meeting comment - noted.
157					Meeting	1/7/2021	Sarah Hardgrave	I agree, from the county's land use perspective, there would be a significant issue if legal lot of record were not accounted for in the budget.	Comment received.	Meeting comment - noted.
158					Meeting	1/7/2021	Sarah Hardgrave	Re: Municipal growth: I think that would be pretty easy to quantify because the potential for that kind of growth is limited for this area. Different question for Marina area and former ft ord.	Comment received.	Meeting comment - noted.

159					Meeting	1/7/2021	Janet Brennan	All I can say is best of luck getting legal lots of record from the county. The county always punts and says it's too detailed. It's crazy. It's not going to be easy Sarah, to find these legal lots in the Toro area. Nobody knows how many legal lots of record there are for the county. Maybe looking at the land use plan and getting a sense for how much development could occur may be the best way.	Comment received.	Meeting comment - noted.
160					Meeting	1/7/2021	Sarah Hardgrave	Did the general plan, 2010 EIR quantify this in any way?	Janet Brennan: No. For example, in Carmel Valley the number of legal lots of record has ranged from 500 to 250 over time, depends on who you're talking to. I don't think we can ask them to get a feel for vacant parcel that could be developed. That's probably the best question rather than legal lots of record which is a more detailed analysis.	Meeting comment - noted.
161					Meeting	1/7/2021	Sarah Hardgrave	Seems like you could look at assessors code for vacant property. But it's an imperfect number. I don't know how into the weeds the GSP needs to get. I do think it would be important to have some general estimate for making sure the potential is accounted for within a sustainable yield allocation. In terms of substantial municipal growth in this area, there's not a lot of room for it. The one major subdivision that was proposed has gone into a conservation easement.	Comment received.	Meeting comment - noted.
162					Meeting	1/7/2021	Beverly Bean	I would like to say a de minimis user could have a large estate property and use a large amount of water. They have their own wells for the property.	Abby Ostovar: De minimis is defined as those using less than 2 AFY. You have to somehow determine how much they're using.	Meeting comment - noted.
163					Meeting	1/7/2021	Beverly Bean	How do you ask them or determine that?	Abby Ostovar: For a 0.4 AFY, that's 5 households under 2 AFY.	Meeting comment - noted.
164					Meeting	1/7/2021	Beverly Bean	Some have vineyards or pools, I can imagine they're using that much water if they are growing grapes. If you can't meter them, how can you know anything?	Abby Ostovar: You could do an estimate to include them in it. You can still do net acreage. DW: It's a difficult question. Self-certification, and then they have to demonstrate they are de minimis. None of the approaches are perfect. No matter what decision we make, we're going to have to draw a line. And if people have issue, they will have to prove it.	Meeting comment - noted.
165					Meeting	1/7/2021	Sarah Hardgrave	I think it would be helpful if you can bring back alternative proposals that include/exclude [de minimis users] based on your further investigations. If we're using some sort of acreage factor, that should be considered in a hybrid approach.	Comment received.	Meeting comment - noted.
166					Meeting	1/7/2021	James Sang	I think de minimis users should be included, and dormant users should not. If they don't have a well and they're not extracting water from the aquifer. If people are drawing water from the aquifer, they should be charged. If they are not, they should not be charged.	Sarah Hardgrave: There's the question of the allocation amount, and the question of what you do with it. That's a future discussion. Abby Ostovar: Typically dormant users are not charged, even if there's space in the pie for them, if they're not using.	Meeting comment - noted.
167					Meeting	1/7/2021	Janet Brennan	Re: Prioritization of pumping controls: Our response depends on what alternatives we're looking at. If there are projects that will increase supply and are cost effective, our answer will be different than just out of the blue. We need more data.	Abby Ostovar: We're working on that.	Meeting comment - noted.
168					Meeting	1/7/2021	Sarah Hardgrave	I would concur with Janet. It seems like our supply projects are really limited in opportunity. It's hard to answer that question without understanding what those options might be.	Abby Ostovar: I'm hoping next time, these parts will come together. We'll try to come up with some kind of proposal or some kind of allocation structure based on this conversation.	Meeting comment - noted.
169					Meeting	1/7/2021	Janet Brennan	What I got out of it is that the data from the Stanford study (AEM) and the Marina Coast area, there was no inconsistency with that data and MCWRA data. Did I read that correctly? My understanding is that there is a lot of conflict with this data and County resources.	Abby Ostovar: The AEM data informs how we understand the basin. I don't know how is conflicts with MCWRA data. DW: I think the consensus is that AEM data generally supports the conceptual model. People have noted there are specific areas where there are some discrepancies. Your concern is about discrepancies?	Meeting comment - noted.
170					Meeting	1/7/2021	Tina Wang	Re: Discrepancies between Stanford and county data. Our plan has said that in the lower 180 and 400- aquifer, which is currently SWI intruded, the AEM data is consistent with the MCWRA chloride maps. There is one thing we pointed out in that chapter, is the dune sand aquifer and the upper 180 foot aq is not SWI intruded, it is fresh. That's a slight difference with the data published by the county. It does not distinguish the specific conditions in our subbasin that is seperated into the upper 180 that isn't intruded and the lower 180 that is intruded.	Comment received.	Meeting comment - noted.

171					Meeting	1/7/2021	Tamara Voss	Re: Discrepancies between Stanford and county data. Number 1, the agency the does not collect data in the Dune Sand Aq. We also don't break down the 180-foot aq into an upper and a lower. This report seems to group the lower with the 400, instead of with the upper 180. We'll have to have further discussion. I'd want to further understand what EKI defines as fresh water, before I would say the upper 180 is not intruded near the coast. It would helpful to define the geographic extent where the consultant is defining freshwater.	Comment received.	Meeting comment - noted.
172					Meeting	1/7/2021	Sarah Hardgrave	In follow-up to this, I would like to suggest inviting Tamara to one of your TAC meetings to further explore these questions. Seems there is a need for further technical discussions in order to address Janet's question about the discrepancies.	Comment received.	Meeting comment - noted.
173					Meeting	1/7/2021	Bob Jaques	With regard to the AEM data, if I recall correctly, in conjunction with CalAm's slant well desalination planning and EIR process, I think the county convened a blue ribbon panel of hydrologists to review. I believe they evaluated the AEM data and rendered their opinions. They had some concerns about how valid that data was. One of my comments in regard to chapter 5 would be that there should be some language in the document that reports on what that panel's findings were regarding the AEM data. They had some concerns about that data being used.	DW: We have discussed the AEM data with some members of the blue ribbon panel. We did talk to some members, they didn't have too many concerns. I will look at some of the specifics of what was brought up today.	Meeting comment - noted.
174					Meeting	1/7/2021	Bob Jaques	Some additional comments: there are so many acronyms, there needs to be an acronym page in the front. It would help me follow the discussion. In the Seaside, we have 3 aquifers, Aromas, Paso, Santa Margarita. I would like a figure that shows the relationship between the different aquifers and where different terminology is being used. I think they're all connected, but they seem to have different names based on which basin you are in.	Comment received.	Meeting comment - noted.
175					Meeting	1/7/2021	Sarah Hardgrave	A suggestion, in terms of the figures, in figures 1-10, if you could put the 2017 and 2018 figures together, you could see the comparison across the years more easily instead of flipping between fig 1 and fig 5 (several pages away). There are some statements around the Deep Aquifer levels decreasing over time. I was wondering if those kinds of analyses are being included in the Deep Aquifer working group as well as with the SWIG, and also if this subbasin is being included in those committee discussion. I'm cognizant of the concerns of MCWD of the Deep Aquifer and the other parts of the valley, I want to make sure these concerns are being heard.	Abby Ostovar: We've worked very well with EKI, and been involved with these discussions. We wanted to get something out to this group. It just takes time to get through this coordination. We'll take this input and keep working.	Meeting comment - noted.
176					Meeting	1/7/2021	Patrick Breen	The Deep Aquifer presentation was shared with the SWIG.	Comment received.	Meeting comment - noted.
177					Meeting	1/7/2021	Janet Brennan	Regarding the findings of the Deep Aquifer I thought that was the outstanding information in this report. It's the most alarming, and good information I've seen.	Comment received.	Meeting comment - noted.
178					Meeting	1/7/2021	Sarah Hardgrave	Statements around connection between aquifers, the Deep Aquifer being hydrologically connected to the Santa Margarita in the Seaside Basin and the Paso Robles being connected in another place. Connectivity, and concerns for the Seaside basin. Page 31 talked about FO 10 and FO11 monitoring wells and the Seaside watermaster report address those monitoring wells as well. I want to make sure those statements being reported here are consistent with what is being reported to the Water Master. The Pumping tough north of this area, I would like to know what that means for this subbasin.	Abby Ostovar: The pumping trough is part of what EKI and MCWD presented to the SWIG. DW: Historically, the Deep is considered Lower Paso and below. And Santa Margarita gets pulled in. We're waiting to see just how connected all those really are. We're looking forward to seeing the Deep Aq investigation come out. Abby Ostovar: It may make more sense when CH 4 is released, and the rewrite.	Meeting comment - noted.
179					Meeting	1/7/2021	Sarah Hardgrave	SWI, and the MCWRA lines with large swaths with question marks. How do we reconcile those areas where we don't have monitoring well information at the front of the SWI lines. How, in this subbasin, where additional monitoring wells will be needed. I think I brought that up at the MCWD meeting as well.	Comment received.	Meeting comment - noted.

180					Email	2/23/2021	Beverly Bean	page 24 -section 3.1.5 delete the Ft Ord Reuse Authority(FORA) which was disbanded in 2020 page 46 section 3.5 1st paragraph eliminate the sentence about FOR A	Comment received.	
181					Meeting	3/5/2021	James Sang	For every 1% of temperature rise, water vapor increases by 4%. Carbon rises and the ground has been drying up. You see this in the hills in the Corral area when you're driving. We have to capture that precipitation when it's coming down, and increase the soil moisture. For us to have rain, we have to have enough soil moisture. We have to capture that precipitation in the ground.	Comment received.	Meeting comment - noted.
182					Meeting	3/5/2021	Sarah Hardgrave	For the minimum threshold historically observed between 1995 and 2015, is that an annual average? Did the levels fluctuate over those 20 years?	Tina Wang: How it will be measured exactly, we will use water levels collected from November/December compared to water levels collected in November/December. For each well, we will look at the lowest water level observed in November/December between 1995 and 2015 and use that as the minimum threshold. Abby Ostovar: The distinction for the Corral area is that we have selected only 2015 water levels. In a similar way, they will benchmark the representative year, and that will become the threshold year. And they're taking a short timeframe since MCWD was formed. It will roughly mirror our approach. Essentially a very similar approach. Patrick Breen: And just to clarify, some water levels are different within that period of time. There are differences amongst the wells, where 2015 was not the lowest year.	Meeting comment - noted.
183					Meeting	3/5/2021	Sarah Hardgrave	I think this information is important for the next part of the presentation. But as for decision-making, we still have to review this information.There is a lot of incredibly valuable information in the packet. But I hadn't see the 1,700 AF/yr until now.	Comment received.	Special meeting scheduled to provide direction on SMCs
184					Meeting	3/5/2021	Janet Brennan	I see that decisions about projects and management actions are related to sustainable yield, and that information isn't provided. We can move ahead based on other factors, but we still need to know that to make decisions. Maybe at future meetings, that inter-relationship between sustainable yield and projects can be defined.	Abby Ostovar: Absolutely. I'd still like to go over the projects and management actions so you can provide strategic direction on what you want us to focus on. We're on a tight timeline to put together the GSP.	Meeting comment - noted.
185					Meeting	3/5/2021	Bob Jaques	Re: MCWDGSA Indirect potable reuse project: Would this water come from Monterey One Water?	Vera Nelson: That's correct. Patrick Breen: What this doesn't solve is the whole universe of source water. We know CSIP is looking to expand, there's the possibility of river water. I don't want to say MCWD has a particular volume of water and we're going to inject it. This is a conceptual model that assumes there is water that needs to be treated. We're not making some sort of claim. This is a conceptual project for injection. The source of the water to be treated is to be determined.	Meeting comment - noted.
186					Meeting	3/5/2021	Janet Brennan	This item is not on the agenda. What is on the agenda is projects that will benefit the Corral de Tierra area.	Comment received.	Special meeting scheduled to discuss Marina-Ord Management Area projects.
187					Meeting	3/5/2021	Marieke Desmond	Patrick, what other sources (I know this is introductory), what other sources of water would potentially be used for recycled injection? If there are any other sources that can be used?	Patrick Breen: We have existing flows to the plant currently, municipal sewer, or water in the Blanco drain, or other drains going to SRDF. There may be new sources that come on in the future from the river or otherwise. It will be water that goes through the plant for treatment before we can put it in the ground. There is no new source we're speculating about.	Meeting comment - noted.
188					Meeting	3/5/2021	John Bramers	Going back to the monitoring wells. How many wells are in the networks? I think there was an a, b, c. What wells? Are they domestic? Ag? What are they? Mainly the MCWD side.	Tina Wang: We'll be sharing a map of the wells at the MCWD stakeholder meeting. In each aquifer group, we have 9-13 monitoring wells, so 20% means about 2-3 wells exceeding MT would result in an undesirable result. They are only monitoring wells. As a background, water production in this area is limited to MCWD municipal use. There are no identified domestic or Ag use.	Meeting comment - noted.

189					Meeting	3/5/2021	John Bramers	You mentioned recharged for the Deep Aquifer. Do you have a study on that already?	Vera Nelson: What we've done is a feasibility study. We've done an analysis where we would have to inject with the timeframes required for pathogen reduction. But we have not done any geochemichal analysis with regard to compatibility. We have looked at where we could inject relative to gradients of existing wells, and how viable that would be.	Meeting comment - noted.
190					Meeting	3/5/2021	John Bramers	I have one more question. It's about injection over the winter months. Is that the best time to do it?	Vera Nelson: The greatest availability of water is in the winter months. For a municipality, the timing doesn't matter as much, it's just more available. It allows the farmers more water for use in the summer months.	Meeting comment - noted.
191					Meeting	3/5/2021	Bob Jaques	If you're doing stream diversion for recharge into the Corral area, are you looking at other downstream effects on users that would benefit from that water naturally recharging?	Abby Ostovar: That analysis will be done later during the feasibility study.	Meeting comment - noted.
192					Meeting	3/5/2021	Beverly Bean	This comment is strictly addressing the first potential project, the rubber dam. I find it bizarre coming to these meetings and then going to the Toro LUAC. We're continually seeing new [housing] projects added to the area using existing water systems Cal-Am and Toro Water, but these systems are still pumping from this basin. On one hand we're talking about ridiculously expensive projects, and on the other hand there is no moratorium on continuing to add pumping to the basin? Do we have authority to restrict pumping?	Sarah Hardgrave: We're getting to that in the pumping allocations discussion.	Meeting comment - noted.
193					Meeting	3/5/2021	Janet Brennan	My reaction to the project list is that recharging the basin is more efficient than anything at the homeowner level, they almost don't seem viable. I did look at the pumping per connection on Page 4 of the analysis. I did look at the amount of water per connection. There are parts of the Corral Area Subbasin that have excessively high water demand per connection. Salinas Hills has a per unit connection of 0.73. There are four or five areas that have an excessively high water demand per connection. Based on that, and this may not be accurate, this points to the directions for the need for a demand allocation.	Abby Ostovar: Thank you, Janet. The analysis was done by Wallace Group to help this committee because we don't have great pumping data here. For the water systems we do have data, there are some that use 0.7 and others that use 0.2. For the water systems where we have data, larger than 15 connections, we use those values. For the estimation for *de minimus* pumping we use 0.4 AF per household, which may also be underestimating it. When thinking about pumping allocations, if you think that value is significantly low, then more work may need to be done.	Meeting comment - noted.
194					Meeting	3/5/2021	Bob Jaques	One of the projects listed in one of the earlier reports talked about using recycled water for irrigation. Could you explain why that is not on the list?	Abby Ostovar: I do have a slide that was a backup slide. Wallace Group did look into wastewater. There are two main sewage systems in this area. One uses this water for medians. We have not been able to find out if the golf courses use recycled water. There is potential for greater water recycling. There has not been interest in the past from WW operators to do recycling. We're looking at incentive programs, or looking at SVBGSA to incentivize those actions.	Meeting comment - noted.
195					Meeting	3/5/2021	Sarah Hardgrave	In the Las Palmas subdivisions, served by Cal Utilities service and Cal Am manages wastewater. They do have recycling of water in that area, which is one of the larger water municipal users. There is some recycling that is occurring in this area and in separate conversations with CalAm's current rate case, that recycling system is very expensive to operate.	Comment received.	Meeting comment - noted.
196					Meeting	3/5/2021	Bob Jaques	I was thinking the Corral de Tierra Golf Course as one of the larger water users in the area, would be a potentially good candidate for recycled water. In any event I think it would be important to look far enough into the golf course as a regional water user as one of the potential reuse projects. It may be so cost prohibitive, but I don't think it should not be an option.	Abby Ostovar: It was a comment from the Wallace Group as well, that further waste water recycling had a high cost. However, we can still list it as an option.	Meeting comment - noted.
197					Meeting	3/5/2021	Sarah Hardgrave	Well, you have some other expensive projects in there, I don't see why this [waste water project] couldn't also be included.	Comment received.	Meeting comment - noted.
198					Meeting	3/5/2021	Christopher Bunn	To add to the wastewater discussion, there's an opportunity. Cal Utilies Services treats the water and then disperses it in spray fields, just to disperse it. There's going to be a bridge at Davis Road, it could include a pipe underneath, and would be quite close to the main sewage lift station for the City of Salinas and then it could be injected and moved to Marina.	Comment received.	Meeting comment - noted.

199					Meeting	3/5/2021	Sarah Hardgrave	I want to add to build on what MCWD described and build on regional projects. If there were a desal or brackish water plant project in the Marina area serving MCWD down to East Garrison, extending a pipeline down the bluffs and then to Toro Park and Las Palmas, looking at municipal users, that was 64% of total usage. Looking at current materials, current pumping is 2400 AF and 64% in urban systems, and sustainable yield is 1,700, if we could have an alternative supply to those areas, we could reach sustainability. It's pie in the sky at the moment. In terms of this analysis for this area of the subbasin, it would be good to include a potential cost of a pipeline from East Garrison down reservation road to those utilities. I'm just throwing it out there. I hope you will consider it for future discussion.	Abby Ostovar: We've been looking for new ideas as well.	Meeting comment - noted.
200					Meeting	3/5/2021	Beverly Bean	I just want to comment on your comment about the B8 Zone. That is a very small part of this subbasin. It is only preventing subdivision, and there are constant efforts to overturn it and change it. The rest of the area is open to development. In the LUAC, we constantly see more houses going in. So the B8 Zone is just a small part of this area.	Abby Ostovar: Thank you. If and when allocations are developed, there will be a much more refined analysis.	Meeting comment - noted.
201					Meeting	3/5/2021	Beverly Bean	Re: Pumping allocations. I want to comment that the golf course should be included in every one of these charts. They have new wells at 800 feet. We're not allowed to know how much they're pumping. We should try to estimate how much it is.	Abby Ostovar: I don't have it included here, but Wallace Group has that estimation of their water use. They have overlying rights, so you can consider them in the overlier portion of the chart as well.	Meeting comment - noted.
202					Meeting	3/5/2021	Janet Brennan	Drinking water systems, are they municipal, or are they not identified on the chart? Thank would be helpful to include on the chart.	Abby Ostovar: DW systems are municipal systems and mutual water systems. We also included an allocations memo, where it is explained more. But thank you for your suggestion to include in our chart.	Meeting comment - noted.
203					Meeting	3/5/2021	Bob Jaques	Of the various approaches you've described here, is there any estimate of the amount of pumping reduction that would curb under those various scenarios to the sustainable yield? Is there anything other than pumping allocations that has a chance to close that gap?	Abby Ostovar: You mean projects?	Meeting comment - noted.
204					Meeting	3/5/2021	Bob Jaques	Other than simply requiring pumping to be reduced, do any of the other things you mentioned achieve the reduction needed to get to sustainable yield?	Abby Ostovar: Good question. We're talking about the magnitude being over 1,000 AF being reduced. Without the new projects mentioned today, these projects are much smaller than the overdraft. It's looking like allocations may be needed. Everybody could cut the same amount. We haven't done what the volumetric cut down would be, I wanted to keep this conversation conceptual. We would also need to consider a minimum for the human right to water per person to have. We haven't done that analysis.	Meeting comment - noted.
205					Meeting	3/5/2021	Bob Jaques	As you mentioned, if you add those project benefits together, it probably wouldn't be a real big number. Requiring reductions in pumping is going to be the path you need to take to get to sustainable yield. And should be included as a probable thing that has to be done.	Abby Ostovar: I understand this is extremely uncomfortable for everyone, but with the GSP we have to show DWR that we can locally manage our groundwater so that the state doesn't come in and do it.	Meeting comment - noted.
206					Meeting	3/5/2021	Janet Brennan	There's a significant emphasis that the allocation structure is not related to groundwater rights, making the distinction. Yet Option 1 is based on overlying rights. Isn't that a contradiction?	Abby Ostovar: It's tricky. We're trying to avoid an adjudication. No one is going to be fully happy, but how do we prevent someone being so unhappy they start an adjudication? It's a really challenging subbasin. We tried to bring you the main options.	Meeting comment - noted.
207					Meeting	3/5/2021	Margaret-Ann Coppernall	I have a question about the notification if wells would go dry. Do you have any data on which wells went dry in the past and what caused them to go dry? I think it's important to avoid crisis management.	Abby Ostovar: We don't know exactly which wells went dry, no one is collecting that data. The closest we came is developing a groundwater contour, and then looking at the depths of wells that have been drilled. We talked about this when we talked about the SMC. There aren't too many wells we could assess accurately because their location information is not accurate. The analysis is based on the depth of the well and the contours, and determining which wells may go dry.	Meeting comment - noted.
208					Meeting	3/5/2021	Margaret-Ann Coppernall	I think we need to include climate change and sea level rise in the analysis.	Abby Ostovar: We are working on developing future sustainable yield which will take into account climate change. When we finish the water budget, it will include that.	Meeting comment - noted.
209					Meeting	3/5/2021	Beverly Bean	The wells that did go dry and caused the B8 moratorium, the wells most likely to go dry are in the B8 zone. It's my impression the *de minimis* users with their own wells that use huge amounts of water on their various activities would not be affected by these allocations. They will continue to use all the water they want.	Abby Ostovar: While the GSA cannot require metering from various users less than 2AF, they can be regulated. The GSA could implement a pumping charge. There are ways they can somewhat be included, there is some ability. Sarah Hardgrave: I found Table 2 in the Wallace Group memo, on Page 56 of the full agenda packet. It has a list of all municipal systems. I appreciated the data provided today. It showed me that there are 312 private non-agriculture wells, and their total use was not as big as I thought it might be.	Meeting comment - noted.

210					Meeting	3/5/2021	Christopher Bunn	As far as metering, I hope we can meter as many entities as possible. With more data, we can have a more honest discussion. As far as irrigated acreage, you have 1027 irrigated acres and you only have 408 AFY for water use. For sake of discussion, an acre of romaine will take 1 AF. You have to check and see where those ranchers are pumping, if it's within the subbasin or just next door in the 180/400. Romaine is the least thirsty of the crops. It's	Abby Ostovar: Given that GEMs cover most agriculture areas, we should be able to use that data for an analysis for water used. We haven't done an analysis about whether someone is pumping from outside the subbasin and bringing it in. Sarah Hardgrave: The table on Page 57 of the report, the note says it was based on lettuce and romaine.	Meeting comment - noted.
211					Meeting	3/5/2021	Beverly Bean	I just want to clarify that this meeting would be to discuss allocations, projects, and the numbers you need from us. I want clarification on what this meeting would be about.	Sarah Hardgrave: We have not provided feedback on projects or pumping allocations options. And we need to discuss the SMCs. Have a more focused conversation that we haven't really been able to do today. Abby Ostovar: The other part of Beverly's point is that we haven't prepared the water budget with EKI. We will get that to you as soon as possible, but it isn't ready yet.	Meeting comment - noted.
212					Meeting	3/5/2021	Sarah Hardgrave	We need to look for about 1,000 AF of either additional water supply projects or supplemental sources, combined with reductions of pumping to achieve sustainability.	Abby Ostovar: That's our best estimate now. We will do full analysis but we'll refine numbers as best we can. It's on the right order of magnitude.	Meeting comment - noted.
218					Special Meeting	3/23/2021	Sarah Hardgrave	It would be helpful to know how many wells will be impacted at each Measurable Objective.	Emily Gardner: I don't have the answer either. We always talk about these plans being pretty iterative. We talk about the Minimum Threshold and Measurable Objective as relatively solid. This has me thinking, say we pick the lowest one, achieve it, and realize there are some wells that have problems, could we then strive to go higher? Abby, do you know anyone doing that? Abby Ostovar: No, but we do have the 5-year update. We can do the data analysis with the data we have. We can do the analysis, but won't be very helpful since so many wells are not shown at their accurate locations.	Meeting comment - noted.
219					Special Meeting	3/23/2021	Gary Kreeger	The Minimum Threshold, 2015, that was in the middle of the big drought? How much of that level was from the drought? How much was from over pumping? If you are picking a drought year, you are picking pretty rock bottom.	Abby Ostovar: We can say that the trend is going down, regardless of drought year. But they both have an impact. It's hard to separate them out. Here, it went lower in 2016, and 2019 was slightly below 2015 levels. DW: It's hard to disaggregate when we already have declining water levels. The drought is overlain on a significant downward trend. Our bigger concern is the ongoing depletion here.	Meeting comment - noted.
220					Special Meeting	3/23/2021	James Sang	I notice already we're below the Minimum Threshold, are you saying we already have to start conserving water? Is there any benefit if the water level goes above the Measurable Objective?	Abby Ostovar: Regardless of being below the Minimum Threshold, you need to still have actions to get to the MO. The lower you are, the harder you have to work to get there. While there are benefits to being higher than the Measurable Objective, so until that happens, I can't quite say.	Meeting comment - noted.
221					Special Meeting	3/23/2021	Christopher Bunn	I think as part of this discussion, I would want to see what the interaction is between the Toro Aquifer and the aquifers of the 180/400. Because unless that's modelled, you're not going to know what the pumping in that basin is really going to be doing and how it will influence this subbasin. I think that's a pretty important part of the puzzle. Now that the model is available, you can run that analysis.	Abby Ostovar: We've mapped the groundwater elevations and we've looked at how the aquifer contours fit together. Our modelers from M&A are working with EKI modelers, and looking specifically at those cross-boundary flows. They're deep in the modeling world trying to figure that out.	Meeting comment - noted.
222					Special Meeting	3/23/2021	Christopher Bunn	Are you going to look at the historical influence of other subbasins? What did pumping outside of the Monterey Subbasin do to the historical decline?	Abby Ostovar: The SVIHM goes back to 1967 or so, but only has one calibration point in the Monterey subbasin. The EKI model goes back to 1998 and the model run is from 2003 to 2018. Those are the time frames where we'll have a good assessment of this.	Meeting comment - noted.
223					Special Meeting	3/23/2021	Bob Jaques	If you reduce your pumping to a sustainable level, your decline would stop but it wouldn't raise the level any higher to where you flattened out. In the Seaside Basin, we're seeing that meeting the sustainable pumping level doesn't make up for the overpumping that occured prier to that. That is something that should be discussed here. If you want to get higher than 2015, you have to look at how to further reduce pumping below the sustainable level or import another source of recharge water.	Comment received.	Meeting comment - noted.
224					Special Meeting	3/23/2021	Ron Stefani	Re: Measurable Objective for groundwater levels: I think we should go with the lowest one. When we get into project costs, as we move up the level, it will get more expensive. I believe it will be cost related.	Abby Ostovar: Excellent point. I will point out these aren't the only options, you can benchmark any year.	Meeting comment - noted.
225					Special Meeting	3/23/2021	Sarah Hardgrave	I would tend to agree. I think we should strive toward something that may be more achievable in the near-term, and see what we can accomplish in the first 5 to 10 years.	Comment received.	Meeting comment - noted.

226					Special Meeting	3/23/2021	Bob Jaques	I'm kind of jumping ahead to projects, just looking at this chart again, if you pick the lowest of the 3 proposed Measurable Objectives, which is 2011, and your 2015 level is that 8 feet below that, and it will go more below before we get to management activities and projects, in the list of projects and management activities under discussion, they all seem targeted at achieving sustainable yield level. That won't meet your objective of raising the groundwater level objective. I think we need to look beyond sustainable yield. We need to look at bringing the groundwater level up, and then maintain sustainability.	Comment received.	Meeting comment - noted.
227					Special Meeting	3/23/2021	Margaret Anne Coppernall	I want to say that I agree with the two speakers who mention the cost. I think it would be helpful to know the cost before we make a decision to compare the cost and affordability. I think the groundwater level is very important, especially with relation to seawater intrusion and taking into considering sea level rise.	Comment received.	Meeting comment - noted.
228					Special Meeting	3/23/2021	Janet Brennan	We have a recommendation of 8 feet and 16 feet, why don't we compromise at 11?	Comment received.	Meeting comment - noted.
229					Special Meeting	3/23/2021	Patrick Breen	Do we have any sense of pump depths and if anything went dry in 2016?	Abby Ostovar: We don't. We have the domestic well analysis where we looked at the depths of wells and water levels. We did it for 2015 levels, but we don't have the accurate locations for the wells, it's only a sampling of them. We could do the same analysis for 2016.	Meeting comment - noted.
230					Special Meeting	3/23/2021	Gary Kreeger	I understand there are difficult decisions to make. If you go above that 8 feet and shoot for 11, it will be a little more work, but it will give you a little more cushion.	Comment received.	Meeting comment - noted.
231					Special Meeting	3/23/2021	Beverly Bean	It troubles me to understand how much about these water levels are projections and estimates and modeling numbers, and how few are actual real numbers from actual wells. The GeoSyntec report recommended more test wells to get a better picture and I don't think that happened. We're not collecting data to make these decisions. How much of what you're recommending is based on actual data from those wells? I don't think we're getting enough real data. The other thing that troubles me is one of the management actions we need to look at is reducing pumping. How are we going to do that? We don't have enough well data, can we do something about getting more well data?	Abby Ostovar: This is based on actual groundwater well data. The domestic well analysis was projected/extrapolated between the monitoring wells. The domestic well analysis was more an estimate based on the depths of the wells versus this is based on actual monitoring data. However, you can include in the implementation actions installing more monitoring wells which could help with management down the road.	Meeting comment - noted.
232					Special Meeting	3/23/2021	Beverly Bean	Are you satisfied with this data, do you think it's enough to make these decisions?	Abby Ostovar: I never think there is enough data, but we have to use what we have.	Meeting comment - noted.
233					Special Meeting	3/23/2021	James Sang	I want to see that Minimum Threshold lowered. Are you planning on telling stakeholders that they have to cut off their water supply? We have to implement these ideas before we do anything? This puts a lot of stress on stakeholders.	Comment received.	Meeting comment - noted.
234					Special Meeting	3/23/2021	Gary Kreeger	I would be hesitant to push the Minimum Threshold lower. We are already overpumping. I agree with Beverly, at some point we have to talk about restrictions on pumping.	Comment received.	Meeting comment - noted.
235					Special Meeting	3/23/2021	Janet Brennan	Recommend a Measurable Objective at the 2008 groundwater level.	Motion passed unanimously.	Will be incorporated into SMCs.
236					Special Meeting	3/23/2021	Sarah Hardgrave	The steep decline is pretty alarming, to see 5 feet from one year to the next. A drop of 30 feet over a 16-year period is very concerning. I would concur with Mr. Jacques to see about having projects that would increase the levels over time. This is a really difficult situation for this area of the subbasin. I do hope that in addition to the projects, that we will also be able to think big picture as well.	Comment received.	Meeting comment - noted.
237					Special Meeting	3/23/2021	Beverly Bean	Does the chart include getting the golf course off potable water for their greens?	Abby Ostovar: In the in-lieu projects, this was a program to incentivize alternative sources instead of pumping. The approach we're trying to take is to not tell specific actors what to do, but we can look at that.	Meeting comment - noted.
238					Special Meeting	3/23/2021	Beverly Bean	On the peninsula during restrictions, there was a moratorium on new hookups. Are restrictions or moratoriums on new hookups on the table? We should be making recommendations to those who do have the power to do so.	Abby Ostovar: We have to work within the authority of the GSA. So we'd have to work in partnership with the County. It might be helpful for future planning development but we need to have a conversation with the County. It won't address existing water use.	Meeting comment - noted.
239					Special Meeting	3/23/2021	Sarah Hardgrave	The Corral de Tierra golf course is not located in close proximity to a sewer system that would be able to recycle water for irrigation. I think that's why it wasn't identified in the list of projects before us. Because the WW facilities are not nearby.	Abby Ostovar: Yes, these WW facilities are near the boundary with the 180/400.	Meeting comment - noted.

240					Special Meeting	3/23/2021	Sarah Hardgrave	In the example of the cease and desist order, it deals with a different circumstance. I think the question that we should ask the staff and consultants to explore is how do that findings of this analysis and ID of overdraft through the GSP, how will the County determine the safe and adequate water supply for new development? How will the county use the GSP to inform their decisions? It is a worthy conversation to have with the County Department of Environmenal Health.	Comment received.	Meeting comment - noted.
241					Special Meeting	3/23/2021	Janet Brennan	Using pumping allocations and control, in essence, will result in in-lieu projects because those are the options available to reduce pumping. It seems to me through an allocations system you could limit new developments by not allocating water to vacant parcels, or limiting the amount of water for vacant parcels, which would be a way to address new development. How difficult will it be to implement pumping allocations?	Abby Ostovar: Developing an allocation structure will be challenging, but it can be done. The goal of it could be to avoid adjudication, which is also a lengthy process. One of the challenging parts in this area will be to figure out how to deal with *de minimis* users. There will be some steps, the MCWRA only collects extraction from a portion of the subbasin. There will be various steps in collecting the data. It's not outside of the realm of what's doable.	Meeting comment - noted.
242					Special Meeting	3/23/2021	Janet Brennan	Table 2, 3,542 connections that could be affected by allocations. In Salinas Hills (0.73 AFY), Corral Estates (0.75 AFY), Robly (0.75 AFY), I mean these are huge water demand figures, especially when you compare to the peninsula.	Comment received.	Meeting comment - noted.
243					Special Meeting	3/23/2021	Bob Jaques	I support Beverly's comments. I think that in the projects, it would be good to add a few more. One could be use recycle water for landscape and golf course. Another could be about limiting or halting new connections. It may be infeasible, but for anyone reading the GSP, if they're not in there, someone might think it wasn't considered as a management action.	Comment received.	Meeting comment - noted.
244					Special Meeting	3/23/2021	Sarah Hardgrave	You've done this analysis of cost, is that a requirement of the GSP? Can you have a project without a cost associated with it?	Abby Ostovar: You don't need a cost, you just need to show you've considered projects and management actions and lay out a path forward. This is mainly for us and our stakeholders to understand the level of effort and which projects to prioritize.	Meeting comment - noted.
245					Special Meeting	3/23/2021	Sarah Hardgrave	I agree with both Bob and Bev on those potential additions.	Comment received.	Meeting comment - noted.
246					Special Meeting	3/23/2021	Bob Jaques	I see a mention of a "direct potable" use and I assume you mean indirect potable use.	Comment received.	Meeting comment - noted.
247					Special Meeting	3/23/2021	Sarah Hardgrave	Re: WW going to Marina. I think the challenge for our management area, if we're sending that water up to be treated, how do we get it back to be used here. I'm not sure how that can come back to this area, except for a pipeline to bring it back.	Abby Ostovar: Our subcontractor talked about increasing the level of treatment at the existing facility. She has a much better handle on the most feasible option and she will scope that. We solicited ideas in November and December. We can add these two new projects, but we need to have this chapter done in the next month.	Meeting comment - noted.
248					Special Meeting	3/23/2021	Margaret Anne Coppernall	Given the steep drop in groundwater level, we need to have a sustainable supply for people who are already existing, who already need it, not new development.	Comment received.	Meeting comment - noted.
249					Special Meeting	3/23/2021	Gary Kreeger	I'd like to know more about the linkage between the authority for approving development and our authority around water. I think there should be no more new development included [in the GSP] to reinforce the idea there's a real problem here. We're talking about allocation controls, do we have the authority to tell people to stop pumping as much? Can we cut back? How do we enforce that?	Sarah Hardgrave: There was a workshop provided for all subbasins on allocations. It is posted on the SVBGSA website.	Meeting comment - noted.
250					Special Meeting	3/23/2021	Sarah Hardgrave	My observation of the proposed projects is that they are costly, complicated to implement, but they are the choices we've got. My biggest concern is that they may not be enough to get to sustainability. That is the challenge in this area. It seems like we need to include all of these options and make an effort for all of these options. But also look outside of this area and look to a regional effort to achieve sustainability. I'm concerned about the declining water levels in the Laguna Seca area. Also, the comment from Mr. Bunn earlier about how are we being affected with what is happening in the 180/400. How can we adjust sustainability in this area working with our adjacent subbasins for potential regional solutions?	Comment received.	Meeting comment - noted.

251					Special Meeting	3/23/2021	Christopher Bunn	Some of the solutions lie outside of your subbasin and that is why the modeling is so crucial. The multi-benefit stream channel could potentially benefit you guys significantly. It could reduce agricultural pumping in the 180/400, which could impact this subbasins well levels. However, the way that project is presented, it's going to fail. Right now it is being presented where the GSA is covering the cost of administration, but you also have the cost of doing the work. It's a 95-mile river, but the final 10 miles can't be worked on. 85 miles and many land owners are absentee, and won't spend the money. That project needs to be done on the whole river and needs to be tweaked. I'd love to see the modeling to see the effects on this subbasin.	Comment received.	Meeting comment - noted.
252					Special Meeting	3/23/2021	James Sang	I'd like to suggest a project only for well owners. I want to see this group suggest to well owners to build infiltrating trenches around their wells to recharge their own wells. Trench 2 feet deep to prevent rainwater from being evaporated. This could be a huge amount of water to recharge their wells.	Sarah Hardgrave: We do have the decentralized stormwater project, which is similar to what you're suggesting. It is a very expensive endeavor for not as much water as we would like.	Meeting comment - noted.
253					Special Meeting	3/23/2021	Sarah Hardgrave	We encourage SVBGSA, EKI and MCWD to think about potential opportunities for projects that would benefit both management areas for the subbasin and also how to coordinate any potential allocation program across both management areas.	Comment received.	Meeting comment - noted.
254					Special Meeting	3/23/2021	Janet Brennan	I'm torn between Option 2 and 3. From a policy perspective, it seems drinking water systems should be a priority. But Option 3 maintains the existing proportion of use.	Comment received.	Meeting comment - noted.
255					Special Meeting	3/23/2021	Beverly Bean	I'm favoring Option 3, it seems like it treats all water users pretty equally. If we prioritize one group over another, we're inviting lawsuits and people who would feel unhappy and unprioritized. Back to my point about a moratorium, if that large precent of users are in a large system, I think the idea of some form of a moratorium would be possible. I think we should consider that when we make these decisions.	Comment received.	Meeting comment - noted.
256					Special Meeting	3/23/2021	Beverly Bean	I think the best way to do it is to treat everyone as equally as possible. Everyone should share the pain.	Comment received.	Meeting comment - noted.
257					Special Meeting	3/23/2021	Margaret Ann Coppernall	I agree and lean towards Option 3. We need to be fair. I know senior overliers will protest if they don't get their fair share. I agree we need to pick the option that is the fairest to everybody.	Abby Ostovar: More analysis will happen, and we'll have to deal with outliers. You're at the right level of thinking.	Meeting comment - noted.
258					Special Meeting	3/23/2021	Sarah Hardgrave	I am also leaning toward Option 3. Sounds like we have a majority of folks leaning in that direction. I would welcome a motion. One question, Abby, we need to achieve sustainability in the entire subbasin. I'm wondering if the discussion of allocations needs to include the Marina-Ord area? Could you work with our other management area on that question?	Abby Ostovar: Groundwater law is still evolving, we're figuring out where the courts are on this issue. Having the Ord area in the middle and separate management areas and different principal aquifers makes this difficult. Patrick Breen: In all our area, we're the only pumper. If there was a reduction on pumping in the area, it would just be us. If we're not sustainable, the reductions would be born solely on the water district, so we don't really have this equity issue.	Meeting comment - noted.
259					Special Meeting	3/23/2021	Janet Brennan	I recommend Option 3 for the allocation system.	Motion passed. Bob Jacques abstained.	Option 3 for a pumping allocation description will be included in the GSP.
260					Special Meeting	3/23/2021	Margaret Anne Coppernall	A topic that came up earlier, about Pure Water Monterey Project that is looking at expansion this week. Looking at FEIR. Is there a way to coordinate with them on a cost analysis for a pipeline to bring recycled water over here in the future?	Sarah Hardgrave: This will be included in the additional projects that will be scoped.	Meeting comment - noted.
261					Special Meeting	3/23/2021	Bob Jaques	Abby, when you're going through the projects slide, there was the topic of prioritizing listed in the packet, or talked about it. I didn't hear any conclusions or consensus about prioritizing. Is that something this group needs to come up with?	Abby Ostovar: You don't have to, but it would be helpful to us if you did. Now would be a great time to do that to include in the chapters.	Meeting comment - noted.

262					Special Meeting	3/23/2021	Bob Jaques	From our perspective, we're concerned about the effects of pumping and the dropping water levels. The modeling shows that the Corral de Tierra pumping is causing the Laguna Seca levels to fall. When you look at the cumulative amount of pumping reductions versus the projects, you need to cut it down by about 1000 AFY. The total amount of the other projects only add up to about 400 AF. It's obvious pumping reductions/allocations will have to be imposed. I think it should rise to the top as one of the most critical choices. I think it should be one of the high priority projects in the GSP.	Comment received.	Meeting comment - noted.
263					Special Meeting	3/23/2021	Beverly Bean	I completely agree with Bob, and I would like to put that forward as a motion. Let's not waste any more time with costly schemes, let's get this pumping down. Motion: Pumping allocations should be our top priority.	Motion passes unanimously.	Prioritization of pumping allocations will be incorporated into the GSP.
264					Special Meeting	3/23/2021	Margaret Anne Coppernall	I think it's a very prudent motion.	Comment received.	Meeting comment - noted.
265					Special Meeting	3/23/2021	Janet Brennan	I agree with the motion.	Comment received.	Meeting comment - noted.
266					Special Meeting	3/23/2021	Marieke Desmond	I appreciate the committee so carefully considering these options. Equity in water will depend on how accurately we measure it. We encourage metering in these allocations discussions.	Comment received.	Meeting comment - noted.
267					Special Meeting	3/23/2021	Marieke Desmond	It's so important to get to the sustainable yield on this issue, but I want the committee to keep looking at supply solutions as well as pumping allocations. Pumping allocations alone aren't necessarily the key to sustainability although they can help get to a better water storage levels.	Sarah Hardgrave: Yes, to clarify, I wasn't saying that we shouldn't pursue any of the projects. It is helpful to have allocation prioritized as an initial action in addition to the projects that were laid out because they won't get us to sustainability by themselves.	Meeting comment - noted.
268					Email	4/12/2021	James Sang	I wanted to present some potential agenda items.	Comment received.	Point #1 was considered throughout the Salinas Valley and it is incorporated in projects for other Subbasins.
								1. Can rainfall harvesting through swales refill wells and increase groundwater and water aquifers?		
								Reference a: You Tube video (Harvesting Water Naturally with Swales by Urban Farmer Curtis Stone)		Point #2 has been incorporated into the overland flow MAR project which was modeled on the Pajaro Valley project noted.
								Reference b: You Tube video (Recharging A Well Part II -John Kaisner The Natural Farmer)		
								Reference c: You Tube video (Swales on Contour can Drought -proof Gardens, Farms and Pastures with Water Harvested Passively by Edible Forest Gardens)		
								Reference d: You Tube Video (Deep Soil Ripping for Water Conservation by Megan Clayton)		
								Reference e: "Deep Soil Ripping as an Effective and Affordable Water Capture Tool written by Amanda C. Krause, Megan K. Clayton, ...et al" Please google search article.		
								2. Can you make a presentation on what UC Santa Cruz is doing to recharge their wells? This is what Robin Lee wanted.		
								Reference a. You Tube video (Enhancing Groundwater Recharge in the Pajaro Valley by California Department of Food and Agriculture)		
								I believe that swales and subsoil plowing can recharge a farmers well, groundwater and aquifers. This is a cheap and easy way to help every farmer and landowner have a plentiful supply of water. This idea will solve California's goals of recharging water aquifers and holding back salt water intrusion into our coastal lands.		
								Can you show this to all interested parties?		

269	4				JotForm	4/22/2021	Ron Weitzman	I am objecting to the claim by the Hydrogeological Working Group in their letter of 5 April 2021 that your designation of the Dune Sand Aquifer as a Principal Aquifer is incorrect. While the EIR for the Monterey Peninsula Water Supply Project, for which HWG has consulted, dismally failed to model that aquifer successfully, with a relative error equal to 30, it has reported that it may account for up to two-thirds of the source water for the project. According to Appendix E2 of the 2017 and final EIR (p. 28), "The third approach used reported results that determined the pumping allocation based on well-screen configuration and model calibration to the test-slant-well pumping results (66% from Model Layer 2 and 34% from Model Layor 4)." That alone qualifies the DSA as a Principal Aquifer. Other reasons supporting that designation also exist. According to the hydrogeologist hired by Water Plus, Barbara Ford, "The extremely low Kv applied to the Dune Sand/A Aquifer unit [in the EIR], and particularly in the underlying layer 3, appears to have resulted in eventually reducing the residual at three of the wells. The extremely low Kv was applied to reduce the residuals at the wells, but because the value seems unreasonable, its use as a mechanism (prop up the head in layer 2) to improve the appearance of the calibration, instead reduces the confidence in the calibration." That contrived low kv makes the Dune Sand Aquifer incorrectly appear to drain little or no water from overlying streams, ponds, and the Salinas River. According to the hydrogeologist hired by the California Coastal Commission, no evidence exists to support that claim and, in fact, evidence shows that aquifer has a seaward gradient, which could allow seawater intrusion only if MPWSP wells draw water from it. The Dune Sand Aquifer is indeed a Principal Aquifer, as your Groundwater Sustainability Plan currently asserts.	Comment received.	The Dune Sand Aquifer is included in the GSP as a Principal Aquifer. Chapter 4 describes it further.
270	1, 3, 4, and 5			Figure 5-1 through 5-10	Email	4/23/2021	MCWRA	Some sections are not completed or indicate future revisions and updates. MCWRA looks forward to an opportunity to comment on those when completed. Suggest that on the Figures that combine the Lower 180-Ft Aquifer and the 400-Ft Aquifer wells, they be symbolized differently. Suggest adding FO-11, along with FO-09 and FO-10 wells, to the monitoring network. On Figures 5-1 through 5-10, suggest changing the color of the dot to something other than black. It is difficult to see the locations when they are close to the black/white dashed boundary lines.	Comment received.	Wells FO-10 and FO-11 are included in the monitoroing network. Additional wells will be added to the monitoring network during Implementation.

271	7				Email	5/27/2021	MCWRA	Appendices mentioned in the text were not provide so MCWRA staff were unable to review.	Comment received.	There are multiple tables accross chapters 5, 7, and 8 that detail the constituents that occur in the groundwater and in tested drinking water systems, as well as the regularity of water quality reporting for these constituents.
								Suggest adding a table that clearly list which analytes and parameter are being collected/measured, including frequency and methodology (i.e. lab analyzed or field measurements w/ hand-held instruments)		Seawater intrusion monitoring will occur in wells with records of either Chloride or TDS as described in Chapter 7. Chloride is prefered, however, TDS will supplement to increase spatial distribution of SWI monitoring. These details are described further in Sections 5.3 and 7.5.
								For seawater intrusion monitoring, suggest clearer description…will chloride concentration be used, or TDS, or conductivity?		
								MCWRA has provided other minor and/or editorial comments on the chapter of the Draft GSP to Montgomery & Associates in a Word document that was supplied for that purpose		
272					Meeting	5/7/2021	John Bramers	I was going to mention on the outreach that it's deceiving in the way it's called. It's Toro Park, San Benancio, etc.….The stakeholders out there hear "Monterey" and don't think they are a part of it.	Donna Meyers: If you think we may know or have contact, but if you have direct contact with them, we'll cross-reference them. We want to make sure we have a completed group. We'll have an outline of how to approach this and any dates. We'll be planning that in the next several weeks and will get you that information, including dates we're striving for.	Meeting comment - noted.
									Sarah Hardgrave: I would welcome any committee members who have contacts at HOAs to please share those with us and I will cross reference them with our District contacts.	
273					Meeting	5/7/2021	Gary Kreeger	Regarding using different models, could you speak to how understanding how our subbasin will interact with others since we know they're all connected?	Derrik Williams: The modeler who is putting this together now, as he is finalizing it, is to make sure the interaction with the other subbasins is well simulated. The model is going to be developed to have an accurate representation across the boundaries. The only thing that will come up will be how we simulate projects in other subbasins. Say, the impact on the 180/400, we'll have to roll it into this model and it is an extra step. If water levels are going up in the 180/400, how will it affect this subbasin? I don't think it's going to be a difficulty, just an extra step. I don't think there will be any inaccuracies.	Meeting comment - noted.

274					Meeting	5/7/2021	Bob Jaques	Agenda makes a brief mention about a seawater intrusion model to be funded with grant funds. How far into the adjacent basins will the model go? I'm interested in it if it will extend into the Seaside subbasin.	Derrik Williams: First plan is to develop the model only for the Monterey Subbasin. Then we will extend it into the 180/400. We want to pick up all seawater intrusion observed. There isn't any seawater intrusion observed in the Seaside subbasin, so it's not in the plan right now. But if we start see that, we will develop a plan on how to extend that.	Meeting comment - noted.
275					Meeting	5/7/2021	Tamara Voss	Just to tag on to Bob's comments and interest in the potential seawater intrusion in the Seaside area, I think Derrik, you're correct that we're not seeing seawater intrusion in the Paso and Santa Margarita aquifers. I do think there is evidence of seawater intrusion in the shallower aquifers, which can then migrate down. The aquifers of use and interest don't have seawater intrusion, but there is high chloride level water in the shallower water that can move vertically down, and this group should not lose track of that mechanism.	Derrik Williams: Point well taken, thank you, Tam.	Meeting comment - noted.
276					Meeting	5/7/2021	Sarah Hardgrave	The recent annual seawater intrusion monitoring included some indicator findings at a recent meeting with the Seaside Watermaster, and I concur with that. I'm glad to hear we're not in a situation of dueling models. There seems to be good agreement on using this model in-lieu of the SVIHM model. Are they using different software platforms? Are they completely separate approaches? Or are they similar based software for the modeling?	Derrik Williams: They are similar software packages, but not identical packages. The fact that they're similar makes it easier to transfer information between the two. The fact that they're different is why the Monterey model will be better for seawater intrusion. They're both based on codes developed by the United States Geological Survey.	Meeting comment - noted.
277					Meeting	5/7/2021	John Bramers	To follow up on that, for the area on Reservation Rd, will that area be managed with the 180/400?	Donna Meyers: That is still planned to be managed as part of the Corral. We would have to do a boundary adjustment. Abby Ostovar: We've thought about a boundary adjustment. It's a complicated process that takes a lot of time. We're just trying to be more explicit in the GSP so it's not just lumped into the Marina Ord management area. They do have a monitoring network closer to those areas.	Meeting comment - noted.
278					Meeting	5/7/2021	John Bramers	I'm confident most of the water in those farming areas is coming from the 180/400. It's going to be a challenge for projects.	Abby Ostovar: That's how we arrived here. As we have gone further in the GSP process, these flags have come up.	Meeting comment - noted.
279					Meeting	5/7/2021	Sarah Hardgrave	One of those areas is the Bluffs Development, the sort of southern one. The other ones are more on the valley floor and in agricultural use. And then there's the one little triangle, also agricultural use?	Abby Ostovar: Strawberries	Meeting comment - noted.
280					Meeting	5/7/2021	Sarah Hardgrave	In terms of the name, referring to it as Reservation Road area makes sense to me. Seem intuitive. Does anyone have other suggestions? Let's go ahead and go with that, as a way to call it out. Will there be some slightly different management actions for those areas that would be more along the lines of the management actions in the 180/400?	Abby Ostovar: Actually, yes, you'll see that in the next slides with regional projects. Benefit assessments will be done. We've widened our scope on projects and management actions.	Meeting comment - noted.
281					Meeting	5/7/2021	Janet Brennan	Relating to the extraction barrier project, to address seawater intrusion. In listing your projects, it only talks about using the water for desalination. It doesn't address the seawater intrusion project specifically. My suggestion is that to be included, specifically. Why is that project not included in the MCWD's proposal to address seawater intrusion in that area?	Patrick Breen: Participation in regional projects is at a conceptual level, MCWD would entertain participating in the regional projects. We have not cited it for the MCWD GSP because it is at the conceptual level. We're not opposed to it.	Meeting comment - noted.
282					Meeting	5/7/2021	Janet Brennan	I suggest you include it in the regional projects.	Abby Ostovar: We're still working through how we develop the partnerships and support. Yes. We'll figure out how to have it in there.	Meeting comment - noted.
283					Meeting	5/7/2021	Janet Brennan	I also have a recommendation for another project for the Corral area. Specifically request the County of Monterey expand the B8 planning area for land use.	Abby Ostovar: That has been brought up previously, thank you for flagging it.	Meeting comment - noted.
284					Meeting	5/7/2021	Sarah Hardgrave	One comment about invasive species eradication, you're talking about the unit cost for remaining work. I don't think invasive species eradication ever ends as it requires ongoing effort.	Abby Ostovar: We've been working with Resource Conservation District of Monterey County (RCDMC) on this, it includes the remaining acres along the Salinas River. The idea is the full 900 acres are treated in a timely manner, with retreatments along the way. What his number doesn't include is if you don't treat it, how arundo will spread.	Meeting comment - noted.
285					Meeting	5/7/2021	Sarah Hardgrave	Will the recharge basins be located in the 180/400? Where are they located?	Abby Ostovar: We don't have locations. This is a notional cost.	Meeting comment - noted.
286					Meeting	5/7/2021	Sarah Hardgrave	To clarify, that is the number for within our planning area? Or for the 180/400?	Abby Ostovar: We had it scoped out for what the 100-acre basin would cost. This number is not realistic for the Monterey subbasin, we have to think a little more carefully about how it would fit here.	Meeting comment - noted.
287					Meeting	5/7/2021	Bob Jaques	What recycling plant are you referring to for the source?	Abby Ostovar: Cal Utilities Service plant.	Meeting comment - noted.

288					Meeting	5/7/2021	Bob Jaques	That's the one right by the Salinas River, off Reservation Road. Was there any investigation into the Las Palmas plant? I know they have surplus water at certain times of the year.	Abby Ostovar: They already put a lot of that water to use in medians and open spaces. The two big things going in are it's costly to go in and costly to pipe it somewhere.	Meeting comment - noted.
289					Meeting	5/7/2021	Tom Adcock	I am on the GSA board at this time, representing a utility, Alco Water Service. My comments don't have anything to do with the GSA board. I am also the general manager for the Cal Utility Service. It's located at the confluence of Toro Creek and the Salinas River. We have ~130 acres of spray field to put secondarily treated wastewater, near the river. I would be happy to work with the GSA or subcommittee or engineering firm to discuss the ability to provide reclaimed wastewater to where our customers are. There's no doubt that it costs a lot to build pipes and transport water. The estimate seems a little high. I think there are ways to place distribution mains to bring that cost down significantly. Very happy to answer any questions. I want to make sure the agency understood Cal US is happy to work with you.	Comment received.	Meeting comment - noted.
290					Meeting	5/7/2021	Sarah Hardgrave	I was involved with early planning and feasibility and design of the Pacific Grove local water project, which provides recycled water to the PG golf course. That's a small package plant that's in operation. It might be a good reference point. I think Wallace Group would have that information.	Abby Ostovar: Piping is a large part of the cost. We didn't see anywhere else to bring the water. We can get together with Mr. Adcock and see where else we could look. Sarah Hardgrave: The primary place of use is the Corral de Tierra Golf Course.	Meeting comment - noted.
291					Meeting	5/7/2021	Margaret Anne Coppernall	I was curious about the rollout for the seawater intrusion extraction portion discussed earlier. I was wondering where it was going to be placed and how it would function.	Sarah Hardgrave: My understanding is that this was identified in the 180/400 plan that was submitted to the Department of Water Resources in 2020. Abby Ostovar: Right now it's a conceptual idea, it is not at the stage for planning or a feasibility study. It hasn't progressed to where we're taking implementation steps.	Meeting comment - noted.
292					Meeting	5/7/2021	Sarah Hardgrave	It's effectively the Highway 1 corridor north of the river?	Derrik Williams: Conceptually, it was placed along Highway 1, north of the river. Conceptually, because it does give us a line that covers the entire basin and protecting most of the municipalities. It will probably change going forward, but conceptually that's the right place.	Meeting comment - noted.
293					Meeting	5/7/2021	Janet Brennan	I would like to ask the committee to consider to ask the County to expand B8 as a recommended program. I would like consideration of that.	Comment received.	Meeting comment - noted.
294					Meeting	5/7/2021	Sarah Hardgrave	I appreciate the project to take brackish water, desalinate it and use it to provide an additional source of water, and the multiple benefits it would produce. I'd like to reiterate my support for a publically owned project for a more affordable supply.	Comment received.	Meeting comment - noted.
295					Meeting	5/7/2021	Beverly Bean	I would support what Janet is saying, I just wonder where it would expand to. Would you base it on the previous study or look at new numbers? Planners and the county don't even enforce it, or know what it is. The county just approved a subdivision, even though the Land Use Advisory Committees (LUAC) pointed out that it was in the B8.	Comment received.	Meeting comment - noted.
296					Meeting	5/7/2021	Janet Brennan	The B8 should be updated to reflect current overdraft conditions, and that the county enforce its B8 zoning.	Comment received.	Meeting comment - noted.
297					Meeting	5/7/2021	Margaret Anne Coppernall	I support if it means getting more information, if it's feasible.	Comment received.	Meeting comment - noted.
298					Meeting	5/7/2021	John Bramers	This is getting into land use. You probably need more information before you vote on it.	Comment received.	Meeting comment - noted.
299					Meeting	5/7/2021	Sarah Hardgrave	It is unclear to me at this time the relationship between our water planning efforts and the land use side of things. It would be helpful to have a better understanding. I'm not disagreeing with Janet's suggestion. It could be an important measure for not intensifying or adding use in the subbasin. It is unclear to me how the GSP recommendations for land use actions would be received on the County side.	Comment received.	Meeting comment - noted.
300					Meeting	5/7/2021	Janet Brennan	The GSA has no land use authority. Under an allocations system, which does not affect water rights, has an effect on land use indirectly. I have no problem with the GSP addressing this more directly. Because the projects are so expensive, and so way off even to transport brackish water here, the problem is so urgent, we need interim measures to address the Corral de Tierra overdraft problem. I would like staff to provide additional thoughts on my recommendations.	Comment received.	Meeting comment - noted.

301					Meeting	5/7/2021	Janet Brennan	GSA's have the ability to fallow land. If that's not a land use application, I don't know what is. There may be indirect relationships. We can't rezone it ourselves. The county has to understand the seriousness of the problem. If they're approving developments in the B8 Zone, there is obviously a lack of understanding about the groundwater impacts. This is an opportunity to establish a relationship.	Emily Gardner: We can be really thoughtful about our relationship with the county and their process. Staff can explore this, and think through how we address it. Gary Petersen: Land use and SGMA, SGMA can't override land use. Once a SGMA plan is in place, then general plans have to consider SGMA plans. We're at a transition place for that. As land use plans are developed, they have to consider the GSP. We have to investigate further and bring back more information. Sarah Hardgrave: Whether or not the GSP and land use decision making process needs to consider on the land use side. The recent project Beverly mentioned, I provided our information from these efforts to one of our land use planners. This is not an adopted plan, so at this point in time, our efforts are not appropriate to take into consideration. Then in the future, does the GSP become something land use jurisdictions consider in their decision making process? That's the question.	Meeting comment - noted.
302					Meeting	5/7/2021	Janet Brennan	Motion: Request SVBGSA staff to address expanding the B8 area as a program to address groundwater extraction in the Toro Area.	Comment received.	Motion passes.
303					Meeting	5/7/2021	Janet Brennan	I think it would be helpful if staff summarized recommendations like "one more monitoring well". Summarize recommendations so the committee is fully aware of what the draft is recommending.	Comment received.	Meeting comment - noted.
304					Meeting	5/7/2021	Bob Jaques	My general comment for both subareas monitoring well networks is both of those subareas abut the Seaside Subbasin, and we know they're hydrogeologically connected and each subbasin can affect the other. I suggest the monitoring network be expanded to include existing monitoring wells in the Seaside Basin that are close to the border, so the effect of any projects or management actions, can be measured to determine the effect they have on the Seaside subbasin. I will also submit comments online as well.	Abby Ostovar: I need to check to see if we can have wells outside of the subbasin included in the monitoring network. We include wells outside for drawing contours, but I'm not sure if we can have wells outside of the subbasin as representative monitoring sites. Tina Wang: The wells we are talking about here are to meet the requirements. It does not prevent us from collecting date from outside the subbasin. It doesn't prevent us from looking at data from adjacent basins.	Meeting comment - noted.
305					Meeting	5/7/2021	Margaret Anne Coppernall	Do we know how many new wells we need, and how much they will cost? Seawater intrusion is such an important issue.	Abby Ostovar: We haven't looked at the cost yet. We will look at existing wells before we install new wells. Patrick Breen: We haven't worked a cost estimate. It depends on type, depth, levels. Some of that needs to be determined before we provide a cost estimate.	Meeting comment - noted.
306					Meeting	5/7/2021	Margaret Anne Coppernall	How many would you need to install?	Tina Wang: Near the coast would be a great location for nested wells for seawater intrusion and monitoring in the deep. We'll look at this for implementation chapters. We're in the process of identifying how many we need.	Meeting comment - noted.
307					Meeting	5/7/2021	Margaret Anne Coppernall	I'm impressed with this chapter, it's so thorough. You did a great job here.	Comment received.	Meeting comment - noted.
308					Meeting	5/7/2021	Sarah Hardgrave	We're focused here in the Corral area. I will comment on the Marina-Ord side, on the seawater intrusion maps, they have this area with question marks. If we can get to answering those question marks, that would be great.	Patrick Breen: We've had meetings to address those.	Meeting comment - noted.
309					Meeting	5/7/2021	Sarah Hardgrave	The Watermaster was grappling with monitoring well issues on the Fort Ord-9, just on the boundary line. Hoping there can be some good collaboration.	Patrick Breen: We're aware and we agree. We'll work with the watermaster to address those issues.	Meeting comment - noted.
310					Meeting	5/7/2021	Sarah Hardgrave	On the Corral side, are you saying there are potentially existing wells to use first?	Abby Ostovar: We're not aware of any existing data collection in those areas, but if there are wells we can perhaps start collecting data.	Meeting comment - noted.
311					Meeting	5/7/2021	Sarah Hardgrave	It came to my attention that Cal-Am is planning to drill a new well for their Toro system. The well that is no longer functioning is being planned to be turned into a monitoring well.	Comment received.	Meeting comment - noted.
312					Meeting	5/7/2021	James Sang	How will you have projects that will refill each aquifer at one time?	Abby Ostovar: Each of the projects will look at which aquifer they impact. None of the projects promise to refill all aquifer at any one time.	Meeting comment - noted.
313					Meeting	5/7/2021	James Sang	Then you will have some wells that will receive a benefit and some wells will go dry.	Abby Ostovar: There could be varied benefits. We will look at what the conditions are throughout the subbasin and have projects to address conditions in all areas.	Meeting comment - noted.

314					Meeting	8/10/2021	James Sang	I was reading through the paperwork and I noticed there were 10 of 15 areas in the Fort Ord area that were contaminated with fluorocarbons. Should we be concerned about that? Because if we try to do any recharge in this area, they left this contamination behind.	Comment received.	Meeting comment - noted.
315					Meeting	8/10/2021	Sarah Hardgrave	I think that is a good question related to the Marina Ord management area.	Patrick Breen: Yes, it is being considered, and the plans are not going to have an impact on the US Army's effort to clean that up. Tina Wang: It's an important thing to note, most of the remediation effort is conducted in the shallow aquifers, which are the Dune Sands and shallow 180. Most of the groundwater activities are in the lower aquifers. We are coordinating with the Army, we are going to comply with any remediation project restrictions. We have described that in Chapter 3 of the GSP, described in the groundwater restriction areas because of the remediation efforts being done there.	Meeting comment - noted.
316					Meeting	8/10/2021	Sarah Hardgrave	Who are the entities responsible for monitoring the exceedances of drinking water and how that might vary depending on the size of the system?	Abby Ostovar: Drinking water standards? We monitor those to sustainable management criteria. Systems that have over 15 connections, those are monitored by the state. Monterey County Health Department monitors 2 to 14 connections.[Correction: Monterey County monitors systems with 2-199 connections, and the State compiles data for systems 15 and larger].	Meeting comment - noted.
317					Meeting	8/10/2021	Sarah Hardgrave	In Chapter 8 where this is discussed more in depth, are *de minimis* wells, the domestic wells, included in this? Are the wells monitored in the same way?	Abby Ostovar: *de minimis* wells is based on how much you pump. Generally domestic wells aren't monitored for [Title 22] groundwater contaminants, but water systems wells are.	Meeting comment - noted.
318					Meeting	8/10/2021	Sarah Hardgrave	For this particular subbasin, with naturally occurring arsenic, are small systems monitored for that?	Abby Ostovar: The county does, and you can see which ones have exceedances. To my knowledge, there is no government regulated monitoring for domestic wells [with a single connection].	Meeting comment - noted.
319					Meeting	8/10/2021	Sarah Hardgrave	For the sustainable management criteria for water quality potentially being correlated to groundwater levels, if the groundwater levels were to lower with the naturally occurring arsenic, could that potentially increase the amount in the wells?	Abby Ostovar: There are many different factors that could affect that, but it is a potential. We don't have enough data to know if there is a certain depth where you will find more arsenic. We know in this area it is naturally occurring, and depth dependent, but we don't have enough information.	Meeting comment - noted.
320					Meeting	8/10/2021	Janet Brennan	I'm concerned about letting groundwater levels decline in the Corral de Tierra subbasin, I don't think it's a prudent approach given the water quality issues. Furthermore, allowing water levels to decline is going to exacerbate the issues in the Laguna Seca. I do not support the level at which the chapter recommends [2015].	Abby Ostovar: This committee set the minimum thresholds and measurable objectives, it's a prerogative that this committee make a decision on which ones are appropriate for this subbasin.	Meeting comment - noted.
321					Meeting	8/10/2021	Beverly Bean	At the last meeting, Janet made a request that the staff address expanding the B8 area as an action to prevent further groundwater extraction. What is going on with that?	Sarah Hardgrave: It is not currently on the agenda, and I recommend that we discuss it under future agenda items.	Meeting comment - noted.
322					Meeting	8/10/2021	Janet Brennan	I support all the comments LandWatch submitted, and the committee should have a chance to review and respond to those comments. I think the water levels should not be allowed to decline in the Corral de Tierra area.	Comment received	Meeting comment - noted.
323					Meeting	8/10/2021	Beverly Bean	I want some clarity on what was just stated. Will the letters be a part of the public record, and how will that happen? I am not familiar with the letter spreadsheet	Emily Gardner: I will forward it to you now. If someone says please forward this to the committee, we do that. If they don't say that, we add it to our letters, and we post it to our website. This area requires a lot more collaboration with Marina Coast. We can just post what we have to the website.	Meeting comment - noted.
324					Meeting	8/10/2021	Sarah Hardgrave	Is it our responsibility to go look for these letters, or will they be included in future meeting material? Then a 90 public comment period. I'm not sure our committee will have the benefit of weighing in during that time. If we can see anything that comes in, it would be helpful.	Comment received	Meeting comment - noted.
325					Meeting	8/10/2021	Beverly Bean	I see the comment table always comes to us and I think letters should also be included. Letters should be noted and sometimes summarized. At this point, I don't want to miss out on public comments. I think these should be shared with materials and on the website.	Comment received	Meeting comment - noted.
326					Meeting	8/10/2021	Sarah Hardgrave	I also think the letters should be available to the public, which is why they're on the website.	Comment received	Meeting comment - noted.
327					Meeting	8/10/2021	James Sang	The issue of arsenic is really the first time I've heard about this. This is really important because it really increases a person's chances of getting cancer. Can you send out a notice to let people know there is a little more arsenic in their wells?	Comment received	Meeting comment - noted.
328					Meeting	8/10/2021	Sarah Hardgrave	I believe that is the responsibility of the Monterey County Health Department, and residents in this area are generally aware of this.	Comment received	Meeting comment - noted.

329					Meeting	8/10/2021	Sarah Hardgrave	In Section 8.5, there's discussion of the process of input, in that particular section it talks about the agreement between the GSAs and Technical Advisory Committee and the stakeholder committees. It doesn't talk about this committee, and I would ask that that be added. Do our two GSA technical experts feel there is adequate and broad enough coverage? Are there areas where new wells are recommended?	Abby Ostovar: It's in Chapter 7, the Monitor chapter. There are data gaps and we do recommend the installation of new wells there.	Meeting comment - noted.
330					Meeting	8/10/2021	Sarah Hardgrave	There were a whole lot of graphs for wells, I would suggest the bulk graphical information be put into an appendix and it can be quite a bit of pages, and maybe those could go to the back for ease of read. Just a suggestion. Then, I was very interested to see all those tables and graphs because it showed areas where the groundwater levels were in a steeper decline. I was concerned to see that in some of the Deep Aquifer wells. I was concerned to also see the groundwater decline in the MPRWMD Fort Ord wells, which are in that Seaside-Marina-Ord boundary. Which is not our group, but wanted to make that observation. There is a fair amount of discussion in this chapter about coordinating with adjacent subbasins. We don't have Bob Jaques here today, but I hope he will bring this to the Watermaster Board to comment and discuss the hydraulic connection on the Seaside side.	Comment received	Meeting comment - noted.
331					Meeting	8/10/2021	Beverly Bean	I agree with Janet, I think the [GWL SMC] needs revisiting.	Comment received	Meeting comment - noted.
332					Meeting	8/10/2021	Gary Kreeger	I agree as well, at the very least I would like to see the staff come back and address what is in the LandWatch letter.	Comment received	Meeting comment - noted.
333					Meeting	8/10/2021	Sarah Hardgrave	When will the groundwater levels information for this past year be added?	Abby Ostovar: We have groundwater levels information through this spring. To avoid having a lot of iterations, the "current" year is 2019 for the GSP.	Meeting comment - noted.
334					Meeting	8/10/2021	Sarah Hardgrave	Given that we had such a dry year, I'd be interested to see what happened this last year.	Abby Ostovar: If revisiting the groundwater levels, it would be helpful to have more guidance on the information that you would find helpful to make a decision, given that time is really tight.	Meeting comment - noted.
335					Meeting	8/10/2021	Sarah Hardgrave	I think we had considerable information at another meeting, and graphs, and years related to our minimum threshold and measurable objective. I think it would be worthwhile to go through that again, considering the letters received. I think it would be worthwhile for this group to see that again and how it was developed.	Comment received	Meeting comment - noted.
336					Meeting	8/10/2021	Janet Brennan	I think the new information received is the relationship between groundwater level and quality. I think this is important to Corral de Tierra. I know staff has said it is difficult to establish the relationship. There is one. We should take a conservative approach in addressing groundwater levels to assure they do not decline in future years. I'm not sure that setting groundwater levels at the 2015 level accomplishes that.	Comment received	Meeting comment - noted.
337					Meeting	8/10/2021	Sarah Hardgrave	If you all (Abby) could plan to prepare a memo that is more specific to the Corral de Tierra conditions, and lay that information out for us to have a discussion, that would be helpful.	Comment received	Meeting comment - noted.
338					Meeting	8/10/2021	Sarah Hardgrave	This is a lot of really good information, and a lot to digest. I'm hoping this presentation will get posted to our webpage, so there is a little more time to look through it.	Comment received	Meeting comment - noted.
339					Meeting	8/10/2021	Janet Brennan	[Re: Model accounting for rainfall intensity and runoff vs recharge] That is not the information we have received previously, we heard that the DWR model doesn't take into account increased intensity [and that is a major flaw in the climate change scenario].	Comment received	Meeting comment - noted.
340					Meeting	8/10/2021	Janet Brennan	I think staff was going to look at a project that would request the county extend the B8 zoning to the residential users on subdivisions?	Emily Gardner: We are working on that. I did speak to legal counsel about that, and we're working on developing a program where we can coordinate with the county. We're working on it and can bring it to the next meeting.	Meeting comment - noted.
341					Meeting	8/10/2021	James Sang	I feel like in the Corral de Tierra area, I see a great potential for using swales or trenches for capturing rainwater. I think all the water coming out of the hills at the base of the hills, you could collect a lot of water in that area. In the Marina area, a waste treatment plant would be great for the area with more population. Plus an area with a lot of sand, you could put trenches and swales there and capture a lot of water.	Sarah Hardgrave: Thank you, I believe those are captured in the decentralized stormwater and rainwater projects.	Meeting comment - noted.
342					Special Meeting	8/25/2021	Janet Brennan	I have several questions about that chapter [8], about groundwater levels and impact to the Seaside Basin. Especially those issues raised in the Land Watch letter.	Emily Gardner: We have that agendized to discuss it today. Depending on your feedback today, it will be incorporated into the chapter.	Meeting comment - noted.

343					Special Meeting	8/25/2021	Sarah Hardgrave	We'll provide input today and depending on the outcome, if there are changes will you post a revised version of the chapter?	Emily Gardner: We'll email and post it. Again, we can get feedback at the September 8 meeting.	Meeting comment - noted.
344					Special Meeting	8/25/2021	Janet Brennan	Do we recommend approval of the Monterey Subbasin GSP?	Emily Gardner: It has depended on each subbasin committee, how formal/informal they want to be. You can be formal and approve each chapter or you can wait until the whole draft GSP in one piece on September 8, and approve it to send it to the Board. Or just have general consensus.	Meeting comment - noted.
345					Special Meeting	8/25/2021	Sarah Hardgrave	If our committee is not able to reach agreement or take a formal vote, individual committee members can still provide comment during the comment period?	Emily Gardner: Yes. There have been some committees that have said the GSP is okay, but acknowledge that there are still things that need work. It's a living document.	Meeting comment - noted.
346					Special Meeting	8/25/2021	Bob Jaques	If we get 3 chapters, and the entire GSP shortly before the September 8 committee meeting, that will be a lot to review. It will be hard to think you will get a motion to approve.	Emily Gardner: We recognize that. We're hoping you will take us up on the 45-day comment period. We're working on the other deadlines for notification.	Meeting comment - noted.
347					Special Meeting	8/25/2021	Sarah Hardgrave	I would just suggest, to think about, whether there would be a possibility for this committee to get together one last time during that 45 day comment period.	Emily Gardner: Yes, that's what we've been tentatively planning with the other subbasins, to review any substantive changes and get feedback.	Meeting comment - noted.
348					Special Meeting	8/25/2021	Bob Jaques	Interested in if there are any pumping depressions within the subbasin.	Comment received	Meeting comment - noted.
349					Special Meeting	8/25/2021	Sarah Hardgrave	I'll just add that those [Toro and Ambler Park] are both Cal Am systems and Cal Am was at that time adding treatment for arsenic. This is a difference between public systems and small water systems and domestic wells, which don't have treatment.	Comment received	Meeting comment - noted.
350					Special Meeting	8/25/2021	Bob Jaques	I think Option 2 is the best. Adjusting wells individually which would put wells at 2008 levels would be desirable from the Seaside Basin perspective.	Comment received	Meeting comment - noted.
351					Special Meeting	8/25/2021	Janet Brennan	What is the impact of the 2015 minimum threshold on the Seaside Basin? We are already in a trend to exceed the 2015 minimum threshold. You made the argument that if we raise the minimum threshold, we're going to have to implement programs faster than we already have to. What's the difference?	Victoria Hermosilla: My understanding of the modeling data is that there is approximately 400 acre-feet per year water moving from Corral to the Seaside Subbasin. I don't know that we have enough data to definitely say what the impacts to Seaside were. Raising water levels in one area will generally raise groundwater levels in neighboring areas as well.	Meeting comment - noted.
352					Special Meeting	8/25/2021	Janet Brennan	Seems like if you have time for 2015, you have time for 2008. I support Bob's recommendation.	Comment received	Meeting comment - noted.
353					Special Meeting	8/25/2021	Beverly Bean	As a resident of the area, I support 2008 as the way we will get the most aggressive action most quickly. All of this is based on a study that is already old. I favor the fastest approach. Favor Option 2.	Comment received	Meeting comment - noted.
354					Special Meeting	8/25/2021	Patrick Breen	What concerns me is setting these thresholds at a level that we won't be able to meet. Do we have a sense of how many projects this would take to get the water into the aquifer? I don't think hydrogeologically it would impact the Marina Coast Water District Management Area.	DW: There isn't a legal issue with this. It's whether it is practicably achievable.	Meeting comment - noted.
355					Special Meeting	8/25/2021	Gary Kreeger	I understand not doing too big of a lift. We need to think about where we need to be, what the problem we're trying to fix.	Comment received	Meeting comment - noted.
356					Special Meeting	8/25/2021	Janet Brennan	I do not support keeping 2015 levels in the Marina-Ord area because it's allowing seawater intrusion. The coastal well project is pretty much pie in the sky. We have funding issues coming down the line. I think that 2008 is reasonable for the Corral de Tierra.	Sarah Hardgrave: To clarify, you raised the LandWatch letter, and you have similar concerns about the 180/400, correct? Janet Brennan: Correct	Meeting comment - noted.
357					Special Meeting	8/25/2021	Margaret-Anne Coppernoll	On an earlier slide it showed groundwater levels going up in 2017 and then going back down.	Sarah Hardgrave: My layman's response is that in 2015 we were in a drought, and in 2017 we had more rain.	Meeting comment - noted.
358					Special Meeting	8/25/2021	Margaret-Anne Coppernoll	What option gives us the most flexibility to adjust to changes in groundwater levels?	Victoria Hermosilla: You can mix and match and add the management action to any of the other options. Vera Nelson: I just want to clarify that changing the minimum thresholds/measurable objectives in the Corral de Tierra area will not change them in the Marina/Ord area. Changing the minimum thresholds/measurable objectives in the Corral de Tierra will not affect seawater intrusion because the Corral de Tierra is at such a high elevation. In the Marina/Ord area, the plan is to keep the minimum thresholds at 2015 and measurable objectives at 2004/2005.	Meeting comment - noted.
359					Special Meeting	8/25/2021	Beverly Bean	Setting lower elevations would cause us to be in violation of the Sustainable Groundwater Management Act.	Comment received	Meeting comment - noted.
360					Special Meeting	8/25/2021	Bob Jaques	I think it would be good to add the management action in Option 3 to Option 2.	Comment received	Meeting comment - noted.

361					Special Meeting	8/25/2021	Christopher Bunn	I was just curious if the minimum thresholds and measurable objectives for elevations have been contemplated in any expansion plans for the city of Marina.	Abby Ostovar: This discussion is only about the Corral de Tierra area and would not affect the Marina/Ord area. Sarah Hardgrave: Hydrogeologically, where the minimum thresholds and measurable objectives are set in the Corral de Tierra would not affect the Marina/Ord area, but a violation for one management area would be a violation of the Sustainable Groundwater Management Act for the subbasin. Vera Nelson: The projected water budgets and GSP do not address projected increases in groundwater extraction. Sarah Hardgrave: Those are pieces of the plan we'll be looking at during the September 8 meeting. I do look forward to seeing the projected water budget information.	Meeting comment - noted.
362					Special Meeting	8/25/2021	Sarah Hardgrave	I want to bring us back to the water quality/arsenic part of the presentation. If we were to change the minimum thresholds/measurable objectives, it doesn't appear to me that it wouldn't necessarily have an effect on the arsenic. So just to reconnect back to the purposes of this discussion, the overarching questions you're raising Janet are more about water supply and not water quality.	Comment received	Meeting comment - noted.
363					Special Meeting	8/25/2021	Janet Brennan	You're correct, that going to the 2008 level would help the Seaside Basin. I am going to make a motion to change to the 2008 levels and add the management action.	Comment received	Meeting comment - noted.
364					Special Meeting	8/25/2021	Bob Jaques	Our modeling shows that while there is some inflow into Seaside now, if groundwater levels continue to decline, that will reverse and water will flow into the Corral de Tierra. So keeping the minimum thresholds high would not only benefit the Corral de Tierra area, but would be a benefit to the Seaside basin as well.	Abby Ostovar: I just want to make it clear that raising the minimum thresholds/measurable objectives will be a significant lift and would mean pumping reductions or costly supply side projects, and this will mainly have an impact on domestic use in the area.	Meeting comment - noted.
365					Special Meeting	8/25/2021	Ron Stefani	I can't support this motion because of the cost of making this change. It's a heavy enough lift with the current option.	Comment received	Meeting comment - noted.
366					Special Meeting	8/25/2021	Patrick Breen	I'm unclear of the different between Option 1 and Option 2.	Victoria Hermosilla: They are effectively the same, averaged. However, one is that broad brush stroke of adding 5 feet, and the other is pinning the change to the specific year for each well. It averages out to be approximately 5 feet, but some wells are different.	Meeting comment - noted.
367					Special Meeting	8/25/2021	Sarah Hardgrave	I'm going to support the motion, mainly because of the urgency of bringing forward a regional water supply, which would also address the issues in the 180/400. By serving a larger region it would be most cost effective. Our office sees the urgency and for that reason will support motion.	Comment received	Motion passes, 5 yes, 4 no Roll call vote: No - Breen, Coppernoll, Stefani, Storms Yes - rest (5)
368					Special Meeting	8/25/2021	Bob Jaques	I have submitted my written comments yesterday, I want to touch on a few for discussion but the committee. First, many projects and management actions in Draft Chapter 9 don't have cost or estimated unit costs. I'm concerned that without costs, we can't put together a budget, not a water budget, an operational budget. I think you should include that in the chapter. I think we need to do a reality check, some of these projects produce so little benefit, that the unit cost is out of sight. We need to see what is reasonable from a cost benefit standpoint.	Comment received	Meeting comment - noted.
369					Special Meeting	8/25/2021	Janet Brennan	I cannot support this [Regional Municipal Supply Project] unless it is declared that it is publicly owned.	Comment received	Meeting comment - noted.
370					Special Meeting	8/25/2021	Janet Brennan	Recharge to Corral de Tierra from stream channel improvements. How does that water get from stream to Corral de Tierra? I think that should be clarified.	Comment received	Meeting comment - noted.
371					Special Meeting	8/25/2021	Janet Brennan	I think you should clarify water diversion as well. Final point, proposed R2 would generate 15,000 acre-feet of water, and proposal would indicate water would go to agriculture. That's more costly than what agriculture can support. Your analysis needs to indicate if that water is really viable for agriculture.	Comment received	Meeting comment - noted.

372					Special Meeting	8/25/2021	Bob Jaques	There are several places in the chapter, I'm given the impression that pumping reduction may not be necessary. Says 'if pumping reductions are necessary.' I think that should be edited out, because without it, projects and management actions fall short. Also, the discussion about getting reclaimed water, I'm getting concerned that the amount of reclaimed water that can be produced is getting oversubscribed. The 180/400 includes expansion of the CSIP area, so reclaimed water will go there. Seaside Basin also. I think you need to make sure everybody is not making a claim, cause it seems like a lot of folks are looking to that reclaimed water.	Abby Ostovar: We can clarify that in the text. In the plans are the potential projects and management actions. It doesn't mean they will be implemented. For example, the Eastside GSP has two 11043 projects, they're just options. When we get to implementation, we'll decide. I hear your concern about overbanking on M1W.	Meeting comment - noted.
373					Special Meeting	8/25/2021	Bob Jaques	On page 9-1-3, de minimis pumpers, I think it would be worth having some legal review made whether it would be possible for MCWRA to have de minimis extractors file extraction reports. SGMA can't impose a fee on them. Probably a simple legal question, I don't think it would be too hard. I think MCWRA could impose that if it would help with basin management.	Sarah Hardgrave: It's a good question, and I think [legal] council here can consider it.	Meeting comment - noted.
374					Special Meeting	8/25/2021	Beverly Bean	In my opinion, pumping reductions are the only project that will help the groundwater.	Comment received	Meeting comment - noted.
375					Special Meeting	8/25/2021	Patrick Breen	Is there a way to determine what existing pumping would need to be minimized to raise water levels? Would a zero pumping scenario get us there within 20 years?	Abby Ostovar: We can look at it. I would need to talk with our modelers. I'm not quite sure what the capabilities are there.	Meeting comment - noted.
376					Special Meeting	8/25/2021	Patrick Breen	This group needs to understand existing pumping. I'm wondering if we're even in a feasible situation. With raised levels, I'm not sure we can even achieve that.	Comment received	Meeting comment - noted.
377					Special Meeting	8/25/2021	Bob Jaques	If you look at the regional projects, you have substantial amounts, not that it's inexpensive. I think it's achievable, on a regional basis. You look at the unit cost with smaller projects, and they're unachievable. Regional projects, even though capital cost is greater, is more reasonable.	Comment received	Meeting comment - noted.
378					Special Meeting	8/25/2021	Sarah Hardgrave	I agree with you Bob. Many of the Corral de Tierra projects seem like a heavy lift and a relatively small benefit for the effort required. It reinforces my perspective that regional projects are preferable.	Comment received	Meeting comment - noted.
379					Special Meeting	8/25/2021	Gary Kreeger	I want to point out that there will be a heavy cost if we don't turn this problem around. Keep it balanced. Yes there's a cost, but also a cost if we run out of water.	Comment received	Meeting comment - noted.
380					Special Meeting	8/25/2021	John Bramers	It seems like this small Corral de Tierra area will be burdened to pay for these projects, is this area even able to pay? Will Seaside participate, because they will benefit? If the GSP for the Corral de Tierra doesn't go through with the board, is the entire subbasin out of compliance?	Comment received	Meeting comment - noted.
381					Special Meeting	8/25/2021	Christopher Bunn	I very much agree with the comments from Bob and Sarah. I think that's the only way this area can be secured. I think there will be a lot of support from the farming community to the north for the right project. These piecemeal projects, I don't see it happening. The Winter release with ASR is primarily a 180/400 project, that project is something that the farmers won't get behind. If you're going to spend that much capital, you might as well get a proper regional project.	Comment received	Meeting comment - noted.
382					Special Meeting	8/25/2021	Margaret-Anne Coppernoll	I support this [Land Use Jurisdiction Coordination Program] for all the committees to see and understand. I think it's important, this collaboration idea.	Comment received	Meeting comment - noted.
383					Special Meeting		Sarah Hardgrave	I appreciate the inclusion of this language. There have been times when water use has been used as the rationale for land use restrictions, but they are related. My sense is that the concern we've heard from Janet was on the land use jurisdictional side. I think it will take commitment from the jurisdictions to consider the GSPs with their land use decisions. It's not a mandate, and may take more general consensus with respect to GSPs and future updates. It seems like a good generalized statement you've made here.	Comment received	Meeting comment - noted.
384					Special Meeting	8/25/2021	Margaret-Anne Coppernoll	I'll make a motion that we include it in all the GSPs.	Comment received	Meeting comment - noted.
385					Special Meeting	8/25/2021	Janet Brennan	I second.	Sarah Hardgrave: So the motion is to include it [Land Use Jurisdiction Coordination Program] in our GSP and encourage the other subbasins to incorporate it.	MOTION PASSES

386					Special Meeting	8/25/2021	John Bramers	Now that the other GSPS have gone to the Board, would this need to go back to the Board?	Emily Gardner: We did mention this at the Board meeting, that there would be edits to the draft GSPs. There is a version that went out for public comment. But there is a version that will have the edits and go back to the board on December 9.	Meeting comment - noted.
387					Email	9/8/2021	Margaret-Anne Coppernoll	1. Page 10-5 - Footnote, line 2 RWS - should this be RMS? 2. Page 10-7 - last paragraph. the wording seems unclear "and subject to seawater intrusion" - is groundwater elevation monitoring subject to seawater intrusion? I recommend clarification on this sentence. I apologize if I missed the correct connection. 3. Page 10-15 - Section 10.7, 2nd paragraph, 1st word: "Cost" should be "Costs herein are"? 4. Page 10-19: Section 10.7.2.2, line 7- there seems to be an extra word: the costs comprise of (extra word) annual analysis and reporting of sustainability conditions. 5. Page 10-20 - line 4: "permitting associated will (should be "with") all potential projects...." Question: Is it possible to describe or list what the actions are that will be implemented for the $35,000 budget item for supporting deep well monitoring/2022/23? I ask because the other budget items contain a description. Maybe a description is not necessary - just inquiring.	Comment received	Thank you for the edits and suggestions. Revisions in the text have been made.
388					Meeting	9/8/2021	Sarah Hardgrave	Can this committee reconvene during the 90 days? We have to acknowledge it was an 834-page packet that we got on a holiday weekend, and it would have been impossible for all of us to digest the new material and plan as a whole. I would recommend that we have another meeting.	Comment received.	Meeting comment - noted.
389					Meeting	9/8/2021	Margaret-Anne Coppernoll	I like that idea. I think we need some more time.	Comment received.	Meeting comment - noted.
390					Meeting	9/8/2021	Bob Jaques	Would we be able to get a look at what the edits will be so we have something to respond to?	Sarah Hardgrave: I think we can request an update along those lines as part of the agenda materials. So we can leave it flexible for our consultants and GSA staffs for making changes. Emily Gardner: Your next regularly scheduled meeting will be that first Friday in November.	Meeting comment - noted.
391					Meeting	9/8/2021	Sarah Hardgrave	I think that will help today's meeting as well. We know we'll have an opportunity to come back with comments and questions. If you have the opportunity or time, I would encourage you to submit comments online in addition to what you've shared at the meetings.	Emily Gardner: To clarify, there is a 90-day notification to the city and county, the exact comment period will be determined when it is released by Marina Coast Water District. Ours is a little longer than 45 days.	Meeting comment - noted.
392					Meeting	9/8/2021	Sarah Hardgrave	When is the deadline to submit to DWR?	Emily Gardner: End of January, and then there will be another comment period.	Meeting comment - noted.
393					Meeting	9/8/2021	Sarah Hardgrave	To receive this, you are also looking for approval?	Emily Gardner: In general, this committee tends to prefer more formal motions. We just like to take it to the board having been reviewed by the committee.	Meeting comment - noted.
394					Meeting	9/8/2021	Bob Jaques	In the bottom right corner, the Corral water budget zone, net annual change in storage, I know in some of the other slides, I thought the overdraft was 1,000 AFY.	Abby Ostovar: So that was prior to having the model, and that was developed by taking groundwater levels between two different years and using a storage coefficient. The storage SMC here is the difference between the MO/MT.	Meeting comment - noted.
395					Meeting	9/8/2021	Sarah Hardgrave	What is the difference between the sustainable yield and the 1,000 AFY Bob is referring to?		Meeting comment - noted.

396					Meeting	9/8/2021	Bob Jaques	Would the modelers consider the 2,800 AFY to be more reliable than the previous 1,000 AFY?	DW: In a way, Bob, I would say it is more reliable because it is based on a more complete analysis of the basin. I would not say we're going to throw out the 1,000. We will keep it to look at the uncertainties. Yes, it is more reliable, but it is not the final word. Abby Ostovar: Keep in mind, the water budget is a requirement from DWR. It is one aspect to guide management. What we should be focused on is avoiding those undesirable results. Even though we do have imperfect and incomplete information, we know groundwater levels have been declining and that information can help guide management.	Meeting comment - noted.
397					Meeting	9/8/2021	Bob Jaques	What is the timeframe on this?	Abby Ostovar: This is projected out 50 years. Tina Wang: Those should be dates instead of numbers. The reason we're running these scenarios is because this subbasin is very interconnected to the other subbasins. We want to see how the boundary conditions and climate will affect the outcome of the model. The message that we're getting from this analysis is that it's very much dependent on boundary conditions as well as climate.	Meeting comment - noted.
398					Meeting	9/8/2021	Janet Brennan	All of this is going to the advisory committee, and I want to know if the threshold will be revised to the 2008 level before it goes to the advisory committee for consideration. This was one item that has a close vote, and the advisory committee may want to weigh in on this important issue. They should get chapters that reflect our agreement	Emily Gardner: What you're getting today and the board will get tomorrow is a verbal explanation that this has been changed. The plan was to have the advisory committee receive the same draft you received. There are time constraints. If something is ready before, then yes, but hopefully this explanation as Abby has presented is fine.	Meeting comment - noted.
399					Meeting	9/8/2021	Sarah Hardgrave	When we come back to a meeting in late October, hopefully that will be enough time to make those changes. Maybe, to Janet's point, there can be a slide explaining the discussion this committee had on Aug 25 so it's really clear that it happened, and they are receiving the information about it. I think it will continue to be a point of discussion. To Patrick's concern, better understanding of how the revised MT/MO, are we already at the Undesirable Result with the 20% below, and what does that really mean for us? I think there needs to be more discussion on how realistic it would be, especially based on water budget information.	Abby Ostovar: That is what the model shows.	Meeting comment - noted.
400					Meeting	9/8/2021	Sarah Hardgrave	I think we really need to talk about the project options and how far they would get us.	Abby Ostovar: If I get through the rest of the slides, it will get to the projects and we can continue this discussion.	Meeting comment - noted.
401					Meeting	9/8/2021	Bob Jaques	At the last meeting, one of my comments was about *de minimis* wells and requiring them to do reporting. Do you know if any legal look has been made into that?	Sarah Hardgrave: Can we pause on that question, Bob? The supervisors are in a meeting and Les Girard is there. If he can come to this meeting, we can ask him when he joins us here.	Meeting comment - noted.
402					Meeting	9/8/2021	Janet Brennan	Regarding: "There is no known impact to depth and concentrations of arsenic". I think it is more accurate to say there is a lack of data regarding the concentration and depth. Maybe that's a little technical, but it implies that there is no relationship when in fact there is no data to support a relationship. Am I off base? I suggest you change the wording.	Abby Ostovar: I can change that for the board meeting.	Meeting comment - noted.
403					Meeting	9/8/2021	Janet Brennan	I question whether agriculture is willing to pay a municipal cost for that excess water. You may want to note that somewhere.	Abby Ostovar: Part of the reason we have a range here is because it will require a number of conversations about where the water goes. There are a number of steps to bring this to fruition, or really to understand how this should be scoped.	Meeting comment - noted.
404					Meeting	9/8/2021	Margaret-Anne Coppernoll	My concern is related to Bob's question about *de minimis* wells, because that seems to give us a large data gap that is important to close. For the well registration, do we know how many exist? It's important to know considering the drops in the groundwater levels.	Sarah Hardgrave: I believe there is detailed information about the breakout of the different types of systems.	Meeting comment - noted.
405					Meeting	9/8/2021	Margaret-Anne Coppernoll	My question is about the legality and obtaining meters. I liked what Bob had to say and his questions.	Sarah Hardgrave: Again, we're going to hold off on that until legal counsel can join us.	Meeting comment - noted.
406					Meeting	9/8/2021	Steve McIntyre	I think it would be interesting to see when that analysis is done, to look at the reduction in pumping with respect to both the previous SMC and revised SMC, to look at what the difference might be.	Comment received.	Meeting comment - noted.

407					Meeting	9/8/2021	Christopher Bunn	It seems like the more I hear and read through this GSP, the more questions I have. No subbasin is mired entirely in itself, even if the 180/400 farmers meets its MOs, but Corral de Tierra is still losing water, how does the "do no harm" play into that relationship? Will the [Reservation Road areas] be included? Regarding the Regional water supply project and farmers, at municipal [water] cost levels, you can't farm. But I think there could be some kind of window or agreement for farmers to subsidize the cost of that water.	Abby Ostovar: With regards to projects and management actions along the Reservation Road area, we would address this as we go. That is Salinas Valley Basin GSA's responsibility, but any projects and management actions would have to be evaluated on its impact and participation level.	Meeting comment - noted.
408					Meeting	9/8/2021	John Bramers	I heard "need more data" a half dozen times, but we're setting MTs with a lack of data. My question is, we have to be sustainable in 20 years. By putting that MT at 2008, how many pumping allocations and projects will we have to do, and can we even get to that MT?	Abby Ostovar: We don't know at this point what the level of effort will be. It will be substantial regardless.	Meeting comment - noted.
409					Meeting	9/8/2021	John Bramers	How many wells are we looking at right now? If they all fall below, what is that?	Abby Ostovar: We don't know right now.	Meeting comment - noted.
410					Meeting	9/8/2021	James Sang	I notice a lot of wells are located in the southern part of the Corral de Tierra area. You've mentioned several projects, but are they really relevant to raising the water levels in the wells? Will it actually help us raise the groundwater levels in those wells in the southern part of the basin?	Sarah Hardgrave: Thank you for that comment, it reinforces further discussion here.	Meeting comment - noted.
411					Meeting	9/8/2021	Christopher Bunn	If the 180/400 meets the MOs, but Corral de Tierra is still losing water, how does the "do no harm" policy apply?	DW: Part of this is going to be a legal assessment. I would say that the idea is that you cannot prevent a neighboring subbasin from achieving sustainability. What that means has not been tested yet. Does that mean a neighboring subbasin has to have SMC you agree with? We are trying to set up SMC between our GSPs so there won't be a significant gap. It's an advantage to how we're approaching this whole valley. But the answer is it hasn't been tested yet.	Meeting comment - noted.
412					Meeting	9/8/2021	Patrick Breen	Of the 1,200 AFY being pumped, do we know how much is *de minimis* ? Just remind me, does the Sustainable Groundwater Management Act have jurisdiction over overlying pumpers?	Sarah Hardgrave: The first part of your question, one of the reports we received, had a table of the number of water systems and the number of *de minimis* wells, in addition to the small and regulated system. I know that information is available, but not quickly. Abby Ostovar: This was a memo we had the Wallace Group put together on extraction data in the area.	Meeting comment - noted.
413					Meeting	9/8/2021	Patrick Breen	Are we even able to regulate them? Is our ability to regulate them, shouldn't that be considered and weighed?	Sarah Hardgrave: Again, that is a legal question to give to Les. I hope you're keeping a list for him. Emily Gardner: I did ping Les quickly. MCWRA does have the authority to require meters for *de minimis* users, not the GSA. So it would have to be in partnership with them.	Meeting comment - noted.
414					Meeting	9/8/2021	John Bramers	If we can't get *de minimis* users to participate, I don't think we can balance this basin. Even if you can put a meter on those *de minimis* users, can you put an allocation on them? Also, when you talk about a well in the Upper Corral area, where is that going to?	Emily Gardner: I also have the pie chart that shows the percentage of *de minimis* users I can share.	Meeting comment - noted.
415					Meeting	9/8/2021	Janet Brennan	Even if you could regulate all the pumping and reduce pumping by 1,200 AFY, you're still not going to address the overdraft problem. It's more complex than just putting limits or having an allocation system.	Comment received.	Meeting comment - noted.
416					Meeting	9/8/2021	Sarah Hardgrave	If we set the targets at these different levels, we need more information than we have now, and explain what we would need at each level, and how the projects could meet the criteria. I think that goes to James Sang's comment, how we raise the levels. I do continue to see that if the regulated utility system, that would be the most reasonable to tie in to potable domestic water supply, that's the best way to reduce the amount of pumping.	Comment received.	Meeting comment - noted.
417					Meeting	9/8/2021	Patrick Breen	We're showing our water levels generally stabilizing but what we're going to encounter is some current wells going dry. Are we going to spend so much money to avoid a certain amount of wells going dry, or submit a plan where some wells will go dry. I understand the ramifications. In the context of what we're dealing with here, how much money are we willing to spend on a sustainable level, and maybe a sustainable level that is lower than we prefer. How much storage is in the Corral de Tierra area? Do we know that?	Abby Ostovar: We haven't put a number on the storage for the Corral de Tierra. There's a question of if it's feasible. I'm hearing that a lot of this is about trade-offs. Patrick, you put it well. Domestic wells were prioritized here, but the trade-off is cost. That conversation about projects and management actions to implement, and which will be prioritized, is where we'll head for implementation.	Meeting comment - noted.

418					Meeting	9/8/2021	Bob Jaques	In one of the earlier chapters there was a graph showing groundwater levels over time. And the groundwater levels continue to decline for a number of years and then they go up after projects and management actions are implemented. I'm curious how the rebound is determined. From the current list of projects and management actions, it doesn't look like we'll get there. Even if you turn off all the pumping, you're saying here that we won't get there. So it seems like someone was making assumptions about when those projects and management actions will be implemented. Do you recall that slide? Is that something that can be easily explained?	Abby Ostovar: I think what you're thinking about is the Marina-Ord area. We don't have "a project" scenario. Are you referring to interim milestones? It is just showing what will be needed to reach those levels.	Meeting comment - noted.
419					Meeting	9/8/2021	Bob Jaques	If those are interim milestones, if there was a way that those have been determined.	Abby Ostovar: It's not tied to specific projects. It assumed it will take a few years to implement and it will take some time to rebound.	Meeting comment - noted.
420					Meeting	9/8/2021	Bob Jaques	Okay, you may want to highlight that a little more because I didn't pick that up.	Comment received.	Meeting comment - noted.
421					Meeting	9/8/2021	Sarah Hardgrave	I think in this time, we've made some suggestions on what type of additional discussion is needed and time to review the documents and develop more comments and questions. I think at this time, our committee should recommend releasing this document for review.	Comment received.	Meeting comment - noted.
422					Meeting	9/8/2021	Patrick Breen	I make a motion	Comment received.	Motion passes, draft released for review
423					Meeting	9/8/2021	Margaret-Anne Coppernoll	I second it.	Comment received.	Meeting comment - noted.
424					Meeting	9/8/2021	Sarah Hardgrave	Bob and I did give an overview presentation to this to the Seaside watermaster. I will add one comment on the plan. In Chapter 2, there wasn't much mentioned on the need for coordination with the adjudicated basin. I noticed that was a missing piece. The shared boundary between Marina Coast and the FO-9/10 wells have been a subject of discussion of the watermaster.	Comment received.	Meeting comment - noted.
425					Meeting	10/22/2021	Bob Jaques	Are there comments from the online form? I see there are always different spots. I really like to look at the next versions of the draft GSP, because so many comments are made and it's nice to see where revisions are made from comments.	Emily Gardner: Yes, we are working on it as fast as we can. We will try to get it at the end of November. We're going to try to get it to you as soon as possible.	Meeting comment - noted.
426					Meeting	10/22/2021	Sarah Hardgrave	There have been quite a few comment letters that are comments on multiple subbasins. It's a little bit of a task to comb through and see what is specific to the Monterey Subbasins. Is MCWD receiving separate comments? Are they preparing separate responses?	Patrick Breen: It's my understanding that EKI and Montgomery are compiling the responses together into one table.	Meeting comment - noted.
427					Meeting	10/22/2021	Janet Brennan	Re: Undesirable Results. This section about GSA projects to not let water levels fall below minimum thresholds, that suggests to me there is a relationship between groundwater levels and quality. Previously, the conclusion was that they could not establish a relationship, this implies there is a relationship, this seems to be a change in direction.	Abby Ostovar: You're correct. When we looked at arsenic, we couldn't find a relationship with groundwater levels. This is a more general statement that deals with all constituents of concern. It's one of the strategies we will use to make sure we don't have degradation, but we would have to look at each constituent individually. Emily Gardner: Exceedance of minimum thresholds refers to water quality specifically.	Meeting comment - noted.
428					Meeting	10/22/2021	Sarah Hardgrave	I have the same observation as Janet, so thank you for the clarification. I am hearing what you're saying about arsenic and the relationship with groundwater levels in the Corral de Tierra. It's a very specific constituent of concern. There isn't a clear relationship between groundwater levels and naturally occurring arsenic. For other constituents, groundwater levels can impact quality. This statement will be applied to all constituents in all subbasins. I'm just restating what you said so I understand.	Comment received.	Meeting comment - noted.
429					Meeting	10/22/2021	Sarah Hardgrave	I'm wondering if in the Monterey plan, if the clarification we made here can be added for the Corral de Tierra area. Specific concerns about arsenic and groundwater levels can be clarified, not necessarily influenced by groundwater levels. The challenge we have is that it's naturally occurring and not related to the overpumping issues we have. I would also assume that over time, there will be careful monitoring to see if there is a greater relationship than is currently understood.	Emily Gardner: In our definition of undesirable results, or the SMC chapter, perhaps where we talk about general groundwater quality. Abby Ostovar: We could reference it where we do talk about it. If someone just reads this, they might miss it. Emily Gardner: Yes we can point back to how we describe it elsewhere in the GSP.	Meeting comment - noted and incorporated

430					Meeting	10/22/2021	Bob Jaques	Re: model results: I think more than anything, this shows how severely in overdraft this subbasin really is. Regardless of the minimum thresholds/measurable objectives, if you stop all pumping, you just have an unsustainable condition.	Comment received.	Meeting comment - noted.
431					Meeting	10/22/2021	Janet Brennan	I was going to make a similar observation. No matter what we adopt. Even if we stop all pumping, we continue to decline because of leakage to other subbasins?	Abby Ostovar: Yes.	Meeting comment - noted.
432					Meeting	10/22/2021	Steve McIntyre	So if there is leakage, and you stop all pumping, is there also the possibility that adjoining subbasins is somewhat harming this subbasin? Hydrologically, I'm sure there is another term for it.	Abby Ostovar: It is interconnected with other subbasins. Part of this is a challenge because we are projecting other subbasins' groundwater levels which we don't really know. Any model is also built on the best available data, and there are uncertainties including several data gaps in this area. This area is largely not covered by GEMS. The estimation of extraction may be less than what is actually occurring. But yes, this is related to adjacent subbasins, in as much as other adjacent subbasins are impacted by Corral de Tierra.	Meeting comment - noted.
433					Meeting	10/22/2021	John Tilly	Are you aware of how much is going into the Seaside Basin too?	Abby Ostovar: I would need to look at the relationship again. We've talked to the watermaster as well. That area has a three-way partial groundwater level flow divide. We have some information about it, but it's tricky to understand what is going on there. Even with the modeling, it's a tricky area to understand.	Meeting comment - noted.
434					Meeting	10/22/2021	Bob Jaques	One of the difficulties is that the modeling the watermaster has done in the past, we modeled the Paso Robles Formation and Santa Margarita Formation as separate aquifers. The Monterey model has modeled them together as a single aquifer, the El Toro. Their modeling shows an inflow to the Laguna Seca, and our model shows an outflow from the Laguna Seca. We expect in the early years of implementation we will find compatibility between the two approaches. The two aquifers, grouped together, are grouped from a lack of additional monitoring input. They will need to be separated to view the outflows and inflows.	Abby Ostovar: We did talk about this to figure out what the discrepancies are, and they have different boundaries and different future assumptions. We started to look at how those simulations work differently. In the EKI model, they do separate out the formations, but for the GSP they are grouped.	Meeting comment - noted.
435					Meeting	10/22/2021	Beverly Bean	It seems to me that this kind of slide should be in the report and used as a wake up call to the powers that be, the political powers. For people to understand that this aquifer is so severely impacted, I want to know if you will put a no pumping scenario in the plan. I hope it wasn't brought back to us to revise the SMC.	Abby Ostovar: One idea we had for this committee, we were thinking this could be brought into the report as a project scenario like MCWD has, and perhaps into Chapter 9.	The no pumping scenario output was added to the plan
436					Meeting	10/22/2021	Janet Brennan	I'm inclined to go back to the original SMC, to keep it in the realm of possibility. Our recommendation will impact the general population, it impacts all the residents in the Corral de Tierra. We have limited participation from that community. I'm really concerned about adopting something that is beyond any reasonable expectation.	Comment received.	Meeting comment - noted.
437					Meeting	10/22/2021	Bob Jaques	Our concern is that our modeling indicated we will lose water even if we stop all pumping. If we do, the water rises and the gradient slopes more steeply to the Corral de Tierra. So then we're unsustainable, but how much more can we do beyond not pumping? We're already looking at other water for our subbasin for replenishment. As we talked at the last meeting, if we can generate new water, it sounds like all subbasins are in need of a new water source. I follow the 180/400, and they have their extraction barrier and potential desalination. We see the Corral de Tierra and Monterey Subbasin leaks a substantial amount of water to the 180/400. If the 180/400 could stabilize, it seems like it would solve some of the Monterey issues. We're just concerned about the Corral de Tierra area water levels not being brought back up.	Comment received.	Meeting comment - noted.
438					Meeting	10/22/2021	Sarah Hardgrave	The Seaside Basin has already gone through their step-wise reductions, and we're still having issues.	Comment received.	Meeting comment - noted.
439					Meeting	10/22/2021	Janet Brennan	The failure of all these sub-plans is to not identify a regional solution for the Salinas Basin that address the need for redistribution of water within the entire basin. That is a major concern of all of us. We just need to have a more comprehensive view and regional approach than just looking at projects. Some southern subbasins are not looking at the redistribution of water and we need to have a coordinated approach.	Comment received.	Meeting comment - noted.

440					Meeting	10/22/2021	Beverly Bean	While I certainly agree with the regional needs, I want to take up the comment on the participation of Corral de Tierra residents. They pump happily away without realizing they are contributing to a problem. I think the "no-pumping" slide should be in the plan, and I don't think we should change the SMC back to the original levels. I think this needs to be a dramatic warning.	Comment received.	Meeting comment - noted.
441					Meeting	10/22/2021	Ron Stefani	I am going to support the original SMC. Staff didn't pick that number out of the air. There has been a lot of work that has gone into this. If we can meet the minimum threshold and measurable objectives, they can be moved again later down the road.	Comment received.	Meeting comment - noted.
442					Meeting	10/22/2021	Steve McIntyre	I have to agree with Beverly, that 95% of the Corral de Tierra residents don't have a clue, and I'm one of the 95%. As much as I am involved elsewhere. I think the slide today is quite dramatic, and we should include it in the GSP. I think this needs critical attention, and we won't get it without some shock value.	Comment received.	The no pumping scenario output was added to the plan
443					Meeting	10/22/2021	John Bramers	I don't disagree with putting it in the GSP, and I do agree with putting it back to 2015. Did we ever get clarification that *de minimis* users, and how they will participate in restrictions? I remember that was key. We still need to get that clarification. Are we going to have leakage no matter what? Is leakage a pat of not being able to get to sustainability? Do we have to get to a point where there's no leakage?	Abby Ostovar: The Salinas Valley is hydraulically connected. You will never operate in a vacuum. This area is the area of recharge for here and the areas around it. We won't get no leakage, we all have to work together to get to our undesirable results. They are connected, and it's a joint effort no matter what. Emily Gardner: The authority around regulating *de minimis* users. While the GSA has limitations on how the regulate *de minimis* pumpers, the MCWRA does have that authority. So we'd have to work through the MCWRA. Donna Meyers: The County of Monterey also has that ability as well.	Meeting comment - noted.
444					Meeting	10/22/2021	Sarah Hardgrave	I'll make a motion to go back to the 2008, 2015 SMC levels that had been in place prior to the August meeting.	Motion Passes	SMC for groundwater levels was adjusted based on Subbasin Committee vote
445					Meeting	10/22/2021	Janet Brennan	I'll send this comment on to staff so you can understand it. This whole section needs clarification, it's based on so many assumptions. 'Sustainable' is based on other basins meeting their obligations. If you could re-take a look at that page and make it understandable for the lay person, I would appreciate it.	Donna Meyers: We're happy to do that, no problem.	Meeting comment - noted.
446					Meeting	10/22/2021	Margaret-Anne Coppernall	I just want to bring up the *de minimis* wells again. I wonder how many there are and how much they're pumping. There's no way to know how much they're pumping. We need to include them in the equation because it is going to affect everybody. We need the information to make the correct decisions. It will require everybody. Do we know many *de minimis* wells there are?	Abby Ostovar: We did an analysis on parcels, assuming if they weren't served by a water system, they would be on a well. We applied an average household use, and other reasonable assumptions. We don't know exactly because there hasn't been measurement in this area.	Meeting comment - noted.
447					Meeting	10/22/2021	Sarah Hardgrave	It was something like 150 or 160 wells?	Abby Ostovar: Just to clarify, one definition is 'individual households' and another is 'less than 2 acre-feet per year'. The estimation of *de minimis* use here is based on individual parcels. Some small water systems would be considered *de minimis* because they might use less than 2 acre-feet per year, but they are included under mutual water systems.	Meeting comment - noted.

448					Meeting	10/22/2021	Bob Jaques	I just, earlier this morning, got a chance to read through the LandWatch letter, it was quite a lengthy letter. One of the things they go through strongly is the issue of financial ability to do projects. It seems to be a comment regarding listing projects, and not adequately demonstrating the financial ability for the GSA to carry the scenario out. It's striking for the Corral de Tierra area, and the ability to bring in new water sources, and the incredibly high cost to go along with that. I was disappointed to see the graphic on the 50-year period. I asked Abby how water levels would rebound during implementation, and the response was that it was assumed that projects would be implemented to achieve that. Part of the comment letter from LandWatch was that it was insufficient. Every project, when you add them all up, it's not enough. It's going to be hard for DWR to approve this. Even if we go back to other groundwater levels, the rationale is not supported with facts. That is something that should be addressed here for an acceptable GSP. I wanted to put that here as a comment. After reading that, I share their concerns.	Abby Ostovar: You did hire M&A to write a passing plan. This takes a similar approach as the 180/400, and this plan is more reasonable. We do believe this is a passing plan for DWR. It doesn't mean it won't be a heavy lift. DWR doesn't need to know exactly what you will do and how you will finance it. They want to know you have a range of options that you will develop funding mechanisms as you go. I think everyone here knows you will need to move quickly in this area.	Meeting comment - noted.
449					Meeting	10/22/2021	Janet Brennan	There is a difference between which deciding which projects and having an overall view of the viability of any project. Given the lack of regional consensus, many of the projects that will address the problem are not viable. There is a step between just listing a bunch of projects and having more information, we could have more information on some of the projects on the viability of the solution. That is what LandWatch is looking for.	Sarah Hardgrave: I just want to say again, we're planning to hold a community meeting on Nov 17 for the Corral de Tierra, and our outreach for that meeting will hopefully include several advertisements through several channels. We will ask staff to provide feedback at this meeting. We are tentatively looking to hold it in person, perhaps at San Benancio Middle School. Related to this discussion, supervisor Adams made a board referral on regional projects identified in the GSPs. This conversation emphasizes the importance of meeting with these stakeholders. There is not any desire or intent to step on the toes of the GSA or MCWRA, just a recognition that the board of supervisors are not fully familiar with what is coming out of the GSPs. Just want to have a common understanding of the GSPs, and a better understanding of these regional concepts. We have been talking with staff to do this in early December. It's not a referral to alter or change the GSPs, more to figure out next steps. Recognizing the GSA has plans for the integration, so multiple agencies and community leaders can have a more common understanding, and not just the folks who have been more active.	Meeting comment - noted.
450					Meeting	10/22/2021	Sarah Hardgrave	We're planning to hold a community meeting on Nov 17 for the Corral de Tierra, and our outreach for that meeting will hopefully include several advertisements through several channels. We will ask staff to provide feedback at this meeting. Related to this discussion, supervisor Adams made a board referral on regional projects identified in the GSPs. This conversation emphasizes the importance of meeting with these stakeholders. There is not any desire or intent to step on the toes of the GSA or MCWRA, just a recognition that the board of supervisors are not fully familiar with what is coming out of the GSPs. Just want to have a common understanding of the GSPs, and a better understanding of these regional concepts. We have been talking with staff to do this in early December. It's not a referral to alter or change the GSPs, more to figure out next steps. Recognizing the GSA has plans for the integration, so multiple agencies and community leaders can have a more common understanding, and not just the folks who have been more active.		Meeting comment - noted.
451					Meeting	10/22/2021	Bob Jaques	Would you be able to have that November 17 meeting to have a public display, like in the newspaper? Some folks may not otherwise be informed.	Emily Gardner: We have published previous notifications in the Monterey County Weekly.	Meeting comment - noted.
452						12/13/2021	**Janet Brennan**	Our agenda says to receive the Monterey Subbasin Plan, and that means we can recommend an action on that plan. I find that wording to be misleading. I would encourage staff to indicate that an action item is being contemplated. That is my comment on how the agenda is worded. Second, MCWD GSA, do they submit the whole plan included the part of the CDT area? Or just their part?	**Emily Gardner:** Just one plan, they submit the whole plan.	Meeting comment - noted.

453					Meeting	12/13/2021	**Sarah Hardgrave**	That submittal by MCWD is pursuant to the agreement between the GSAs?	**Emily Gardner:** We're following the spirit of the agreement. They will submit in January. **Patrick Breen:** It's a similar practice we follow with the 180/400. As the SVBGSA was the lead on that plan, they submitted. Since MCWD is the lead on this plan, we will submit based on the framework agreement even through there are different management areas.	Meeting comment - noted.
454					Meeting	12/13/2021	**Norm Groot**	Building on committee member Brennan's comment, if there are revisions suggested, and also at the Advisory Committee meeting, is there a possibility there will be another special meeting to review those changes, and in effect, approve them? I'm just wondering if there will be substantive changes made.	**Comment received**	Meeting comment - noted.
455					Meeting	12/13/2021	**Sarah Hardgrave**	I think if there are substantive changes this committee would want to review them.	**Emily Gardner:** If there are, we could reconvene. But we are getting up to the deadline here. There is another meeting on the schedule just in case. Since there are two GSAs, it takes more coordination. If there are suggestions today, it would be great to land on the language you would like to see, and that would go to the board. I would like to make best use of our limited time.	Meeting comment - noted.
456					Meeting	12/13/2021	**Sarah Hardgrave**	Give that the purview of this committee is on the Corral de Tierra area, I would like to focus on that. If there are significant changes for the Marina-Ord area, I would not recommend we meet again to review those changes. I'm posing this as a question.	**Comment received**	Meeting comment - noted.
457					Meeting	12/13/2021	**Janet Brennan**	Are you saying we shouldn't be commenting on the entire plan? I have comments on the Marina portion, so what are you saying?	**Comment received**	Meeting comment - noted.
458					Meeting	12/13/2021	**Sarah Hardgrave**	Yes we should comment on the plan as a whole, but I would suggest comments on the Marina-Ord area should be given to the MCWD GSA board. I would recommend that.	**Donna Meyers:** Any members of the committee should submit your comments on that part of the GSP to the MCWD GSA board as well. Our two agencies have a cooperative agreement where MCWD GSA is the lead on the GSP. It's helpful for them to get those as wells.	Meeting comment - noted.
459					Meeting	12/13/2021	**Janet Brennan**	Based on what Patrick said earlier, they are prepared to address some changes we recommend. We are being asked to forward and recommend approval of this entire plan to the AC and Board, and limit our discussion to CDT does not seem appropriate to me.	**Comment received**	Meeting comment - noted.
460					Meeting	12/13/2021	**Sarah Hardgrave**	That was not my suggestion, to limit comments to CDT. It was to submit those comments also directly to the MCWD GSA Board.	**Comment received**	Meeting comment - noted.
461					Meeting	12/13/2021	**Janet Brennan**	How do we do that?	**Patrick Breen:** We have a portal similar to SVBGSA.	Meeting comment - noted.
462					Meeting	12/13/2021	**Janet Brennan**	If this is a recommendation of our entire committee, how do we make that input as a whole committee.	**Patrick Breen:** If the committee in aggregate wants to comment on the entire plan, you can do it in the portal or at our board meeting. **Donna Meyers:** I think if there are comments as a committee for the whole plan, you could refer to that today. Sorry for the confusion.	Meeting comment - noted.
463					Meeting	12/13/2021	**Sarah Hardgrave**	I just want to encourage that comments on the Marina-Ord area go to the MCWD board in addition to our committee comments. Does the MCWD board meet in December?	**Patrick Breen:** Our December meeting is tonight, and will discuss this DWR version tonight. In January it will go forward for Plan Adoption and submittal to DWR.	Meeting comment - noted.
464					Meeting	12/13/2021	**Janet Brennan**	I did hear very positive feedback about the meeting from community members who did attend. Just want to thank staff and Sarah.	**Donna Meyers:** Last Thursday, I also received an invitation from Commercial Property Organization. I did that presentation Thursday and to the M1W Board on November 29. We've had two additional meetings on that area as well.	Meeting comment - noted.
465					Meeting	12/13/2021	**Janet Brennan**	For the plan as a whole, I know that in the Monterey, the Marina-Ord planning area is totally dependent on the plans and programs in the 180/400. Given staff's response on the meaning of "plans" and "subbasins," why doesn't the Marina-Ord part of the plan include the plans and programs of the 180/400 to avoid any confusion regarding implementation of those programs?	**Emily Gardner:** There is language in there that specifically describes supporting the plans from 180/400 and Seaside. It's the most appropriate way forward, but describing someone else's plan is not describing your own plan.	Meeting comment - noted.

466					Meeting	12/13/2021	**Janet Brennan**	This relates to the overall planning process. It seems that integration of all these plans should have been done during the planning of all these GSPs. We'll take another 5 years, and we'll have to revise all the subbasin plans. This seems extremely inefficient, and a waste of time. For the CDT, that depends on getting new water supplies. Based on what AG is willing to support, there is no support to bring in water for the CDT area. I am extremely frustrated by the lack of an integrated planning process, if we ever get to it given the various interests in the AG community to fund basin-wide projects. That is my view of this entire planning process, and I find it very disheartening.	**Donna Meyers:** Yes we talked last Friday. What I would like you to know is that the integrated component across subbasins for integration and implementation is the highest priority for staff. We will literally start in February. We've already scoped a document. This may seem an inefficient way, but we were required by SGMA to complete subbasin plans. Many of these basins, need immediate action and continued feasibility analysis. I realize there is frustration in the water charges framework which seemed like the glue to hold it all together, but after additional conversations, we see starting with allocations as an important stepping stone. We hope to do that immediately. All of this is to say, in year 5 when we update the GSPs, there will be an "integrated' chapter for how these all relate. In the meantime, we need to work with SGMA, get buy-in. We need to get our plans in from local stakeholders. Then as an agency, we have an opportunity to take a closer look in less a planning perspective, and a more integrative perspective. We will continue work in an integrated fashion. We have to. The valley is something that operates in an integrated manner. We need to keep that in our manner of assessing, and we won't lose sight of that. I understand your frustration with the process, and I hope we will get a document that will make sense to you soon.	Meeting comment - noted.
									Gary Petersen: So, to bring some historical context to this, the January submittal marks 7 years we've been at work with SGMA, We completed the 1st four to five chapters of the integrated plan, and then we realized, the necessity of bringing these subbasins together in a coherent manner, we lacked the information to do that without the existence of the subcommittees, that DWR required us to take a different route, because we wanted to do a single plan for the entire basin. That's where we understood the necessity of linking these pieces together and those conversations continued to be ongoing. We lacked the substance to do that at the beginning. We wanted to do a whole basin plan. We also lacked the capacity. Producing these plans has been a remarkable accomplishment. We needed to set the integrated piece on a shelf to get through these plans with a stringent timeline. Having spoken to many people across the state, SGMA was set up to get the plans done. The long-term goal is sustainability. By setting tight deadlines, we had to meet the letter of the law, we had to get these plans done. This left many people frustrated, and left many incapable of producing adequate plans. The plan is getting to the beginning. In my opinion, there was no way to get to an integrated plan while meeting the strict timelines from DWR. No one has ever walked away from the idea of understanding that this valley needs to work together to solve these issues. That's why we ended up here and I understand Janet I read that land watch letters and I've been tracking all that and I don't disagree with a lot of it, but there was just a matter of what was possible at this point. Along the way, because of this, changed the way that water planning is done in Monterey County, and the way we will gather data, and advance this entire process to sustainability.	

467					Meeting	12/13/2021	**Beverly Bean**	I want to comment that we can write plans 'til the cows come home. When the plans are approved, and we don't implement them, what good is it? We have an article in the 180/400 Plan to put a moratorium on new wells in the Deep Aquifer until the Study is completed. It is a priority item. When I brought this to the AC, it was shot down. If the plans are approved, what is the point if they are not implemented. I think it's an exercise in paper-shuffling. In the 180/400 it calls for capital projects, the water charges framework is the way to make it happen. Now we have two subbasins saying they will not participate in the water charges framework, because they are not in overdraft. Now, the 180/400 is unsustainable and cannot pay for these projects because half the valley refuses to participate. Corral de Tierra cannot reach sustainability. We have incredible subsurface flow into the 180/400, which I'm glad to see in the plan admitting that not even if we stop pumping and corral we still can't get to sustainability, because all that water flows into the 180/400, the gradients etc I assume these models are correct. I think we're paper shuffling. I find it very incredibly difficult to put my approval, my yes vote, to send this plan to the State. I'm as frustrated as Janet. I think we need to get real. If we're not going to implement all these wonderful plans we're writing, if that isn't going to happen because of the structure, and the power structure, and the votes, the super majorities that are required; I'm frustrated. The only reason I'm hanging in there is that hopefully we can get the pumping allocations in Corral de Tierra, and coordination with the land use. Just these small things, because I know the capital projects aren't going to happen, because there's no funding. I'm just hanging in there for those things to try and happen. I find it incredibly difficult.	**Donna Meyers:** I will just state that staff is committed to implementation. Friday, I met with SWRCB as well as Senator John Laird. We will continue to seek funding from the state, which is historic surplus at this point with $31BIL, as well as with the $1TRIL Infrastructure Bill, which if focused on water as one of its primary four focuses. which may be a once-a-century opportunity to obtain that kind of resource to bring back to the community. If we are able to bring national and state leaders to the table to understand what needs to get done, which looks to be an insurmountable issue of finance. SGMA requires us to not only look to allocations, which can solve one of our issues, but it also looks to us to actually, but also to remove or eliminate SWI in the 180/400. We do need to accomplish all the criteria that SGMA lays out to meet sustainability in 20yr. I am confident we are getting the attention required from both fed and state leaders, even prior to submission, with regards to the available resources. Will these resources pay for all of it? No, we will need to have local funding. There is a great interest in what we're doing, and I believe that we will be receiving state and federal funding for these kinds of projects. And that is where the state and federal funds really need to be spent, is in the sustainability actions around water supply, drought readiness, and climate change, so I really I appreciate your comments but I do believe that there is a resource through the state and federal infrastructure investment in domestic water that has not occurred in state history. So we'll be going after those resources, and we have been going after those resources over the last 60 days in preparation for being competitive for those kinds of opportunities so we'll keep working on that.	Meeting comment - noted.
468					Meeting	12/13/2021	**Beverly Bean**	In the listing of projects and actions at the end of the plan for CDT, the pumping allocations is first in the list. Does that listing indicate priority? In other words, is pumping allocations the number one thing, because there was some argument about that at the advisory committee about whether the list indicated priority. The second question I have, this implementation of a moratorium, is there any way to have further discussion on this? I don't feel it's been adequately discussed either at the advisory committee or on the board. Why are they not implementing the deep aquifer moratorium? It's a policy issue, it needs to be discussed.	**Donna Meyers:** That item is not noticed today, but I'm happy to chat offline. There will be items on the AC meeting this week that will be of interest. I don't believe I can speak with you about the moratorium. This is not an that's not a noticed item on our agenda for your stakeholder committee. I'm trying to keep track of all these plans, but I don't believe that the allocations reflects a priority, but I would ask Abby or Emily to answer that. **Emily Gardner:** We do reflect that the allocations discussion was a preferred project of the subbasin committee. It's in Chapter 10, below P&MA. Ultimately we'll talk about the subbasin implementation committee that will be formed, and early in 2022 we're going to look at the plan look at the projects and management actions, including allocations that are included in the plan, and talk about the funding that's needed, and talk about the costs/benefits, and the next steps, and that subbasin implementation committee will be the ones to get the projects rolling.	Meeting comment - noted.
469					Meeting	12/13/2021	**Sarah Hardgrave**	I think our committee has been clear on a couple different occasions that allocations were the highest priority. We made motions to that effect, and that is a clear statement from the committee. We have not made any motion on the prioritization of the other projects. Each of those is the nominal amount of supplemental supply for a lot of money, and those will be hard conversations.	**Comment received**	Meeting comment - noted.
470					Meeting	12/13/2021	**Margaret-Anne Coppernoll**	When I opened the plan, I was just blown away by how fantastic it is. You have all done a great job of putting this together, and it was a complex undertaking. Like any plan, getting to the implementation phase, you will always have changes that occur. I do agree that allocations of pumping should be a priority, as that will be a first step to get people to conserve. This is a fantastic way to take a detailed look at where we are, and energetically come up with solutions. I think the plan is a great way to do that. I want to tell everybody on this committee, and you've done a fabulous job, and this plan is phenomenal. I think there are issues with self-reporting, but I think well registration may cover that for details on what's pumped out. I want to thank you all for everything, and Merry Christmas and Happy New Year if I don't't see you all. I think a lot can be carried over in implementation for operational decisions, on the ground where it really counts.	**Comment received**	Meeting comment - noted.

471					Meeting	12/13/2021	**Max Storms**	I appreciate the work done. We are the largest water purveyor in the basin, so it's important to us to keep an eye on things for our own planning. For the most part, we have a lot of interest in the Salinas Valley. It's been very informative to be on this committee. We've just been trying to follow along. Thank you.	**Comment received**	Meeting comment - noted.
472					Meeting	12/13/2021	**Ron Stefani**	I think great job by staff. I think Margaret said it best, this is a plan, and once we start implementing it, it will be tweaked. No one is going to fund anything until you know what you're funding. Everyone will say no until we know what we're getting. Thank you.	**Comment received**	Meeting comment - noted.
473					Meeting	12/13/2021	**Patrick Breen**	I would like to echo some of the points made. I want to extend my appreciation for everyone collegial nature to get this done. I know there have been disagreements. It's been refreshing to see the camaraderie to get this together. It's going to be critical to continue that camaraderie moving forward. It will be critical that our neighbors succeed. Thank you.	**Comment received**	Meeting comment - noted.
474					Meeting	12/13/2021	**Norm Groot**	I want to address some of the comments expressed here today on moving forward. I want to point out 'what happens if we don't have a plan?'. I think we need to consider the alternatives here. And we're seeing what will happen to some of those GSPs that have been deemed inadequate. If we submit a plan, and we admit it's not perfect, but it's really consensus-building and will be refined as we go along. We've been saying that for months. We need to maintain that local control. This may not be the optimal plan, the alternative is worse. Let's keep local control. I just want to make sure we're looking at the larger perspective here if we don't have a plan to submit in January.	**Comment received**	Meeting comment - noted.
475					Meeting	12/13/2021	**Janet Brennan**	I'm prepared to make a motion to forward this to the Advisory Committee.	**Comment received**	**MOTION PASSES UNANIMOUSLY**

477					Meeting	12/13/2021	**Sarah Hardgrave**	I have appreciated the opportunity to participate in this committee. We've had some very robust discussions in the last year and a half. This has been a very important exercise in looking at the CDT management area. We've talked a number of times about the past studies, and it's been known for a long time that this is an area that has GW sus issues. This process has shined a light on the particular challenges this area faces in a new and different way. The GeoSyntec report was done over a decade ago, and never implemented, acknowledging Beverly's point that there have been previous plans not implemented. Under SGMA, we have additional tools, both carrots and sticks, to address this particular area we've been focused on. Our particular concerns, that cross outside of this management area, are driven by the specific issues of this area. This area is unique considering the urban/ag division, compared to the rest of the Basin. It does make for unique and specific challenges. Moving forward, the priority in addition to allocations and controls, does need to be DW controls and constraints. By my estimation, ~3,500 unique connections, or roughly 7,000 people dependent on groundwater supplies in the Corral de Tierra area. That's substantial, so moving forward with het integrated implementation actions, the integration committee should focus on DW issues and purveyors, including MCWD, and Castroville CSD, and so on; I think that is a very important area of focus moving forward. That is of utmost importance in this area. I don't believe this area can solve its issues without participating in regional DW solutions. Supply for people for DW in their homes in an area where we have two regulated utilities, 30-50 mutual water companies, and 160 different domestic well owners, we just have a unique situation.	**Comment received**	Meeting comment - noted.
								I think we've come up with some good options, but the implementation phase of this plan will be critical. We definitely need to get the word out there on these issues. Moving forward on implementation, I hope we get broader representation of actual managers of the small water systems as well as domestic well owners. It's been helpful to have Max here, but there are a lot of other folks involved that I hope engage moving forward. Lastly, my observation on the comments received on the plan, were comments made across all the GSPs. Or the ones specific to the Monterey Subbasin, were more about the Marina-Ord area. For the subbasin as a whole, this really is a subbasin that needs to coordinate with its neighbors to reach sus. The importance of collab with MCWD to address issues in the 180/400 came out to me as an important thing moving forward. If this plan says the Marina-Ord is sus if the 180/400 is sus, that's a heavy lift, and we have to all be at the table together. I concur with your comments on integration, Janet, and the importance of it. For Seaside, I was involved in the early years of the adjudication. If it had not been for the adjudication, that would be another Salinas Valley GSP. The Monterey Subbasin is the bridge to the peninsula, and there is incredible politics around water on the peninsula. I think the Seaside Watermaster needs to be at the table with implementation. We have invested quite a bit in water projects for the peninsula. I have concerns about risk for SWI in Seaside and monitoring along that boundary. The hydrogeology along that boundary was in question then. Now with SGMA, we can work on it further. The boundary with the Laguna Seca will be one of the most important areas of study going forward. I hope everyone stays engaged. This is not a plan that can be put on a shelf; we have to take action to address these issues.		
								If the conditions in the CDT area are described to DWR as they are in the plan, it would have been a critical area, not medium priority. The specific actions that need to be taken will be really important.		
480					Meeting	12/13/2021	**Beverly Bean**	Am I correct that you have to live or work in the Basin in order to be in the implementation committee?	**Emily Gardner:** That is what the Board voted on, yes.	Meeting comment - noted.

481					Meeting	12/13/2021	**Janet Brennan**	I represent LandWatch, which is county-wide, which I believe counts as work.	**Emily Gardner:** On that logic, I believe yes. It's not an organization seat, but an individual person. So if an individual person works for that organization and joins, and that organization represents the area, that's different. **Donna Meyers:** I would ask Marina. The other thing is that Janet, you are on the Board as well. I would ask Marina to clarify. **Marina Pantchenko:** The Board voted that individuals must reside or work in that area.	Meeting comment - noted.
482					Meeting	12/13/2021	**Janet Brennan**	Well, I prepared an application this morning, so we'll find out. But you have to be on a subcommittee to be on the implementation committee, is that correct? I would have to be on the Monterey Basin to be on the implementation committee?	**Emily Gardner:** Each subbasin will have an implementation committee to receive updates and move forward. We will also have an Integrated committee, and those folks will weigh in on multi-subbasin projects, and valley-wide implementation steps.	Meeting comment - noted.
483					Meeting	12/13/2021	**Sarah Hardgrave**	For this subbasin, will there be an opportunity for a representative from each Management area? It seems like we would need that because of the distinct issues facing each area.	**Emily Gardner:** We have a few other suggestions for the Integration Committee, that we can take to the Board. Right now, it's the MCWD GSA is on that committee, but not necessarily a stakeholder in that area. Similar for the Arroyo Seco GSA. We can forward this suggestion along to the board.	Meeting comment - noted.
484					Meeting	12/13/2021	**Sarah Hardgrave**	I would encourage sending out a notice of this implementation committee to your list of all the mutual water companies and domestic well owners as much as you have a list. I would like to see more of the small water systems engaged. I think this will be important for moving forward. We're not describing specific seats, I want folks to know about this opportunity.	**Emily Gardner:** We can send it to the same folks we invited to the stakeholder outreach event. And you can send it to your list as well. If you all could forward it along to your lists, we would really appreciate it. **Patrick Breen:** Can we just be clear about what implementation means, geographically? I just want to be really clear.	Meeting comment - noted.
485					Meeting	12/13/2021	**Sarah Hardgrave**	Are you planning to do anything like this for the Marina-Ord area? Generally, our Board is our GSA board. We're in discussion now about whether we want some stakeholder group. We're still determining that.	**Comment received**	Meeting comment - noted.
486					Meeting	12/13/2021	**Beverly Bean**	Is this implementation committee going to be just Corral, or will it include MCWD?	**Patrick Breen:** We need to be clear that we're talking about two different GSAs. This committee is a part of the SBVGSA. The MCWD GSA is the responsible area for the Marina-Ord area.	Meeting comment - noted.
487					Meeting	12/13/2021	**Beverly Bean**	As we solicit applications for the Implementation, does that include the Marina-Ord area, members from that to be on this implementation committee, or is it just referring to Corral?	**Donna Meyers:** It's just Corral because of the two different agencies.	Meeting comment - noted.
488					Meeting	12/13/2021	**Sarah Hardgrave**	As helpful as it's been to have Patrick on this committee here for coordination, I would encourage MCWD GSA to have someone on the implementation committee for coordination purposes.	**Patrick Breen:** We'll take that consideration under advisement and figure out how we're going to approach our implementation governance and decision.	Meeting comment - noted.

Appendix 3-A

1993 and 1996 Annexation Agreements

MCWRA/U.S. Army, 1993. Agreement No. A-06404 - Agreement between the United States of America and the Monterey County Water Resources Agency Concerning Annexation of the Fort Ord Into Zones 2 and 2A of the Monterey County Water Resources Agency, dated September 1993.

MCWRA/MCWD, 1996. Annexation Agreement and Groundwater Mitigation Framework for Marina Area Land, dated March 1996.

AGREEMENT NO. A-06404

AGREEMENT BETWEEN THE UNITED STATES OF AMERICA AND THE MONTEREY COUNTY WATER RESOURCES AGENCY CONCERNING ANNEXATION OF FORT ORD INTO ZONES 2 AND 2A OF THE MONTEREY COUNTY WATER RESOURCES AGENCY

This Agreement is entered into this 21st day of September, 1993, by and between the Government of the United States of America ("Government"), represented by the United States Army, and the Monterey County Water Resources Agency ("MCWRA"), a political subdivision of the State of California, represented by the Monterey County Board of Supervisors.

1. Purpose and Authority:

a. Purpose: The purpose of this agreement is to provide the terms and conditions under which the Fort Ord Lands will be annexed into the Zones.

b. Authority:

(1) By California law, the MCWRA is responsible for managing the surface water and groundwater resources in the Salinas Valley and providing flood control and water conservation services throughout Monterey County. The authority for the MCWRA to enter into this agreement is cited in California Water Code, Appendix 52-43 (Appendix "A"). The MCWRA has the authority to annex the Fort Ord Lands overlying the Seaside Basin based on a Memorandum Of Agreement between the MCWRA, the MPWMD, and the Pajaro Valley Water Management Agency, dated May 10, 1993 (Appendix "B").

(2) The authority for the Government to enter into this agreement was provided in Public Law 101-510 (National Defense Authorization Act for Fiscal Year 1991), Section 2101, dated November 5, 1990 and amended by Public Law 102-190 (National Defense Authorization Act for Fiscal Years 1992 and 1993), Section 2702, dated December 5, 1991. The funding for the Government to enter into this agreement was provided by Public Law 101-519 (Military Construction Appropriations Act, 1991), dated November 5, 1990.

2. Definitions:

a. United States Army Engineer District, Sacramento, California ("Corps"): A field operating agency of the Army Corps of Engineers, a major command of the Army; the agency that will execute this agreement on behalf of the Government;

b. Fort Ord: An existing Army installation in north Monterey County currently operating under the Army Forces Command; Fort Ord will realign to an enclave under provisions of Public Law 101-510 (Defense Base Closure and Realignment Act of 1990); on October 1, 1994, this installation will no longer be known as Fort Ord and will instead be known as the Presidio of Monterey Annex under the Army Training and Doctrine Command; disposal of excess Fort Ord property pursuant to Public Law 101-510 could begin before October 1, 1994 provided the Army has issued a Record of Decision on the Environmental Impact Statement for the Disposal and Reuse of Fort Ord; parts of Fort Ord were leased on a long term basis prior to the realignment decision;

c. Presidio of Monterey Annex ("POM Annex"): The proposed residual military mission enclave remaining on Fort Ord after its realignment; this annex shall continue operations in support of the Department of Defense and other federal agencies in the Monterey Peninsula area; the boundaries of the POM Annex should be finalized by early 1994;

d. Presidio of Monterey ("POM"): An existing Army installation in Monterey County operating under the Army Forces Command; on October 1, 1994, will be under the Army Training and Doctrine Command; POM is the home of the Defense Language Institute; POM will also be responsible for the proposed POM Annex;

e. Reserve Center ("RC"): An existing Army Reserve Center located on 12 acres of Fort Ord not contiguous to the POM Annex; the RC will remain after the realignment of Fort Ord;

f. Fort Ord Lands: A term denoting all lands within the existing boundaries of Fort Ord including: property needed to support the Army's future mission requirements (POM Annex and RC); property under a long term lease; property awaiting disposal either in a caretaker status or under an interim lease; and property already disposed;

g. Salinas Basin: The Salinas River Groundwater Basin; the Salinas Basin generally underlies the northwestern portion of Fort Ord;

h. Seaside Basin: The Seaside Groundwater Basin; the Seaside Basin generally underlies the southwestern portion of Fort Ord;

i. Monterey Peninsula Water Management District ("MPWMD"): A California Special District created by the State Legislature in 1978 having water management authority over the Seaside Basin;

j. Project: A future, long term, reliable, potable water system for the POM Annex/RC and other areas; the Project will provide at least 6,600 acre-feet per year which will permit all Salinas Basin wells on Fort Ord Lands to be shut down except during emergencies; stopping all pumping from the Salinas Basin on Fort Ord Lands is necessary to mitigate seawater intrusion; the MCWRA is currently developing such a Project to supply water to the Fort Ord Lands, Marina, Salinas, Toro Park, and perhaps other areas in north Monterey County; it is also possible that another water agency, district, utility, or purveyor could develop a smaller scale Project to supply water for just the Fort Ord Lands;

k. Project Implementation: The potable water system cited in paragraph 2.j. shall be considered "implemented" upon both the completion of construction and the delivery of potable water to POM Annex/RC from the completed water system;

l. Zones: Zones 2 and 2A of the MCWRA which are the zones of benefit for the MCWRA Nacimiento and San Antonio Dams, respectively.

3. <u>Problem and Scope:</u>

a. Fort Ord overlies two groundwater basins, the Salinas Basin and the Seaside Basin. See Appendix "C" for a map. Most of the installation's facilities and all of its potable wells overlie the Salinas Basin. The portion of the installation which overlies the Seaside basin has less development consisting mostly of family housing and recreational facilities. Fort Ord's only active well in the Seaside Basin is a non-potable well to irrigate the golf courses. Fort Ord's peak annual withdrawal from the Salinas basin from 1980 to 1992 was 6,600 acre-feet in 1984; and the peak withdrawal from the Seaside Basin from 1986 to 1989 was 424 acre-feet in 1989.

b. The Salinas Basin has had a problem with seawater intrusion since the 1940's. Seawater intrusion occurs when groundwater levels fall below sea level. This is caused by pumping more water out of an aquifer than is being recharged into it. Pumping by Fort Ord has contributed to this problem, but only to a limited extent as the Fort Ord pumping from the Salinas Basin from 1988 to 1992 averaged only 5,200 acre-feet per year and the estimated Salinas Basin overdraft (amount that pumping exceeds recharge) is about 50,000 acre-feet per year. Seawater intrusion has forced the abandonment of many wells along the coast, and required Fort Ord to relocate their well field inland in 1986. In contrast to the Salinas Basin, the Seaside Basin appears to be in a nearly balanced condition.

c. Because of the magnitude of the seawater intrusion problem, a regional solution is needed. Without a regional solution, Fort Ord's remaining potable wells will eventually become contaminated by seawater. The MCWRA is developing a Project to provide a regional water supply system. The MCWRA is also developing the Castroville Sewage Reclamation/Irrigation Project. Both of these projects are intended to mitigate the effects of seawater intrusion in the Salinas Basin.

d. As long as there is an Army enclave on Fort Ord Lands, the Army will need a reliable potable water supply. In view of the limited life of Fort Ord's remaining potable wells, annexation is prudent because it will permit access to water produced by a future MCWRA project. Additionally, annexation will facilitate the disposal and reuse of Fort Ord Lands, and enhance the market value of any property which is sold. This is because, without annexation, the existing Salinas Basin overdraft could significantly limit the water rights of Fort Ord Lands except for the POM Annex/RC.

e. There have been questions raised over Fort Ord's right to withdraw groundwater from the Salinas Basin. Fort Ord/POM Annex/RC claim certain legal rights to the use of water from the Salinas Basin due to their federal status. However, the MCWRA claims limited regulatory authority over Fort Ord/POM Annex/RC's use of Salinas Basin water with respect to withdrawals of polluted or contaminated groundwater; and the MCWRA also claims ownership rights over water used by Fort Ord/POM Annex/RC which is released into the Salinas Basin from the Nacimiento and San Antonio Dams. Annexation and the terms of this agreement will clarify the water rights of both parties.

4. Terms and Conditions:

a. Execution of this agreement, which includes the Annexation Assembly and Evaluation Report (Appendix "D"), shall be deemed to be a petition by the Government, as the present owner of all Fort Ord Lands, to permit the annexation of the Fort Ord Lands by the MCWRA into Zones 2 and 2A. The MCWRA shall thereafter promptly commence proceedings for such annexation, and will diligently and in good faith pursue such annexation proceedings to completion.

b. The parties have discussed and agreed on payment of a fee by the Government totaling $7,400,000, as authorized by Public Law 101-510 and appropriated by Public Law 101-519. The basis for this fee is discussed in section IV.F.1. of the attached Annexation

Assembly and Evaluation Report. Fort Ord will be annexed into the Zones in consideration of the payment of the fee. The Government shall have no further financial responsibility or obligation of any kind to the MCWRA with respect to existing water project costs, e.g., Nacimiento and San Antonio Reservoirs. Further, the MCWRA releases the Government from any and all claims related to Fort Ord's groundwater withdrawals from the Salinas Basin prior to this agreement, and from any claims related to any Government action that may have caused or contributed to seawater intrusion in the Salinas Basin.

c. After execution of this agreement and until Project Implementation, Fort Ord/POM Annex/RC may withdraw a maximum of 6,600 acre-feet of water per year from the Salinas Basin, provided no more than 5,200 acre-feet per year are withdrawn from the 180-foot aquifer and 400-foot aquifer. The 6,600 and 5,200 acre-feet thresholds correspond to the annual peak (1984) and recent average (1988-1992) amounts of potable water Fort Ord has withdrawn from the Salinas Basin (does not include pumpage from the non-potable golf course well in the Seaside Basin). Groundwater withdrawals from the Salinas Basin by Fort Ord/POM Annex/RC for the purpose of environmental restoration shall not count toward the 6,600 and 5,200 acre-feet thresholds. Additionally, groundwater withdrawals from the non-potable golf course well shall not count toward the 6,600 and 5,200 acre-feet thresholds because this well is located in the Seaside Basin. The MCWRA agrees not to object to any Fort Ord/POM Annex/RC withdrawal under 6,600 acre-feet per year, except in compliance with California Water Code Appendix, Chapter 52, Section 22. If the MCWRA is concerned about a withdrawal, the MCWRA will first notify the Fort Ord/POM Annex Commander. The parties agree to make every effort to first resolve seawater intrusion disputes through mutual agreement. In any event, the MCWRA, after notice from the Fort Ord/POM Annex Commander, will not object to withdrawals in support of war, national emergency, contingency operation, troop mobilization, or unexpected mission requirements, and such withdrawals shall not count toward the 6,600 and 5,200 acre-feet thresholds. The Government will develop a water conservation program at Fort Ord/POM Annex/RC and will institute, in its discretion, measures to conserve water. The Government will participate in MCWRA water conservation initiatives and programs as mutually agreed by the parties.

d. Until Project Implementation, Fort Ord/POM Annex shall have exclusive ownership and operation of potable wells #24, #29, #30, #31, #32, Jacks well, and Pilarcitos well in the Salinas Basin, and the non-potable golf course well #1 in the Seaside Basin. See Appendix "C" for the locations of these wells. Jacks well, Pilarcitos well, and well #24 are inactive; well #32 has recently failed; and the rest are active. The MCWRA agrees not to object to Fort Ord/POM Annex/RC replacing any existing well or adding any new well on Fort Ord Lands subject to the conditions described in paragraph 4.c. above. Also until Project Implementation, Fort Ord/POM Annex/RC shall be the sole user of the aforementioned wells, provided that the Government, in its sole discretion, may permit the use of the Salinas Basin wells by others for use on Fort Ord Lands, or may provide water from the Salinas Basin wells to others on Fort Ord Lands in connection with any reuse plans. The Government shall retain all reasonable and necessary utilities and reserve all necessary easements to operate and maintain all Fort Ord/POM Annex/RC wells. After Project Implementation, Fort Ord/POM Annex shall retain ownership of the aforementioned wells, and the Government agrees to stop pumping from the Salinas Basin wells except for an emergency such as fire fighting or a situation as described at the end of paragraph 4.c. above. Project Implementation shall be no cause to curtail or stop pumping from any Seaside Basin well on Fort Ord Lands.

e. The Government will not pay any MCWRA assessments (such as standby charges, water delivery charges, water project assessments, etc.) until a MCWRA developed Project is implemented. This applies to not only the portions of Fort Ord retained by the Army, but also to any other portions of Fort Ord transferred to federal entities. See paragraphs 4.j.(3) and 4.j.(4) for a discussion of these future assessments.

f. The annexation into the Zones shall provide the Government with appropriate representation in Zone administration and decision making.

g. Should future litigation, regulation or other unforeseen action diminish the total water supply available to the MCWRA, the MCWRA agrees that it will consult with the Fort Ord/POM Annex Commander. Also, in such an event, the MCWRA agrees to exercise its powers in a manner such that Fort Ord/POM Annex/RC shall be no more severely affected in a proportional sense than the other members of the Zones.

h. If prior to Project Implementation, any Fort Ord/POM Annex well (including any located in the Seaside Basin) becomes contaminated with seawater, or is adversely affected by regulatory or legal action, the MCWRA: shall cooperate with the Government in finding an interim water supply; shall assist the Government in any permit processes necessary to obtain such an interim water supply; and shall provide the same services to the Government as it would to any other municipal water supplier in the Zones under similar circumstances. The Government will bear the costs of obtaining such an interim water supply. Such costs will not include the cost of MCWRA staff time in providing services to the Government hereunder. The MCWRA will continue to monitor the rate of seawater intrusion, and will keep the Fort Ord/POM Annex Commander informed as to: the rate of seawater intrusion; the progress of plans for its Project; and the estimated remaining life of the Fort Ord/POM Annex wells. The MCWRA shall pass to the Fort Ord/POM Annex Commander any information they may obtain related to the continuing yield of Fort Ord/POM Annex wells located in the Seaside Basin.

i. As part of the disposal of Fort Ord, the Government is considering transferring the ownership and operation of the Fort Ord wells and water distribution system to a successor water purveyor, utility, or agency. Under such a transfer, the MCWRA agrees that the Government, in its sole discretion, may transfer its applicable water rights under this agreement to the successor water purveyor, utility, or agency. The MCWRA also agrees not to object to such a successor obtaining or developing a water supply from outside the Salinas Basin for the Fort Ord Lands.

j. If the opportunity arises and it is in the Government's best interests, the Government, in its sole discretion, may participate in a Project developed by an organization other than the MCWRA. In any event, Government participation in a MCWRA developed Project would be contingent on the following:

(1) The MCWRA shall, upon Project Implementation, continue to provide water and related services to Fort Ord/POM Annex/RC and shall provide for Government representation in MCWRA decisions affecting Fort Ord/POM Annex/RC, and in MCWRA's administration of the Project.

(2) The water allocation to be made available to POM Annex/RC from the Project shall be based only on the water needed to support the Army's future, long term mission requirements, or as otherwise agreed to by the parties. By the time of Project Implementation, all excess Fort Ord Lands should have been disposed. The water allocation to be made available to the disposed property from the Project shall be an issue between these property owners and the MCWRA.

(3) The capital cost for the Project shall be distributed among all properties within the Zones in an equitable manner. The Government would favorably consider a funding plan similar to the MCWRA's proposed funding plan for the Castroville Sewage Reclamation/Irrigation project in which approximately 50 percent of the capital cost is funded by the MCWRA members receiving the water, and 50 percent is funded by other members in

the Zones. An acceptable funding plan will also require that the capital cost paid by each member receiving water from the Project generally be proportional to their water allocation from the system. In any funding plan, the Government will reserve the right to pay the capital cost through either periodic assessments, or by a lump sum amount. The Government does not intend to be a party to any agreement in which military appropriations fund an inequitable portion of the capital cost of the Project. The $7,400,000 annexation fee shall not count toward the Government's share of the Project's capital cost.

(4) The MCWRA's cost to operate and maintain (O&M) the Project should be distributed on the basis of water usage or allocation. If the MCWRA proposes to distribute O&M costs on the basis of property area, then the Government only intends to pay such an assessment and any applicable standby charges on the Fort Ord Lands needed to support Army missions, i.e., POM Annex and RC. The Government will not pay O&M assessments or standby charges for any Fort Ord property in a caretaker status awaiting disposal. Any federal entities which have acquired portions of Fort Ord will not pay standby charges on property which is unsuitable for development.

(5) Prior to either the initiation or commitment of any military appropriations to the Project by the Government, the MCWRA shall complete all appropriate feasibility studies and environmental reviews. With respect to only Fort Ord Lands under Army control, participation in the Project, or any other water supply project is subject to compliance with applicable federal laws and regulations, e.g., Army Regulation 420-41 and Federal acquisition regulations; and subject to final review and approval by the Government.

(6) As Fort Ord/POM Annex/RC will, upon Project Implementation, rely on the MCWRA's ability to provide potable water, the MCWRA shall defend the rights of Fort Ord/POM Annex/RC to a water supply upon implementation of the Project as though those rights were its own.

5. <u>Funding:</u>

a. The Government hereby obligates, pursuant to section 2702 of Public Law 102-190, $7,400,000 for the annexation fee, the basis of which is set forth in Appendix D, section IV.F.1. Upon completion of the annexation, the Government shall make payment to the MCWRA in the amount of $7,400,000.

b. The $7,400,000 annexation fee shall be the maximum Government payment in consideration for the annexation of the Fort Ord Lands and the execution of this agreement.

c. The parties recognize that this agreement is subject to the availability of funds provided by Congress.

6. Duration of Agreement:

a. If the Government decides to participate in a Project developed by an organization other than the MCWRA pursuant to paragraph 4.j. of this agreement, the MCWRA agrees to either terminate this agreement or negotiate modifications to it if so requested by the Government.

b. In the event the Army ends its presence at Fort Ord, the MCWRA agrees to either terminate this agreement or negotiate modifications to it if so requested by the Government.

c. If Fort Ord has not been annexed to the Zones by September 30, 1995, the MCWRA agrees to either terminate this agreement or negotiate modifications to it if so requested by the Government.

d. If the MCWRA has not achieved reasonable progress by December 31, 1999, toward implementation of a MCWRA developed project; or a MCWRA developed Project has not been implemented by December 31, 1999, and the Government is not convinced that the MCWRA can achieve Project Implementation within a time frame deemed reasonable by the Government, then the MCWRA agrees to either terminate this agreement or negotiate modifications to it if so requested by the Government.

e. In the event this Agreement is terminated before the annexation has been completed, the MCWRA, in its sole discretion, may continue with the annexation; however, in such circumstance, the Government shall not make any payment for such annexation. In the event this agreement is terminated after the Fort Ord Lands have been annexed into the Zones, the Government will not demand return of the payment. In the event this agreement is terminated by the Government pursuant to any of the above conditions, the MCWRA agrees not to file any claim against the Government related to the termination.

SUBJECT: Annexation of Fort Ord into Zones 2 and 2A of the Monterey County Water Resources Agency

7. Binding on Successors: This agreement shall be binding upon and shall inure to the benefit of the non-federal successors and assigns of the Government's interest in the property now known and referred to as Fort Ord, California, except that this agreement shall not exempt any such non-federal successor or assign, whether of fee title or some lesser interest in the property, from any ordinance or other regulation enacted by the MCWRA or from any assessment, charge, tax, or other monetary exaction levied by the MCWRA. All such non-federal successors and assigns shall be subject to regulation and be subject to assessment, charge, tax, or other monetary exaction to the extent allowed by law at the time such enactment or levy is in effect.

FOR THE UNITED STATES OF AMERICA

Michael W. Owen

Acting Assistant Secretary of the Army for Installations, Logistics and Environment

9/10/93

Date

FOR THE MONTEREY COUNTY WATER RESOURCES AGENCY

[signature]

Monterey County Board of Supervisors

September 21, 1993

Date

Appendices:

- A - California Water Code, Appendix 52-43
- B - Addendum No. 1 to the Memorandum Of Agreement Between the MCWRA, the Monterey Peninsula Water Management District, and the Pajaro Valley Water Management Agency
- C - Location of the Existing Wells
- D - Annexation Assembly and Evaluation Report

§ 52-43. Annexation to zones

Sec. 43. (a) In addition, or as an alternative, to the procedures for amending zones described in Section 7, any territory in the agency lying within the watershed within which a zone is situated may be annexed to that zone pursuant to this section. Territory which is in, or annexed to, one zone may be annexed to another zone pursuant to this section.

(b) The following applies with respect to the annexation of new territory to any zone pursuant to this section:

(1) (A) A petition for annexation by election signed by 25 percent of the freeholders residing in the territory proposed to be annexed as shown by the last equalized assessment roll of the county shall be presented to the board.

(B) The petition shall designate specifically the boundaries of the territory proposed to be annexed and its assessed valuation as shown by the last equalized assessment roll and shall ask that the territory be annexed to the zone. The petition shall be accompanied by a bond in the sum of not less than one hundred dollars ($100), to be approved by the board and filed with the clerk of the board as security for the payment by the petitioners of the reasonable cost of the election on annexation, in the event that at the election less than a majority of the votes cast are in favor of annexation. The petition shall be verified by the affidavit of one of the petitioners.

(C) The petitioner shall be published by the petitioners for at least two weeks preceding its hearing in a newspaper of general circulation published in the zone, if there is one, or, if not, in a newspaper of general circulation published in the agency, together with a notice stating the number of signers of the petition, the time when the petition will be presented to the board and that all persons interested may appear and be heard. It shall not be necessary to publish the names of the signers.

(D) At the time specified for the hearing, the board shall hear the petition and may adjourn the hearing from time to time. Upon final hearing of the petition, the board, if it approves the petition as originally presented or in a modified form, shall make an order describing the exterior boundaries of the territory proposed to be annexed and ordering that an election be held in such territory for the purpose of determining whether or not the territory shall be annexed to the zone. The order shall fix the day of the election, which shall be within 60 days from the date of the order, and shall show the boundaries of the territory proposed to be annexed to the zone and shall set forth the measure to be submitted to the voters of such territory and shall designate the precincts, polling places and election officers for such election and state the times between which the polls shall be open. The order shall be published pursuant to Section 6066 of the Government Code. This order shall be entered in the minutes and is conclusive evidence of a due presentation of a proper petition, and of the fact that each of the petitioners was, at the time of the signing and presentation of the petition, qualified to sign.

(E) The election shall be held and conducted as provided in Chapter 1 (commencing with section 22000) of Part 1 of Division 12 of the Elections Code and sample ballots and polling place cards shall be mailed as provided in section 10012 of the Elections Code. If a majority of the votes in the territory proposed to be annexed at an election called therein by the board for that purpose are in favor of the annexation, the clerk of the board shall make and cause to be entered in the minutes and endorsed on the petition an order approving the petition and the petition shall be filed. The entry is conclusive evidence of the fact and regularity of all prior proceedings of every kind required by law and of the facts stated in the entry. The board at its next regular meeting after the entry shall, by an order, alter the boundaries of the zone and annex to it the territory described in the petition. The order of the board is conclusive evidence of the validity of all prior proceedings leading up to the annexation and recited in the order, and from and after the order the territory is part of the zone. If, at the election, less a majority of the votes in a territory proposed to be annexed are in favor of the annexation of the territory to the zone, the signers of the petition shall, within 10 days after the canvassing of the votes of the election, pay to the board the reasonable cost of the election and, if not paid within 10 days, the board may sue on the bond to recover the cost of the election. If the result of the election is against annexation, the board shall, by order, disapprove the petition and enter the order in its minutes. No other proceeding shall be taken in relation thereto until the expiration of six months from the presentation of the petition, except to collect the costs of the election.

APPENDIX A

(2) (A) A petition for annexation without election signed by the owners of real property in the territory proposed to be annexed which real property represents at least 75 percent of the total assessed valuation of real property in the territory as shown by the last equalized county assessment roll, shall be presented to the board.

(B) The petition shall designate specifically the boundaries of the territory and the assessed valuation of real property therein as shown by the last equalized county assessment roll and shall show the amount of real property owned by each of the petitioners and its assessed valuation as shown by the last equalized county assessment roll. The petition shall ask that the territory be annexed to the zone. The petition shall be verified by the affidavit of one of the petitioners.

(C) The petition shall be published by petitioners at least two weeks preceding the hearing in a newspaper of general circulation published in the zone, if there is one, or, if not, in a newspaper of general circulation published in the agency. With the petition there shall be published a notice stating the number of signers of the petition, the time when the petition will be presented to the board and stating that all persons interested may appear and be heard. It shall not be necessary to publish the names of the signers. A printed copy of the petition and notice as so published shall be mailed pursuant to Sections 53520 to 53523, inclusive, of the Government Code.

(D) At the time designated the board shall hear the petition and any person interested, and may adjourn the hearing from time to time. Upon the hearing of the petition, the board shall determine whether or not it is in the best interests of the zone and the territory that the territory be annexed to the zone and the board may modify the boundaries of the territory proposed to be annexed as set forth in the petition by decreasing the area of the territory. If the board upon final hearing determines that it is in the best interests of the zone and of the territory proposed to be annexed that the territory be annexed, it shall make an order describing the boundaries of the territory proposed to be annexed and shall alter the boundaries of the zone and annex to it the territory described in the petition and the territory is then a part of the zone.

(3) A petition for annexation without election signed by 100 percent of the owners of real property in the territory proposed to be annexed may be presented to the board. The petition shall designate specifically the boundaries of the territory and shall ask that the territory be annexed to the zone. The petition shall be verified by the affidavit of one of the petitioners. The board shall determine, upon reviewing the petition, whether or not it is in the best interest of the zone and the territory that the territory be annexed to the zone. The board may modify the boundaries of the territory proposed to be annexed as stated in the petition by decreasing the area of the territory. If the board determines that it is in the best interest of the zone and of the territory proposed to be annexed that the territory be annexed, the board shall make an order describing the boundaries of the territory proposed to be annexed and shall alter the boundaries of the zone and annex to it the territory described in the petition, and the territory is then a part of the zone.

(4) No petition or request for annexation pursuant to paragraphs (1) to (3), inclusive, may be accepted by the board if a zone annexation petition involving any of the same territory is pending before it for annexation to the same zone.

(5) An order for annexation may be by ordinance or resolution. Whenever any new territory is annexed to a zone, the territory thereupon becomes subject to all the liabilities and entitled to all the benefits of the zone. Any order for annexation may provide for, or be made subject to, the payment of a fixed or determinable amount of money for the acquisition, transfer, use, or right of use of all or any part of the existing property, real or personal, of the zone. The board may provide that payment of the amounts shall be either: (1) in lump sums or (2) in semiannual installments with interest thereon at a rate not to exceed 12 percent over a period not to exceed 10 years beginning on July 1 following the next succeeding March 1. If the payment is in semiannual installments, the board shall provide in the ordinance that the total of each sum to be paid by each parcel shall constitute a lien on the parcel as of noon on the next succeeding March 1, the same as the lien for general agency and zone taxes; that the semiannual installments shall be paid and collected at the same time and in the same manner and by the same persons as, and together with and not separately from, general agency and zone taxes and shall be delinquent at the same time and thereafter subject to the same thereafter sell, lease, or otherwise dispose of the property in the manner prescribed by law for counties.

(Stats.1990, c. 1159 (S.B.2580), § 41.)

Historical and Statutory Notes

Derivation: Former § 52-31, enacted by Stats.1947, c. 699, § 31.

A

ADDENDUM NO. 1 TO
MEMORANDUM OF AGREEMENT BETWEEN
THE MONTEREY COUNTY WATER RESOURCES AGENCY,
THE MONTEREY PENINSULA WATER MANAGEMENT DISTRICT AND
THE PAJARO VALLEY WATER MANAGEMENT AGENCY

This is Addendum No. 1 to the memorandum of agreement (MOA) between and among the Monterey County Water Resources Agency (MCWRA), the Monterey Peninsula Water Management District (MPWMD) and the Pajaro Valley Water Management Agency (PVWMA), dated December 15, 1991. The date of this addendum for reference purposes is September 28, 1992.

RECITALS

This addendum to the MOA is entered into in light of the following facts:

A. MCWRA is developing a Seawater Intrusion Program (SIP) to mitigate the effects of seawater intrusion into the groundwater basin along the coast under Ft. Ord, Marina, and the Castroville area. This program has been in the planning stages for several years. As part of this program, it has been proposed that pumping from existing groundwater wells supplying Fort Ord and the Marina County Water District (MCWD) be curtailed or eliminated, the construction of additional wells in the seawater intrusion area be limited or prohibited, and a replacement potable water supply be provided to Fort Ord and the MCWD by MCWRA, from wells to be constructed in the Salinas Valley. In order to control pumping from existing wells, MCWRA may acquire the existing wells. MCWRA may at some time seek to levy assessments within the subject area, to impose charges for water provided to the subject area, and to raise revenues from within the subject area in other ways, in order to operate, maintain, and improve the SIP in that area. MCWRA decisions on whether to proceed with this project will be made in the future.

B. MPWMD has an interest in this part of the SIP, in that part of Fort Ord and adjacent areas are within MPWMD's boundaries. Nevertheless, MPWMD does not wish to participate in the SIP, and does not wish to impede its implementation.

C. The impending closure of Ft. Ord calls for additional coordination among the three parties to this MOA.

D. The Board of Directors and/or Board of Supervisors of the Monterey County Water Resources Agency has requested changes in the original MOA.

APPENDIX B

AGREEMENTS

1. Consent to project within territory of Ft. Ord. The parties hereto agree that MCWRA may carry out the SIP within the territory presently occupied by Fort Ord and northwards along the coast, may acquire existing wells drawing water from the Salinas Valley and other property within the territory, may provide water to the territory in connection with the SIP, and may exercise any regulatory authority within that territory as may be needed in connection with the SIP and may levy assessments and impose charges in connection with the SIP for water provided within such territory, without any further compliance with the terms of the MOA, notwithstanding that any part of such territory may be located within the boundaries of MPWMD.

2. Future expansion of MPWMD boundaries. If MPWMD boundaries are expanded to include additional territory involved in the SIP, MPWMD will not object to the continued operation of the SIP in that area.

3. Coordination of programs and activities in connection with closure of Fort Ord. The MCWRA, PVWMA, and MPWMD will coordinate programs related to the closure of Fort Ord and will cooperate in the implementation of future developments within the Fort Ord area. In anticipation that a portion of the future water delivery system to the Fort Ord area will be located within the MPWMD area and that the water supply for that system will be developed from the MCWRA area which is outside of the MPWMD area, the MPWMD and the MCWRA will comply with one another's ordinances as follows:

(a) The MCWRA shall have exclusive authority to regulate water delivery systems that deliver water to the area that is both within the present Fort Ord boundaries and within the MPWMD boundaries in existence at the time of the regulation, and the MPWMD will comply with any such ordinance enacted by the MCWRA.

(b) The MPWMD shall have exclusive authority to regulate the management of the Seaside groundwater basin within the present Fort Ord boundaries, and the MCWRA will comply with any such ordinance enacted by the MPWMD.

(c) This Memorandum of Agreement does not commit the MCWRA to provide any specific quantity of water to Fort Ord or to any portion of it, nor does it commit the MCWRA to provide any water to Fort Ord from the Salinas Valley Groundwater Basin. It also does not give to an other agency the authority to compel provision of water to Fort Ord.

4. Deletion of paragraph 18. Paragraph 18 is deleted from the original MOA.

B

5. Deletion of paragraph 19. Paragraph 19 is deleted from the original MOA.

IN WITNESS WHEREOF, the parties execute this memorandum of agreement as follows:

MONTEREY COUNTY WATER RESOURCES AGENCY:

Dated: May 25, 1993 By ______________________
Chair, Board of Supervisors

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT:

Dated: 15 APRIL 1993 By ______________________
Chair, Board of Directors

PAJARO VALLEY WATER MANAGEMENT AGENCY:

Dated: 7/14/93 By ______________________
Chair, Board of Directors

* *

Approved as to form:

____
Counsel for MCWRA

Dated: 5/6/93

Approved as to form:

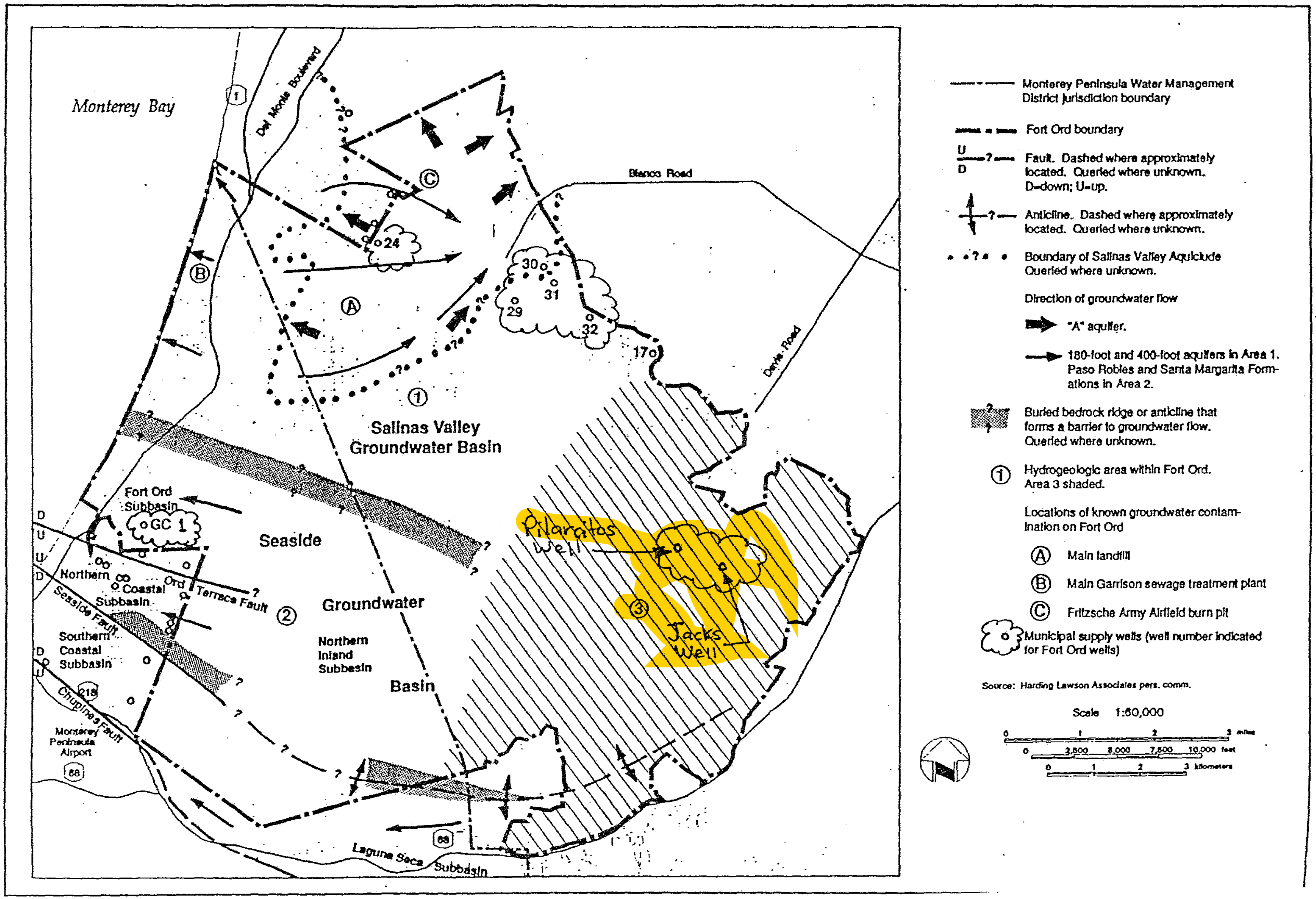
____
Counsel for MPWMD and PVWMA

Dated: April 7, 1993

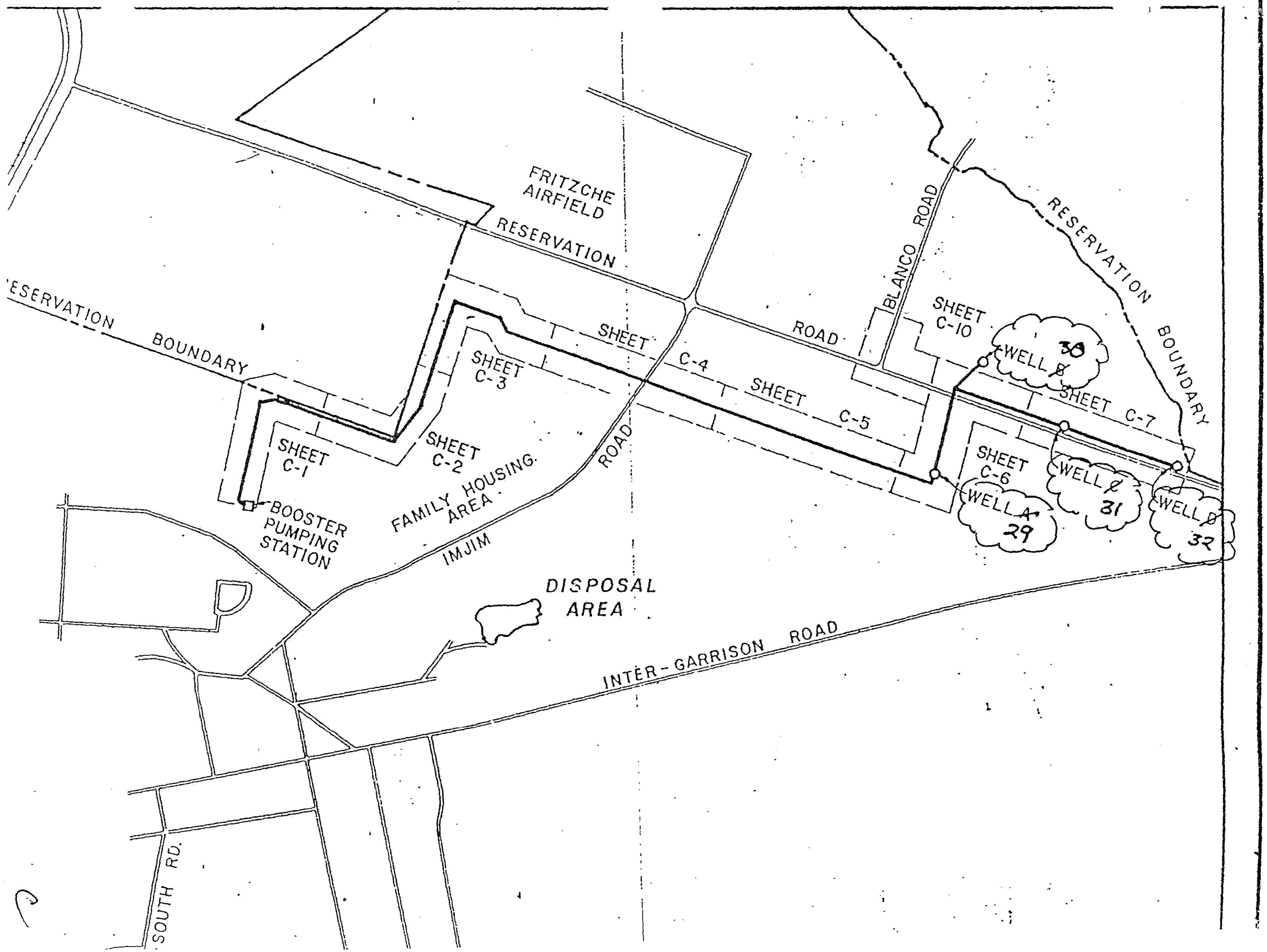
(MOA.ADD - 2/17/93)

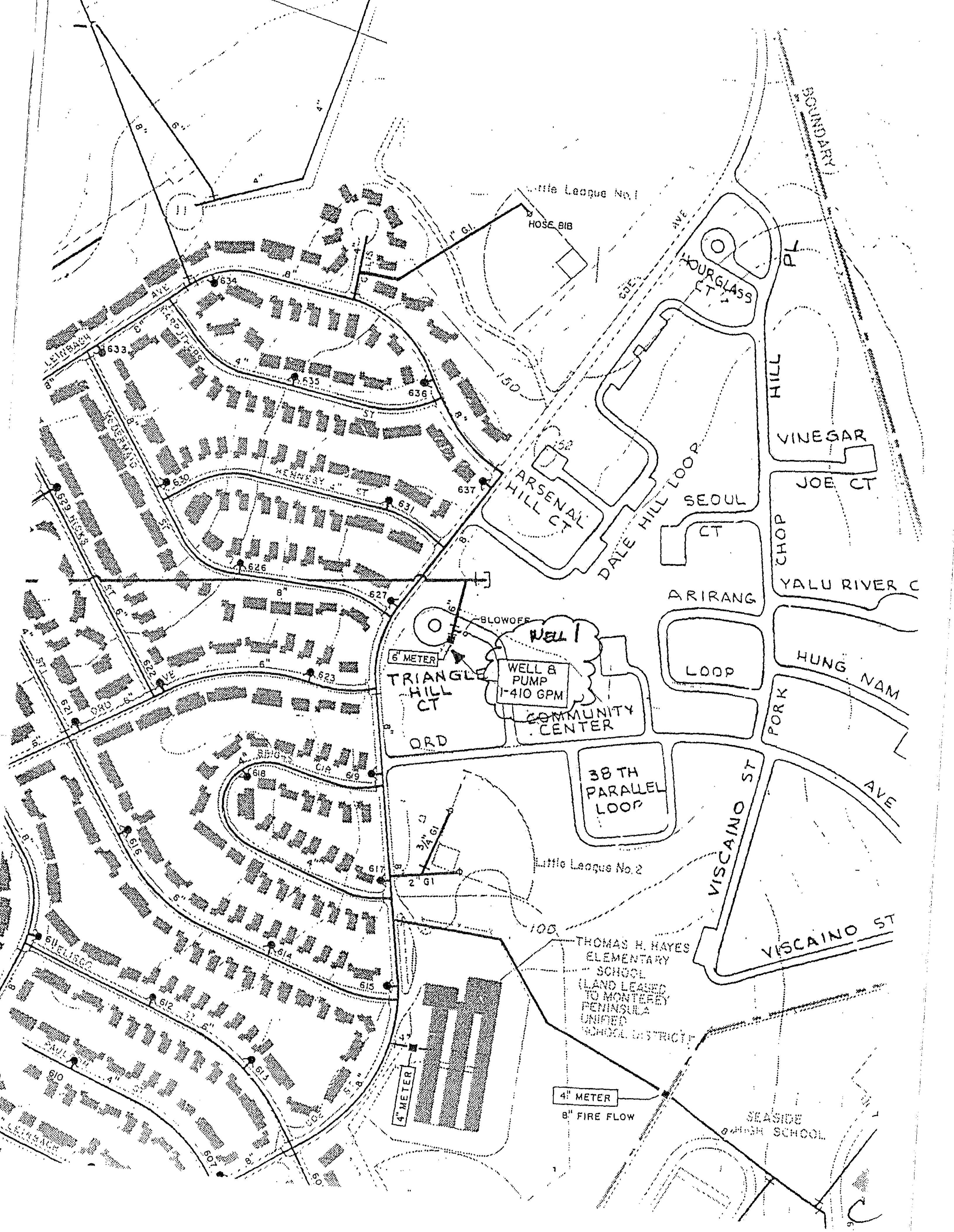
B

Hydrogeologic Conditions in the Fort Ord Vicinity



APPENDIX C


FRITZCHE AIRFIELD
RESERVATION
RESERVATION BOUNDARY
BLANCO ROAD
RESERVATION BOUNDARY
ROAD
SHEET C-10
WELL 30
SHEET C-4
SHEET C-5
SHEET C-7
SHEET C-3
SHEET C-1
SHEET C-2
SHEET C-6
WELL 31
WELL 29
WELL 32
ROAD
FAMILY HOUSING AREA
BOOSTER PUMPING STATION
IMJIM
DISPOSAL AREA
INTER-GARRISON ROAD
SOUTH RD.
C



Little League No.1
HOSE BIB
1" GI
BOUNDARY
HOURGLASS CT
PL
HILL
CHOP
VINEGAR
JOE CT
SEOUL
CT
ARSENAL HILL CT
DALE HILL LOOP
YALU RIVER C
ARIRANG
LOOP
HUNG NAM
PORK
AVE
BLOWOFF
WELL 1
6" METER
WELL & PUMP 1-410 GPM
TRIANGLE HILL CT
COMMUNITY CENTER
ORD
38 TH PARALLEL LOOP
VISCAINO ST
VISCAINO ST
3/4" GI
2" GI
Little League No.2
THOMAS H. HAYES ELEMENTARY SCHOOL (LAND LEASED TO MONTEREY PENINSULA UNIFIED SCHOOL DISTRICT)
4" METER
4" METER
8" FIRE FLOW
SEASIDE HIGH SCHOOL
AVE
ST
HENNEBY
ORD
HICKS
150
100

ANNEXATION ASSEMBLY AND EVALUATION REPORT FOR THE ANNEXATION OF FORT ORD BY THE MONTEREY COUNTY WATER RESOURCES AGENCY

10 SEPTEMBER 1993

I. EXECUTIVE SUMMARY. The purpose of this annexation by the Monterey County Water Resources Agency (MCWRA) is to provide the basis for a long term, reliable, potable water supply to support the Army's residual mission at Fort Ord after it is realigned per the Base Closure and Realignment Act of 1990. Annexation will also facilitate the disposal and reuse of the portions of Fort Ord not needed to support the Army's residual mission. This report provides the background and justification for the annexation, which is contingent on the conditions in the accompanying Agreement. See Exhibit 1 for a regional map showing Fort Ord, and Exhibit 2 for the location of cities surrounding Fort Ord.

II. INTRODUCTION.

A. Overview of Annexation.

1. Fort Ord, like all large communities in North Monterey County, obtains all of its water supply from groundwater. From the map at Exhibit 3, it can be seen that the northwestern part of Fort Ord (Area 1) overlies part of the Salinas Valley Groundwater Basin (Salinas Basin). Within Area 1, there are three aquifers known as the 180-foot, 400-foot, and 900-foot aquifers. These aquifers are not necessarily found in every location of Area 1. Presently, Fort Ord has three active potable wells in the 180-foot and 400-foot aquifers of the Salinas Basin (wells 29, 30, and 31). By California law, the MCWRA has water management authority over the Salinas Basin. The Salinas Basin has been in an overdraft condition for many years.

2. The southwestern part of Fort Ord (Area 2 on the map) overlies the Seaside Groundwater Basin (Seaside Basin), which is divided into several subbasins due to geologic conditions. The part of Fort Ord which overlies the Seaside Basin supplies a substantial amount of recharge to this basin. Presently, Fort Ord has only one active well in the Seaside Basin to irrigate the Fort Ord golf courses (well 1). Due to occasional high salinity, water from this well is considered to be non-potable. By California law, the Monterey Peninsula Water Management District (MPWMD) has water Management authority over the Seaside Basin. In contrast to the Salinas Basin, the Seaside Basin appears to be in a nearly balanced condition.

3. In the eastern part of Fort Ord (Area 3 on the map), the boundary between the Salinas and Seaside Basins is not defined. This is not a significant issue since this area has a low

APPENDIX D

infiltration rate and subsurface permeability. As a result, the area is unsuitable for significant groundwater development, and it probably doesn't contribute a substantial amount of recharge to the western basins.

4. Pumping by Fort Ord has contributed to the Salinas Basin overdraft, but only to a limited extent as the Fort Ord withdrawals from 1988 to 1992 averaged only 5,200 acre-feet per year compared to the estimated Salinas Basin overdraft of about 50,000 acre-feet per year. The overdraft has resulted in the intrusion of seawater into the Salinas Basin which has caused the contamination of many wells along the entire coastal region, including several on Fort Ord. Although recent studies show that the rate of seawater intrusion may have slowed in the Fort Ord area, the seawater is continuing at a rapid pace in the Castroville-Salinas area several miles north of Fort Ord. Exhibit 4 shows the seawater intrusion problem. The MCWRA has requested the annexation of all of Fort Ord as part of its long term effort to halt all pumping along the Salinas Basin coastal region by providing a replacement water supply. In this manner, the seawater intrusion could be stopped and perhaps even reversed.

5. Fort Ord realized that the seawater intrusion would eventually contaminate its remaining wells, so in January 1990 the President requested Congress approve a military construction project for $7,400,000 to "Purchase part of a regional water supply system, as the first phase of a two-phase regional water supply project to provide a dependable long-term water supply for Fort Ord and the cities of Marina and Castroville." The fiscal year 1991 Defense legislation provided a $7,400,000 authorization and appropriation for the annexation of Fort Ord into the MCWRA. Additional funds for the Army's share of the regional water supply project (second phase) were never budgeted because the 1991 Defense Base Realignment and Closure process (BRAC 91) dictated that the 7th Light Infantry Division stationed at Fort Ord relocate to Fort Lewis, Washington. As a consequence, the Army deferred action on the annexation until the future status of Fort Ord was determined, and more information was available on the cost for the Army to participate in a regional water supply project.

6. Pursuant to BRAC 91, part of Fort Ord will be retained to support the Defense Language Institute (DLI) at the nearby Presidio of Monterey (POM). This Fort Ord enclave is designated as the POM Annex. Additionally, a 12 acre Reserve Center within Fort Ord will be retained (not contiguous to the POM Annex). As part of the BRAC 93 process, the Army recommended that the POM and POM Annex be closed, and the DLI be relocated to Fort Huachuca, Arizona. However, the 1993 Defense Base Closure and Realignment Commission's recommendations, which the President endorsed to Congress, call for the DLI to remain at the POM, and for the POM Annex to be downsized to only include housing and the commissary, child care facility, and post exchange. Congress is not expected to disapprove the Commission's recommendations.

7. With a BRAC 93 decision to retain an Army presence at Fort Ord, it is imperative that the Army obtain a reliable water supply to support the residual mission. For the Army to gain access to a regional water supply project being developed by the MCWRA, annexation is required. Annexation will also benefit the Army by facilitating the disposal and reuse of the parts of Fort Ord to be excessed. More detail on these and other benefits is provided in section IV.E. of this report.

B. Area to be Annexed. The area to be annexed is the whole of Fort Ord, California, which is made up of 28,602.84 acres. Refer to Exhibits 14 through 18 for real estate maps of the installation.

C. Purpose of the Area and Mission Objectives. Prior to BRAC 91, Fort Ord's primary purpose was to station the 7th Light Infantry Division. Subsequent to BRAC 93, the installation's primary purpose will be to provide housing and other facilities in support of the nearby POM and Naval Post Graduate School.

D. Present and Future Uses of the Property. Relocation of the 7th Light Infantry Division is in progress with the last units scheduled for departure by December 1993. Pursuant to BRAC 91, the Army is disposing of excess property in accordance with applicable law. To support the residual mission, the POM Annex is presently configured to occupy about 1,500 acres. However, under BRAC 93, the POM Annex is to be downsized by excessing facilities such as both golf courses. The Environmental Impact Statement for the disposal and reuse of Fort Ord, which is nearing completion, has identified the following possible uses for the parts of Fort Ord to be excessed: educational, office park (private and government), commercial, recreational, aviation, natural resource management, and housing.

E. Acquisition Origin of Fort Ord. The original Fort Ord reservation comprising 15,809.50 acres was purchased by the United States from the David Jacks Corporation on 4 August 1917. After 1940, an additional 12,793.34 acres were acquired. The total area is 28,602.84 acres.

F. Political Subdivision Seeking Annexation. The subdivision seeking annexation of all the lands comprising Fort Ord is the MCWRA which, per California law, is responsible for managing the surface water and groundwater resources in the Salinas Valley and providing flood control and water conservation services throughout Monterey County. MCWRA is requesting that Fort Ord be annexed into Zones 2 and 2A. The MCWRA established Zone 2 as the benefit assessment zone in connection with the construction of Nacimiento Reservoir (completed in 1957), and established Zone 2A as the benefit assessment zone in connection with the construction of San Antonio Reservoir (completed in 1967). Since the construction of these reservoirs, the MCWRA has operated a groundwater recharge program for the benefit of Zones 2 and 2A, using waters from the two reservoirs and other programs to enhance natural percolation in the Salinas Basin. It is appropriate for Fort Ord to be annexed into Zones 2 and 2A because Fort Ord's potable water supply has historically come from the Salinas Basin. Per a Memorandum of Agreement signed in May 1993 between the MPWMD and MCWRA, the MPWMD does not object to the MCWRA annexing that part of Fort Ord overlying the Seaside basin provided that the MPWMD retains water management authority over the portion of the Seaside Basin underlying Fort Ord. Refer to Exhibit 19 for a large map showing the existing boundaries of Fort Ord and Zones 2 and 2A. Note that although a small portion of Fort Ord is currently shown to be within Zones 2 and 2A, the property is not presently annexed. Refer to Exhibit 20 for a large map showing the entire area of Zones 2 and 2A.

III. LEGAL STATUS OF THE PROPERTY

A. Title Held by the Government. The Army has a fee title interest in the property proposed for annexation. This action by the MCWRA will not affect the Army's title.

B. Degree of Legislative Jurisdiction. The degree of jurisdiction over most of the property is exclusive federal jurisdiction. Annexation will not alter this jurisdiction and it will not interfere with official Army activities or functions including those remaining after realignment and closure.

C. Applicable State Annexation Laws and Ordinances. The procedures for annexation are found in California Water Code, Appendix 52-43 (see Appendix A to the Agreement). The Army intends to petition the MCWRA Board of Supervisors for annexation pursuant to section 43.(b)(3). Pursuant to section 43.(b)(5), annexation may require a fee. See section IV.F. of this report for a discussion of the annexation fee.

D. Regulations on Annexation. The following govern the actions of the Army in annexations:

1. Army Regulation 405-25, Annexation (1 April 1974).

2. Engineering Regulation 405-1-12, Chapter 9, Federal Legislative Jurisdiction and Annexation (Change 4, 5 September 1978).

IV. POTENTIAL IMPACT OF ANNEXATION.

A. Source of Utilities. Water is the only utility that will be affected by the proposed annexation. Fort Ord now receives all of its water from wells on Fort Ord that are owned and operated by the Army. Since seawater intrusion is threatening these wells, the Army needs a long term, reliable, replacement water supply. Such a water supply would likely come from a future MCWRA project; however, the Agreement provides the Army with the flexibility to obtain a replacement water supply from another source if the opportunity arises and it is in the Army's best interests. The replacement water supply system will provide water in bulk to the installation. The Army or a successor entity will continue to be responsible for operating and maintaining the water distribution system on Fort Ord Lands. Paragraph 4.d. of the Agreement addresses the fact that the Army will retain the necessary easements to operate and maintain Army wells.

B. Adverse Impacts on the Mission.

1. Utilities and Services. Annexation will have no impact on Fort Ord utilities and services, or the installation's plan to find a water purveyor to take over the water distribution system.

2. Taxation and Licensing. Municipalities acquire the power to tax private persons and private property by annexation. Military personnel, to some extent, and Government instrumentalities such as Post Exchanges are exempt from such taxation. The Agreement states that the Army will provide the MCWRA with $7,400,000 in consideration for the annexation. However, the Agreement also stipulates that the Army will not pay any MCWRA assessments (including standby charges) until after the POM Annex and Reserve Center gain access to a replacement water supply provided by the MCWRA (see paragraph IV.F.2.). To the extent that federal property may be exempt from local assessments, a utility service contract in accordance with AR 420-41 between the Army and the MCWRA may require the payment of a contractual fee to replace any assessments. Such fee will be mutually agreed upon.

C. Effect on Installation Master Plans. Upon annexation, the MCWRA will acquire some control over Fort Ord's water supply. From a practical standpoint, this control should not prevent the Army from constructing any projects needed to support Fort Ord's residual mission. Additionally, the Agreement provides Fort Ord with special rights to obtain any water needed in the event of war, national emergency, contingency operation, troop mobilization, or unexpected mission requirements.

D. Annexor's Capability to Furnish Benefits.

1. The main benefit the Army expects to receive from the MCWRA is a long term, reliable water supply. Based on its charter, the MCWRA should be the most capable organization to plan, finance, construct, and operate a regional water supply system. The MCWRA's first attempt to develop a water supply system for Fort Ord and Marina was halted in 1992 due to opposition from land owners in and around the proposed Buena Vista well field (located inland from Fort Ord). This project had a capacity of 11,600 acre-feet/year.

2. An alternative project now being studied by the MCWRA consists of dispersed wells along a 20 mile stretch of the Salinas River and storing excess runoff from the Arroyo Seco River (a tributary of the Salinas River) in a shallow aquifer using percolation ponds. Water would then be pumped from the dispersed well system and from the shallow aquifer to replace the potable wells serving Fort Ord, Marina, Salinas, Toro Park, and perhaps other areas in north Monterey County. Water would also be provided to recharge the Salinas Basin near the coast to raise the groundwater level and halt (or even reverse) the seawater intrusion. The Water Transfer Project is being planned for a capacity of about 50,000 acre-feet per year. Construction completion is planned by the year 2000. The MCWRA's current estimated cost of this project is $157 million, which equates to a capital cost of $3,155 per acre-foot per year.

3. There is another MCWRA project to mitigate seawater intrusion which is already under design. The project will upgrade the existing regional sewage treatment plant to tertiary standards, and pipe the effluent to Castroville for crop irrigation. This project should provide about 19,500 acre-feet per year, and is estimated to cost $71 million. When this project comes on line (maybe as early as 1996), the estimated 50,000 acre-feet per year Salinas Basin overdraft will be significantly reduced. This should extend the life of all wells near the coast, including those on Fort Ord. The MCWRA intends to use the Army's $7.4 million annexation fee to complete design of the Castroville Project.

4. Based on the above reasons, it is concluded that the MCWRA is the most capable organization to provide a reliable water supply for the Fort Ord Lands. This is a challenging task as the MCWRA is under considerable pressure to develop a regional water supply project quickly because the wells serving over 100,000 people in the coastal region are being threatened by seawater intrusion. Because of this threat, the State Water Resources Control Board is monitoring the MCWRA's progress in this area. If the MCWRA, for whatever reason, is unable to develop a regional water supply system, then the Agreement permits the Army to obtain a long term water supply for the POM Annex and Reserve Center from another party. Additionally, even if the MCWRA is making progress in developing a regional water supply project, the Agreement provides the Army the option of obtaining a long term water supply for the POM Annex and Reserve Center from another party if it is in the Army's best interests, e.g., the other water source is less costly or available at a more advantageous time.

E. <u>Benefits to Accrue from Annexation.</u> Upon annexation of Fort Ord into Zones 2 and 2A, the MCWRA will not immediately provide any direct governmental service on the installation. The benefits of annexation will accrue initially on an indirect basis, and direct services will be provided later. The benefits to the Army from annexation are as follows:

1. The most important benefit of annexation is that it will allow the Fort Ord Lands to gain access to a regional water supply project being developed by the MCWRA. Fort Ord's existing wells are being threatened by seawater intrusion due to the existing Salinas Basin overdraft. The MCWRA is the most capable, and most likely entity to implement a regional water supply project to support the POM Annex and Reserve Center.

2. Another important benefit is that annexation will facilitate the disposal and reuse of the parts of Fort Ord to be excessed under base closure and realignment. This is the main reason for annexing all Fort Ord Lands at this time instead of waiting to annex just the POM Annex and Reserve Center after the MCWRA has better defined its proposed regional water supply project, i.e., all environmental permits and approvals obtained. Under the Agreement, the new owners of Fort Ord excessed property would have the right to drill and pump on their property subject to the conditions described in paragraph IV.E.3. below, and paragraph 4.c. of the Agreement. Also, property which has already been annexed by the MCWRA will be easier to dispose because of its potential access to a long term water supply project being developed by the MCWRA, and a short term water supply from Fort Ord's existing wells (see paragraph IV.E.3. below). Without annexation, the MCWRA or state regulatory agencies could object to the Army providing water to owners of excessed Fort Ord property, even if only for a short duration. Additionally, these same agencies could severely limit or control pumping by the owners of excessed Fort Ord property due to the Salinas Basin overdraft. Lastly, even if all of these new property owners wanted to be annexed, it would be an administrative burden for the MCWRA compared to annexing just Fort Ord.

3. Until the MCWRA's regional water supply project is implemented, annexation will give the Army the right to withdraw up to 6,600 acre-feet per year from the Salinas Basin underlying Fort Ord Lands, and allow the Army to allocate some of this water for reuse. The Army or its successor water purveyor, utility, or agency may also develop groundwater supplies located outside the Salinas Basin. The amount of water needed to support the Fort Ord residual mission was the subject of a June 1993 Report titled "Water Requirements at Fort Ord Under Base Realignment and Closure", which was prepared under the supervision of the Army Corps of Engineers, Institute for Water Resources (IWR). This report concluded that the POM Annex, as presently configured, would require in fiscal year 1995 1,085 acre-feet of potable water provided that additional water conservation measures are implemented. This report also estimated that 403 acre-feet of non-potable water would be used in fiscal year 1995. The non-potable water is pumped for the golf courses from a well located in the Seaside Basin. These requirements would decrease if the POM Annex is downsized in accordance with BRAC 93. Based on a POM Annex potable water requirement of 1,429 acre-feet per year (IWR estimate plus appropriate adjustments computed by Fort Ord), there could be

up to 5,171 acre-feet per year of water available for reuse and to maintain any undisposed Fort Ord Lands and facilities in a caretaker status. Note that the Agreement only allows 5,200 of the 6,600 acre-feet per year threshold to be pumped from the 180-foot and 400-foot aquifers in the Salinas Basin. Fort Ord's active potable wells draw from the 180-foot aquifer, so a new well into the 900-foot aquifer would be needed to gain access to the additional 1,400 acre-feet per year. The Agreement also states that Fort Ord groundwater withdrawals for environmental restoration will not count toward the 6,600 acre-feet per year threshold because either the withdrawals will be small, or if they are large, the water will probably be disposed in the sanitary sewer system where it will be used by the Castroville Sewage Reclamation/Irrigation Project to help reduce seawater intrusion.

4. There is concern that the Fort Ord wells could become contaminated with seawater before the MCWRA implements their regional water supply project. In this event, annexation would be a benefit to the Army because the MCWRA will provide Fort Ord with the same services as they would provide to any other municipal water supplier in the Zones under this circumstance, i.e., assistance in finding an interim water supply and in obtaining any permits. The Army would bear the cost of obtaining this interim water supply. Under the Agreement, the MCWRA will periodically provide Fort Ord with the estimated remaining life of their wells, and the progress on the MCWRA Water Transfer Project.

5. Annexation will resolve questions concerning Fort Ord's right to withdraw groundwater from the Salinas Basin. The Agreement states that in consideration of the $7,400,000 annexation fee, the MCWRA will release the Government from any financial responsibility for existing MCWRA water projects from which Fort Ord may have benefitted (Nacimiento and San Antonio Reservoirs). Additionally, the Agreement states the MCWRA will release the Government from any claims related to seawater intrusion in the Salinas basin.

6. Under California law, annexation will provide the Fort Ord with the same representation in MCWRA matters as any other property owner in Zones 2 and 2A.

7. Another benefit of annexation is that the enclosed Agreement includes some of the conditions which must be satisfied for the Army to participate in a future MCWRA regional water supply project. The objective of these conditions is to assure that the regional water project costs assigned to the Army are equitable in comparison to the Army's allocation of water from the project. These protections are very important in view of the fact that the Army believed it was being saddled with a disproportionate cost share of the original Buena Vista project, and the fact that the POM Annex will only require a small part of the capacity of MCWRA's proposed regional water project. The Army strongly believes that part of the cost of a regional water project must be funded by all

members of Zones 2 and 2A. The water supply project is just as important to halting seawater intrusion as the Castroville Sewage Reclamation and Irrigation project, and the MCWRA plans to have 50 percent of this project funded by Zone 2 and 2A members not receiving water from the Castroville project.

F. Effect on the Budget of the Installation.

1. Annexation Fee: The Army and the MCWRA have agreed upon an annexation fee of $7,400,000, which was authorized and appropriated by Congress in the fiscal year 1991 Defense legislation. The amount of the fee is related to the benefits provided by MCWRA's existing water projects (Nacimiento and San Antonio Dams) and water management practices which protect the yield of the Salinas Basin. It is from this basin that Fort Ord has historically obtained its potable water supply. The annexation fee is consistent with the current MCWRA Annexation Policy at Exhibit 5. There are two components of the fee - for area and water use. The area component is the area to be annexed in acres times $277. The $277 is the sum of the present worth capital cost of each dam divided by the acreage of its respective zone. The water use component is $783 times the maximum amount of water to be pumped from the Salinas Basin in acre-feet per year. The $783 is the present worth, on a acre-foot per year basis, of past operation and maintenance costs for Zones 2 and 2A. Based on information from current and former Fort Ord personnel, it appears that MCWRA's current annexation policy was in effect when the Congressional budget estimate for the annexation fee was developed in 1989. The area component of the fee was apparently computed by using 8,000 acres multiplied by $277/acre or $2,216,000. Since the existing Fort Ord developed area is about 5,000 acres, the 8,000 acre figure was apparently used to account for future growth. The water use component apparently was developed using the peak withdrawal of 6,600 acre-feet/year (1984) multiplied by $783/acre-foot/year or $5,167,000. The area and water use components total $7,383,800, which was rounded to $7,400,000. The Agreement stipulates that the $7,400,000 fee will be paid to the MCWRA after completeion of the annexation.

2. Annual Assessments: The Agreement stipulates that until the POM Annex and Reserve Center receive water from a MCWRA water supply project, the Army shall not pay any assessments such as standby charges, water delivery charges, or water project assessments. Standby charges, which generally fund the MCWRA administrative costs, vary from year to year and have increased over time. At present, these charges are limited to a maximum of $15 per acre per year for each zone, per the California Water Code, Appendix 52-12. For the POM Annex and the Reserve Center, which after annexation will be in two zones (2 and 2A), this would amount to a maximum of $30 per acre. The Army's potential water project assessments (capital costs) and water delivery charges (operation and maintenance) are discussed in Agreement paragraphs 4.j.(3) and

4.j.(4), respectively. The Agreement stipulates that the Army will not pay any assessments or charges on Fort Ord property in a caretaker status awaiting disposal. Additionally, paragraph 7 of the Agreement provides the MCWRA with expanded authority to collect assessments from Fort Ord property leased to private interests by the Army.

V. POSITION OF COUNTY AND OTHER GOVERNMENT ENTITIES ON ANNEXATION.

A. MCWRA. The MCWRA initiated the annexation of Fort Ord to help solve the Salinas Basin seawater intrusion problem, and guarantee a continuing supply of potable water for Fort Ord. Annexation is a necessary step in this process. The MCWRA is moving toward annexing all property within the Salinas Basin so they can effectively manage the aquifer. With the annexation of Fort Ord and Marina, which are both in progress, all major properties within the Salinas Basin will be annexed.

B. Other Political Subdivisions. Letters were sent by the MCWRA to other communities and agencies that share boundaries with Fort Ord or have an interest in the annexation of Fort Ord by the MCWRA. The respondents, with their comments, are listed below. A sample copy of the letter is attached (Exhibit 6), as well as copies of the responses.

1. City of Monterey, CA; voted not to oppose annexation (Exhibit 7).

2. Monterey County Local Agency Formation Commission; voted to support (Exhibit 8).

3. Marina Coast Water District (formerly known as the Marina County Water District); voted not to oppose annexation (Exhibit 9). The Marina Coast Water District is currently working with the MCWRA to be annexed into zones 2 and 2A because of their concerns over the long term reliability of their existing groundwater supply.

4. Monterey Peninsula Water Management District; approved the annexation (Exhibit 10).

5. City of Del Rey Oaks, CA; voted not to oppose annexation (Exhibit 11).

6. City of Marina, CA; initially voted to table consideration of support or opposition to the annexation. The City of Marina has subsequently agreed not to oppose annexation provided that the Agreement stipulates that Fort Ord may pump up to 6,600 acre-feet of water per year from its wells, and that water not needed for the residual mission can be provided for reuse (Exhibit 12). This provision is contained in paragraph 4.c. of the Agreement.

7. City of Seaside, CA; opposes the annexation (Exhibit 13). It is concluded that in spite of this opposing response, Fort Ord should be annexed by the MCWRA. The first reason is that annexation under the terms of the attached Agreement is in the Army's best interest. The second reason is that the Army concludes there is no reasonable basis for a conflict because the Seaside groundwater supply, which is managed by the MPWMD, will not be affected by the MCWRA's annexation of Fort Ord.

VI. CONCLUSION AND RECOMMENDATIONS. This annexation is in the best interests of the Government, and it is recommended that it be approved contingent on the provisions in the attached Agreement.

EXHIBITS:

1 - Regional map
2 - Vicinity map
3 - Map of the Salinas Valley Groundwater Basin
4 - Figures showing the seawater intrusion problem
5 - MCWRA annexation policy
6 - Typical MCWRA letter sent to local interests to obtain comments on the MCWRA's proposed annexation of Fort Ord
7 - Response, City of Monterey
8 - Response, Monterey County Local Agency Formation Commission
9 - Response, Marina Coast Water District
10 - Response, Monterey Peninsula Management District
11 - Response, City of Del Rey Oaks
12 - Response, City of Marina
13 - Response, City of Seaside
14 - Fort Ord real estate map, entire installation
15 - Fort Ord real estate map, segment 1A
16 - Fort Ord real estate map, segment 1B
17 - Fort Ord real estate map, segment 1C
18 - Fort Ord real estate map, segment 1D
19 - Map showing boundaries of Fort Ord and Zones 2 and 2A
20 - Map showing entire Zones 2 and 2A

REPORT TO THE BOARD OF SUPERVISORS OF THE
MONTEREY COUNTY WATER RESOURCES AGENCY

COPY

SUBJECT	BOARD MEETING DATE	AGENDA NUMBER
APPROVE AND AUTHORIZE THE CHAIR TO SIGN THE AGREEMENT AND ANNEXATION RESOLUTION OUTLINING THE TERMS AND CONDITIONS TO ANNEX FORT ORD INTO MONTEREY COUNTY WATER RESOURCES AGENCY ZONES 2 AND 2A	9-21-93 10:50 AM	
WATER RESOURCES AGENCY		

RECOMMENDATION

Approve and authorize the Chair to sign the Agreement and Annexation Resolution outlining the terms and conditions to annex Fort Ord into Monterey County Water Resource Agency Zones 2 and 2A.

SUMMARY

The United States Army has presented the Monterey County Water Resources Agency (MCWRA) with a petition to be annexed into MCWRA's Zones 2 and 2A. The petition includes an Agreement covering the terms and conditions for the annexation (copy attached). On September 13, 1993 the MCWRA Board of Directors received the Agreement and voted to recommend it be approved by your Board. Since the Agreement has been signed by the authorized representative for the Army, your Board's approval and signature by your Board Chair on the Agreement and Annexation Resolution will complete the annexation action and obligate the Army to a payment of $7.4 million to the MCWRA.

DISCUSSION

On July 10, 1990 the Monterey County Board of Supervisors, acting then for the Monterey County Flood Control and Water Conservation District, authorized the Chair of the Board of Supervisors to sign a Memorandum of Agreement (MOA) that contained the terms and conditions for the annexation of Fort Ord into MCWRA Zones 2 and 2A. The MOA was never co-signed by the Army at that time because it did not address the closure of Fort Ord.

On April, 1993 Army officials on Fort Ord submitted an MOA to the MCWRA for approval. This MOA was approved by the Board of Supervisors on April 20, 1993. When this version of the MOA was received by Army officials in Washington DC, it was rejected on the grounds that it did not sufficiently address the down-sizing of Fort Ord or the Installation's future reuse.

The MOA was changed to an "Agreement" and re-written by Army officials in the Pentagon. The Agreement as is now being presented preserves the key components of the earlier MOA and more completely addresses the Army's declining presence on Fort Ord. It establishes a total cap on groundwater pumping from the Salinas Groundwater Basin, quantifies the amount of water the Army will need for their residual presence and quantifies the amount of water that will be available for civilian reuse.

Approval of the Agreement and the Annexation Resolution by the Board of Supervisors at this time will complete the annexation. The Army will become contractually obligated to pay the agreed annexation fee of $7,400,000 upon being presented with the signed Agreement and Annexation Resolution.

The Agreement consists of the Petition for Annexation and Appendices A, B, C, and D. Exhibits to Appendix D, are available upon request at the offices of the MCWRA.

OTHER AGENCY INVOLVEMENT

In August of 1992 the MCWRA sent a letter to all the Communities surrounding Fort Ord and to other agencies that might be affected by the annexation of the Fort into MCWRA Zones 2 and 2A. The letter indicated the MCWRA's intent to pursue the annexation and it asked the addressees to indicate their support or opposition to the intended action. A summary of the responses is shown on pages 10 and 11 of Appendix D, the Annexation Assembly and Evaluation Report. In addition, on September 9, 1993 the Fort Ord Reuse Group wrote a letter to the Army in support of the annexation.

FINANCING

There is no impact to the General Fund. After annexation, the MCWRA would receive $7.4 million from FY 1991 Military Construction Army appropriated funds. The full amount is scheduled to be applied against the costs of the Castroville Reclamation and Irrigation Project.

William F. Hurst
William F. Hurst
General Manager

Before the Board of Supervisors in and for the
County of Monterey, State of California

COPY

Agreement No. A-06404 --
Agreement Between the United States of America and the Monterey County Water Resources Agency Concerning Annexation of Fort Ord Into Zones 2 and 2A of the Monterey County Water Resources Agency, Approved; Chairwoman Authorized to Sign . . . .

Upon motion of Supervisor Johnsen, seconded by Supervisor Strasser Kauffman, and carried, the Board hereby approves Agreement No. A-06404 between the United States of America and the Monterey County Water Resources Agency concerning annexation of Fort Ord into Zones 2 and 2A of the Monterey County Water Resources Agency, and authorizes the Chairwoman to sign said agreement.

PASSED AND ADOPTED this 21st day of September, 1993, by the following vote, to-wit:

AYES: Supervisors Salinas, Shipnuck, Perkins, Johnsen and Karas.

NOES: None.

ABSENT: None.

I, ERNEST K. MORISHITA, Clerk of the Board of Supervisors of the County of Monterey, State of California, hereby certify that the foregoing is a true copy of an original order of said Board of Supervisors duly made and entered in the minutes thereof at page -- of Minute Book 67, on September 21, 1993
Dated: September 21, 1993

ERNEST K. MORISHITA, Clerk of the Board
of Supervisors, County of Monterey,
State of California.

By Nancy Lukenbill
Deputy

Before the Board of Supervisors in and for the County of Monterey, State of California

Resolution No. 93-387 --
A Resolution of the Board of Supervisors of the Monterey County Water Resources Agency Making findings for the Annexation of Certain Territory, Known as the Ft. Ord Annexation, to Zones 2 and 2A of the Monterey County Water Resources Agency, Setting Forth the Conditions for Said Annexation, and Approving Said Annexation.

WHEREAS,

A. For many years, the territory known as Ft. Ord, in Monterey County, California, has obtained its potable water from the Salinas Valley Groundwater Basin.

B. Much of the water in the Salinas Valley Groundwater Basin is derived from the Groundwater recharge program made possible through the operation of Lake Nacimiento and Lake San Antonio. The dams that impound these lakes were built and are operated by the Monterey County Water Resources Agency (MCWRA). The capital, operating and maintenance expenses of these reservoirs have been paid for by the property owners in MCWRA Zones 2 and 2A.

C. Ft. Ord is not in Zones 2 and 2A, and has never paid any of the assessments for the reservoirs, although it has benefited from the groundwater recharge program maintained by Zones 2 and 2A.

D. Over the years, seawater intrusion has progressively advanced into the northern portions of the Salinas Valley Groundwater Basin, rendering wells useless for potable and agricultural purposes and threatening nearby water supplies. Several wells previously used to supply water to Fort Ord have been lost to seawater intrusion.

E. The MCWRA proposes to develop a seawater intrusion program that would replace groundwater wells in the northern portion of the Salinas Valley. The program would rely on groundwater or surface water developed in Zones 2 and 2A. The program would require that all properties to be benefited by the program be in Zones 2 and 2A.

F. The territory of Fort Ord is not in Zone 2 and 2A. The U. S. Government, as owner of said property, desires that the territory of Fort Ord be annexed to Zones 2 and 2A, in order to compensate Zones 2 and 2A for past benefits received and to insure the territory's right to participate in the seawater intrusion program, should a water project be built in Zones 2 and 2A for the benefit of this area.

G. The proposed annexation is not a project within the meaning of CEQA because (1) the terms of the annexation limit the use of water on Ft. Ord to present or historical levels of water use, pending the completion of a water supply project for the benefit of this area, and (2) the annexation does not commit the MCWRA or Ft. Ord to the development of any particular water project or to any other action that will result in changes in the environment. Therefore, it can be seen with certainty that there is no possibility that the annexation will result in significant environmental effects.

H. This annexation is conducted pursuant to the Monterey County Water Resources Agency Act, Section 43.

NOW, THEREFORE BE IT RESOLVED:

1. It is in the best interest of Zones 2 and 2A and the territory described in Exhibit A, referred to herein as the Ft. Ord annexation, that the territory described in Exhibit A be annexed to the zones.

2. The boundaries of the territory to be annexed, as set forth in Exhibit A, are appropriate and need not be modified.

3. There are no other annexation petitions pending before the Agency that involve annexation of any of the same territory to the same zones.

4. The territory described in Exhibit A is hereby annexed to Monterey County Water Resources Agency Zones 2 and 2A, subject to the conditions set forth in the annexation agreement, attached hereto as Exhibit B. The annexation fee shall be paid as provided in Exhibit B.

5. The annexation shall take effect immediately upon the adoption of this resolution.

6. On the effective date of the annexation, the territory described in Exhibit A shall be subject to all the liabilities and entitled to all the benefits of the zone, except as otherwise provided in the annexation agreement, attached hereto as Exhibit B.

Upon motion of Supervisor Johnsen, seconded by Supervisor Karas, the foregoing resolution is adopted this 21st day of September, 1993, by the following vote, to-wit:

AYES: Supervisors Salinas, Shipnuck, Perkins, Johnsen and Karas.

NOES: None.

ABSENT: None.

I, ERNEST K. MORISHITA, Clerk of the Board of Supervisors of the County of Monterey, State of California, hereby certify that the foregoing is a true copy of an original order of said Board of Supervisors duly made and entered in the minutes thereof at page -- of Minute Book 67, on September 21, 1993

Dated: September 21, 1993

ERNEST K. MORISHITA, Clerk of the Board
of Supervisors, County of Monterey,
State of California.

D. Barhill

PETITION FOR ANNEXATION
TO ZONES 2 AND 2A
MONTEREY COUNTY WATER RESOURCE AGENCY
MONTEREY COUNTY, CALIFORNIA

AFFIDAVIT

I, the undersigned, declare under penalty of perjury under the laws of the State of California that the attached Memorandum of Agreement with attachments, when executed by the parties thereto, constitutes a petition for the annexation of the territory of Fort Ord, in Monterey County, California, to Zones 2 and 2A of the Monterey County Water Resource Agency, Monterey County, California, by 100 per cent of the owners of the land described therein, and I am informed and believe that the information contained therein is true and correct.

Dated: 9/10/93

Michael W. Owen
Signature

Name: MICHAEL W. OWEN

Title: Acting Assistant Secretary of the Army
(Installations, Logistics and Environment)

Annexation Agreement and Groundwater Mitigation Framework for Marina Area Lands

March 1996

ANNEXATION AGREEMENT AND GROUNDWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

EXECUTIVE SUMMARY

PURPOSE--Groundwater Planning. This Agreement and Framework provides for annexing lands in the Marina area to MCWRA Zones 2 and 2A, the benefit assessment zones for the Nacimiento and San Antonio reservoirs. The Agreement and Framework establishes a groundwater mitigation framework process for the lands to be annexed, and provides money from the Marina area for Basin management planning.

ANNEXATION TO ZONES 2 AND 2A--MCWD, Armstrong, Lonestar. Annexation proceeds under section 7 of the MCWRA Act for lands within the service area of MCWD, and lands owned by Armstrong and Lonestar. Annexation of the MCWD service area was effective immediately upon approval by the MCWRA Board of Supervisors. The Armstrong Ranch annexation will be effective when LAFCO approves concurrent annexation to MCWD and the City of Marina on conditions satisfactory to Armstrong (including recordation of a final subdivision map). The Lonestar annexation will take effect when the Lonestar Property is annexed to MCWD.

Annexation Fees--more than $3,500,000. Annexation fees are based on $277/acre of land annexed, and $783/af of water to be used. The fee for land on which water is not used is $27.70/acre. The fee for agricultural water is $261/af. Annexation fees total more than $3,500,000, plus interest, as follows:

Fees for MCWD are $2,449,410, based on 1,750 acres @ $277/ac. and 3,020 afy of water @ $783/af, and a credit of $400,000 already paid by MCWD for groundwater management planning.

Fees for Armstrong will be about $970,000 for Area A (urban), based on 900 acres @ $277/ac. and 900 afy @ $783/af, and an amount subject to final determination upon actual annexation for Area B (irrigated and unirrigated agriculture). If the annexation of the Armstrong Ranch occurs more than seven years after MCWRA approves the Annexation Agreement, Armstrong will pay the then-current annexation fees. If the agricultural water use on Area B of the Armstrong Ranch changes, Armstrong will pay an additional 2/3 of the then-current water charge portion of the annexation fee, and if water is used on any area annexed as unirrigated, Armstrong will pay an additional 9/10 of the then current land charge.

Fees for Lonestar will be $166,621, based on 104 acres using water @ $277/ac., and 264 acres of unirrigated, vacant land @ $27.70/ac., and 500 afy of water with quality below agricultural standards @ $261/af. If Lonestar's use changes to a potable use, or if Lonestar is supplied water from the MCWD or has water available from the BMP, or if Lonestar uses water on the open-space area, Lonestar will pay the other two-thirds of the water charge.

Payments for MCWD, Armstrong and Lonestar may be in a lump sum, or in installments over 10 years from the date of annexation, with 6% annual interest.

Annexation fees will be dedicated to paying costs of a BMP process that includes benefits for the Marina Area, and for management and protection of the deep aquifer.

Annual Assessments. After annexation, Marina area lands will pay annual assessments for MCWRA Zones 2, 2A and 2Z.

GROUNDWATER LIMITS--4,440 AFY

Pumping Limits. Under the Agreement and Framework, the present MCWD service area is limited to **3020** afy of potable groundwater. Non-agricultural use of Basin groundwater on the Armstrong Ranch is limited to **920** afy, 20 afy when the Agreement and Framework becomes effective, an additional 150 afy upon annexation, and additional increments of 150 afy every two years thereafter. Groundwater underlying approximately 730 acres of the Armstrong Ranch is limited to agricultural use, except that **20** afy can be used for potable uses, and water from that area can also be used at the regional treatment plant. Lonestar will limit its pumping to its current use of **500** afy.

Reclaimed Water Management. MCWD has the right to receive tertiary treated water from the SVRP plant. MCWD will defer taking summer flows of more than 300 afy (all summer flows if a reservoir is built). MCWD will take its entitlement over 300 afy from winter flows, and plan to store the water for use in the summer. MCWD will pay MCWRA for each acre-foot of reclaimed water received from the SVRP, with the price determined each year by a formula.

Water Storage Site. Armstrong will reserve not more than 250 acres of land for the MCWD for a possible water storage site, subject to planning and CEQA compliance. Armstrong will donate the land over about 12 years, as Armstrong's entitlement to potable groundwater use increases in 150 afy increments, or MCWD can acquire land as needed by paying $25,000 per acre (which can be recovered in Armstrong's fees to annex land to MCWD). MCWD, MCWRA, the City of Marina (and MRWPCA, if it signs the Addendum) agree not to take any more land on the Armstrong Ranch, except for specified, limited purposes. Armstrong has reserved well sites to irrigate Area B and to provide water for MRWPCA's regional treatment plant.

Alternate Water Supplies--300 afy of new water.

BMP. MCWRA's BMP planning will include consideration of the Marina area for a Basin alternative to groundwater pumping in the Marina area.

MCWD. MCWD will continue to plan for new water supplies, such as wastewater reclamation and desalination, to replace and supplement groundwater pumping.

Deep Aquifer Management. MCWRA and MCWD will manage the 900' aquifer to protect and preserve it and to sustain a secure water supply source for MCWD.

Water Source for Fort Ord. MCWD's deep wells may be used to provide up to 1400 afy of water already allocated to Fort Ord as part of the Fort Ord annexation to Zones 2 and 2A.

CONSERVATION. MCWD's aggressive water conservation program will continue in the Marina area.

EQUAL TREATMENT. The MCWRA will not impose greater restrictions on the Marina area's water use from the Basin than are imposed on water use or supply for use within the City of Salinas.

MRWPCA ADDENDUM. The Addendum attached to the Agreement and Framework as Exhibit "G" would provide for MRWPCA to join the Agreement and Framework on terms which would include possible acquisition of a buffer zone for the Regional Treatment Plant, and agreement to the other terms of the Agreement and Framework.

-o0o-

TABLE OF CONTENTS

Page

TABLE OF CONTENTS
(Continued)

Page

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Page

EXHIBITS

ANNEXATION AGREEMENT AND GROUNDWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

SUBJECT: **Management and Protection of Salinas River Groundwater Basin; Annexation of Marina Area Lands To Zones 2 and 2A of the Monterey County Water Resources Agency**

1. PURPOSE AND AUTHORITY.

1.1. Purpose. The purpose of this Agreement and Framework is to help reduce seawater intrusion and protect the groundwater resource and preserve the environment of the Salinas River Groundwater Basin through voluntary commitments by the Parties to limit, conserve and manage the use of groundwater from the Salinas River groundwater basin, and to provide the terms and conditions for the annexation of certain territory in the Marina area to the Monterey County Water Resources Agency's benefit assessment Zones 2 and 2A as a financing mechanism providing additional revenues to the Monterey County Water Resources Agency to manage and protect the groundwater resource in the Salinas River Groundwater Basin and to reduce seawater intrusion.

1.2. Authority. This Agreement and Framework is entered into under the authority of the Agency Act, the California Water Code, and the California Government Code.

2. DEFINITIONS AND DESIGNATIONS. The following definitions and designations apply to this Agreement and Framework:

2.1. Parties.

2.1.1. Marina Coast Water District ("MCWD"). A political subdivision of the State of California, located in Monterey County, governed by MCWD's Board of Directors.

2.1.2. Monterey County Water Resources Agency ("MCWRA"). A water and flood control agency created by the State of California, with jurisdiction coextensive with Monterey County, governed by the Monterey County Water Resources Agency Board of Supervisors.

2.1.3. J. G. Armstrong Family Members ("Armstrong"). The owners of the Armstrong Ranch in the Marina area of Monterey County.

2.1.4. RMC Lonestar ("Lonestar"). A California general partnership and owner of the Lonestar property in the Marina area of Monterey County.

2.1.5. City of Marina ("City"). An incorporated municipality within Monterey County, organized and operating under the laws of the State of California, governed by its City Council.

2.2. AFY. Acre-feet per year.

2.3. Agency Act. MCWRA's enabling legislation adopted by Chapter 1159 of the Statutes of 1990, and Chapter 1130 of the Statutes of 1991, set forth in full in West's California Water Code Appendix, Chapter 52.

2.4. Armstrong Ranch. About 1850 acres of land in the Marina area, as shown on Exhibit "C," about 322 acres of which is within the City of Marina, plus an additional 150 acres not shown on Exhibit "C" which is already in the Zones.

2.5. Basin. The Salinas River Groundwater Basin.

2.6. BMP. The MCWRA's Basin Management Plan for the Salinas River Groundwater Basin.

2.7. CEQA. The California Environmental Quality Act, Public Resources Code sections 21000 and following.

2.8. CSIP. The Castroville Seawater Intrusion Project, a distribution system project already approved and being implemented by MCWRA to provide reclaimed water for irrigation in the Castroville Area of Monterey County.

2.9. Effective Date. Subject to paragraph 4, this Agreement and Framework shall be fully effective when executed by all the Parties.

2.10. Exhibits.

"A" The general geographic relationship of MCWD, Armstrong and Lonestar to the Basin and to the Zones is shown on the diagram attached to this Agreement and Framework as Exhibit "A."

"B" MCWD service area to be annexed

"C" Armstrong Ranch land to be annexed

"D" Lonestar property to be annexed

"E" Calculation of Incremental Cost for Tertiary Treated Water

"F" Armstrong Areas Reserved For Transfer to MCWD

"G" MRWPCA Addendum

2.11. FEIR. The Final Environmental Impact Report for the Salinas Valley Seawater Intrusion Program (February 1992).

2.12. Fort Ord. The land within the boundaries of the former Fort Ord Military Reservation.

2.13. Lonestar Property. A parcel containing about 400 acres of land in the Marina area, as shown on Exhibit "D."

2.14. Marina Area. Lands served by, adjacent to, or within the sphere of influence of MCWD.

2.15. MCWD Water Plans. The Urban Water Master Plan and the Urban Water Shortage Contingency Plan adopted by MCWD.

2.16. MCWRA/MRWPCA Agreement. Monterey County Agreement No. A-6078, "Agreement Between The Monterey County Water Resources Agency And The Monterey Regional Water Pollution Control Agency For Construction And Operation Of A Tertiary Treatment System," dated for reference purposes June 16, 1992, as amended on or before December 1, 1995.

2.17. Mitigation Plan. A plan for a potable water supply capable of mitigating the effects of seawater intrusion and providing a long-term potable water supply to MCWD's distribution system.

2.18. Mitigation Plan Implementation. The Mitigation Plan shall be considered "implemented" upon the delivery of potable water to MCWD's distribution system from a completed, long-term, potable water supply system, after system testing has been successfully completed.

2.19. Agreement and Framework. This Annexation Agreement and Groundwater Framework for Marina Area Lands.

2.20. Monterey Regional Water Pollution Control Agency ("MRWPCA"). A joint powers authority providing sewage treatment service to its member entities in Northern Monterey County, governed by its Board of Directors.

2.21. MRWPCA Annexation Agreement. "Annexation Agreement Between The Marina County Water District And The Monterey Regional Water Pollution Control Agency," dated April 25, 1989, as amended on or before December 1, 1995.

2.22. 1990 Agreement. Monterey County Agreement No. A-5471, "Preliminary Agreement Between United States of America, Marina Coast Water District, and Monterey County Flood Control and Water Conservation District," dated July 12, 1990.

2.23. SVRP. The Salinas Valley Reclamation Project, a project already approved and being implemented by MCWRA, in cooperation with MRWPCA, to reclaim water at the MRWPCA's regional treatment plant, for irrigation through the CSIP.

2.24. Zones. Zones 2 and 2A of the MCWRA, which are the zones of benefit and assessment for the MCWRA's Nacimiento and San Antonio reservoirs.

3. FACTS AND CIRCUMSTANCES. This Agreement and Framework is entered into with regard to the following facts and circumstances:

3.1. The MCWRA has approved fourteen other annexations to Zones 2 and 2A since 1991. Like other areas which have been annexed, the Marina area is within the Salinas River Groundwater Basin, has been using groundwater for many years, and has strong claims to groundwater rights. Since the Fort Ord annexation in 1993, the Marina area is surrounded on three sides by Zones 2 and 2A, and by Monterey Bay to the west.

3.2. MCWRA agreed in the 1990 Agreement to "encourage and support" annexing MCWD to Zones 2 and 2A. MCWD has worked for about thirteen years with the MCWRA on plans for a reliable, long-term water supply for the northern Basin area, including the Marina area and Fort Ord. MCWD's participation has included payment of money to assist the planning effort. As part of the 1990 Agreement, MCWD paid for survey and planning work for the long-term water supply effort. Sums paid by MCWD to MCWRA total over $400,000. The work for which MCWD paid will be useful for the Mitigation Plan.

3.3. MCWD, City, Armstrong and Lonestar claim the right to use groundwater from the Basin, to the full extent provided by law. MCWD takes water from wells owned and operated by MCWD and drilled into the "180-foot", "400-foot" and "900-foot" aquifers in the Basin. About ninety-eight percent of potable water used currently by MCWD comes from the 900-foot aquifer. MCWD's current maximum pumping capacity is 5,800 gpm (9,350 afy) of potable water and 1,100 gpm (1,770 afy) of other usable water. Allowing for routine maintenance and providing a contingency factor for emergency shutdown, MCWD's current estimated operational pumping capacity for potable water is 3900 gpm (6,000 afy).

3.4. MCWD agreed in writing in 1988 to cooperate with the City in providing water service to the Lonestar property and the Armstrong Ranch. A coordinated and centralized water supply for the Marina Area in furtherance of that 1988 agreement will facilitate management and protection of the groundwater resource in the Marina Area. Armstrong claims the right and ability to use not less than 920 afy of potable water from the Basin to provide potable water service to the Armstrong Ranch, and the right to use water for agricultural purposes. MCWD currently supplies some water to the Armstrong Ranch. The Armstrong Ranch will need reclaimed water for golf course purposes, park purposes and such other general uses as may be required by any agency having jurisdiction as a condition of development. The Lonestar property currently uses about 500 afy of groundwater from the Basin.

3.5. The MCWD Water Plans are based on a total need within MCWD's current boundaries of 3,020 afy of water for potable uses and about 280 afy additional water suitable for irrigation, and on additional projected need by the rest of the Marina area as specified in the MCWD Water Plans.

3.6. MCWRA has previously annexed Fort Ord into Zones 2 and 2A. The September 1993 Agreement for that annexation provides that until implementation of a project to provide a substitute supply, a maximum of 6,600 afy may be withdrawn from the Basin for use on Fort Ord lands, provided no more than 5,200 afy are withdrawn from the 180-foot aquifer and 400-foot aquifer. The USA received a credit against annexation fees for about $400,000 paid under the 1990 Agreement.

3.7. Pursuant to paragraph 12 of the MRWPCA Annexation Agreement, MCWD has the right to obtain from the MRWPCA, at the regional treatment plant, treated wastewater for reuse by the MCWD in quantities equal to the volume of MCWD wastewater treated by MRWPCA and such additional quantities as from time to time are not committed to any other users for beneficial use. MCWD's cost for such treated wastewater will be the MRWPCA's incremental cost over secondary treatment, to meet applicable local, state and federal requirements for water reuse.

3.8. The MCWRA/MRWPCA Agreement provides that the SVRP shall be designed and built for tertiary treatment of wastewater to be used for irrigation through the CSIP. That Agreement also mentions possible future interties with other agencies. The MCWRA/MRWPCA Agreement commits flows of wastewater to the CSIP as provided in Article IV and Exhibit C of that Agreement, excepting flows taken by MCWD pursuant to the MRWPCA Annexation Agreement.

4. REQUEST FOR ANNEXATION.

4.1. Request by MCWD, Armstrong, and Lonestar. Execution of this Agreement and Framework shall be deemed to be a formal and joint request by the signatories that the MCWRA's Board of Supervisors exercise their authority under section 7 of the Agency Act (West's California Water Code App. § 52-7) to annex to the Zones the lands described in Exhibits "B", "C" and "D" to this Agreement and Framework, on the terms and conditions of this Agreement and Framework as executed by the requesting signatories. No other terms or conditions shall apply to any annexation under this Agreement and Framework without the written agreement of all the Parties affected by the change.

4.2. Request by MCWD. MCWD is requesting immediate annexation of all the lands described in Exhibit "B." The lands to be annexed include the land which contains Olson School and the Methodist Church.

4.3. Request by Armstrong. Armstrong is requesting annexation of its land described in Exhibit "C", which annexation would take effect as provided in paragraph 6.2 of this Agreement and Framework.

4.4. Request by Lonestar. Lonestar is requesting immediate annexation of its land described in Exhibit "D", which annexation would take effect as provided in paragraph 7.3. of this Agreement and Framework.

4.5. Effect of Request. Other than to serve as a formal annexation request pursuant to section 7 of the Agency Act, this Agreement and Framework shall have no effect until its execution by the MCWRA.

5. TERMS AND CONDITIONS--MCWD.

5.1. Quantity limitations on MCWD's groundwater pumping.

5.1.1. Commencing on the effective date of this Agreement and Framework and continuing until Mitigation Plan Implementation, MCWD will limit its withdrawal of potable groundwater from the Basin for land in the Marina area and outside the former Fort Ord Military Reservation to 3,020 afy of potable groundwater, and only such additional quantities as are permitted by this paragraph 5.1. MCWRA's groundwater resource planning for the existing MCWD service area will be based on the latest information and projections contained in the MCWD Water Plans, using 3,020 afy as a planning guideline for potable water use.

5.1.1.1. After compliance with all applicable requirements of law, including but not limited to CEQA, MCWD may improve the interconnection between the MCWD water system and the water system serving Fort Ord, to provide for joint, conjunctive and concurrent use of all system facilities to serve Fort Ord and other areas served by MCWD, and the other Parties will cooperate on MCWD's increased withdrawal of potable groundwater by up to 1,400 afy from the 900-foot aquifer to enable the increased withdrawals from 5200 afy to 6600 afy for use on Fort Ord, as provided in paragraph 4.c. of the September 1993 Agreement between The United States of America and the MCWRA.

5.1.1.2. If the Armstrong property has been annexed to the Zones, the other Parties will cooperate on MCWD's increased withdrawal of up to 920 afy from the Basin, on the condition that such withdrawals shall be used only to provide water to the Armstrong Ranch and, to the extent that such water is requested and accepted by Armstrong, such use shall in its entirety be applied to the satisfaction of Armstrong's entitlement under paragraph 6.9. of this Agreement and Framework.

5.1.1.3. If the Lonestar property has been annexed to the Zones, the other Parties will cooperate on MCWD's increased withdrawal of up to 500 afy from the Basin, on the condition that such withdrawals shall be used only to provide water to the Lonestar property, and, to the extent that such water is requested and accepted by Lonestar, such use shall in its entirety be applied to the satisfaction of Lonestar's entitlement under paragraph 7.2. of this Agreement and Framework.

5.1.2. Conditioned upon MCWRA's compliance with paragraphs 5.1, 5.2, 5.3., 5.5, 5.7, 8.1, 8.2 and 8.3, after Mitigation Plan Implementation, MCWD will be governed by such limitations on the withdrawal of water from the Basin as shall be included in the terms of the Mitigation Plan.

5.2. <u>No objection by MCWRA to MCWD withdrawals except pursuant to section 22 of Agency Act</u>. The MCWRA shall not object to any withdrawal by MCWD which is mentioned in section 5.1 above, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by MCWD may be used only within the Basin.

5.3. <u>Management of 900-foot aquifer</u>. The Parties agree that the "900-foot" aquifer should be managed to provide safe, sustained use of the water resource, and to preserve to MCWD the continued availability of water from the "900-foot" aquifer. The Parties will work to include in a Mitigation Plan the concept that water from the Mitigation Plan which costs less than the cost of desalinated water should be the primary source of potable water for the lands described in Exhibits "B", "C", and "D", and wells in the "900-foot" aquifer should be a secondary source, if seawater intrusion is shown to be affecting the "900-foot" aquifer by credible scientific evidence. The Parties will also work together on measures to protect the "900-foot" aquifer.

5.4. <u>Compliance with CEQA and other applicable laws</u>. MCWD's participation in the Mitigation Plan or any other alternative water supply plan is subject to compliance with all applicable laws, including but not limited to CEQA, and to review and approval by the MCWD.

5.5. <u>MCWD development of alternative water supplies</u>. MCWRA agrees that it is appropriate for MCWD to plan for and develop any new water supplies, including but not limited to wastewater reclamation and desalination, that help to meet MCWD's needs, except that the MCWRA believes that the unilateral development of water by MCWD would not be appropriate from any of the following sources: the 180-foot and 400-foot confined aquifers in the Pressure Area of the Salinas Valley Groundwater Basin, the unconfined aquifer in the three other areas in the Salinas Valley Groundwater Basin (East side, Forebay, and Upper Valley), and the Salinas River and its tributaries.

5.6. <u>MCWD payment to MCWRA for tertiary treated water</u>. In satisfaction of paragraph 12 of the MRWPCA Annexation Agreement, MCWD will pay to MCWRA the incremental cost over secondary treatment to receive tertiary treated water from MRWPCA's planned tertiary treatment facilities at its regional treatment plant. The Parties agree that this cost shall be calculated as set forth on Exhibit "E" to this Agreement and Framework.

5.7. MCWD right to receive tertiary treated water from MRWPCA plant.

5.7.1. Pursuant to the MRWPCA Annexation Agreement, on or after the date of first delivery of water from the CSIP and upon compliance with all then-applicable requirements of law, including but not limited to CEQA, MCWD shall have the right to receive tertiary treated water from the tertiary treatment plant constructed and maintained pursuant to the SVRP, as provided herein.

5.7.2. The CSIP requires maximum available reclaimed water flows from the SVRP during the months of April through September to replace historically high uses of groundwater during those months, and to thereby maximize environmental benefits. Accordingly, during the months of April through September, MCWD agrees to defer taking any water over 300 afy it is entitled to take from the tertiary treatment plant under the MRWPCA Annexation Agreement. MCWD will also defer taking the first 300 afy of such flows to which it is entitled, if and after MCWD constructs a reservoir to store replacement winter flows.

5.7.3. During the months of October through March, MCWD may take the full amount of the reclaimed water to which it would, under the MRWPCA Annexation Agreement, have first priority during those months, together with an amount of water equal to the amount deferred during the immediately preceding months of April through September under paragraph 5.7.2. above. MCWD will take the deferred amount in equal or approximately equal monthly portions spread throughout the October-March period, or as otherwise agreed in writing by the MCWD and the MCWRA.

5.7.4. If MCWD's ability to supply reclaimed water is interrupted for any reason, MCWD and MCWRA will act jointly and diligently, together and with MRWPCA, to mitigate possible damage to users of such flows, including possible interim use of MCWD's wells to provide a substitute source of water.

5.8. Effective date of annexation. The annexation to Zones 2 and 2A of the MCWD lands described in Exhibit "B" shall take effect immediately upon approval of the annexation by the MCWRA Board of Supervisors on the terms of this Agreement and Framework, or, if the annexation is approved by ordinance, then thirty (30) days after adoption of an ordinance approving the terms of this Agreement and Framework.

5.9. Annexation fee.

5.9.1. Amount of MCWD annexation fee. To annex all the land described in Exhibit "B" to the Zones, MCWD shall pay to MCWRA an annexation fee in the amount of Two Million Eight Hundred Forty-Nine Thousand Four Hundred and Ten Dollars ($2,849,410.00) (based on 1750 acres in the MCWD service area and water extraction use of 3020 afy). MCWD shall pay this amount, subject to any adjustments hereinafter described, in semi-annual installments as provided in paragraph 5.9.3. below. By giving written notice to MCWRA on or before May 1, 1997, MCWD may elect to pay the annexation fee in full, without interest, in one lump sum on or before July 1, 1997.

5.9.2. Credit. MCWD shall have a credit of $400,000 against the annexation fee, based on the 1990 Agreement and the similar credit previously given to the U.S.A. on the annexation of Fort Ord to the Zones.

5.9.3. Payment of annexation fee. MCWD shall pay its annexation fee as follows:

5.9.3.1. From the total amount of the annexation fee, subtract the credit of $400,000, to determine the "net annexation fee." MCWD may elect to pay the net annexation fee in one lump sum, as provided in paragraph 5.9.1, or may pay in installments as provided below. If MCWD elects to pay in one lump sum, any late payment shall bear interest at the annual rate of 6% from the due date and shall be subject to the same penalties and collections procedures as are set forth in paragraph 6.7. of this Agreement and Framework.

5.9.3.2. MCWD may pay in twenty semi-annual installments, beginning in the fiscal year commencing on July 1, 1997, with interest at the annual rate of six percent (6%) on the unpaid principal balance accruing from July 1, 1997, and with semi-annual payments due on November 1 and February 1 and delinquent on December 10 and April 10 each fiscal year. The interest included in payments consisting of both principal and interest shall be calculated as though the installment were paid on the last day before delinquency, even if the installment is paid in advance of that date. The total amount of each installment paid on the net annexation fee shall be sufficient to amortize the full amount of principal and interest in twenty (20) equal semi-annual installments. There shall be no pre-payment penalty.

5.10. MCWD use of revenues prior to full payment of annexation fee. Until MCWD pays or receives credit for the entire annexation fee and all accrued interest on the fee, all revenue received by MCWD from the lands annexed to the Zones pursuant to this Agreement and Framework for or in connection with providing water and sewer service to the lands shall be used only for activities and functions duly performed by MCWD in connection with providing water and sewer service, including, but not limited to, the payments required under this Agreement and Framework.

6. TERMS AND CONDITIONS--ARMSTRONG.

6.1. Ranch Areas. Annexation of the Armstrong Ranch to the Zones contemplates two general areas of the Ranch, which are designated for convenience "Area A" and "Area B." Area A consists of about 900 acres which is expected to be developed for urban uses. Area B consists of about 950 acres, a portion of which is expected to be used for irrigated agriculture, and about 220 acres of which is expected to be given to MCWD to store treated water. For purposes of determining assessments, standby charges and the like, the initial classification of the land within Area B will be determined at the time of annexation.

6.2. Effective Date of Annexation. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Armstrong Ranch to the Zones at the time and on conditions approved by LAFCO and satisfactory to Armstrong for concurrent annexation of the Armstrong Ranch to MCWD and the City of Marina, including recordation of a final subdivision map upon conditions satisfactory to Armstrong.

6.3. Participation by Armstrong in MCWD water sources. Subject to compliance with all then-applicable requirements of law, including but not limited to CEQA, Armstrong Ranch shall be entitled at all times to participate on an equitable basis with MCWD in potable water sources developed by MCWD pursuant to paragraph 5.5. of this Agreement and Framework, in which event the limitations concerning the use of water on the Armstrong Ranch, as set forth in paragraph 6.9. shall not be applicable to using potable water developed pursuant to paragraph 5.5.

6.4. Prerequisites to annexation to MCWD and the City of Marina. Any application to LAFCO for annexation of any Armstrong Ranch property to either MCWD or the City of Marina shall be concurrently submitted by the City and MCWD, and shall provide that such property to be annexed shall be within the boundaries of both MCWD and the City of Marina.

6.5. Annexation fee.

6.5.1. When the Armstrong Ranch has been annexed to the Zones, Armstrong will pay to MCWRA an annexation fee computed as the sum of

6.5.1.1. the product of multiplying the number of acres annexed by $277/acre for land intended for urban or irrigated use and $27.70/acre for land intended for grazing, dry land farming or other unirrigated use, and

6.5.1.2. the product of multiplying the number of afy of water from the Basin or the Mitigation Plan allocated to the annexed land by $783/af for potable water intended for urban use and $261/af for water intended for agricultural use. Such charge shall not be applicable to any water from a source other than the Salinas Valley Groundwater Basin or the Salinas River and its tributaries.

6.5.2. Fees for Armstrong are estimated to be about $969,660 for Area A, based on 900 acres @ $277/ac. and 920 afy @ $783/af, and an amount subject to final determination upon actual annexation for Area B. For example, based on 250 irrigated acres @ $277/ac., 700 unirrigated acres @ $27.70/ac., and 650 afy of water @ $261/af, the annexation fees for Area B would be about $258,000.

6.5.3. If annexation of the Armstrong Ranch occurs more than seven years after MCWRA approves this Agreement and Framework, Armstrong shall pay the then-current annexation fees, instead of the fees set forth in paragraph 6.5.1 above.

6.5.4. Armstrong may elect to pay the annexation fee in a lump sum as provided in paragraph 6.6 below, or may pay the annexation fee in installments as provided in paragraph 6.7 below. There shall be no prepayment penalty.

6.5.5. If the agricultural water use on Area B is changed to a potable or industrial use, then Armstrong shall pay to the MCWRA as an additional annexation fee, an additional water charge computed as two-thirds (2/3rds) of the product of the number of afy changed multiplied by the then-current annexation water charge. If Armstrong uses water on any part of the Armstrong Ranch which is initially annexed as land for unirrigated use, Armstrong shall pay an additional land fee of nine times the land fee specified for such land in 6.5.1.1 above. The additional water charge or land fee will be paid either in one lump sum, due and payable on the July 1 immediately following the change in water use, or in twenty (20) equal semi-annual installments over ten (10) years, with the payment period and interest accrual beginning on that July 1, in the same manner as prescribed for Armstrong's original annexation fee and subject to the same rules.

6.6. Payment of annexation fee in lump sum. If paid in a lump sum, the annexation fee shall be due and payable in full on July 1, next succeeding the first March 1 after the effective date of the annexation. Armstrong may elect to pay the annexation fee in full in one lump sum by giving written notice of such election to MCWRA not later than the May 1 immediately preceding the date payment is due. Any late payment shall bear interest at the annual rate of 6% from the due date, and shall be subject to the same penalties and collection procedures as are set forth in paragraph 6.7.

6.7. <u>Payment of annexation fee in installments</u>.

6.7.1. If paid in installments, the installments shall include interest on the unpaid principal balance at the annual rate determined in the manner hereinafter set forth, which interest shall begin to accrue on July 1, next succeeding the first March 1 after the effective date of the annexation. The interest rate on installments shall be six percent per annum. The interest included in each installment shall be calculated as though the installment were paid on the last day before delinquency, even if the installment is paid in advance of that date.

6.7.2. The amount of each semi-annual installment shall be sufficient to amortize the full amount of principal and interest in twenty (20) equal semi-annual installments.

6.7.3. The semi-annual installments shall be paid and collected at the same time and in the same manner and by the same persons as, and together with and not separately from, general agency and zone taxes and shall be delinquent at the same time and thereafter subject to the same delinquency penalties. The first installment shall be due on November 1 following July 1, next succeeding the first March 1 after the effective date of the annexation and shall be delinquent if not paid on or before the following December 10. The second installment shall be due on the following February 1 and shall be delinquent if not paid on or before the following April 10. Thereafter, installments shall fall due and become delinquent on the same dates each year.

6.7.4. The full amount of principal and interest shall be paid not later than April 10, in the tenth year following July 1, next succeeding the first March 1 after the effective date of the annexation.

6.7.5. The amount of each installment shall constitute a lien on each annexed parcel as of noon on the March 1 immediately preceding the fiscal year (July 1-June 30) in which payment of the installment will be due. If the property is subdivided, then a prorata share of the annexation fee shall become a lien on each individual parcel, based upon the ratio that the land area of the individual parcel bears to the total land area of all parcels against which the annexation fee is a lien. All laws applicable to the levy, collection and enforcement of general agency and zone taxes, including, but not limited to, those pertaining to delinquency, correction, cancellation, refund and redemption, shall be applicable to such installments.

6.7.6. MCWD shall pay to MCWRA any fees to annex the lands within the MCWD Reserved Area described in paragraph 6.10 and shown on Exhibit "F" to this Agreement and Framework.

6.8. <u>Costs, assessments, fees and charges</u>. Costs, assessments, fees and charges imposed by MCWD in connection with providing water and wastewater treatment capacity and service to the Armstrong Ranch must be equitable and reasonable and must be reasonably related to services and benefits received, consistent with the County Water District Law (Water Code sections 30,000 and following), with Government Code sections 50076 and 66013, and with applicable case law.

6.9. Quantity limitations on Armstrong water use.

6.9.1. Armstrong shall have the right to utilize on the Armstrong Ranch groundwater for irrigation, and 920 afy of additional water for potable uses withdrawn from the Basin, subject to the limitations set forth herein. Armstrong shall limit potable water withdrawn from the Basin and used for potable purposes on the Armstrong Ranch to no more than 20 afy when this Agreement and Framework becomes effective, 150 afy upon annexation to the Zones, and an additional 150 afy every two years thereafter, up to the total of 920 afy for potable purposes from the Basin.

6.9.2. MCWD shall provide Armstrong with water service for all residential, municipal and industrial uses on the Armstrong Ranch. In providing such service, the water allocation for Armstrong, set forth above in paragraph 6.9.1., shall be added to the MCWD water allocation, as provided in paragraph 5.1.

6.9.3. Groundwater underlying Area B shall be used solely for agricultural activities conducted on Area B, except that not more than 20 afy of such groundwater may be used for potable uses on the Armstrong Ranch, and additional groundwater underlying Area B also may be used by the MCWD on the part of Area B conveyed to MCWD and may also be used on the adjacent lands of the MRWPCA.

6.9.4. The limits on water use provided by this paragraph 6.9. shall not apply to use of reclaimed water or of potable water developed from a source other than the Salinas Valley Groundwater Basin or the Salinas River and its tributaries.

6.10. Reservation of lands for MCWD.

6.10.1. MCWD Reserved Area . Armstrong shall reserve, for use by MCWD, the area shown diagrammatically on Exhibit "F" to this Agreement and Framework as "MCWD Reserved Area", and the non-exclusive easements shown on Exhibits "C" and "F" in favor of MCWD, appurtenant to said MCWD Reserved Area and to MCWD's reclaimed water system and transferrable with either, for construction, roads, utilities (including communications), pipelines, and any other purpose for which a road may be used, subject to the non-exclusive easements shown on Exhibits "C" and "F" to be reserved in favor of Armstrong, which said reserved easements in favor of Armstrong shall be for wells (located within the southerly 60' of the 160' x 1000' strip as shown on Exhibit "F", which wells may be relocated within said strip from time to time, on well sites which may extend north of the southerly 60' of the strip) for agricultural irrigation, roads, utilities (including communications), pipelines, and any other purpose for which a road may be used, shall be freely assignable and usable by others, and not subject to being extinguished or limited because of overburden or surcharge, and which said reserved easements shall not interfere or be used so as to interfere with the use of the balance of said MCWD Reserved Area for the production, storage, or distribution of treated water (tertiary treatment or its equivalent), or potable water. Before either MCWD or Armstrong installs any facilities in the reserved easements, MCWD and Armstrong will meet and confer to assure that their respective uses of and facilities in the said reserved easements will not conflict. Both parties shall act reasonably in considering the needs of the other. MCWD shall not place any non-potable water impoundment within the 160′ x 1000′ strip, nor any non-potable water pipeline closer than 110′ north of the southerly boundary. MCWD shall not be required to move any facilities the installation of which has been approved by Armstrong. Water from wells located in said reserved strip shall be used only on lands of Armstrong and also may be used by the MCWD on the part of Area B conveyed to MCWD and may also be used on the adjacent lands of the MRWPCA.

6.10.1.1. The MCWD Reserved Area, which shall not exceed 250 acres within the boundaries shown on Exhibit "F", will be "office" surveyed at the expense of MCWD within sixty days, and "field" surveyed at the expense of MCWD within one year, following approval by the MCWRA Board of Supervisors of this Agreement and Framework.

6.10.1.2. MCWD will diligently undertake, and MCWRA, City and Armstrong will cooperate in the planning and conduct of, the appropriate environmental review and application for appropriate permits to use MCWD Reserved Area for facilities for the production, storage, or distribution of treated water (tertiary treatment or its equivalent), or potable water. Any use other than for the production, storage, or distribution of treated water (tertiary treatment or its equivalent), or potable water, shall require the prior written approval of Armstrong, and any conveyances from Armstrong to MCWD shall contain appropriate restrictions on such additional use in the form of a condition subsequent to the conveyances and a power of termination in favor of Armstrong. Any attempt to condemn the power of termination shall be subject to the provisions of paragraph 6.10.3. as if it were a condemnation of fee title.

6.10.1.3. MCWD may use and take conveyance of the MCWD Reserved Area in phases of not less than 40 acres. Armstrong's obligation to reserve the MCWD Reserved Area shall expire at midnight on June 30, 2003, or upon delivery to Armstrong of written notice from MCWD cancelling MCWD's right to receive conveyance of the MCWD Reserved Area. Armstrong's obligation to reserve the MCWD Reserved Area shall be extended to July 1, 2010, if MCWD has begun to use at least 40 acres of the MCWD Reserved Area by June 30, 2003.

6.10.2. Gift by Armstrong or payment by MCWD. Armstrong has offered to make a gift to MCWD, at the agreed value of $25,000 per acre, of 50 acres of the MCWD Reserved Area for the first 150 afy of water which Armstrong is entitled to withdraw from the Basin as provided in paragraph 6.9. of this Agreement and Framework, and 40 acres for each additional 150 afy which Armstrong may withdraw pursuant to paragraph 6.9, or less than 40 acres for the last 150 afy, if the last remaining portion of the MCWD Reserved Area is less than 40 acres, but in no event to exceed the total acreage of the area shown as the MCWD Reserved Area on Exhibit "F" to this Agreement and Framework. This offer may be accepted by MCWD following such final annexation at any time during the time Armstrong is reserving the MCWD Reserved Area. In any event, however, and notwithstanding the foregoing, upon receipt by Armstrong of written request from MCWD, Armstrong will forthwith convey all or part of the MCWD Reserved Area to MCWD by grant deed. Any such part must begin in the southwest corner of MCWD Reserved Area, must be parallel to the southerly and westerly boundaries of the MCWD Reserved Area, must be rectangular or trapezoidal in shape, must be at least 40 acres in size, and must be free of any financial encumbrances except taxes and assessments not delinquent, but subject to all other encumbrances, and further subject to all laws, ordinances, regulations and rights of all governmental bodies having jurisdiction in, on or over the subject real property as they may from time to time exist. Title shall also be subject to the lien of a first deed of trust for each conveyance, executed by MCWD in favor of Armstrong securing the obligation of MCWD in favor of Armstrong next hereinafter referred to. Beginning six months after conveyance of any part of the MCWD Reserved Area which is not conveyed as a gift to MCWD, MCWD shall commence paying to Armstrong a sum calculated by multiplying the number of acres in such conveyance by Twenty-Five Thousand Dollars ($25,000.00). The price of $25,000 per acre shall be adjusted as of July 1, 2003, if Armstrong's obligation to reserve the property is extended to 2010 pursuant to paragraph 6.10.1.3. of this Agreement and Framework. In such event, the price per acre shall be computed by multiplying $25,000 by the percentage increase or decrease in the Cost of Living Index for all urban consumers in the San Francisco-Oakland-San Jose Area (1982-1984=100), occurring between July 1, 1997 and July 1, 2003, or the closest dates to such dates for which figures are available. Payment shall be made in 20 equal semi-annual payments, commencing six months after such conveyance, sufficient to amortize the obligation fully, with the unpaid principal balance bearing interest from the date of conveyance to MCWD, at the prime rate of the Bank of America in San Francisco, California, as of July 1 each year during the term of this obligation, but not to exceed the maximum rate permitted by law to be charged by Armstrong in such transaction. Any such payments made or to be made by MCWD, together with interest from the date of MCWD's payment, through December 31, 2010, at the prime rate of interest of the Bank of America in San Francisco, California, shall be included in computing annexation fees, capacity charges and service charges charged by MCWD for the part of the Armstrong Ranch to which the payments made by MCWD to Armstrong relate.

6.10.3. Waiver of further acquisitions by MCWD, MCWRA, and City of Marina; liquidated damages. Except for incidental water system and wastewater system and storm water system easements, incidental access easements, incidental road easements, and incidental utility easements, as may be necessary from time to time, and further excepting land dedicated to public uses through the development process as a condition of development, MCWD, City, and MCWRA shall not seek to acquire fee title to land or easements thereon on any part of the Armstrong Ranch by eminent domain for use in providing water or wastewater service, or for any other public purpose whatsoever, except that, as to City only, said prohibition shall apply only with respect to eminent domain for water or sanitary sewer facilities and shall not be applicable to eminent domain for other public purposes; provided, however, that in the event that any of said agencies shall, notwithstanding the foregoing covenant, warranty and representation, seek to exercise the power of eminent domain for any other purpose except as excepted above, then, and in that event, all Parties hereto hereby agree that the fair market value of and the price to be paid for all such land lying within MCWD Reserved Area as shown on Exhibit "F" hereto (and any additional area shown on an exhibit to a fully executed addendum to this Agreement and Framework) shall be the sum of Twenty-Five Thousand Dollars ($25,000.00) cash per acre and the fair market value and purchase price for all land lying outside of said MCWD Reserved Area as shown on Exhibit "F" hereto (and any additional area shown on an exhibit to a fully executed addendum to this Agreement and Framework) shall be the sum of ONE HUNDRED THOUSAND Dollars ($100,000.00) cash per acre. FURTHERMORE, IN THE EVENT THAT MCWD, CITY, AND MCWRA, OR ANY OF THEM, SHOULD BREACH THIS COVENANT, WARRANTY AND REPRESENTATION, THEN, AND IN THAT EVENT, THE PARTIES AGREE THAT ARMSTRONG SHALL BE ENTITLED TO RECOVER FROM SUCH BREACHING PARTY, AS LIQUIDATED DAMAGES, AN AMOUNT EQUAL TO THE DIFFERENCE BETWEEN THE PRICE PER ACRE ACTUALLY PAID AND TWENTY-FIVE THOUSAND DOLLARS ($25,000.00) PER ACRE MULTIPLIED BY THE NUMBER OF ACRES SO TAKEN IN THE CASE OF LAND WITHIN SAID MCWD RESERVED AREA (AND ANY ADDITIONAL AREA SHOWN ON AN EXHIBIT TO A FULLY EXECUTED ADDENDUM TO THIS AGREEMENT AND FRAMEWORK), AND THE DIFFERENCE BETWEEN THE PRICE PER ACRE ACTUALLY PAID AND ONE HUNDRED THOUSAND DOLLARS ($100,000.00) PER ACRE MULTIPLIED BY THE NUMBER OF ACRES TAKEN IN THE CASE OF LAND LYING OUTSIDE OF MCWD RESERVED AREA (AND ANY ADDITIONAL AREA SHOWN ON AN EXHIBIT TO A FULLY EXECUTED ADDENDUM TO THIS AGREEMENT AND FRAMEWORK), AS LIQUIDATED DAMAGES, WHICH THE PARTIES AGREE IS A REASONABLE SUM CONSIDERING ALL THE CIRCUMSTANCES EXISTING ON THE DATE OF THIS AGREEMENT AND FRAMEWORK, INCLUDING THE RELATIONSHIP OF THE SUM TO THE RANGE OF HARM TO ARMSTRONG THAT REASONABLY COULD BE ANTICIPATED AND THE ANTICIPATION THAT PROOF OF ACTUAL DAMAGES WOULD BE COSTLY OR INCONVENIENT. IN PLACING THEIR SIGNATURES BELOW, EACH PARTY SPECIFICALLY CONFIRMS THE ACCURACY OF THE STATEMENTS MADE ABOVE AND THE FACT THAT EACH PARTY WAS REPRESENTED BY COUNSEL WHO EXPLAINED THE CONSEQUENCES OF THIS LIQUIDATED DAMAGES PROVISION AT THE TIME THIS AGREEMENT AND FRAMEWORK WAS MADE.

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

____

____

____

____

____

____

____

____

____

____

____

____

____

____

____

MCWD Thomas P. Moore April 12, 1[illegible]

CITY

____

MCWRA

____

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ MCWD

______________________________ ______________________________

______________________________ CITY

______________________________ ______________________________

______________________________ MCWRA

______________________________ ______________________________

____

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

ARMSTRONG

MCWD

CITY

MCWRA

6.11. Annexation of portions of Armstrong Ranch used by MCWD. Notwithstanding any other provision of this section 6, portions of the Armstrong Ranch owned and/or used by MCWD may be annexed to the Zones at any time, upon MCWD's written request for such annexation, and after compliance with all then-applicable laws. Any annexation fees or charges by MCWRA for such annexed lands shall be paid by MCWD.

7. TERMS AND CONDITIONS--LONESTAR.

7.1. Compliance with Agency Act Section 22. The MCWRA acknowledges that it may not object to any withdrawal by Lonestar permitted by this section 7, except in compliance with section 22 of the Agency Act. All groundwater withdrawn from the Basin by Lonestar may be used only within the Basin.

7.2. Quantity Limitations. Commencing on the effective date of this Agreement and Framework, Lonestar shall limit withdrawal and use of groundwater from the Basin to Lonestar's historical use of 500 afy of groundwater.

7.3. Annexation of Lonestar Property to the Zones. Approval of this Agreement and Framework by the MCWRA Board of Supervisors shall constitute approval for annexation of the Lonestar Property in accordance with the terms of this Agreement and Framework. The actual annexation will occur as follows: The Lonestar Property annexation to the Zones will not take effect until the Lonestar Property has been approved for prior or concurrent annexation into MCWD. When such approval has been

obtained, Lonestar shall notify MCWRA, and the MCWRA Board of Supervisors shall declare by resolution the effective date of the annexation.

7.4. Annexation fee.

7.4.1. Amount of original annexation fee. When the Lonestar Property has been annexed to the Zones, Lonestar will pay to MCWRA an annexation fee computed as follows:

104 acres x $277 (land fee)	=	$ 28,808
264 acres x $27.70 (open space)	=	7,313
500 afy x $783/3 (water charge)	=	130,500
Total principal (original fee)	=	166,621
Total interest @ 6%	=	57,370
Total payment	=	223,991
Semi-annual payments	=	11,200

7.4.2. Choice of lump sum or installment. Lonestar may elect to pay the annexation fee in one lump sum or may pay in semi-annual installments.

7.4.3. Lump sum payment. If paid in a lump sum, the original annexation fee shall be due and payable in full on July 1, next succeeding the first March 1 after the effective date of the annexation. Lonestar may elect to pay the annexation fee in full in one lump sum by giving written notice of such election to MCWRA not later than the May 1 immediately preceding the date payment in a lump sum would be due. Any late payment shall bear interest at the annual rate of 6% from the due date, and shall be subject to the same penalties and collection procedures as are set forth in paragraph 7.4.4.

7.4.4. Installment payments.

7.4.4.1. If the original annexation fee or any addition thereto is paid in installments, the installments shall include interest on the unpaid principal balance at the annual rate determined pursuant to this Agreement and Framework. The interest rate on installments on the original annexation fee shall be six (6) percent per annum and shall begin to accrue on July 1, next succeeding the first March 1 after the effective date of the annexation. The interest rate for the additional water charge shall be equivalent to that which the County would pay for funds borrowed at the time the additional water charge is determined and shall begin to accrue at the beginning of the applicable payment period. The interest included in each installment shall be calculated as though the installment were paid on the last day before delinquency, even if the installment is paid in advance of that date.

7.4.4.2. The amount of each semi-annual installment shall be sufficient to amortize the full amount of principal and interest in twenty (20) equal semi-annual installments.

7.4.4.3. The semi-annual installments shall be paid and collected at the same time and in the same manner and by the same persons as, and together with and not separately from, general agency and zone taxes and shall be delinquent at the same time and thereafter subject to the same delinquency penalties. The first installment shall be due on November 1 following July 1, next succeeding the first March 1 after the effective date of the annexation and shall be delinquent if not paid on or before the following December 10. The second installment shall be due on the following February 1 and shall be delinquent if not paid on or before the following April 10. Thereafter, installments shall fall due and become delinquent on the same dates each year.

7.4.4.4. The full amount of principal and interest shall be paid not later than April 10, in the tenth year following July 1, next succeeding the first March 1 after the effective date of the annexation.

7.4.4.5. The amount of each installment shall constitute a lien on the annexed property as of noon on the March 1 immediately preceding the fiscal year (July 1-June 30) in which payment of the installment will be due. If the property is subdivided, then a prorata share of the annexation fee shall become a lien on each individual parcel, based upon the ratio that the land area of the individual parcel bears to the total land area of all parcels against which the annexation fee is a lien. All laws applicable to the levy, collection and enforcement of general agency and zone taxes, including, but not limited to, those pertaining to delinquency, correction, cancellation, refund and redemption, shall be applicable to such installments.

7.4.5. <u>Additional annexation fee for change in water use</u>. If the water use on the Lonestar Property is changed from an industrial or agricultural use to a potable or other use, or if MCWD delivers potable water to the Lonestar Property pursuant to paragraph 5.1.1.3., then Lonestar shall pay to the MCWRA as an additional annexation fee, an additional water charge computed as two-thirds (2/3rds) of the product of 500 afy multiplied by the then-current annexation water charge. If Lonestar uses water on the 264-acre open-space area, Lonestar shall pay an additional land fee of nine times the land fee specified for the area in 7.4.1. above. The additional water charge or land fee will be paid either in one lump sum, due and payable on July 1, immediately following the change in water use, or in twenty (20) equal semi-annual installments over ten (10) years, with the payment period and interest accrual beginning on that July 1, in the same manner as prescribed for Lonestar's original annexation fee and subject to the same rules.

7.4.6. Additional annexation fee for Mitigation Plan water supply allocation. If a substitute supply of potable Mitigation Plan water is approved for the Lonestar Property pursuant to Section 22 of the MCWRA Act, then, when the contract for construction of the Mitigation Plan has been approved by the MCWRA Board of Supervisors, and when Lonestar begins using water for potable uses, Lonestar will pay as an addition to its annexation fee an additional water charge computed as two-thirds (2/3rds) of the product of the amount so allocated multiplied by the then-current annexation water charge. The additional water charge will be paid either in one lump sum, due and payable on July 1, immediately following approval of both the Mitigation Plan water supply for Lonestar and the construction contract for the Mitigation Plan, or in twenty (20) equal semi-annual installments over ten (10) years, with the payment period and the interest accrual beginning on that July 1, in the same manner as prescribed for Lonestar's original annexation fee and subject to the same rules.

7.4.7. Non-duplication of additional annexation fees. The additional annexation fees set forth in paragraphs 7.4.5 and 7.4.6 above are not intended to be cumulative. If Lonestar becomes liable to pay both of the additional annexation fees, then Lonestar shall be obligated to pay only the higher of the two fees, and any amounts previously paid towards the lower additional fees shall be credited towards payment of the higher.

8. TERMS AND CONDITIONS--GENERAL.

8.1. Equal treatment by MCWRA and MCWD. If future litigation, regulation or other unforeseen action diminishes the total water supply available to MCWRA, MCWRA agrees that it will exercise its powers so that MCWD, Armstrong and Lonestar shall be no more severely affected in a proportional sense than other lawful users of water from the Zones, based on the right before the imposition of any uniform and generally applicable restrictions as described in paragraph 8.2 to use at least the quantities of water from the Basin described in paragraphs 5.1., 6.9., and 7.2. MCWRA shall not at any time seek to impose greater restrictions on water use from the Basin by MCWD, Armstrong or Lonestar than are imposed on users either supplying water for use or using water within the city limits of the City of Salinas. MCWD, Armstrong and Lonestar will comply with any basin-wide or area-wide water allocation plans established by the MCWRA which include MCWD, Armstrong and Lonestar, and which do not impose on use of water on the lands described in Exhibits "B", "C", and "D" restrictions greater than are imposed on users either supplying water for use or using water within the City of Salinas, and which satisfy the requirements of paragraph 5.2 of this Agreement and Framework.

8.2. Water Conservation Measures. MCWD, Armstrong and Lonestar shall use, and MCWD may require the use of reasonable and appropriate water conservation measures on the lands described in Exhibits "B", "C" and "D" to this Agreement and Framework, which water conservation measures shall be uniformly applied and may be more restrictive but shall not be less restrictive than measures implemented by MCWRA as part of a Basin-wide or area-wide water conservation program. All planning and environmental review for the lands described in Exhibits "B", "C", and "D" to this Agreement and Framework shall be based on the requirement that development on such lands shall use reasonable and appropriate water conservation measures comparable to measures implemented by MCWRA as part of a Basin-wide or area-wide water conservation program, and by MCWD as part of a water conservation program applicable uniformly within MCWD's service area.

8.3. Defense of Rights. Upon Mitigation Plan Implementation, MCWRA will defend the rights of MCWD, Armstrong and Lonestar to a supply of water from the Mitigation Plan, as though those rights were the rights of MCWRA. Participation by MCWD, Armstrong and Lonestar in the Mitigation Plan or any other alternative water supply plan is subject to compliance with all applicable laws, including but not limited to CEQA.

8.4. Use of Annexation Fees. Annexation fees from the MCWD service area, the Armstrong Ranch and the Lonestar Property shall be used by MCWRA to pay the costs of a BMP process that includes mitigation plans for the Marina Area based on the planning guidelines contained in this Agreement and Framework. Such annexation fees shall also be used for management and protection of the "900-foot aquifer."

8.5. Assessments. After approval by the Board of Supervisors of annexation to the Zones of any property described in the exhibits to this Agreement and Framework, each parcel annexed shall be subject to all uniform assessments, charges, fees, and other exactions levied in Zones 2 and 2A for the fiscal year beginning on July 1, next succeeding the first March 1 after the effective date of the annexation, and shall remain subject thereto for as long as such exactions are levied and the parcel remains within the levying zone.

8.6. Recordation. Upon approval of this Agreement and Framework by the Board of Supervisors and execution by all Parties, this Agreement and Framework shall be recorded in the office of the Monterey County Recorder. All signatures shall be notarized as necessary to record the Agreement and Framework.

9. DISPUTE RESOLUTION PROCEDURE.

9.1. If any dispute arises between the Parties as to the proper interpretation or application of this Agreement and Framework, the Parties shall first seek to resolve the dispute in accordance with this Agreement and Framework, and the Parties must meet and confer under this Agreement and Framework before filing any court action.

9.2. If any dispute under this Agreement and Framework arises, the Parties shall first meet and confer, in an attempt to resolve the matter between themselves. Each party shall make all reasonable efforts to provide to the other Parties all the information that the party has in its possession that is relevant to the dispute, so that all Parties will have ample information with which to reach a decision.

9.3. If, notwithstanding the good faith efforts of a party requesting in writing the resolution of a dispute under this Agreement and Framework, a dispute remains unresolved sixty-one (61) days after delivery of the request to the other party, the party requesting resolution may file suit for legal and equitable relief, including specific performance, as appropriate.

10. CHALLENGE OF LAWS. Nothing herein contained shall be construed as stopping or otherwise preventing any party to this Agreement and Framework from contesting by litigation or other lawful means the validity, constitutionality, construction, or application of any law of this State, any ordinance of the public entities that are Parties hereto, or any rule, regulation or practice of the public entities that are Parties hereto.

11. WAIVER OF RIGHTS. Any waiver at any time by any party hereto of its rights with respect to a default or any other matter arising in connection with this Agreement and Framework shall not be deemed to be a waiver with respect to any other default or matter. None of the covenants or agreements herein contained can be waived except by the written consent of the waiving party.

12. NOTICES. All notices and demands required under this Agreement and Framework shall be deemed given by one party when delivered personally to the principal office of the other party; when faxed to the other party, to the fax number provided by the receiving party; or five days after the document is placed in the United States mail, first class, registered mail, or certified mail, postage prepaid, addressed to the other party as follows:

To MCWD:	11 Reservation Road Marina, CA 93933-2099 Phone No.: (408) 384-6131 Fax No.: (408) 384-2479
To MCWRA:	General Manager P. O. Box 930 Salinas, CA 93902-0930 Phone No.: (408) Fax No.: (408) 424-7935

To City: City Manager
211 Hillcrest Avenue
Marina, CA 93933
Phone No.: (408) 384-3715
Fax No.: (408) 384-0425

To Armstrong: John A. Armstrong
270 River Road
Salinas, CA 93908
Phone No.: (408) 455-1907
Fax No.: (408) 455-2817

To Lonestar: RMC LONESTAR
Attention: Mr. John Rubiales
P.O. Box 5252
Pleasanton, CA 94566
Phone No.: (510) 426-8787
Fax No.: (510) 426-2225

The address or fax number to which any notice or other writing may be given or made or sent to any party may be changed upon written notice given by such party as above provided.

13. SEVERABILITY. If any one or more of the covenants or agreements set forth in this Agreement and Framework on the part of MCWRA, MCWD, City, Armstrong or Lonestar, or any of them, to be performed should be contrary to any provision of law or contrary to the policy of law to such extent as to be unenforceable in any court of competent jurisdiction, then such covenant or covenants, agreement or agreements, shall be null and void and shall be deemed separable from the remaining covenants and agreements and shall in no way affect the validity of this Agreement and Framework; provided, that if voiding of such individual covenants or agreements without voiding the whole agreement would frustrate a material purpose of Lonestar in entering into this Agreement and Framework, then this whole Agreement and Framework shall be null and void ab initio as to Lonestar only.

14. PARAGRAPH HEADINGS. Paragraph headings in this Agreement and Framework are for convenience only and are not to be construed as a part of this Agreement and Framework or in any way limiting or amplifying the provisions hereof.

15. SUCCESSORS AND ASSIGNS. This Agreement and Framework and all the terms, covenants, agreements and conditions herein contained shall inure to the benefit of and be binding upon the successors and assigns of the Parties hereto.

16. ADMINISTRATORS. MCWD and MCWRA hereby designate their respective General Managers as their Administrators for this Agreement and Framework. City designates its City Manager as City's Agreement and Framework Administrator. Armstrong designates Mr. John A. Armstrong as its Agreement and Framework Administrator. Lonestar designates Mr. John Rubiales as its Agreement and

Framework Administrator. All matters concerning this Agreement and Framework shall be submitted to the Agreement and Framework Administrators or such other representatives as the Agreement and Framework Administrators may designate for their respective agencies. Any party may, in its sole discretion, change its designation of the Agreement and Framework administrator and shall promptly give written notice to the other Parties of any such change.

17. NEGOTIATED AGREEMENT AND FRAMEWORK. This Agreement and Framework has been arrived at through negotiation between the Parties. Neither party is to be deemed the party which prepared this Agreement and Framework within the meaning of Civil Code section 1654.

18. AMENDMENT. This Agreement and Framework may be amended only by a writing signed by the Parties affected by the amendment.

19. COUNTERPARTS. This Agreement and Framework may be executed in counterparts. Each fully executed counterpart shall be deemed a duplicate original, and all counterparts which together contain the signatures of all the Parties shall be deemed, when attached together, one complete and integrated original document.

20. ADDENDUM. A form of Addendum for the MRWPCA is attached hereto as Exhibit "G." When the Addendum is fully executed in its present form or in an amended form, it shall be attached to this Agreement and Framework as an integral part of this Agreement and Framework, and the provisions of the Addendum shall be deemed specifically and fully incorporated into this Agreement and Framework by this reference.

IN WITNESS WHEREOF, the Parties execute this Agreement and Framework as follows:

Dated: March 26, 1996

MONTEREY COUNTY WATER RESOURCES AGENCY

By Edith Johnsen

Edith Johnsen
Chair, Board of Supervisors

Dated: ______________, 1996

MARINA COAST WATER DISTRICT

By ______________________________

Thomas P. Moore
President, Board of Directors

By ______________________________

Malcolm D. Crawford
Secretary, Board of Directors

STATE OF CALIFORNIA) ss.
COUNTY OF MONTEREY)

On this 26th day of March, 1996, before me, Ernest K. Morishita, Clerk of the Board of Supervisors, in and for said County and State, personally appeared Edith Johnson, known to me to be the Chairperson of said Board of Supervisors of the County of Monterey, and known to me to be the person who executed the within instrument on behalf of said political subdivision, and acknowledged to me that such County of Monterey executed the same.

ERNEST K. MORISHITA, Clerk of the Board of Supervisors of Monterey County, State of California

By: Pamela Olivas
Deputy Clerk

Framework Administrator. All matters concerning this Agreement and Framework shall be submitted to the Agreement and Framework Administrators or such other representatives as the Agreement and Framework Administrators may designate for their respective agencies. Any party may, in its sole discretion, change its designation of the Agreement and Framework administrator and shall promptly give written notice to the other Parties of any such change.

17. NEGOTIATED AGREEMENT AND FRAMEWORK. This Agreement and Framework has been arrived at through negotiation between the Parties. Neither party is to be deemed the party which prepared this Agreement and Framework within the meaning of Civil Code section 1654.

18. AMENDMENT. This Agreement and Framework may be amended only by a writing signed by the Parties affected by the amendment.

19. COUNTERPARTS. This Agreement and Framework may be executed in counterparts. Each fully executed counterpart shall be deemed a duplicate original, and all counterparts which together contain the signatures of all the Parties shall be deemed, when attached together, one complete and integrated original document.

20. ADDENDUM. A form of Addendum for the MRWPCA is attached hereto as Exhibit "G." When the Addendum is fully executed in its present form or in an amended form, it shall be attached to this Agreement and Framework as an integral part of this Agreement and Framework, and the provisions of the Addendum shall be deemed specifically and fully incorporated into this Agreement and Framework by this reference.

IN WITNESS WHEREOF, the Parties execute this Agreement and Framework as follows:

Dated: ______________, 1996

MONTEREY COUNTY WATER RESOURCES AGENCY

By ______________________
Edith Johnsen
Chair, Board of Supervisors

Dated: April 12, 1996

MARINA COAST WATER DISTRICT

By Thomas P. Moore
Thomas P. Moore
President, Board of Directors

By Malcolm D. Crawford
Malcolm D. Crawford
Secretary, Board of Directors

Dated: April 8, 1996

JAY MAX ARMSTRONG

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________
DARRELL L. MURRAY, Trustee

Dated: ______________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

____
CLYDE W. JOHNSON III

Dated: ______________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

JAMES IRVINE ARMSTRONG, JR.

Dated: ______________, 1996

____
JAY MAX ARMSTRONG

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By Darrell L. Murray 4/4/96
DARRELL L. MURRAY, Trustee

Dated: ______________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

____
CLYDE W. JOHNSON III

Dated: ______________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

John A. Armstrong
JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

James Irvine Armstrong Jr.
JAMES IRVINE ARMSTRONG, JR.

Dated: ______________, 1996

____
JAY MAX ARMSTRONG

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________________
DARRELL L. MURRAY, Trustee

Dated: 4-4-, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By Clyde W Johnson III Trustee
CLYDE W. JOHNSON III, Trustee

Dated: 4-4, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By Clyde W Johnson III Trustee
CLYDE W. JOHNSON III, Trustee

Dated: 4-4, 1996

Clyde W Johnson III
CLYDE W. JOHNSON III

Dated: 4-4, 1996

Edwin A Johnson
EDWIN A. JOHNSON

Dated: Mar 29, 1996

John A Armstrong
JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

James Irvine Armstrong Jr.
JAMES IRVINE ARMSTRONG, JR.

Dated: ______________, 1996

____
JAY MAX ARMSTRONG

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________________
DARRELL L. MURRAY, Trustee

Dated: ______________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

____
CLYDE W. JOHNSON III

Dated: ______________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

[signature]
JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

[signature]
JAMES IRVINE ARMSTRONG, JR.

Dated: ________________, 1996

____
JAY MAX ARMSTRONG

Dated: ________________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________________
DARRELL L. MURRAY, Trustee

Dated: ________________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ________________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ________________, 1996

____
CLYDE W. JOHNSON III

Dated: ________________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

John A. Armstrong
JOHN A. ARMSTRONG II

Dated: ________________, 1996

Susanne Irvine Armstrong
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

James Irvine Armstrong
JAMES IRVINE ARMSTRONG, JR.

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: Apr. 4, 1996

By Susanne Irvine Armstrong, Trustee
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996

By John A. Armstrong, Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996

By James Irvine Armstrong Jr, Trustee
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ______________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: ______________, 1996

RMC LONESTAR, a California general partnership

By ______________________________

Dated: ______________, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: ______________, 1996

By ______________________
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996

By [signature] Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996

By [signature] Tr
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ______________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________
Walter J. McCullough

By ______________________
Elizabeth S. Armstrong

Dated: ______________, 1996

RMC LONESTAR, a California general partnership

By ______________________

Dated: ______________, 1996

CITY OF MARINA

By ______________________
James L. Vocelka, Mayor

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: ____________, 1996 By ____________
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996 By [signature] Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996 By [signature]
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ____________, 1996 THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By [signature]
Walter J. McCullough

By Elizabeth Armstrong
Elizabeth S. Armstrong

Dated: ____________, 1996 RMC LONESTAR, a California general partnership

By ____________

Dated: ____________, 1996 CITY OF MARINA

By ____________
James L. Vocelka, Mayor

Dated: _______________, 1996

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

By ______________________________
_________________________, Trustee

Dated: _______________, 1996

____
JAMES IRVINE ARMSTRONG, JR.

Dated: _______________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: Mar 26, 1996

RMC LONESTAR, a California general partnership

By [signature]

Dated: _______________, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

Dated: ________________, 1996

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

By ______________________________
__________________________, Trustee

Dated: ________________, 1996

____
JAMES IRVINE ARMSTRONG, JR.

Dated: ________________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: ________________, 1996

RMC LONESTAR, a California general partnership

By ______________________________

Dated: 4/8/96, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

APPROVED AS TO FORM:

Dated: 8/5, 1996

William K. Rentz
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ______________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ______________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ______________, 1996

THOMPSON, HUBBARD & OMETER
A Law Corporation

By ______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ______________, 1996

PILLSBURY, MADISON AND SUTRO

By ______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: _______________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: March 26, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By _______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: _______________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: _______________, 1996

THOMPSON, HUBBARD & OMETER
A Law Corporation

By _______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: _______________, 1996

PILLSBURY, MADISON AND SUTRO

By _______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ________________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ________________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: July 29, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ________________, 1996

THOMPSON, HUBBARD & OMETER
A Law Corporation

By ______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ________________, 1996

PILLSBURY, MADISON AND SUTRO

By ______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ________________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ________________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: MARCH 29, 1996

THOMPSON, HUBBARD & OMETER
A Law Corporation

By [signature]
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ________________, 1996

PILLSBURY, MADISON AND SUTRO

By ______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ________________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ________________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ________________, 1996

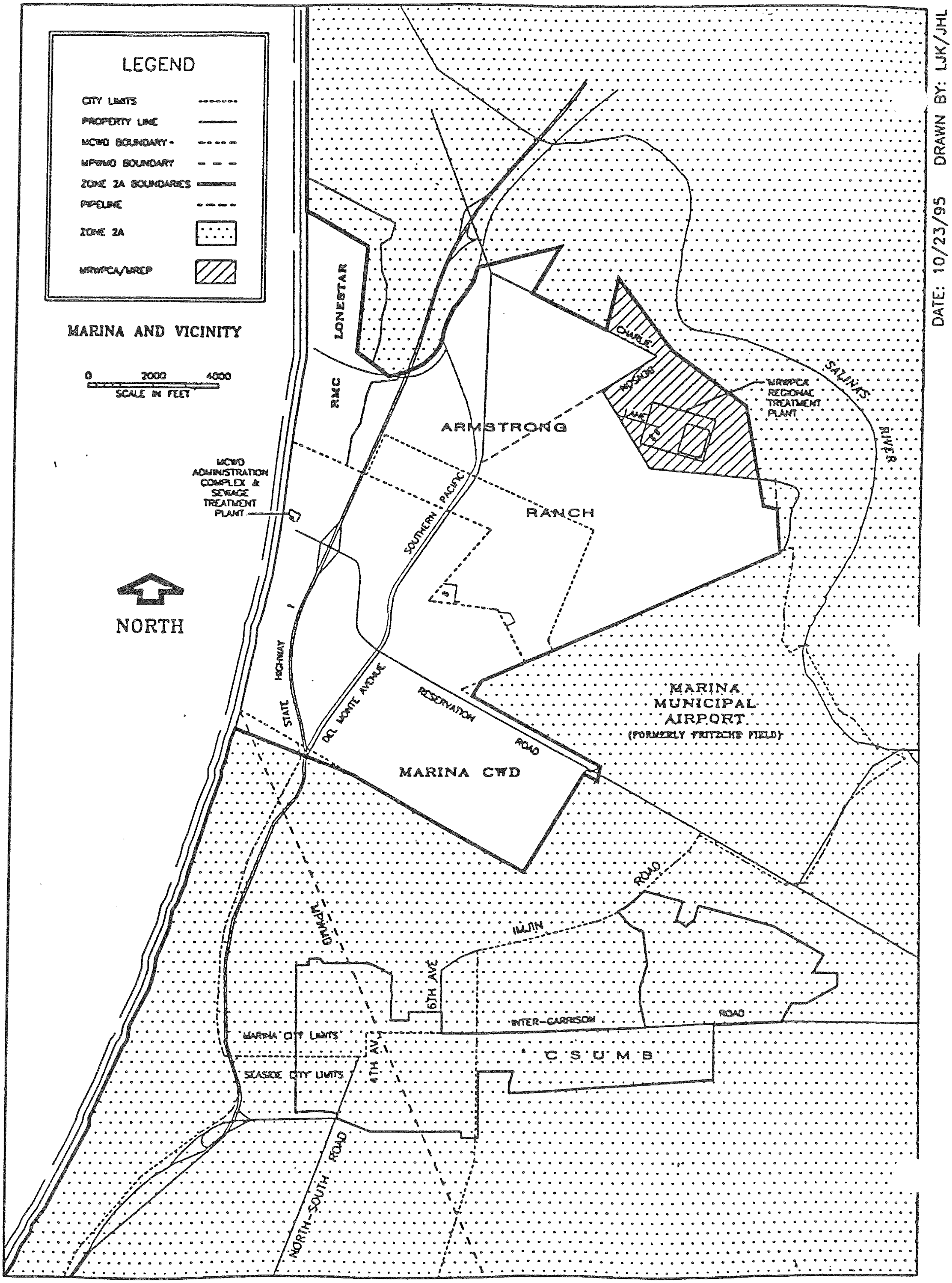
THOMPSON, HUBBARD & OMETER
A Law Corporation

By ______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: March 26, 1996

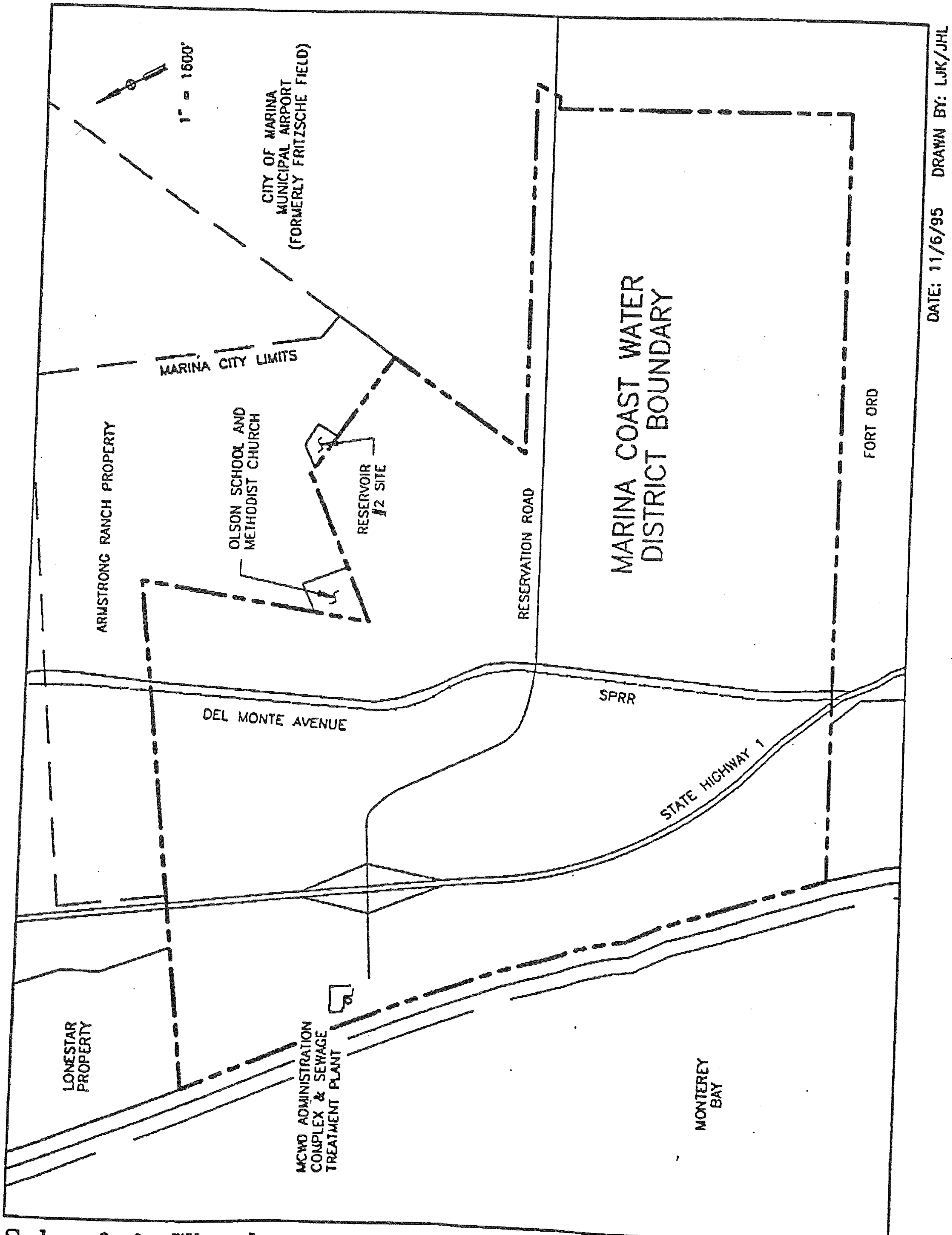
~~PILLSBURY, MADISON AND SUTRO~~ The Genesis Law Group LLP

By [signature]
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR



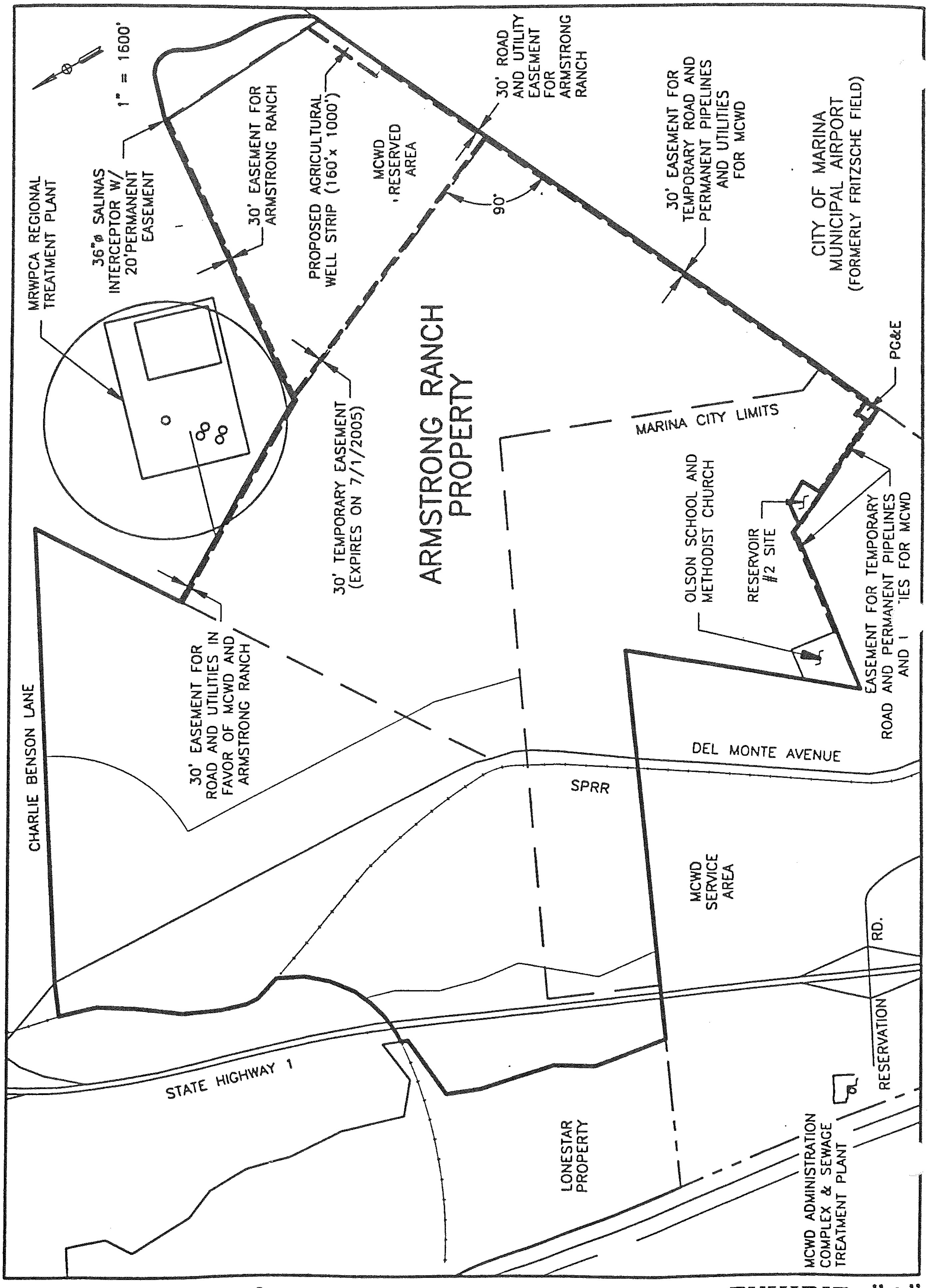
Schaaf & Wheeler

EXHIBIT "A"



Schaaf & Wheeler

EXHIBIT "B"



Schaaf & Wheeler

EXHIBIT "C"

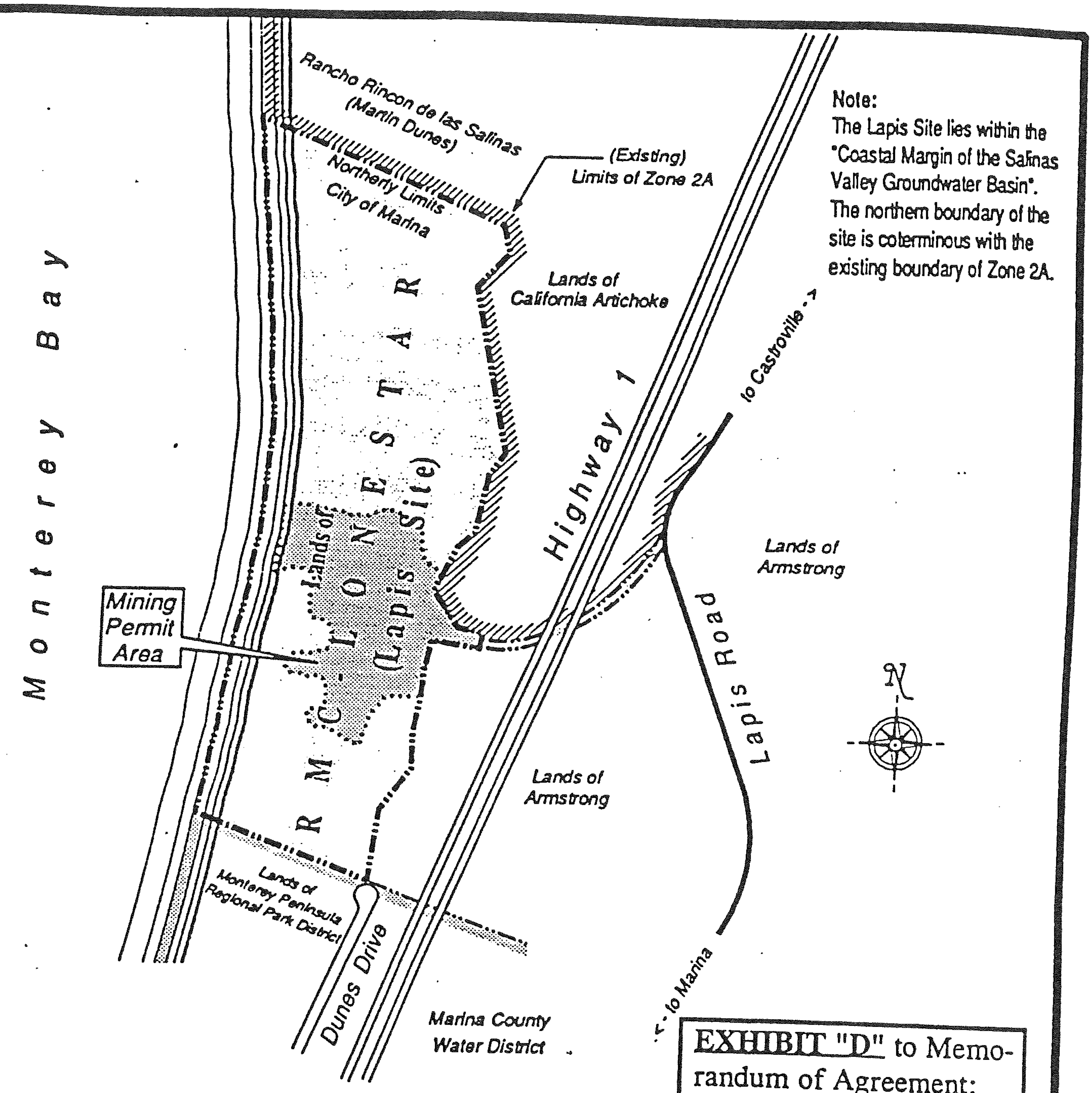


EXHIBIT "D" to Memorandum of Agreement: "Lonestar Property to be Annexed."

VICINITY MAP

Grant Deed

Grant deed dated April 22, 1929
recorded August 29, 1929
Volume 204 Official Records, at page 127.
(See Exhibit D1 for Legal Description)

Assessor's Parcel Numbers

203-011-01
203-011-16
203-011-17
203-011-19
203-011-20

michael d. ashley
CIVIL ENGINEER
(415) 341-2669

EXHIBIT "D1"

LEGAL DESCRIPTION - LANDS OF RMC-LONESTAR

(based on preliminary report from Western Title Insurance Company dated December 12, 1986)

Said land is situate in the County of Monterey, State of California, and is described as follows:

PARCEL 1

A part of Monterey City Lands Tract No. 1 embracing the sand dunes along the shore of Monterey Bay, described as follows, to-wit:

BEGINNING at the common corner of the Rancho Rincon de las Salinas and the Monterey City Lands Tract No. 1 on the shore of Monterey Bay, from which an old Four inch by Four inch post marked "R S 3 Wit" standing on Rancho boundary bears South 63° 20′ East Twelve and 79/100 chains distant; thence Variation 16° 50′ East, following the shore line of bay South 1° 05′ West Sixty and 00/100 chains to station; thence South 5° 40′ West Thirty-three and 00/100 chains to station; thence South 11° 30′ West Thirty-one and 02/100 chains to the Northerly boundary of the land of David Jacks; thence leaving the shore of the Monterey Bay and following the fence along the Northerly line of the land of David Jacks Corporation South 65° 30′ East, Twenty-three and 61/100 chains to station; thence South 65° 12′ East Five and 31/100 chains a Four inch by Four inch post marked "E. B. & A. L. S. Cor. No. 1" standing at the foot of sand hills and at the Easterly side thereof, Seven and 23/100 chains to station from which the point of intersection of Jacks boundary fence with the center line of the S. P. R. R. at station 281 plus Fifty-one and 6/10 bears South 65° 12′ East Fifty-one and 73/100 chains distant; thence leaving the Jacks boundary and following the old fence skirting the Easterly side of sand dunes North 7° 30′ East Eleven and 00/100 chains; thence North 15° 15′ East Five and 87/100 chains to station; thence North 34° East Six and 92/100 chains to station; thence North 11° 30′ East One and 00/100 chains to station; thence North 5° 45′ West Five and 18/100 chains to station; thence North 12° 15′ East Five and 66/100 chains to station; thence North 4° West 3 and 60/100 chains to station; thence North 34° East One and 27/100 chains to station; thence North 14° 30 East Three and 29/100 chains to station; thence North 6° 45′ West Three and 83/100 chains to center line of Lapis Spur track; thence North 0° 15′ East Five and 51/100 chains to station; thence North 22° 30′ East Four and 10/100 chains to station; thence North 16° 45′ East Five and 05/100 chains to station; thence North 34° East Four and 17/100 chains to station; thence North 13° East Ten and 15/100 chains to station; thence North 30° 45′ East Two and 45/100 chains to station; thence North 13° 40′ East Two and 72/100 chains to an old fence corner; thence North 9° 35′ West One and 83/100 chains to station 17; thence North 9° 35′ West Twenty-seven and 60/100 chains to station 18; thence North 32° 40′ East Five and 21/100 chains to station 19; thence North 70° East Two and 27/100 chains to station 20; thence North 46° 50′ East Two and 16/100 chains to station 21; thence North 12° 45′ West Three and 05/100 chains to station 22; thence North 26° 30′ East One and 92/100 chains to a Four inch by Four inch post marked E. B. & A. L. S. Cor. No. 23" standing in the fence on the line between the Monterey City Lands and the Rancho Rincon de las Salinas, thence leaving foot of sand hills and following said line fence across same North 63° 20′′ West Forty-two and 02/100 chains to the place of beginning.

PARCEL 2

All those certain lots, pieces or parcels of land situate, lying and being in the County of Monterey, State of California, described as follows:

A PART of Monterey City Lands Tract No. 1, described as follows:

A strip of land one hundred feet wide measured at right angles to and lying fifty feet on each side of a line located and described as follows:

BEGINNING at a point on the Eastern boundary of the piece of land here-in-before described as Parcel 1, said point bearing North 6° 45′ West from station numbered 9 on said boundary line and distant Two hundred fifty-two and 5/10 feet therefrom thence by a straight line bearing South 77° 29′ East Five hundred seventy-nine and 38/100 feet; thence by a 6° 00′ curve to the left (radius 955.04 feet), Five hundred seventy-six and 81/100 feet; thence by a straight line bearing North 67° 54-1/2′ East Six hundred forty-eight and 08/100 feet; thence by a 5° 00′ curve to the left (radius 1146.01 feet) Eleven hundred thirty-nine and 2/10 feet, more or less, to the Western line of the Southern Pacific Company's Railroad right of way.

EXCEPTING THEREFROM that portion conveyed to the State of California by deed dated May 31, 1974 and recorded August 19, 1974, on Reel 930, Official Records, at page 909, Monterey County Records.

PARCEL 3

All those certain lots, pieces or parcels of land situate, lying and being in the County of Monterey, State of California, described as follows:

All that portion of Monterey City Lands Tract No. 1 lying between the Western boundary line of Parcel 1 of the property described in the deed from John A. Armstrong et al, to E. B. & A. L. Stone Company, a corporation, dated January 24, 1907, and recorded January 24, 1907 in Liber 95 of Deeds, page 388, and the Western boundary line of the property patented to the City of Monterey, by patent, dated November 19, 1891, and recorded November 16, 1896 in Liber "F" of patents at page 178.

PARCEL 4

All those certain lots, pieces or parcels of land situate, lying and being in the County of Monterey, State of California, described as follows:

All that part of Monterey City Lands Tract No. 1 described as follows:

BEGINNING at a Four inch by Four inch post marked "B 6" standing in the Eastern Boundary of the certain 399.70 acre tract conveyed by J. G. Armstrong Co., a corporation, to the E. B. & A. L. Stone Co., a corporation by deed dated January 31, 1911, and recorded in volume 117, of Deeds at page 283, Monterey County Records, from which station 9 of said boundary bears South 6° 45′ East one hundred ninety-five and 08/100 feet distant; thence along said Eastern boundary North 6° 45′ West Fifty-seven and 7/10 feet to a station in center line of one hundred foot right of way as shown in above mentioned deed; thence North 0° 15′ East, still along said Eastern boundary three hundred sixty-three and 6/10 feet to a station; thence North 22° 30′ East one hundred seven and 0/10 feet to a four inch by four inch post marked "B 1" in said Eastern boundary; thence leave said boundary South 29° 50′ East three hundred ninety-two and 2/10 feet to a four inch by four inch post marked "b 2"; thence South 45° 29′ East one hundred thirty-one and 0/10 feet to a four inch by four inch post marked "B 3"; thence South 77° 40′ East two hundred seventy-six and 0/10 feet to a four inch by four inch post marked "B 4"; thence South 12° 20′ West, at fourth-nine and 9/10 feet to the Northern line of above mentioned one hundred foot right of way at one hundred forty-nine and 9/10 feet the Southern line of same, one hundred fifty-five and 0/10 feet to a four inch by four inch post marked "b 5", thence North 77° 40′ West, five feet southerly of and parallel with the Southern line of said right of way five hundred seventy-four and 3/10 feet to the place of beginning.

Courses all true variation of magnetic needle being 17° 15′ East. Surveyed by Cozzens & Davies, Salinas, California, March 1922

EXHIBIT E

ELEMENTS OF YEARLY INCREMENTAL COSTS
FOR ADD-ON OF RECLAIMED WATER FOR M & I PUROSES OVER AND ABOVE THAT COMMITTED TO THE CASTROVILLLE SEAWATER IRRIGATION PROJECT

1) Operation and Maintenace (O&M) Element of costs to provide tertiary treatment (in \$/acre-foot for the year of ?). Costs for the previous year will be used to estimate the next year costs. An adjustment will be included in the following year to reflect actual costs. The next year flow volume demand for MCWD will be based on a projection submitted by the MCWD to the MCWRA by June 30, three months before delivery of next year reclaimed water to the MCWD reservoir.

- Chemical costs
- Power costs
- Sludge management costs
- Labor costs
- Repair and replacement costs

$$\text{O\&M ELEMENT (in \$/acre-foot)} = \frac{\sum \text{chemicals + power + sludge mgmt. + labor + repair \& replacement costs}}{\text{Projected Next Year Flow Volume Demand [CSIP(afy) + MCWD(afy)]}} \pm \text{adjustment for previous year}$$

2) Bureau of Reclamation Loan Element (BRLE). Includes Reimbursible Interest During Construction (RIDC) and Emergency Reserve Fund Contribution (ERFC) in \$ / acre-foot for the year of ?.

$$\text{APPLICABLE ANNUAL PERCENTAGE for M\&I (AAPM\&I)} = \frac{\text{Projected next year flow volume demand for MCWD (afy)}}{\text{Projected Next Year Flow Volume Demand [CSIP(afy) + MCWD(afy)]}}$$

$$\text{BRLE(\$) FOR YEAR (?)} = \frac{\text{AAPM\&I x [PRINCIPAL + INTEREST(7.625\%) ON OUTSTANDING PRINCIPAL + RIDC + ERFC FOR YEAR(?)]}}{\text{Projected next year flow volume demand for MCWD (afy)}}$$

3) Increased capital cost element to cover M&I for the MCWD.

No additional capital costs.

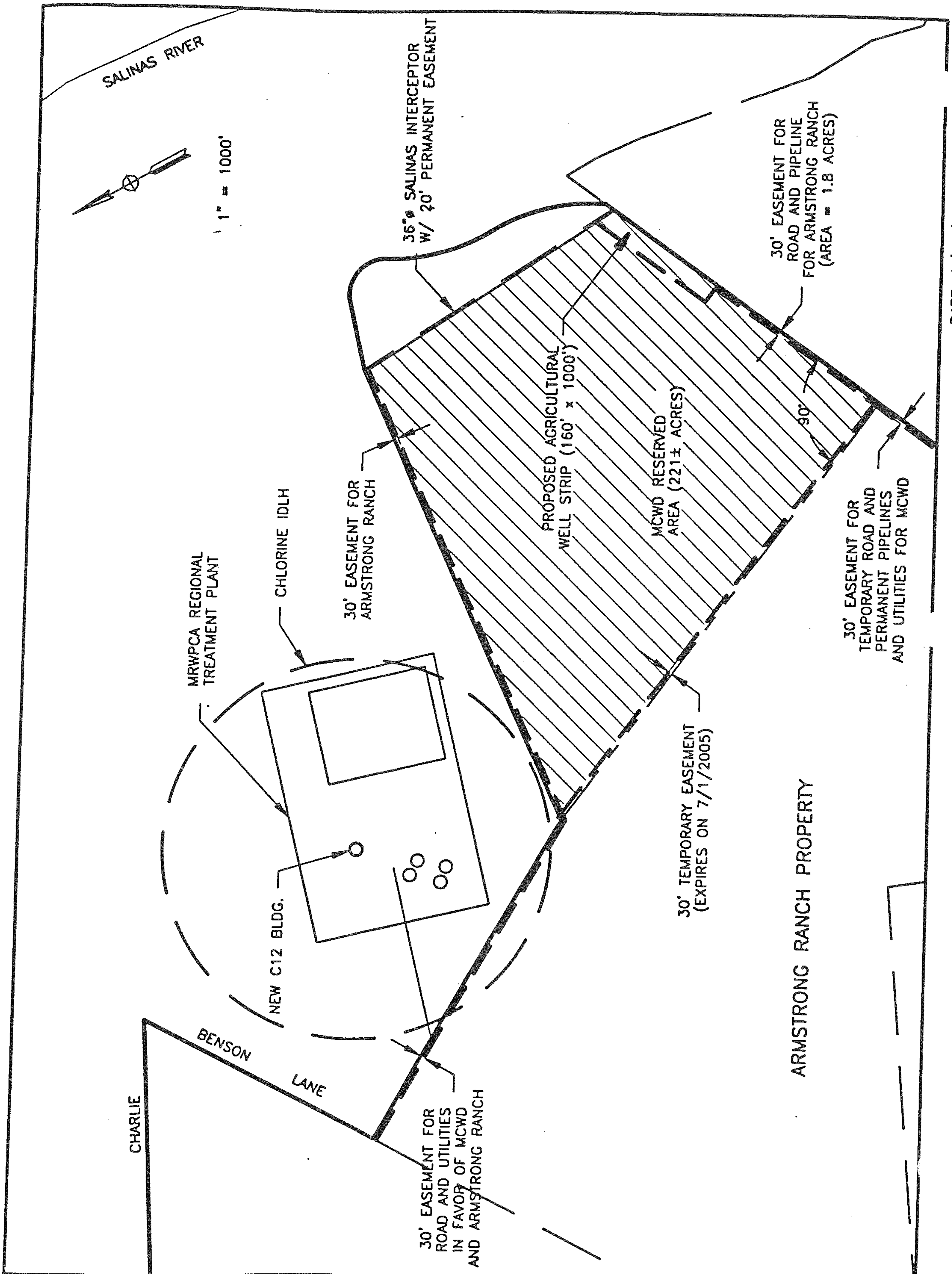
4) Capital Risk Share Element (CRSE) in \$ / acre-foot for the year of ?.

$$\text{CRSE (\$)} = \frac{\text{AAPM\&I x [SVRP Debt Service for State Revolving Fund(Schedule A Line 18)+ 1/3 of Bonds (Schedule A, Line 25) FOR YEAR(?)]}}{\text{Projected next year flow volume demand for MCWD (afy)}}$$

SVRP ANNUAL DEBT SERVICE - SCHEDULE A

A	A	B	C	D	E	E	G	H	I	J	K	L	M	N	Q	P	Q	R	S
2																		Total	($ Thousands)
3	Fiscal Year Ending	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2037	TOTAL
5	US Bureau of Reclamation Loan - SVRP																		
6	Principal Payment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	588.6	588.6	588.6	588.6	588.6	588.6	588.6	588.6	15891.4	20600.0
7	Interest Payment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1570.8	1535.0	1496.5	1455.0	1410.4	1362.4	1310.8	1255.2	8802.9	
8	Interest Payment - 22%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	345.6	337.7	329.2	320.1	310.3	299.7	288.4	276.1	1936.6	6220.2
9	RIDC Payment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5	46.5	46.5	46.5	46.5	46.5	46.5	46.5	1255.5	1627.5
10	Emergency Reserve Fund Contributions	0.0	0.0	0.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	0.0	0.0	0.0	0.0	130.0
11	*Total US Bureau of Reclamation Debt Service SVRP*	*0.0*	*0.0*	*0.0*	*13.0*	*13.0*	*13.0*	*13.0*	*13.0*	*993.7*	*985.8*	*977.3*	*968.2*	*958.4*	*934.8*	*923.5*	*911.2*	19083.5	*28577.7*
12	Line 6 + Line 7 + Line 9 + Line 10									2218.9	2183.1	2144.6	2103.1	2058.5	1997.5	1945.9	1890.3		
14	State Revolving Fund Loan - SVRP																		
15	Principal Payment	0.0	0.0	0.0	0.0	347.2	358.0	369.2	380.7	392.6	404.9	417.6	430.6	444.1	457.9	472.3	487.0	4077.1	9448.1
16	Interest Payment	0.0	0.0	0.0	0.0	295.3	284.5	273.3	261.7	249.8	237.6	224.9	211.8	198.4	184.5	170.2	155.4	247.1	3400.4
17	Emergency Reserve Fund Contributions	0.0	0.0	0.0	0.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	0.0	0.0	0.0	130.0
18	*Total State Revolving Fund Debt Service SVRP*	*0.0*	*0.0*	*0.0*	*0.0*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*687.5*	*642.5*	*642.5*	4324.2	*12978.5*
21	Bonds - Variable/Fixed																		
22	Principal Payment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.6	70.3	75.4	80.8	86.6	92.8	99.5	106.7	8792.8	9470.5
23	Interest Payment	0.0	0.0	0.0	1387.5	2322.4	1896.7	1437.6	995.9	681.9	677.2	672.1	666.7	660.9	654.6	647.9	640.8	11388.5	130.0
24	Total Bond Debt Service	0.0	0.0	0.0	1387.5	2322.4	1896.7	1437.6	995.9	747.5	747.5	747.5	747.5	747.5	747.4	747.4	747.5	20181.3	9600.5
25	*Total Bond Debt Service for SVRP (1/3 of Total)*	*0.0*	*0.0*	*0.0*	*462.0*	*773.4*	*631.6*	*478.7*	*331.6*	*248.9*	*248.9*	*248.9*	*248.9*	*248.9*	*248.9*	*248.9*	*248.9*	6720.4	*3197.0*
26																			130.0
28	***TOTAL ANNUAL DEBT SERVICE FOR SVRP - INCLUDES $4,000,000 FOR PIPELINE***	*0.0*	*0.0*	*0.0*	*475.0*	*1473.8*	*1332.1*	*1179.2*	*1032.1*	*1930.0*	*1922.2*	*1913.7*	*1904.6*	*1894.8*	*1871.2*	*1814.8*	*1802.6*	30128.1	*44753.2*
29	Line 18 + Line 25				462.0	1460.8	1319.1	1166.2	1019.1	936.4	936.4	936.4	936.4	936.4	936.3	891.3	891.4		
34	Annual Demand Projections																		
35	Projected CSIP Demand (afy)	0	0	15000.0	16,000	17,000	18,000	19,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000		
36	Projected MCWD M&I Demand (afy)	0	0	70	100	150	500	1,550	1,800	2,000	2,200	2,200	2,200	2,200	2,200	2,200	2,200		
37	Total CSIP + MCWD Pojected Demand	0	0	15,070	16,100	17,150	18,500	20,550	21,800	22,000	22,200	22,200	22,200	22,200	22,200	22,200	22,200		
38	AAPM & I	0.0000	0.0000	0.0046	0.0062	0.0087	0.0270	0.0754	0.0826	0.0909	0.0991	0.0991	0.0991	0.0991	0.0991	0.0991	0.0991		
40	Elements of Incremental M&I Costs - See Exhibit E																		
41	O&M Element for M&I - See Exhibit E Item 1																		
42	Projected O&M Cost –																		
43	PCA LETTER OF 10/24/95	0	0	1,667	1,717	1,769	1,822	1,876	1,933	1,990	2,050	2,112	2,175	2,240	2,308	2,377	2,448		
44	$1,526,000, 1994 @ 3%/YR																		
45	O&M Element in $/acre ft																		
46	Projected O&M Cost in $/acre ft / Total CSIP + MC	0	0	111	107	103	98	91	89	90	92	95	98	101	104	107	110		
48	Bureau Loan Element - See Exhibit E Item 2																		
49	(BRLE) in $/acre ft																		
51	(Line 12 x Line 38) / Line 36	0	0	0	0	0	0	0	0	101	98	97	95	93	90	88	85		
53	Increase in Capital Costs for M& I Element																		
54	No increase in Capital $	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
56	Capital Risk Share Element (CRSE) - See Exhibit E Item 4																		
57	Line 29 x Line 38 / Line 36 in $/acre ft	0.0	0.0	0.0	28.7	85.2	71.3	56.7	46.7	42.6	42.2	42.2	42.2	42.2	42.2	40.2	40.2		
59	Total Incremental Cost																		
60	Line 46 + Line 51 + Line 54 + Line 57	0.0	0.0	110.6	135.3	188.3	169.8	148.0	135.4	233.9	232.9	233.9	234.9	235.8	236.1	234.9	235.6		
62										28446.1	31008.8	31008.8	31008.8	31008.8	31008.8	31008.8	31008.8		
63	Amortization of $4,000,000 @ flow share									14.2	14.1	14.1	14.1	14.1	14.1	14.1	14.1		

DAF[illegible] 11/27/95 loan5.wk4



Schaaf & Wheeler

EXHIBIT "F"

EXHIBIT G

MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY ADDENDUM TO

ANNEXATION AGREEMENT AND GROUNDWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

1. PURPOSE. The Parties to the Agreement and Framework agree with the Monterey Regional Water Pollution Control Agency ("MRWPCA") that it is in the best interests of all of them and the persons they represent if the MRWPCA is also a party to the Agreement and Framework, with certain additional terms specific to the MRWPCA. If this Addendum is approved by the MRWPCA within one year of approval of the Agreement and Framework and this Addendum by the other Parties, this Addendum will become part of the Agreement and Framework, and the MRWPCA will be considered a party to the Agreement and Framework, effective from the date the Agreement and Framework and this Addendum are approved by the Board of Supervisors of the MCWRA.

2. MRWPCA. MRWPCA is a joint powers authority providing sewage treatment service to its member entities in Northern Monterey County, governed by its Board of Directors.

3. MRWPCA SUPPORT FOR ANNEXATION. MRWPCA is supporting the request for annexation contained in paragraph 4.1 of the Agreement and Framework to encourage reasonable and beneficial water reuse, and to help implement the MCWRA/MRWPCA Agreement, the MRWPCA Annexation Agreement, and the SVRP.

4. RESERVATION FOR MRWPCA. Armstrong shall reserve, for use by MRWPCA, the area shown diagrammatically on Exhibit "I" to this Addendum (hereinafter the "MRWPCA Reserved Area"), subject to the non-exclusive easements shown on Exhibit "I" to be reserved in favor of Armstrong and MCWD, which said reserved easements in favor of Armstrong and MCWD shall be for roads, utilities (including communications), pipelines, and any other purpose for which a road may be used, shall be freely assignable and usable by others, and not subject to surcharge.

4.1. Survey. The MRWPCA Reserved Area, which shall not exceed 10 acres, will be "field" surveyed at the expense of MRWPCA within one year following approval by the MCWRA Board of Supervisors of the annexation to the Zones of any of the lands described in Exhibit "C" to the Agreement and Framework.

4.2. Use. MRWPCA will diligently undertake, and MCWD, City, MCWRA and Armstrong will cooperate in the planning and conduct of, the appropriate environmental review and application for appropriate permits to use the MRWPCA Reserved Area solely and exclusively as a buffer zone between the existing Regional Treatment Plant and the Armstrong Ranch. Any additional use is subject to the written approval of Armstrong first had and obtained, and any conveyance from Armstrong to MRWPCA shall contain appropriate restrictions on such additional use in the form of a condition subsequent and a power of termination in favor of Armstrong. Any attempt to condemn the power of termination shall be subject to the provisions of paragraph 6.10.3 as if it were a condemnation of fee title.

4.3. Expiration of Reservation. Armstrong's obligation to reserve the MRWPCA Reserved Area shall expire at midnight on June 30, 2003, or upon delivery to Armstrong of written notice from MRWPCA cancelling MRWPCA's right to receive conveyance of the MRWPCA Reserved Area.

4.4. Payment. Upon conveyance of the MRWPCA Reserved Area to MRWPCA, MRWPCA shall pay to Armstrong a sum calculated by multiplying the number of acres in such conveyance by Twenty-Five Thousand Dollars ($25,000.00).

4.5. Title. Upon receipt by Armstrong of written request from MCWD, Armstrong will forthwith convey all or part of the MRWPCA Reserved Area to MRWPCA by grant deed, free of any financial encumbrances except taxes and assessments not delinquent, but subject to all other encumbrances, and further subject to all laws, ordinances, regulations and rights of all governmental bodies having jurisdiction in, on or over the subject real property as they may from time to time exist.

5. ATTACHMENT TO AGREEMENT AND FRAMEWORK; INCORPORATION BY REFERENCE. When this Addendum is fully executed, it shall be attached to the Agreement and Framework as an integral part of the Agreement and Framework, and the provisions of Sections 1, 2, 3, 8, and 9 through 20, inclusive, and paragraphs 4.5, 5.6, 5.7 and 6.10.3 of the Agreement and Framework are specifically incorporated into this Addendum by this reference and shall apply to the terms of this Addendum and as fully to MRWPCA as though MRWPCA had signed the Agreement and Framework. A person duly authorized by MRWPCA places his or her initials here to indicate MRWPCA's specific agreement to the provisions of paragraph 6.10.3:

Signature: ______________________________

Printed Name and Title: ______________________________

STATE OF CALIFORNIA) ss.
COUNTY OF MONTEREY)

On this 26th day of March, 1996, before me, Ernest K. Morishita, Clerk of the Board of Supervisors, in and for said County and State, personally appeared Edith Johnsen, known to me to be the Chairperson of said Board of Supervisors of the County of Monterey, and known to me to be the person who executed the within instrument on behalf of said political subdivision, and acknowledged to me that such County of Monterey executed the same.

ERNEST K. MORISHITA, Clerk of the
Board of Supervisors of Monterey
County, State of California

By: Pamela Olivas
Deputy Clerk

6. <u>NOTICES</u>. Notices to MRWPCA under this Addendum and the Agreement and Framework shall be addressed as follows:

General Manager
5 Harris Court, Building D
Monterey, CA 93940
Phone No.: (408) 372-3367
Fax No.: (408) 372-6178

The address or fax number to which any notice or other writing may be given or made or sent may be changed upon written notice given as provided in paragraph 12 of the Agreement and Framework.

7. <u>ADMINISTRATOR</u>. MRWPCA hereby designates MRWPCA's General Manager as its Administrator for this Agreement and Framework.

IN WITNESS WHEREOF, the Parties execute this Addendum as follows:

Dated: ________________, 1996 MRWPCA

By ______________________________
Keith Israel, Agency Director

Dated: March 26, 1996 MONTEREY COUNTY WATER RESOURCES AGENCY

By Edith Johnsen
Edith Johnsen
Chair, Board of Supervisors

Dated: ________________, 1996 MARINA COAST WATER DISTRICT

By ______________________________
Thomas P. Moore
President, Board of Directors

By ______________________________
Malcolm D. Crawford
Secretary, Board of Directors

Dated: ________________, 1996

____
JAY MAX ARMSTRONG

6. <u>NOTICES</u>. Notices to MRWPCA under this Addendum and the Agreement and Framework shall be addressed as follows:

General Manager
5 Harris Court, Building D
Monterey, CA 93940
Phone No.: (408) 372-3367
Fax No.: (408) 372-6178

The address or fax number to which any notice or other writing may be given or made or sent may be changed upon written notice given as provided in paragraph 12 of the Agreement and Framework.

7. <u>ADMINISTRATOR</u>. MRWPCA hereby designates MRWPCA's General Manager as its Administrator for this Agreement and Framework.

IN WITNESS WHEREOF, the Parties execute this Addendum as follows:

Dated: ______________, 1996 MRWPCA

By ______________________________
Keith Israel, Agency Director

Dated: ______________, 1996 MONTEREY COUNTY WATER RESOURCES AGENCY

By ______________________________
Edith Johnsen
Chair, Board of Supervisors

Dated: ______________, 1996 MARINA COAST WATER DISTRICT

By Thomas P. Moore
Thomas P. Moore
President, Board of Directors

By Malcolm D. Crawford
Malcolm D. Crawford
Secretary, Board of Directors

Dated: ______________, 1996

____
JAY MAX ARMSTRONG

6. NOTICES. Notices to MRWPCA under this Addendum and the Agreement and Framework shall be addressed as follows:

General Manager
5 Harris Court, Building D
Monterey, CA 93940
Phone No.: (408) 372-3367
Fax No.: (408) 372-6178

The address or fax number to which any notice or other writing may be given or made or sent may be changed upon written notice given as provided in paragraph 12 of the Agreement and Framework.

7. ADMINISTRATOR. MRWPCA hereby designates MRWPCA's General Manager as its Administrator for this Agreement and Framework.

IN WITNESS WHEREOF, the Parties execute this Addendum as follows:

Dated: _______________, 1996 MRWPCA

By ______________________________
Keith Israel, Agency Director

Dated: _______________, 1996 MONTEREY COUNTY WATER RESOURCES AGENCY

By ______________________________
Edith Johnsen
Chair, Board of Supervisors

Dated: _______________, 1996 MARINA COAST WATER DISTRICT

By ______________________________
Thomas P. Moore
President, Board of Directors

By ______________________________
Malcolm D. Crawford
Secretary, Board of Directors

Dated: April 8, 1996

Jay M. Armstrong
JAY MAX ARMSTRONG

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By [signature] 4/4/96
DARRELL L. MURRAY, Trustee

Dated: ______________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

____
CLYDE W. JOHNSON III

Dated: ______________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

[signature]
JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

James Irvine Armstrong Jr. [signature]
JAMES IRVINE ARMSTRONG, JR.

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________
DARRELL L. MURRAY, Trustee

Dated: 4-4, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By Clyde W Johnson III Trustee
CLYDE W. JOHNSON III, Trustee

Dated: 4-4, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By Clyde W Johnson III Trustee
CLYDE W. JOHNSON III, Trustee

Dated: 4-4, 1996

Clyde W Johnson III
CLYDE W. JOHNSON III

Dated: 4-4, 1996

Edwin A Johnson
EDWIN A. JOHNSON

Dated: Mar 29, 1996

[signature]
JOHN A. ARMSTRONG II

Dated: ______________, 1996

____
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

James Irvine Armstrong, Jr.
JAMES IRVINE ARMSTRONG, JR.

Dated: ______________, 1996

THE SANDRA ARMSTRONG MURRAY REVOCABLE TRUST UTA dated March 7, 1989

By ______________________________
DARRELL L. MURRAY, Trustee

Dated: ______________, 1996

THE LOIS AND CLYDE JOHNSON, JR., 1989 IRREVOCABLE TRUST

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

THE JOHNSON FAMILY REVOCABLE LIVING TRUST UTA dated November 29, 1989

By ______________________________
CLYDE W. JOHNSON III, Trustee

Dated: ______________, 1996

____
CLYDE W. JOHNSON III

Dated: ______________, 1996

____
EDWIN A. JOHNSON

Dated: Mar 29, 1996

[signature]
JOHN A. ARMSTRONG II

Dated: Apr. 4, 1996

[signature] Susanne Irvine Armstrong
SUSANNE IRVINE ARMSTRONG

Dated: Mar. 29, 1996

[signature] James Irvine Armstrong, Jr.
JAMES IRVINE ARMSTRONG, JR.

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: Apr 4, 1996 — By Susanne Irvine Armstrong, trustee
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996 — By [signature] Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996 — By James Irvine Armstrong trustee,
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ______________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: ______________, 1996

RMC LONESTAR, a California general partnership

By ______________________________

Dated: ______________, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: ______________, 1996 By ______________________
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996 By [signature] Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996 By [signature] Trustee
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ______________, 1996 THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________
Walter J. McCullough

By ______________________
Elizabeth S. Armstrong

Dated: ______________, 1996 RMC LONESTAR, a California general partnership

By ______________________

Dated: ______________, 1996 CITY OF MARINA

By ______________________
James L. Vocelka, Mayor

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

Dated: ______________, 1996

By ______________________
SUSANNE IRVINE ARMSTRONG, Trustee

Dated: Mar 29, 1996

By [signature] Trustee
JOHN A. ARMSTRONG II, Trustee

Dated: Mar. 29, 1996

By [signature] Trustee
JAMES IRVINE ARMSTRONG, JR., Trustee

Dated: ______________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By [signature]
Walter J. McCullough

By Elizabeth S. Armstrong
Elizabeth S. Armstrong

Dated: ______________, 1996

RMC LONESTAR, a California general partnership

By ______________________

Dated: ______________, 1996

CITY OF MARINA

By ______________________
James L. Vocelka, Mayor

Dated: ________________, 1996

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

By ______________________________
______________________________, Trustee

Dated: ________________, 1996

____
JAMES IRVINE ARMSTRONG, JR.

Dated: ________________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: MAR 26, 1996

RMC LONESTAR, a California general partnership

By [signature]

Dated: ________________, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

Dated: ________________, 1996

SUSANNE IRVINE ARMSTRONG, JAMES IRVINE ARMSTRONG, JR., and JOHN A. ARMSTRONG II, as Trustees of the Trust for the benefit of MARY JANET ARMSTRONG WEBER as set forth in the Order Settling Report of Trustees due to the death of Lois Armstrong, etc., in the Estate of Irvine Armstrong, also known as James Irvine Armstrong, Deceased, recorded January 4, 1988, in Reel 2191, Official Records of Monterey County at page 643 therein (hereinafter referred to as the "Mary Janet Armstrong Weber Trust")

By ______________________________
______________________________, Trustee

Dated: ________________, 1996

____
JAMES IRVINE ARMSTRONG, JR.

Dated: ________________, 1996

THE 1990 ARMSTRONG FAMILY TRUST established by Declaration dated July 2, 1990

By ______________________________
Walter J. McCullough

By ______________________________
Elizabeth S. Armstrong

Dated: ________________, 1996

RMC LONESTAR, a California general partnership

By ______________________________

Dated: 4/8/96, 1996

CITY OF MARINA

By ______________________________
James L. Vocelka, Mayor

APPROVED AS TO FORM:

Dated: 8/5, 1996

WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for MRWPCA

Dated: ________, 1996

THOMPSON, HUBBARD AND OMETER
A Law Corporation

By ________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ________, 1996

PILLSBURY, MADISON AND SUTRO

By ________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ________________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: March 26, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By _______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for MRWPCA

Dated: ________________, 1996

THOMPSON, HUBBARD AND OMETER
A Law Corporation

By _______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ________________, 1996

PILLSBURY, MADISON AND SUTRO

By _______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ______________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ______________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: July 29, 1996

Robert R. Wellington
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: July 29, 1996

Robert R. Wellington
ROBERT R. WELLINGTON
Legal Counsel for MRWPCA

Dated: ______________, 1996

THOMPSON, HUBBARD AND OMETER
A Law Corporation

By ______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: ______________, 1996

PILLSBURY, MADISON AND SUTRO

By ______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: _______________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: _______________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By _______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: _______________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: _______________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for MRWPCA

Dated: MARCH 29, 1996

THOMPSON, HUBBARD AND OMETER
A Law Corporation

By [signature]
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: _______________, 1996

PILLSBURY, MADISON AND SUTRO

By _______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

APPROVED AS TO FORM:

Dated: ________________, 1996

____
WILLIAM K. RENTZ
Deputy County Counsel, Monterey County

Dated: ________________, 1996

NOLAND, HAMERLY, ETIENNE & HOSS
A Professional Corporation

By ______________________________
Lloyd W. Lowrey, Jr.
Legal Counsel for MARINA COAST WATER DISTRICT

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for CITY OF MARINA

Dated: ________________, 1996

____
ROBERT R. WELLINGTON
Legal Counsel for MRWPCA

Dated: ________________, 1996

THOMPSON, HUBBARD AND OMETER
A Law Corporation

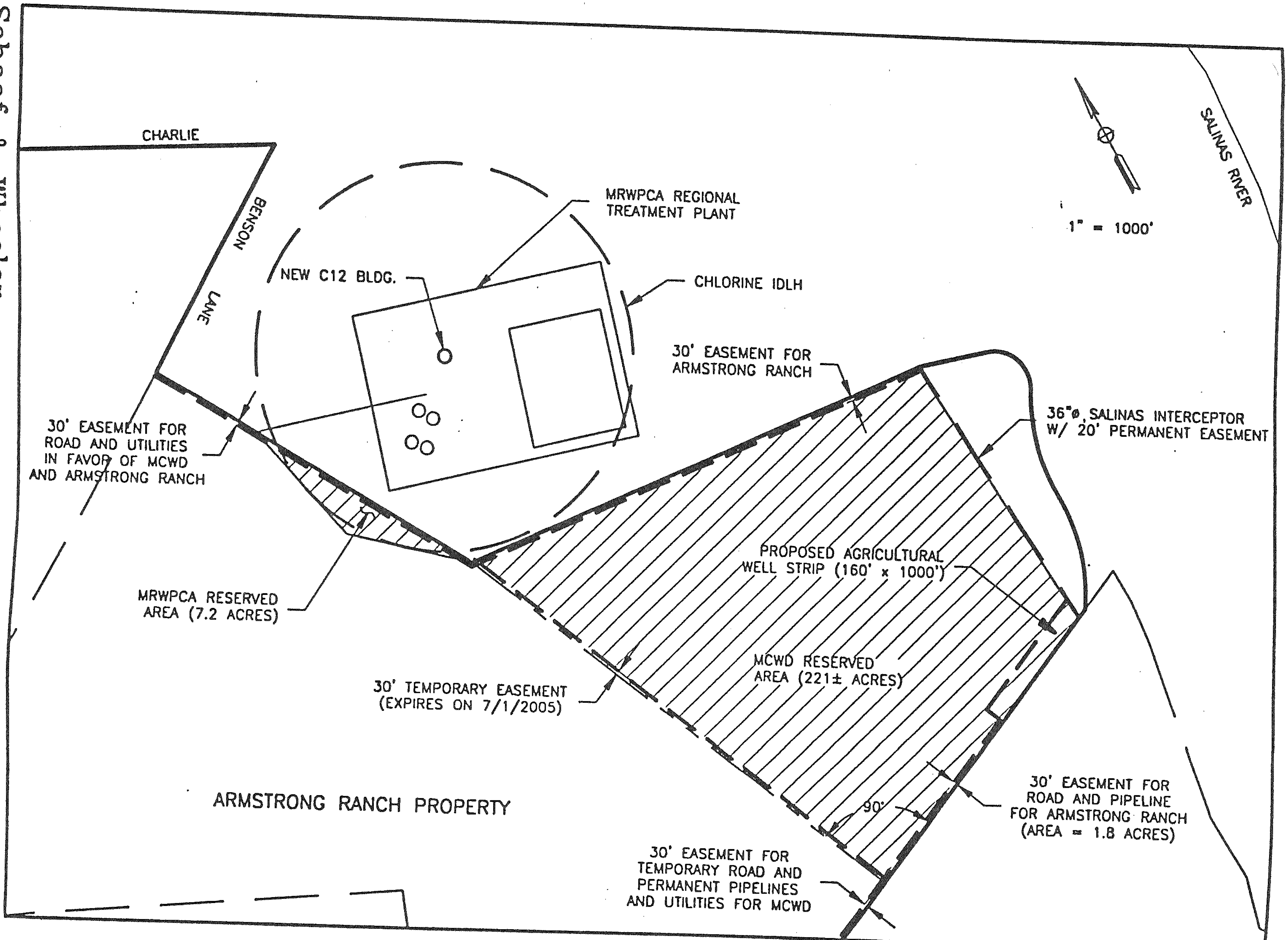
By ______________________________
Donald G. Hubbard
Legal Counsel for J.G. ARMSTRONG FAMILY MEMBERS

Dated: March 26, 1996

The Genesis Law Group
~~PILLSBURY, MADISON AND SUTRO~~

By ______________________________
Thomas P. O'Donnell
Legal Counsel for RMC LONESTAR

Schaaf & Wheeler



DATE: 2/27/96 DRAWN BY:

EXHIBIT

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of CALIFORNIA

County of MONTEREY

On 04-12-96 (Date) before me, *SONIA L. ANGELO, NOTARY PUBLIC* * (Name and Title of Officer (e.g., "Jane Doe, Notary Public")),

personally appeared * * * * * *THOMAS P. MOORE* * * * * * (Name(s) of Signer(s)),

☐ personally known to me – OR – ☒ proved to me on the basis of satisfactory evidence to be the person~~(s)~~ whose name~~(s)~~ is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she/they~~ executed the same in his/~~her/their~~ authorized capacity~~(ies)~~, and that by his/~~her/their~~ signature~~(s)~~ on the instrument the person~~(s)~~, or the entity upon behalf of which the person~~(s)~~ acted, executed the instrument.

SONIA L. ANGELO
Comm. # 1087856
NOTARY PUBLIC - CALIFORNIA
Monterey County
My Comm. Expires Feb. 16, 2000

WITNESS my hand and official seal.

Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: ANNEXATION AGREEMENT AND GROUNDSWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

Document Date: APRIL 12, 1996 Number of Pages: 27 w/ EXH A-F

Signer(s) Other Than Named Above: NONE

Capacity(ies) Claimed by Signer(s)

Signer's Name: THOMAS P MOORE

☐ Individual
☒ Corporate Officer
Title(s): PRESIDENT, BOARD OF DIRECTORS
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: ____________

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

MARINA WATER COAST DISTRICT

Signer's Name: ____________

☐ Individual
☐ Corporate Officer
Title(s): ____________
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: ____________

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of CALIFORNIA

County of MONTEREY

On APRIL 17, 1996 (Date) before me, * *SONIA L. ANGELO, NOTARY PUBLIC* * (Name and Title of Officer (e.g., "Jane Doe, Notary Public")),

personally appeared * *MALCOLM D. CRAWFORD* * * * * * * (Name(s) of Signer(s)),

☐ personally known to me – OR – ☒ proved to me on the basis of satisfactory evidence to be the person(~~s~~) whose name(~~s~~) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she~~/~~they~~ executed the same in his/~~her~~/~~their~~ authorized capacity(~~ies~~), and that by his/~~her~~/~~their~~ signature(~~s~~) on the instrument the person(~~s~~), or the entity upon behalf of which the person(~~s~~) acted, executed the instrument.

SONIA L. ANGELO
Comm. # 1087856
NOTARY PUBLIC - CALIFORNIA
Monterey County
My Comm. Expires Feb. 16, 2000

WITNESS my hand and official seal.

[signature]
Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: ANNEXATION AGREEMENT AND GROUNDSWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

Document Date: APRIL 17, 1996 Number of Pages: 27 w/EXH A-F

Signer(s) Other Than Named Above: NONE

Capacity(ies) Claimed by Signer(s)

Signer's Name: MALCOLM D. CRAWFORD

- ☐ Individual
- ☒ Corporate Officer
  Title(s): SECRETARY, BOARD OF DIRECTORS
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney-in-Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: ______

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

MARINA WATER COAST DISTRICT

Signer's Name: ______

- ☐ Individual
- ☐ Corporate Officer
  Title(s): ______
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney-in-Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: ______

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of CALIFORNIA

County of MONTEREY

On APRIL 12, 1996 (Date) before me, * *SONIA L. ANGELO, NOTARY PUBLIC* * * * (Name and Title of Officer (e.g., "Jane Doe, Notary Public")),

personally appeared * *THOMAS P. MOORE* * * * * * * (Name(s) of Signer(s)),

☐ personally known to me – **OR** – ☒ proved to me on the basis of satisfactory evidence to be the person(~~s~~) whose name(~~s~~) is/~~are~~ subscribed to the within instrument and acknowledged to me that he/~~she~~/~~they~~ executed the same in his/~~her~~/~~their~~ authorized capacity(~~ies~~), and that by his/~~her~~/~~their~~ signature(~~s~~) on the instrument the person(~~s~~), or the entity upon behalf of which the person(~~s~~) acted, executed the instrument.

SONIA L. ANGELO
Comm. # 1087856
NOTARY PUBLIC - CALIFORNIA
Monterey County
My Comm. Expires Feb. 16, 2000

WITNESS my hand and official seal.

Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

Title or Type of Document: EXHIBIT G MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY ADDENDUM TO ANNEXATIO AGREEMENT AND GROUNDWATER MITIGATION FRAMEWORK FOR MARINA AREAL LANDS

Document Date: APRIL 12, 1996 Number of Pages: SIX

Signer(s) Other Than Named Above: NONE

Capacity(ies) Claimed by Signer(s)

Signer's Name: THOMAS P. MOORE

- ☐ Individual
- ☒ Corporate Officer
  Title(s): PRESIDENT, BOARD OF DIRECTORS
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney-in-Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: ______

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

MARINA COAST WATER DISTRICT

Signer's Name: ______

- ☐ Individual
- ☐ Corporate Officer
  Title(s): ______
- ☐ Partner — ☐ Limited ☐ General
- ☐ Attorney-in-Fact
- ☐ Trustee
- ☐ Guardian or Conservator
- ☐ Other: ______

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

State of CALIFORNIA

County of MONTEREY

On 04-17-96 (Date) before me, *SONIA L. ANGELO, NOTARY PUBLIC* * * (Name and Title of Officer (e.g., "Jane Doe, Notary Public")),

personally appeared * * *MALCOLM D. CRAWFORD* * * * * * * (Name(s) of Signer(s)),

☐ personally known to me – OR – XX proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

SONIA L. ANGELO
Comm. # 1087856
NOTARY PUBLIC - CALIFORNIA
Monterey County
My Comm. Expires Feb. 16, 2000

WITNESS my hand and official seal.

[signature]
Signature of Notary Public

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of Attached Document

EXHIBIT G

Title or Type of Document: MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY ADDENDUM TO ANNEXATION AGREEMENT AND GROUNDWATER MITIGATION FRAMEWORK FOR MARINA AREA LANDS

Document Date: APRIL 17, 1996 Number of Pages: 6

Signer(s) Other Than Named Above: NONE

Capacity(ies) Claimed by Signer(s)

Signer's Name: MALCOLM D. CRAWFORD

☐ Individual
XX Corporate Officer
Title(s): SECRETARY, BOARD OF DIRECTORS
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: ____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing:
MARINA COAST WATER DISTRICT

Signer's Name: ____

☐ Individual
☐ Corporate Officer
Title(s): ____
☐ Partner — ☐ Limited ☐ General
☐ Attorney-in-Fact
☐ Trustee
☐ Guardian or Conservator
☐ Other: ____

RIGHT THUMBPRINT OF SIGNER
Top of thumb here

Signer Is Representing: ____

ACKNOWLEDGMENT

STATE OF New Mexico)
: ss.
COUNTY OF Bernalillo)

On april 8, 1996, before me, Lupe Estrada, a Notary Public, duly commissioned and sworn, personally appeared JAY MAX ARMSTRONG

☐ personally known to me, or

☒ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Lupe Estrada
Signature

OFFICIAL SEAL
LUPE ESTRADA
NOTARY PUBLIC-STATE OF NEW MEXICO
My commission expires: 3-29-98

{Seal}

ACKNOWLEDGMENT

STATE OF WASH)
: ss.
COUNTY OF KING)

On 4/4, 1996, before me, SANDRA G. HARVEY, a Notary Public, duly commissioned and sworn, personally appeared DARRELL L. MURRAY

☑ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Sandra G. Harvey
Signature

SANDRA G. HARVEY NOTARY PUBLIC COMMISSION EXPIRES 3-11-97 STATE OF WASHINGTON

{Seal}

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF Fresno)

On April 4, 1996, 1996, before me, Lupe M. Perez, a Notary Public, duly commissioned and sworn, personally appeared CLYDE W. JOHNSON III

☐ personally known to me, or

☑ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Signature

LUPE M. PEREZ
COMM. #972946
NOTARY PUBLIC-CALIFORNIA
FRESNO COUNTY
MY COMMISSION EXPIRES
SEPTEMBER 7, 1996

{Seal}

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF Fresno)

On April 4, 1996, before me, Lupe M. Perez, a Notary Public, duly commissioned and sworn, personally appeared EDWIN A. JOHNSON

☐ personally known to me, or

☒ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Signature

LUPE M. PEREZ
COMM. #972946
NOTARY PUBLIC-CALIFORNIA
FRESNO COUNTY
MY COMMISSION EXPIRES
SEPTEMBER 7, 1996

{Seal}

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF MONTEREY)

On March 29, 1996, before me, Jeannine L. Kreider, a Notary Public, duly commissioned and sworn, personally appeared JOHN A. ARMSTRONG II

☒ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Signature {Seal}

Jeannine L. Kreider
Comm. #1090740
NOTARY PUBLIC - CALIFORNIA
MONTEREY COUNTY
Comm. Exp. March 17 2000

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF MONTEREY)

On March 29, 1996, before me, Jeannine L. Kreider, a Notary Public, duly commissioned and sworn, personally appeared JAMES IRVINE ARMSTRONG, JR.

☒ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Signature

{Seal}

Jeannine L. Kreider
Comm. #1090740
NOTARY PUBLIC - CALIFORNIA
MONTEREY COUNTY
Comm. Exp. March 17 2000

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF Yolo)

On April 4, 1996, before me, Kara K Walker, a Notary Public, duly commissioned and sworn, personally appeared SUSANNE IRVINE ARMSTRONG

☒ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that she executed the same in her authorized capacity, and that by her signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Kara K. Walker
Signature

{Seal}

KARA K. WALKER
Comm. #992609
NOTARY PUBLIC - CALIFORNIA
YOLO COUNTY
Comm. Expires April 25, 1997

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF MONTEREY)

On MAY 6, 1996, before me, PAUL M. HAMERLY, a Notary Public, duly commissioned and sworn, personally appeared WALTER J. McCULLOUGH

☑ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Paul M. Hamerly
Signature

{Seal}

PAUL M. HAMERLY
COMM. #1033393
Notary Public-California
Monterey County
My Comm. Exp. Sept. 20, 1998

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF MONTEREY)

On MAY 6, 1996, before me, PAUL M. HAMERLY, a Notary Public, duly commissioned and sworn, personally appeared ELIZABETH S. ARMSTRONG

☑ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that she executed the same in her authorized capacity, and that by her signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

Paul M. Hamerly
Signature {Seal}

PAUL M. HAMERLY
COMM. #1033393
Notary Public-California
Monterey County
My Comm. Exp. Sept. 20, 1998
VRS2 VRS2

State of California

County of Alameda

On April 1, 1996, before me, Judith Ann Duit/Notary Public, personally appeared Ronald L. Blick, personally known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal.

Judith Ann Duit, Notary Public

JUDITH ANN DUIT
Comm. # 1036845
NOTARY PUBLIC - CALIFORNIA
Alameda County
My Comm. Expires Aug. 21, 1998

OPTIONAL INFORMATION

The information below is not required by law. However, it could prevent fraudulent attachment of this acknowledgment to an unauthorized document.

CAPACITY CLAIMED BY SIGNER (PRINCIPAL)

- ☐ INDIVIDUAL
- ☑ CORPORATE OFFICER

President RMC LONESTAR
TITLE(S)

- ☐ PARTNER(S)
- ☐ ATTORNEY-IN-FACT
- ☐ TRUSTEE(S)
- ☐ GUARDIAN/CONSERVATOR
- ☐ OTHER: ____

SIGNER IS REPRESENTING:
Name of person(s) or entity(ies)
RMC LONESTAR

DESCRIPTION OF ATTACHED DOCUMENT

Annexation Agreement and Groundwater Mitigation Framework for Marina Area Lands
TITLE OR TYPE OF DOCUMENT

27 plus exhibit A - I
NUMBER OF PAGES

3/26/96
DATE OF DOCUMENT

____
OTHER

City of Marina

211 HILLCREST AVENUE
MARINA, CA 93933
TELEPHONE (408) 384-3715
FAX (408) 384-0425

Marina 1975

CERTIFICATE OF ACKNOWLEDGEMENT

STATE OF CALIFORNIA)
) *ss.*
County of Monterey)

On April 5, 1996, before me, Joy P. Junsay, City Clerk of the City of Marina, California, personally appeared James L. Vocelka, Mayor of the City of Marina, California, personally known to me to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

WITNESS my hand and official seal of the City of Marina, California.

Dated this 8th day of April, 1996.

Joy P. Junsay, City Clerk

ACKNOWLEDGMENT

STATE OF CALIFORNIA)
: ss.
COUNTY OF MONTEREY)

On March 29, 1996, before me, Jeannine L. Kreider, a Notary Public, duly commissioned and sworn, personally appeared DONALD G. HUBBARD

☒ personally known to me, or

☐ proved to me on the basis of satisfactory evidence

to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his authorized capacity, and that by his signature on the instrument, the person, or the entity upon behalf of which the person acted, executed the same.

WITNESS my hand and official seal.

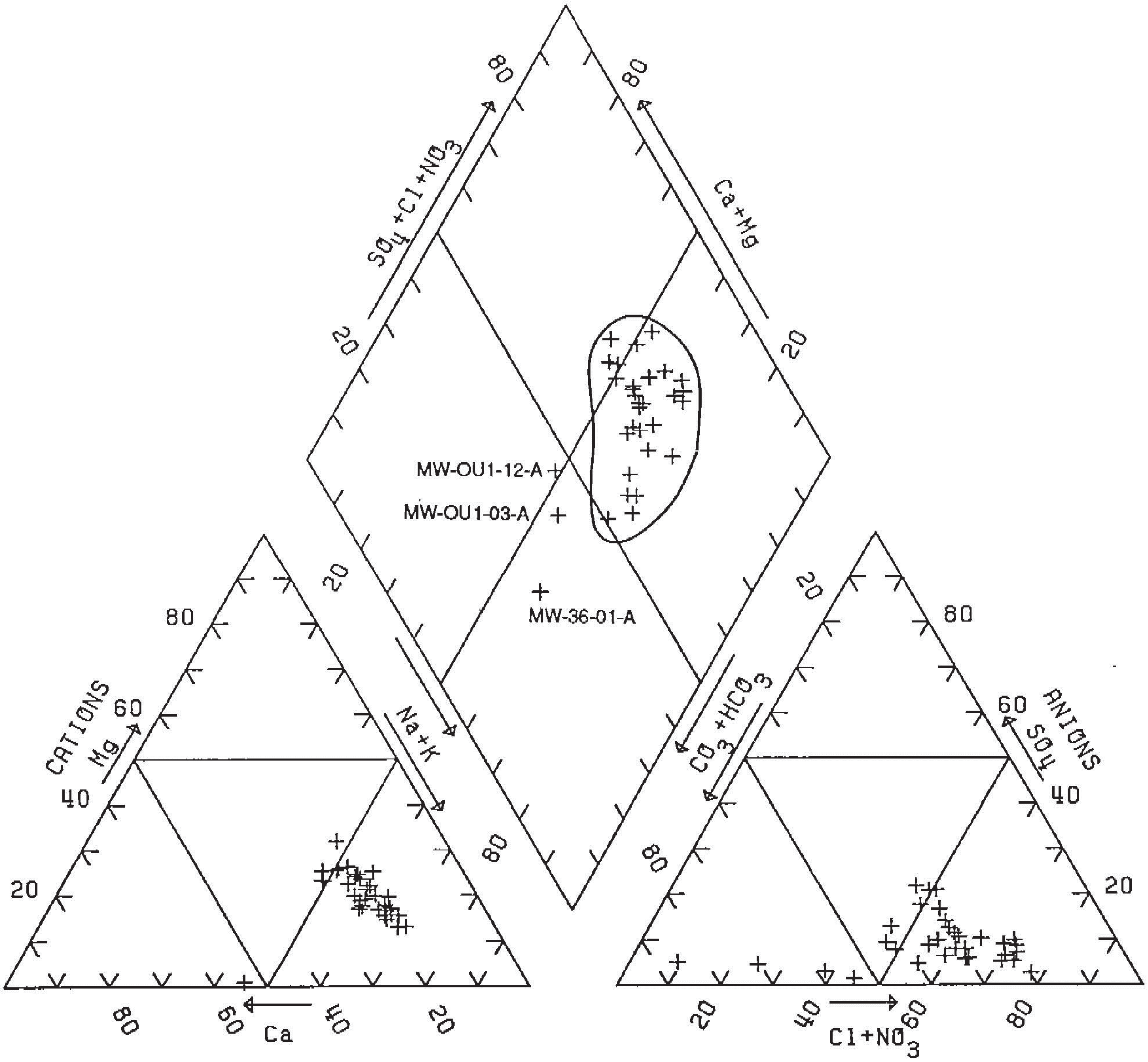
Signature

{Seal}

MGC1 Jeannine L. Kreider
Comm. #1090740
NOTARY PUBLIC - CALIFORNIA
MONTEREY COUNTY
Comm. Exp. March 17 2000

Appendix 4-A

Supplemental Hydrogeologic Conceptual Model Figures



Legend:

+ A-Aquifer Water Sample

Ford Ord A-Aquifer Water Quality

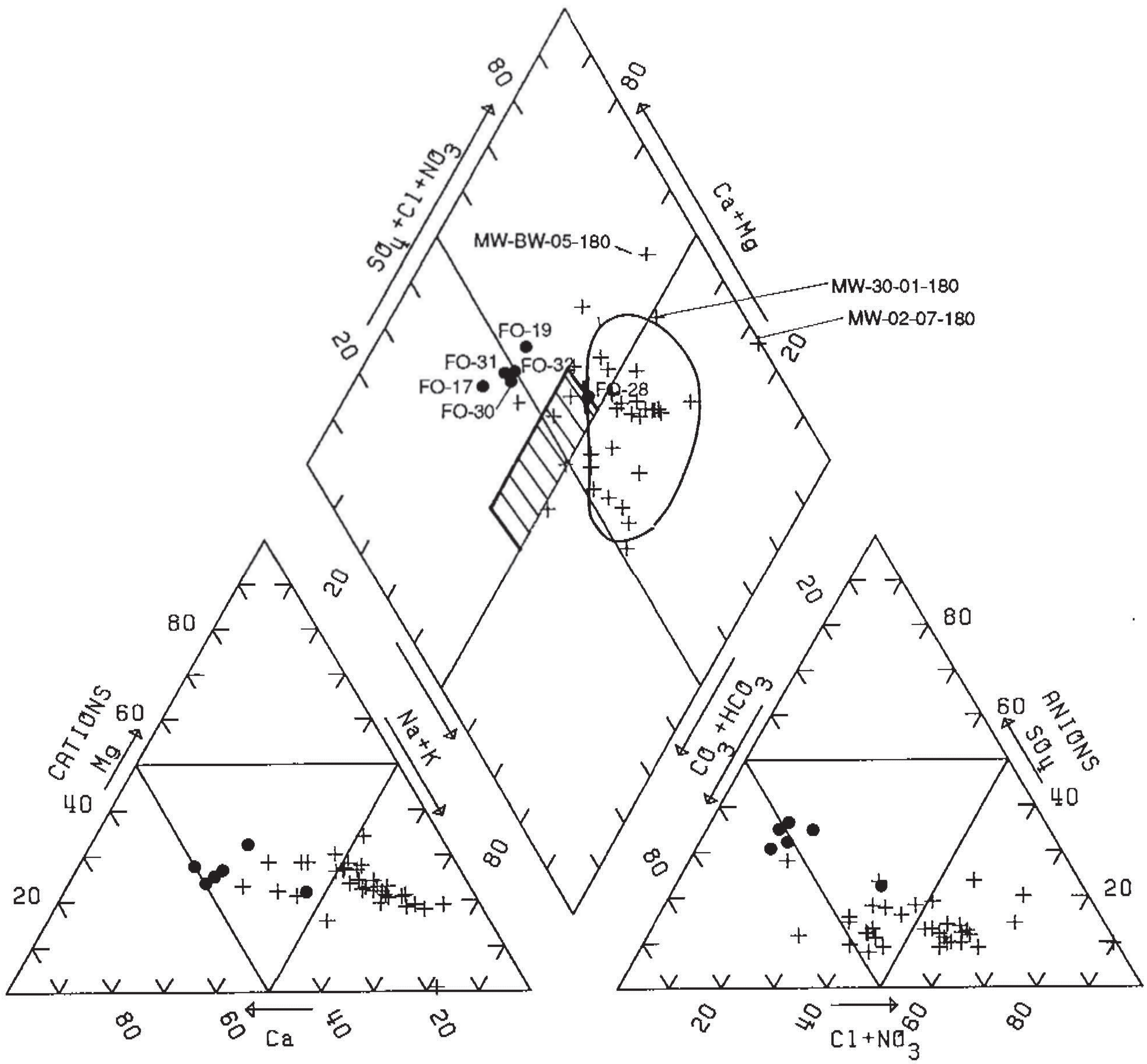
Source:

Adapted from HLA (1994).

Piper Diagram,
Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure A4-1



Legend:

180-Foot Aquifer Water Sample (1992 Data)

Ford Ord Water-Supply Water Sample (1985 Data)

Ford Ord A-Aquifer Water Quality

Salinas Valley 180-Foot Aquifer Water Quality *(DKT, 1989)*

Source:

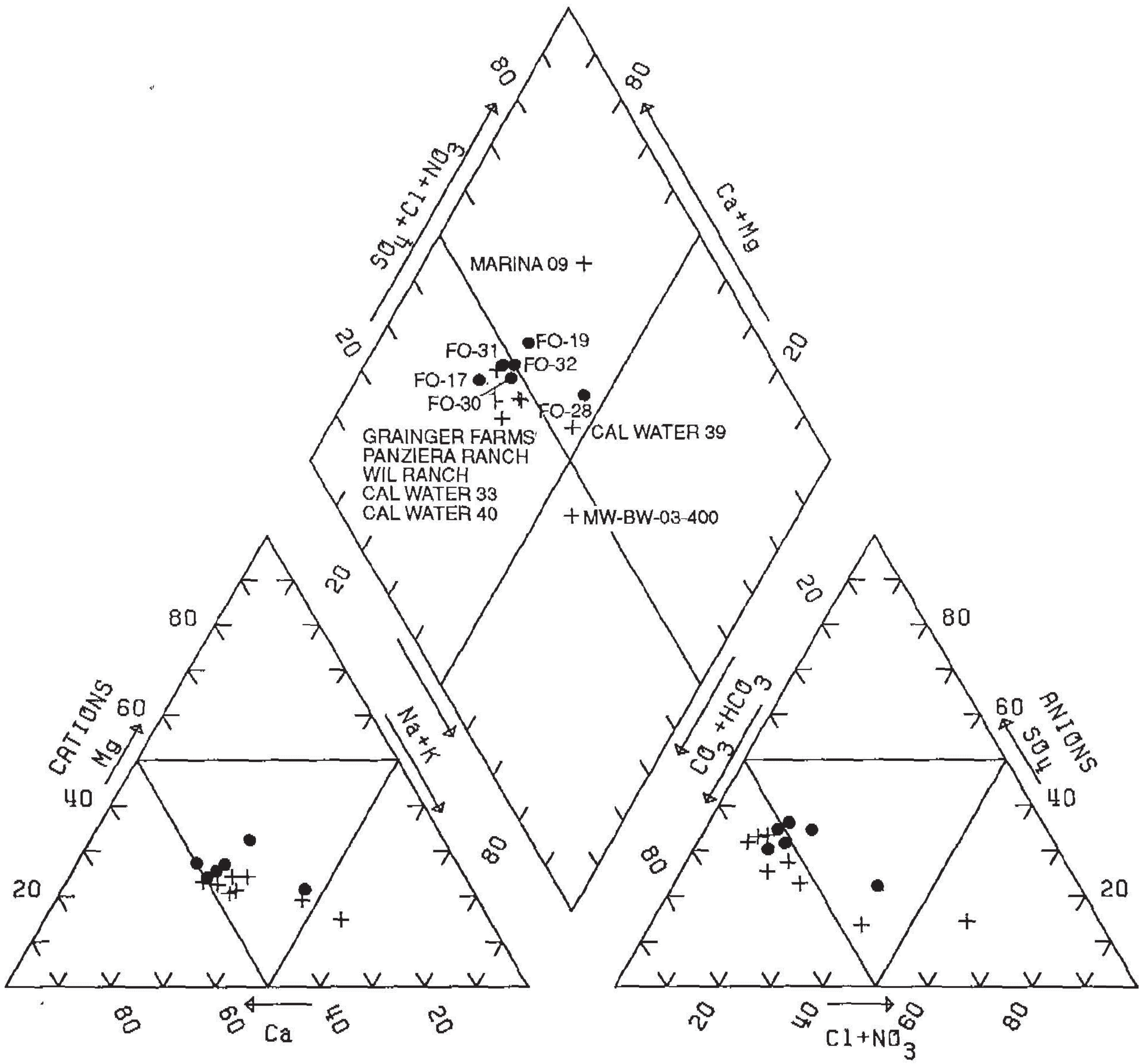
Adapted from HLA (1994).

Piper Diagram, 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure A4-2

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend:

+	400-Foot Aquifer Water Sample (1992 Data)
●	Ford Ord Water-Supply Water Sample (1985 Data)
(outline)	Ford Ord A-Aquifer Water Quality

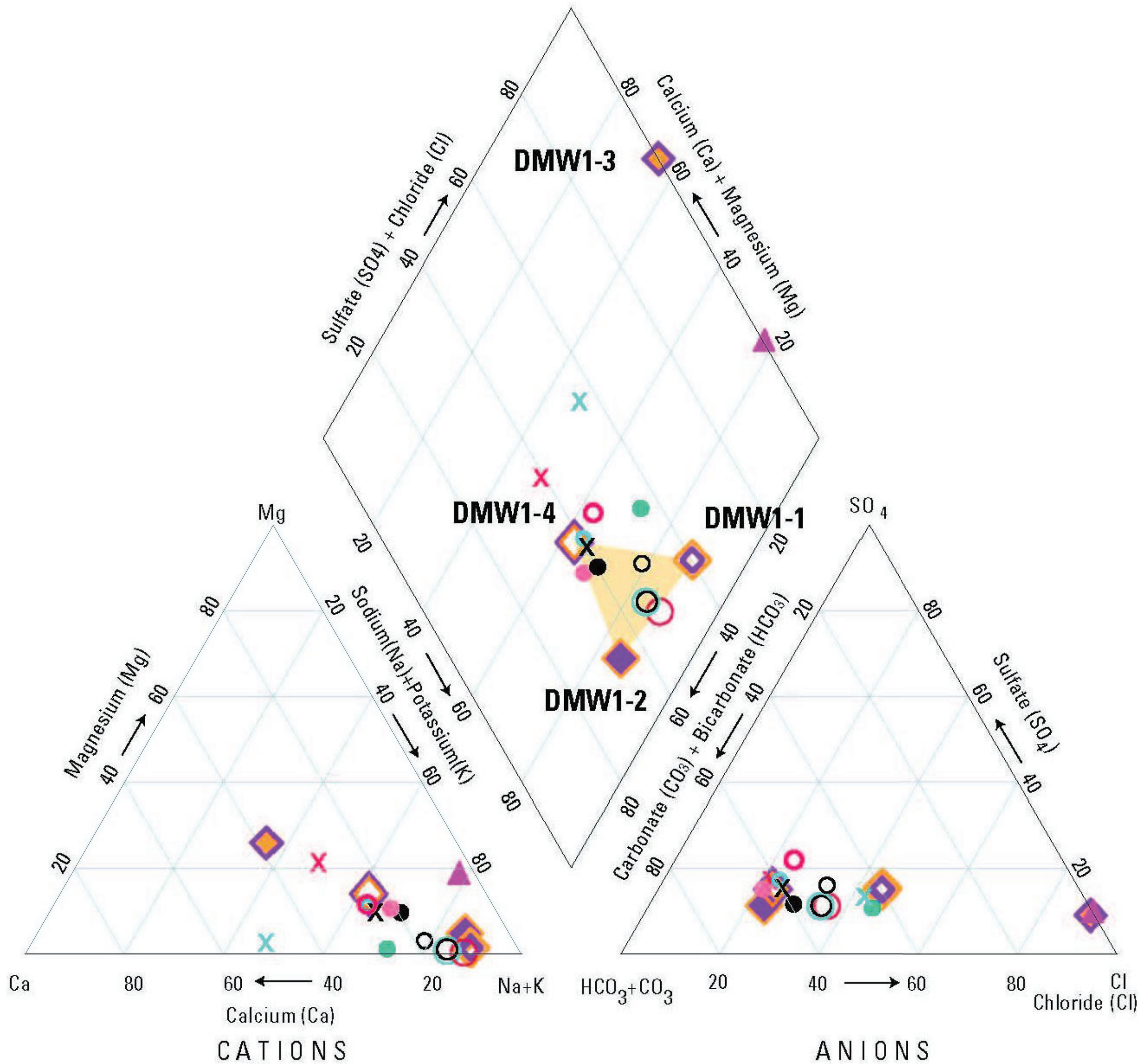
Source:

Adapted from HLA (1994).

Piper Diagram, 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure A4-3



Legend:

Wells - Deep Aquifer Monitoring
14S/1E

- 24L5 [DMW1-4] (930'-950')
- 24L4 [DMW1-3] (1,040'-1,060')
- 24L3 [DMW1-2] (1,410'-1,430')
- 24L2 [DMW1-1] (1,820'-1,860')

(') - Indicatesdepth in feet below land surface

- Seawater

Wells - Water Supply
14S/2E

	1995	1997	2000	MCWD Well Number
31K2M	x	x	x	9
32	o	o	o	10
32D1	●	●	●	11
30	O	O	O	12

Source:

Adapted from USGS (2002).

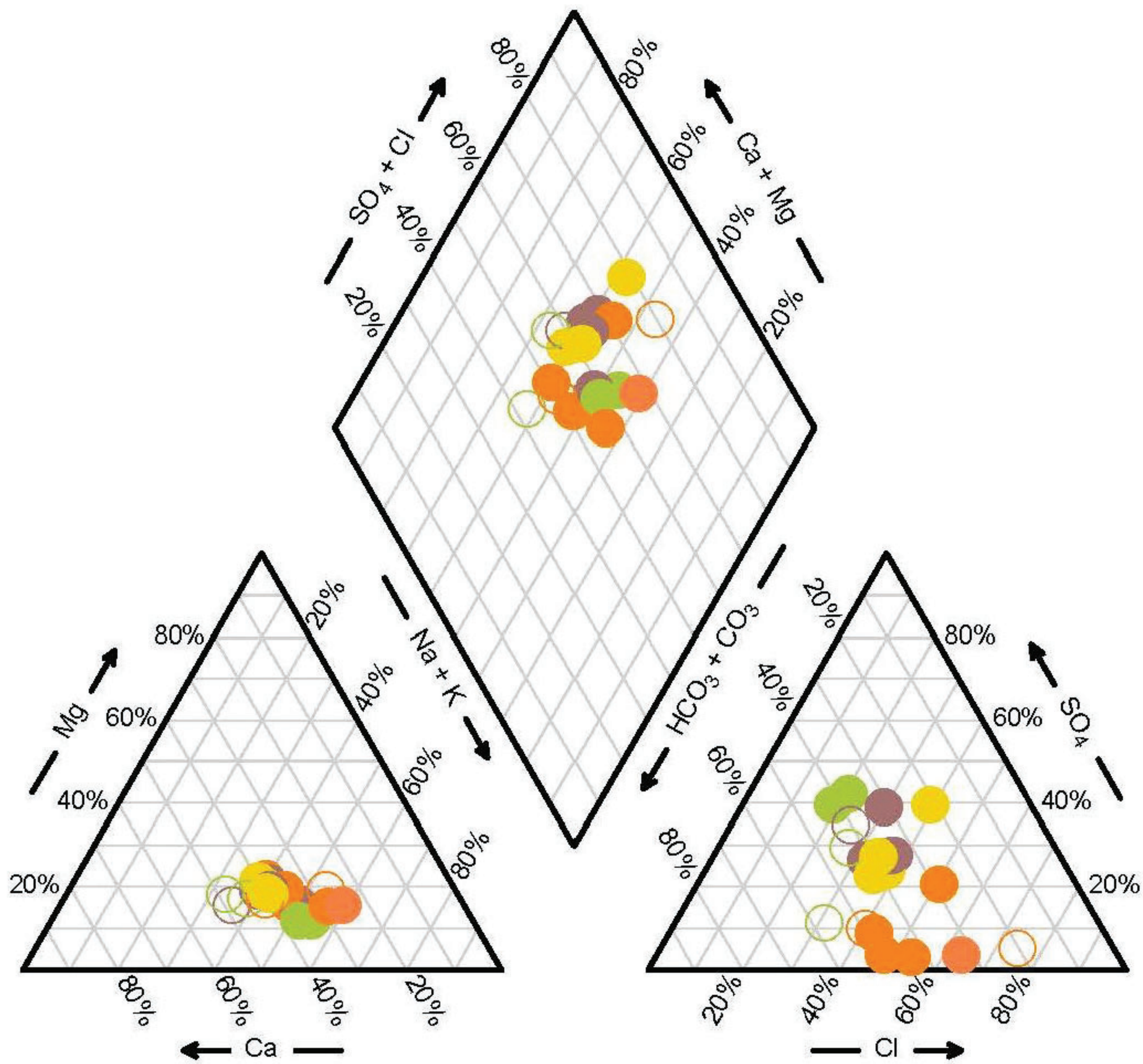
Notes:

1. Trilinear diagram of major-ion chemistry for selected groundwater samples drom the deep-aquifer system in the Salinas Valley, 1995, 1997, and 2000 with samples from DMW1 wells, 2000.

Piper Diagram, Deep Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure A4-4



Legend:

- QTc
- QTc + Tsm
- Tsm
- QTc + Tmd
- Tmd
- Tmd + Tus
- Tus

Source:

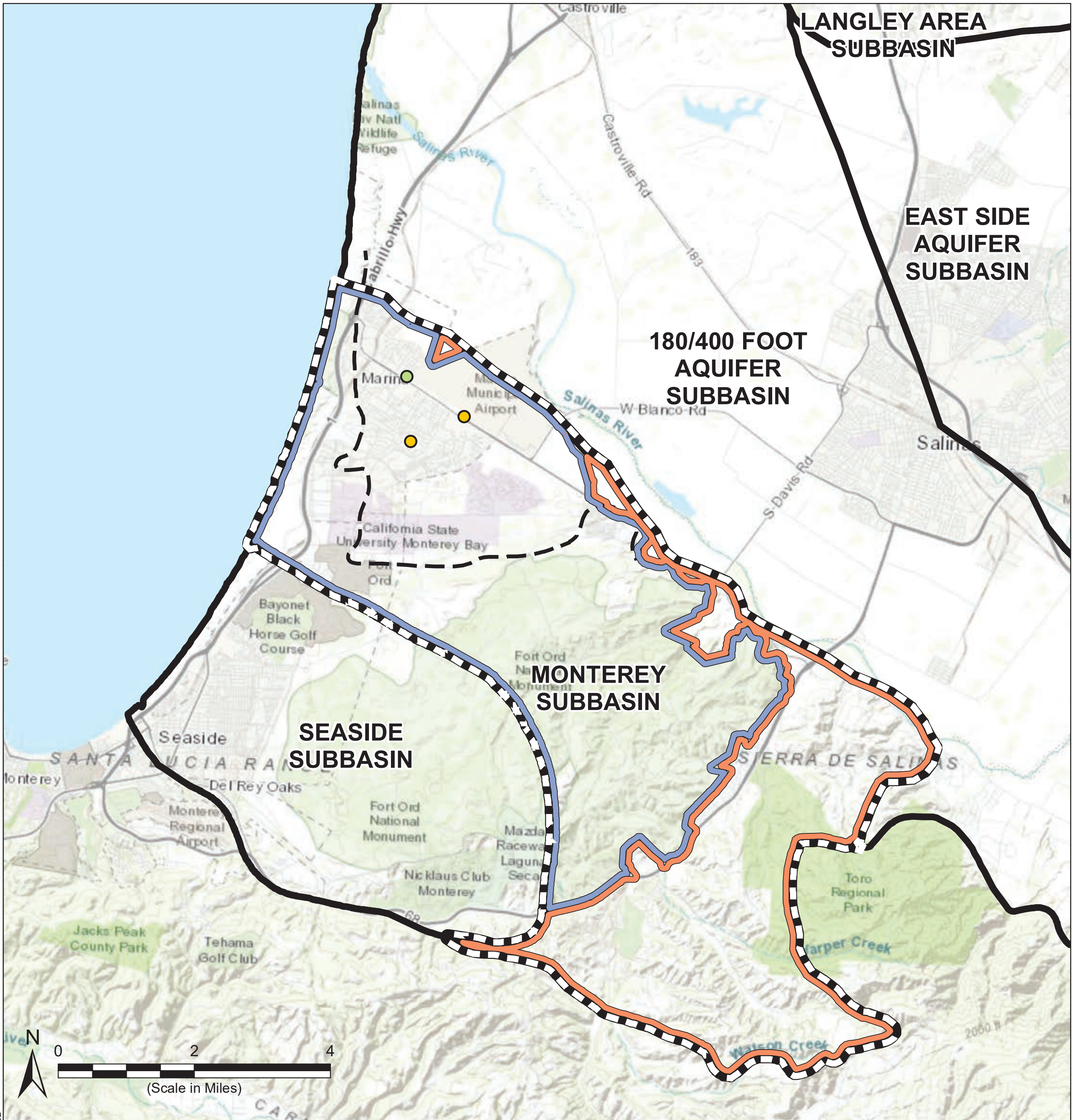
Adapted from GeoSyntec (2007).

Piper Diagram, Corral de Tierra Area

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure A4-5

20200623.121603 G:\B60094.03\2020-06\Figure 4-18 through 4-31.dwg Fig 4-18



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Extent of FO-SVA (Harding ESE, 2001)

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Transmissivity (ft^2/d)

- Less than 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 30,000
- Greater than 30,000

Abbreviations

ft^2/d = square feet per day

Notes

1. All locations are approximate.

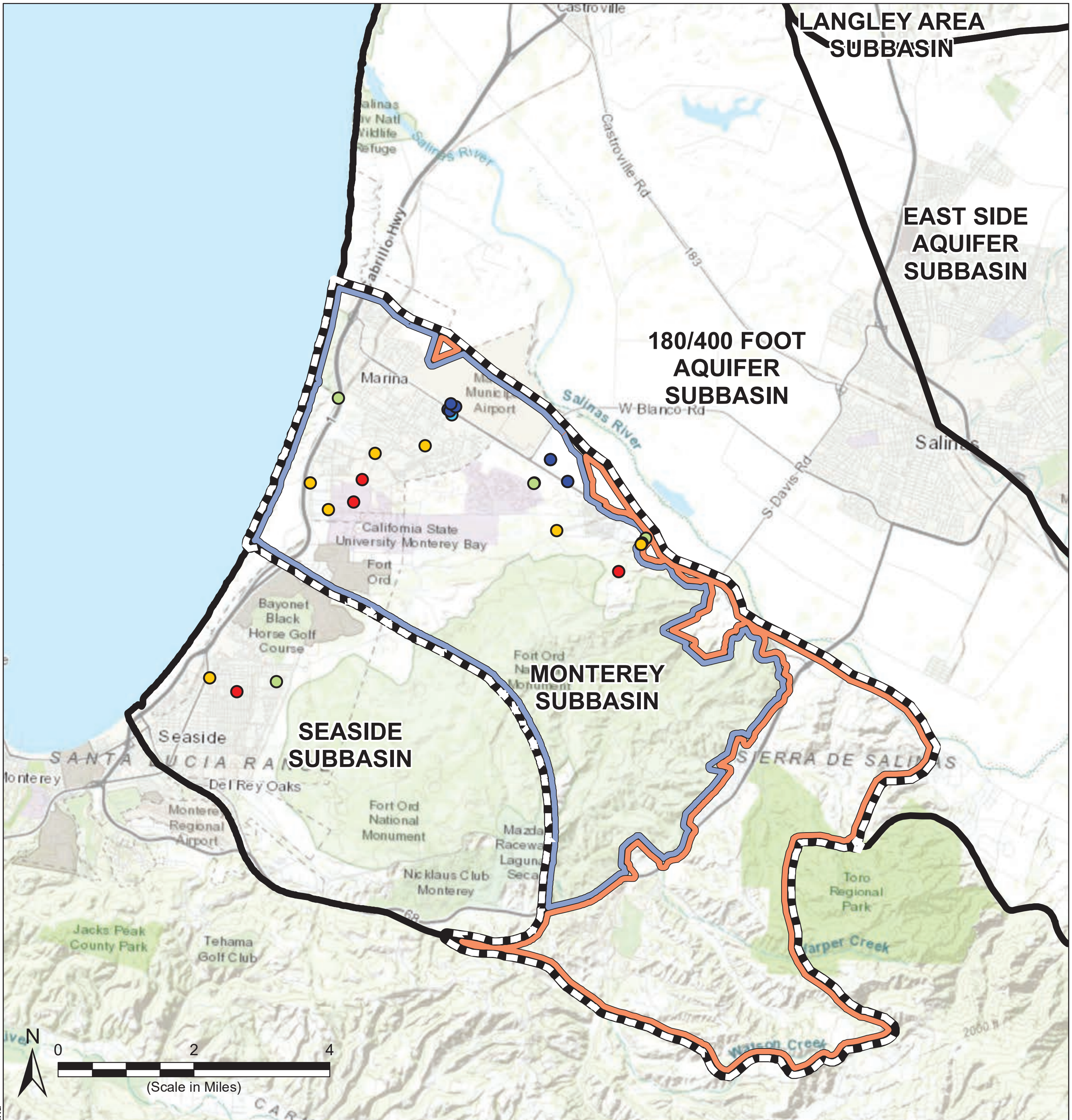
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 December 2020.
2. Transmissivities are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Transmissivities in the Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure 4A-6



Path: X:\B60094\Maps\2020\12\FigA4-7_Transmissivity_180_400.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Transmissivity (ft^2/d)

- Less than 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 30,000
- Greater than 30,000

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft^2/d = square feet per day

Notes

1. All locations are approximate.

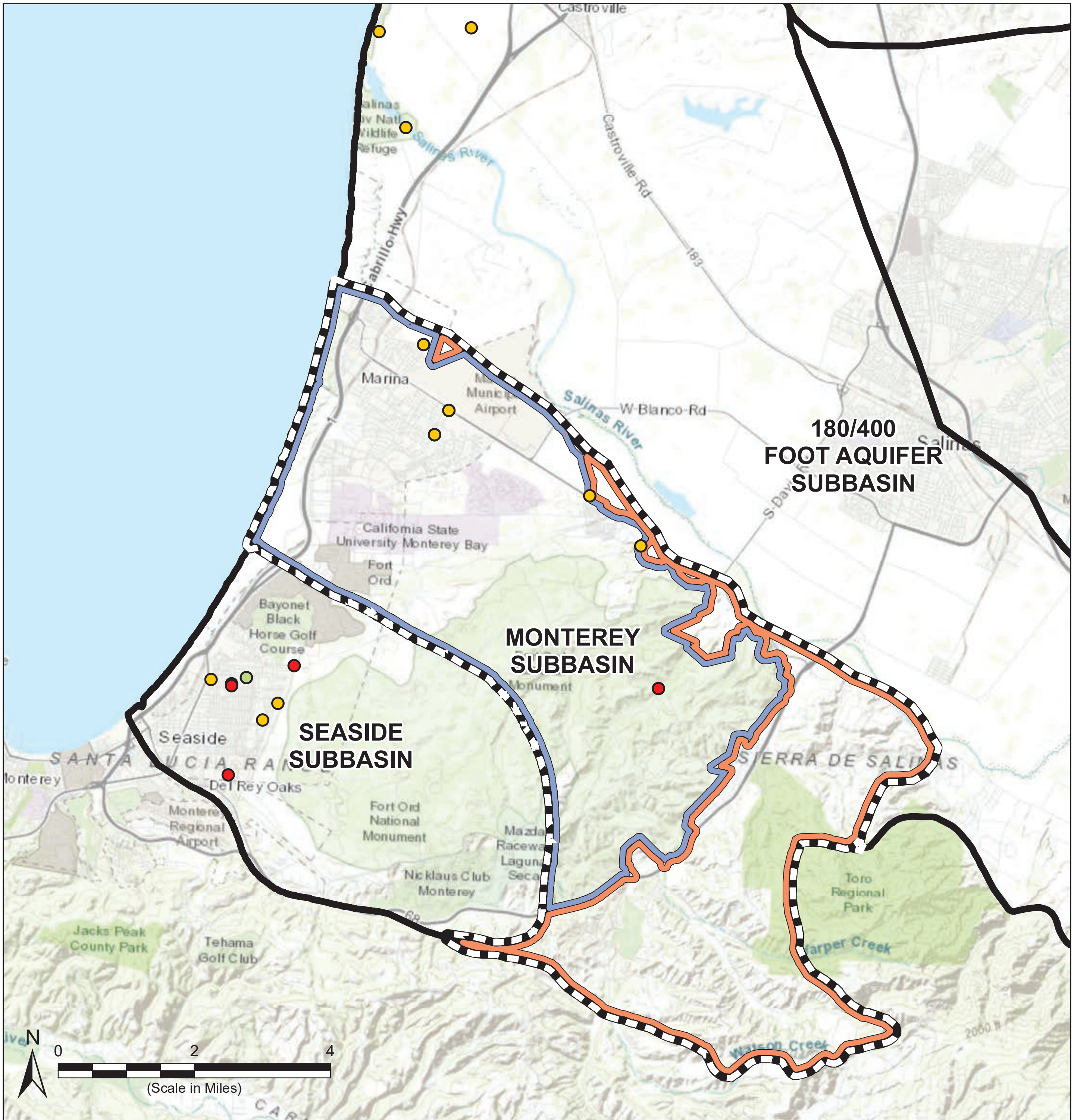
Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 December 2020.
2. Transmissivities are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Transmissivities in the 180-Foot Aquifer and 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure 4A-7



Path: X:\B60094\Maps\2020\12\FigA4-8_Transmissivity_Deep.mxd

Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Transmissivity (ft^2/d)

- Less than 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 30,000
- Greater than 30,000

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

ft^2/d = square feet per day

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 December 2020.
2. Transmissivities are obtained from the sources below:
   HLA, 1994
   HLA, 1999
   MACTEC, 2006
   USACE, 2006
   USGS, 2002
   MCWD, 2019

Measured Transmissivities in the Deep Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
December 2020

Figure 4A-8

Appendix 5-A

Relationship between Total Dissolved Solids and Chloride in the Lower 180-Foot/400-Foot Aquifer in the Monterey Subbasin

Appendix 5-A
Relationship between Total Dissolved Solids and Chloride in the Lower 180-Foot/400-Foot Aquifer within the Monterey Subbasin

GSP Emergency Regulations require that (1) Seawater Intrusion minimum threshold to be established using a chloride concentration isocontour (§354.28 (c)(3)).and that (2) monitoring of Seawater Intrusion to be "using chloride concentrations, or other measurements convertible to chloride concentrations…" (§354.34 (c)(3)) The Monterey Subbasin Groundwater Sustainability Plan (GSP) intends to use total dissolved solids (TDS) concentration data as a proxy for determining seawater intrusion where chloride data is unavailable. Therefore, this memorandum examines historic chloride and TDS data within the seawater intruded lower 180-Foot/400-Foot Aquifer of the Monterey Subbasin and establishes a relationship between elevated TDS and chloride concentrations within this aquifer.

TDS and chloride data from wells that meet the following criteria within the Monterey Subbasin are selected for this analysis:

- Has at least 15 TDS and/or chloride measurements; and
- Is screened in the lower 180-Foot/400-Foot Aquifer.

A total of 71 wells met the criteria above. Within these 71 wells, this analysis compiled TDS and chloride concentrations that were sampled at each well during the same sampling event (i.e. "TDS-CL measurement pairs"). The distribution of the number of TDS-CL measurement pairs for these 71 wells are shown in Figure 5A-1 below. As shown on Figure 5A-1, there is an abundance of wells with TDS-CL measurement pairs.

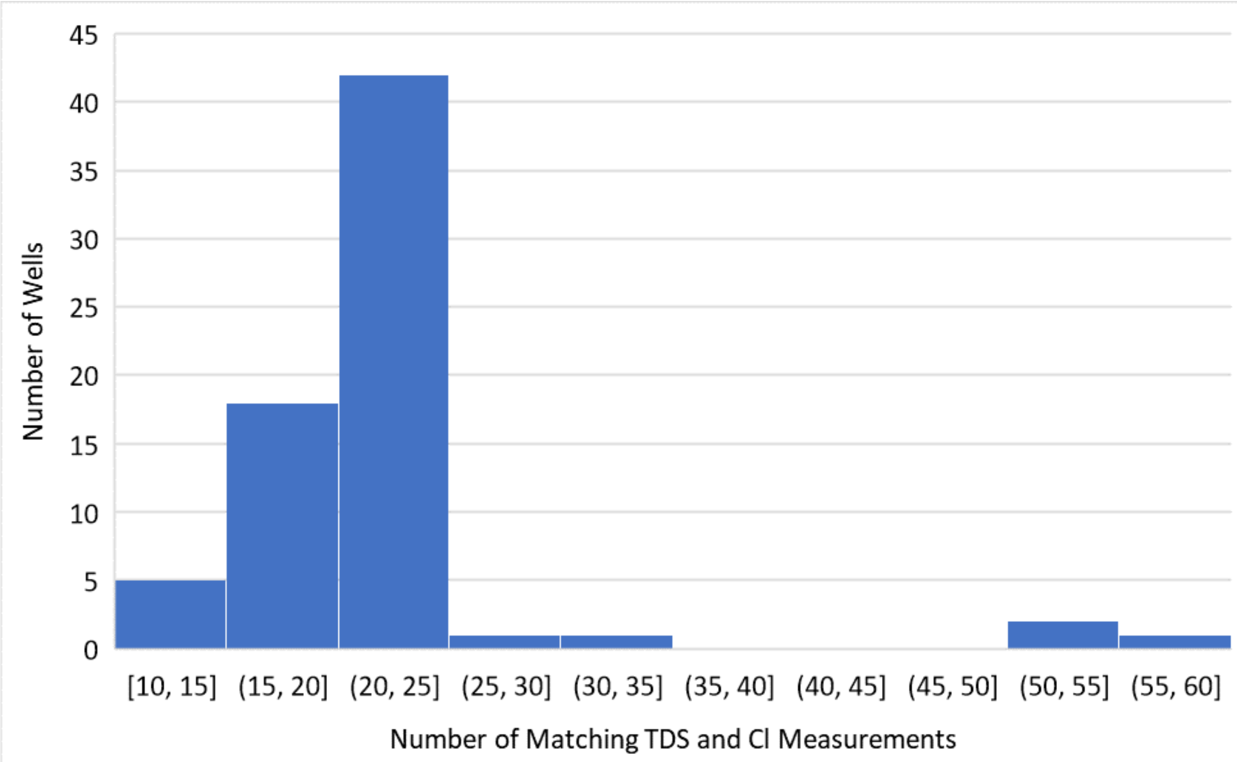


Figure 5A-1. Distribution of TDS-CL Measurement Pairs

Figure 5A-2 analyzes the temporal distribution of these TDS-CL measurement pairs. As shown on Figure 5A-2, very limited TDS-CL measurement pairs were collected beyond 2008, which is especially due to the lack of chloride data during this period. However, a large quantity of TDS-CL measurement pairs data was collected between 2002 and 2008.

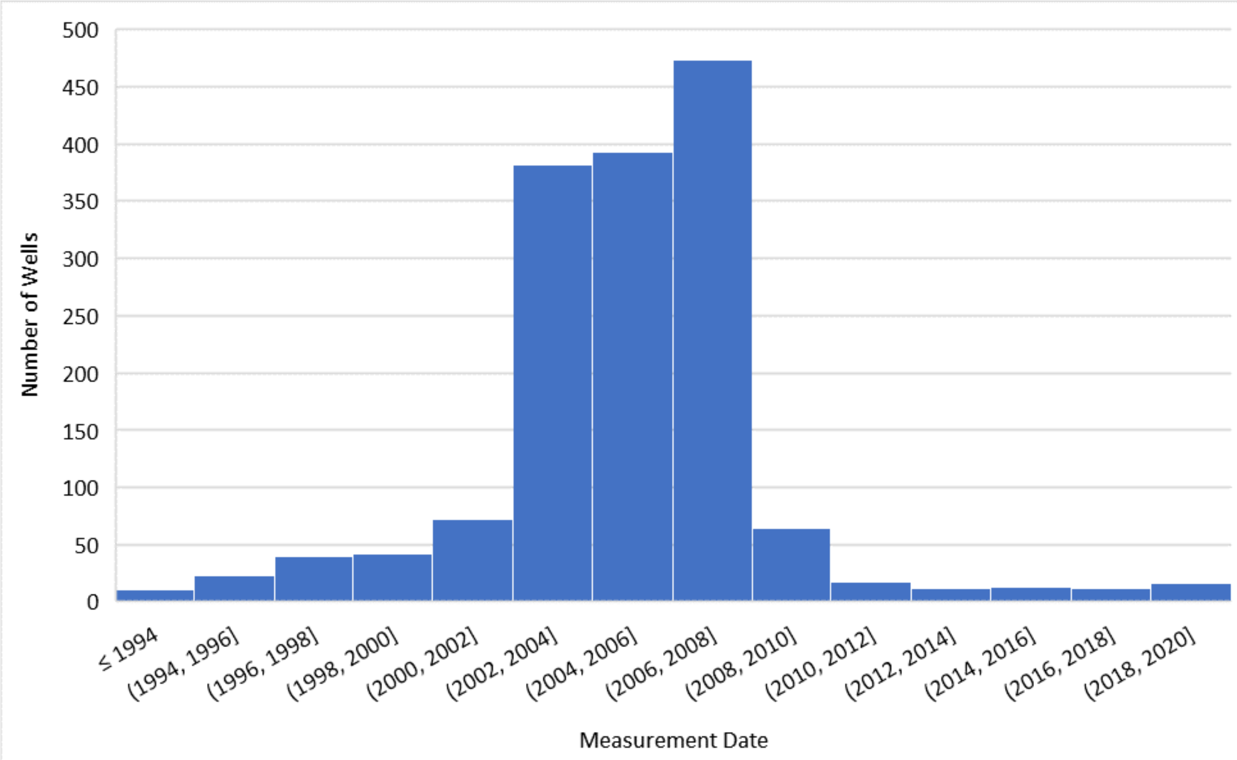


Figure 5A-2. Distribution of TDS-CL Measurement Dates

With the existing TDS-CL measurement pairs data, Figure 5A-3 shows a scatter plot of TDS and chloride concentrations[1] in lower 180-Foot/400-Foot Aquifer wells. As shown in Figure 5A-3 below, there is a strong positive linear relationship between chloride concentration and TDS concentration.

[1] Average concentrations were computed for wells that have duplicate measurements.

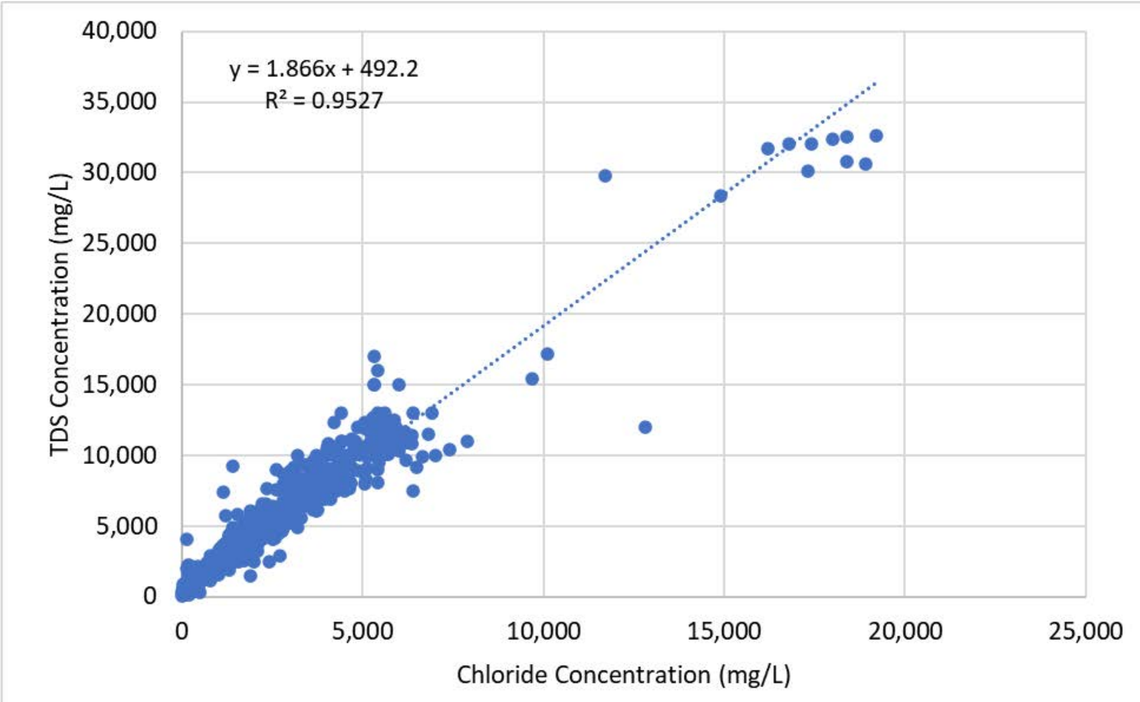


Figure 5A-3. TDS vs. Chloride Concentration, Linear Scale

To examine this relationship further, the below (Figure 5A-4) plots the TDS and chloride concentrations on a log-log scale. As shown on this graph, the TDS-chloride concentrations relationship weakens at very low (below 100 mg/L) chloride concentrations. This is consistent with the fact that a certain level of TDS is associated with other naturally occurring constituents. It appears that the natural TDS within this aquifer is low, at approximately 300 mg/L TDS. Increase in TDS concentrations above this level is strongly correlated to chloride concentration increases.

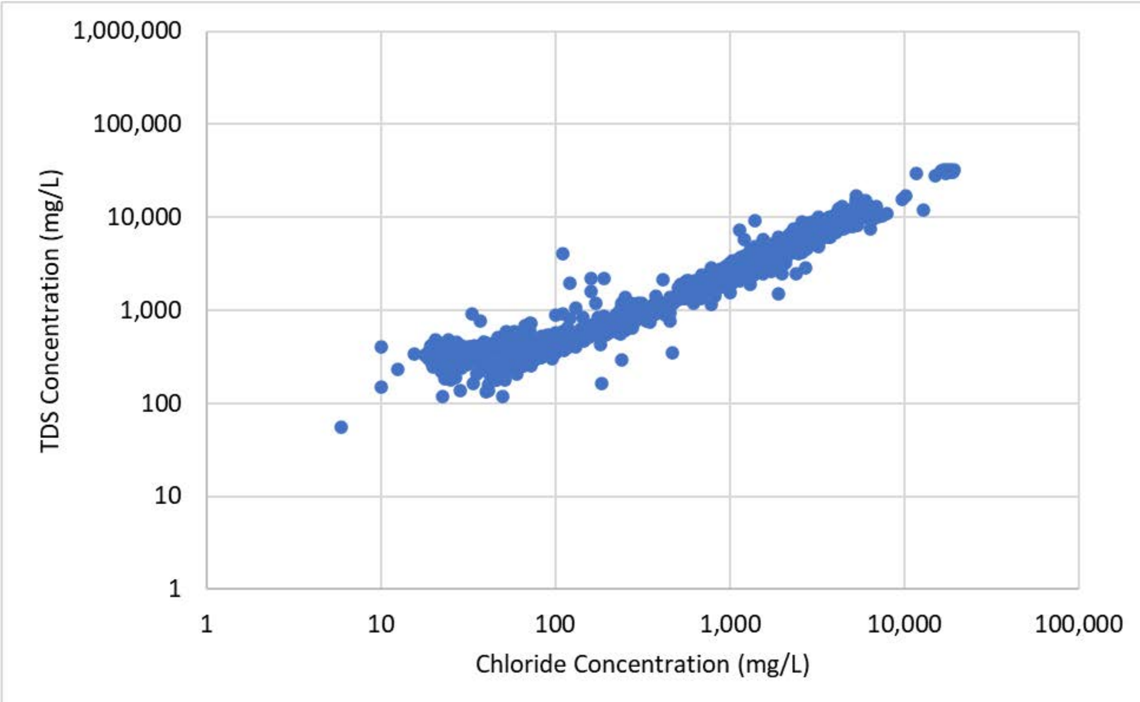


Figure 5A-4. TDS vs. Chloride Concentration, Log-Log Scale

Therefore, a trendline is fitted to these historic TDS-CL measurements within the lower 180-Foot/400-Foot Aquifer assuming a natural TDS at 300 mg/L (Figure 5A-5). The fitted relationship establishes a conversion between TDS and chloride concentration within this aquifer, and is as follows:

$$TDS\ (mg/L) = 1.91 \times Chloride\ (mg/L) + 300$$

The Monterey Subbasin GSP adopts a seawater intrusion definition at of 500 mg/L chloride. Based on this relationship, it can be concluded that (1) elevated TDS concentration that is significantly above 300 mg/L in the lower 180-Foot/400-Foot Aquifer is associated with increases in chloride concentration; and (2) a TDS concentration at approximately 1,250 mg/L in this aquifer is equivalent to a chloride concentration at 500 mg/L.

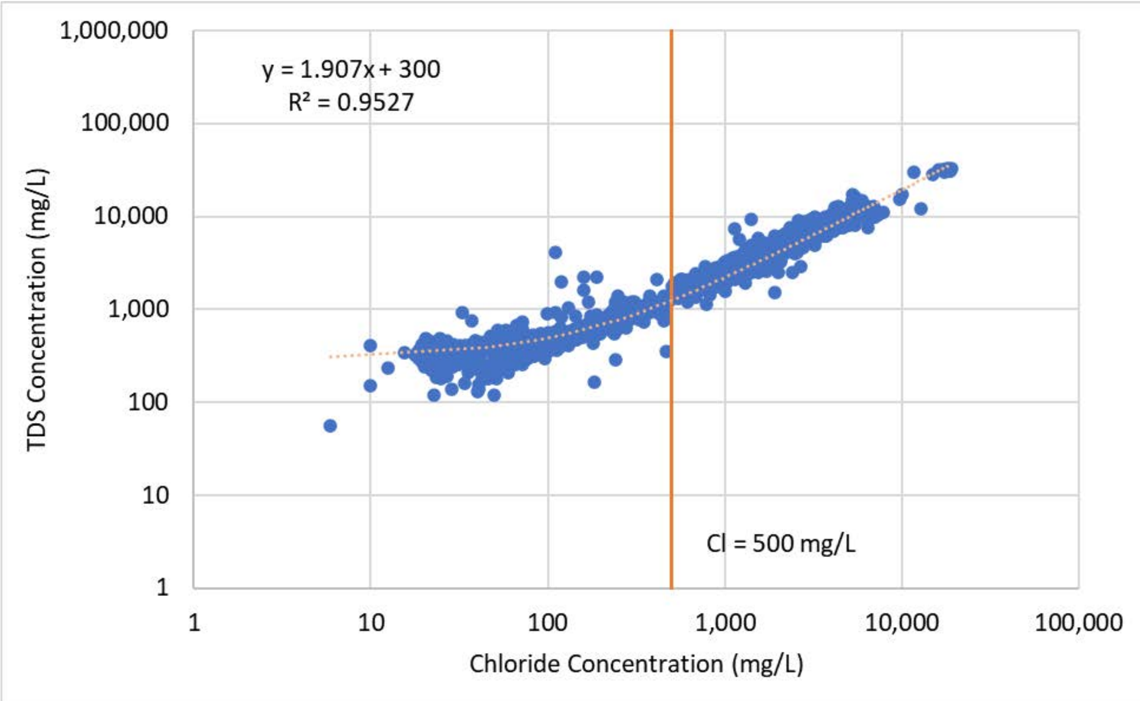
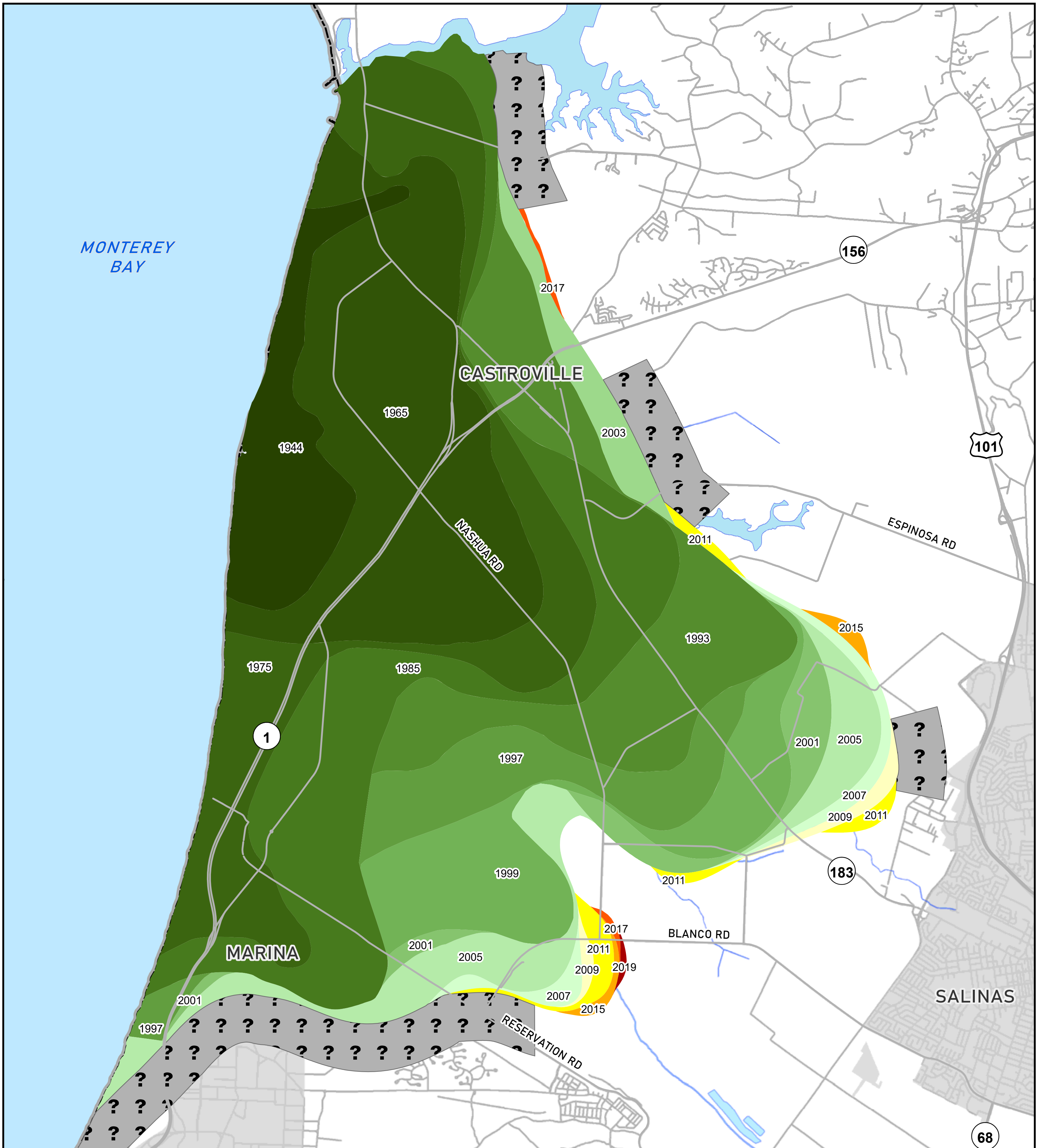


Figure 5A-5. TDS vs. Chloride Concentration, Log-Log Scale with Trendline

Appendix 5-B

MCWRA Seawater Intrusion Maps



Historical Seawater Intrusion Map

Pressure 180-Foot Aquifer

500 mg/L or Greater Chloride Areas

Sewater Intruded Areas By Year

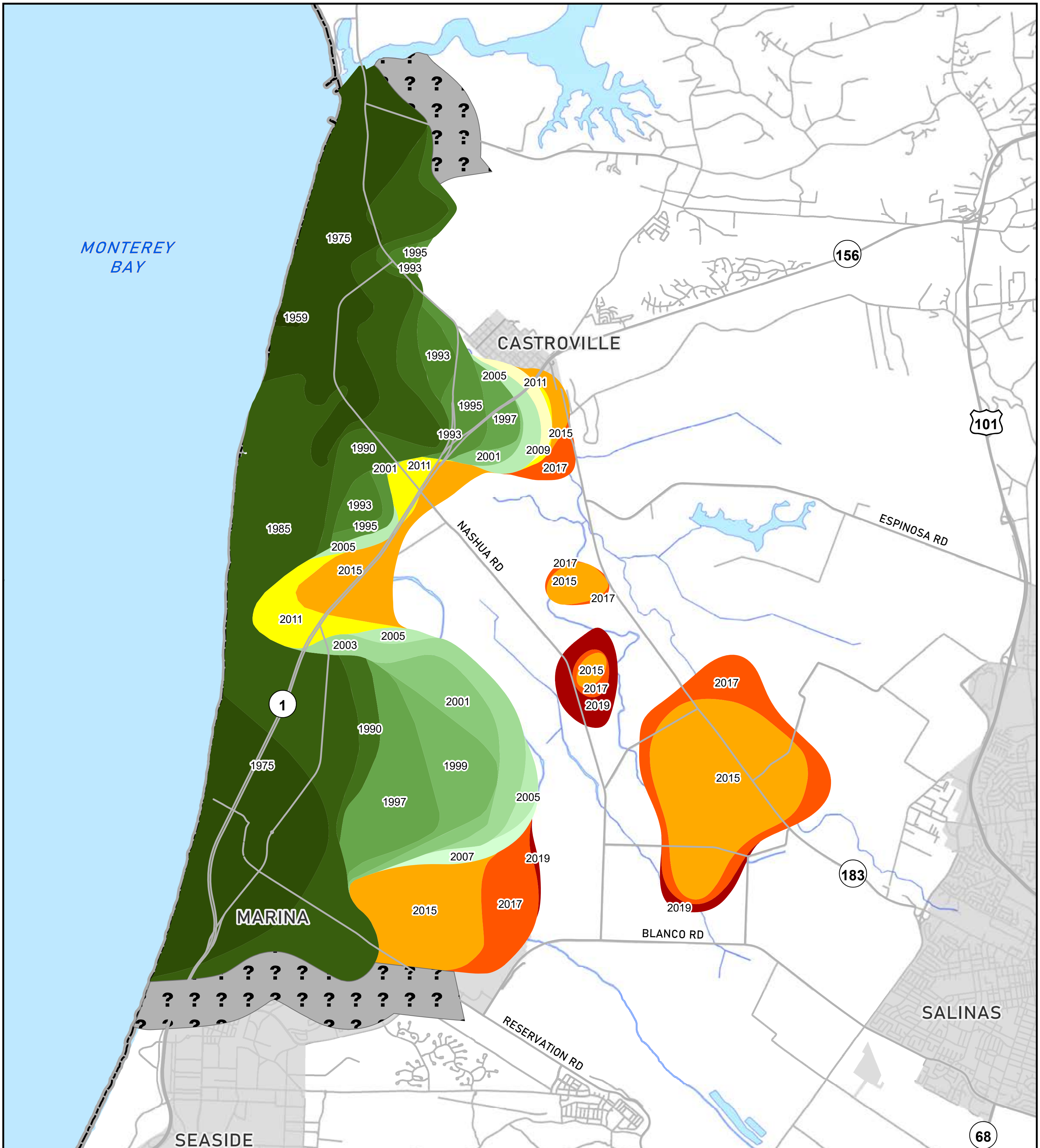
1944	1999	2009
1965	2001	2011/2013
1975	2003	2015
1985	2005	2017
1993	2007	2019
1997		No Data

N W E S

0 0.5 1 1.5 2 Miles

Monterey County Water Resources Agency

Date: 1/28/2020



Sewater Intruded Areas By Year

1959	1997	2009
1975	1999	2011/2013
1985	2001	2015
1990	2003	2017
1993	2005	2019
1995	2007	No Data

Historical Seawater Intrusion Map

Pressure 400-Foot Aquifer

500 mg/L or Greater Chloride Areas

N W E S

0 0.5 1 1.5 2 Miles

Monterey County Water Resources Agency

Date: 1/28/2020

Appendix 6-A

Supplemental Water Budget Tables and Figures

TABLE 6A-1

HISTORICAL ANNUAL GROUNDWATER BUDGET - MONTEREY SUBBASIN

Water Year (Oct-Sept)	DWR Water Year Type[(2)]	Recharge	Pumping	Net Cross-Boundary Flow (Presumed Freshwater)	Net Cross-Boundary Flow (Presumed Seawater)	Annual Change in Groundwater Storage [AFY]	Cumulative Change in Groundwater Storage [AF]
2004	BN	6,557	-6,466	-10,825	0	-10,734	-10,734
2005	W	18,022	-5,939	-9,049	0	3,034	-7,700
2006	W	19,069	-5,801	-9,715	0	3,553	-4,147
2007	D	2,136	-5,982	-9,955	0	-13,801	-17,948
2008	C	8,590	-5,535	-10,512	0	-7,456	-25,404
2009	BN	10,705	-5,404	-10,071	0	-4,771	-30,175
2010	AN	16,446	-5,499	-7,184	0	3,763	-26,412
2011	AN	12,259	-5,423	-6,794	0	42	-26,370
2012	BN	1,775	-5,480	-7,752	0	-11,457	-37,827
2013	C	5,135	-5,636	-7,665	0	-8,166	-45,993
2014	C	1,886	-6,354	-9,621	0	-14,090	-60,082
2015	D	6,935	-4,530	-8,631	0	-6,226	-66,308
2016	AN	15,095	-5,160	-9,815	0	120	-66,188
2017	W	23,486	-5,508	-9,288	0	8,690	-57,498
2018	AN	2,722	-5,900	-5,841	0	-9,019	-66,517
AVERAGE (AFY)	-	**10,055**	**-5,641**	**-8,848**	**0**	**-4,434**	-

Abbreviations

AF = acre-feet
AFY = acre-feet per year
DWR = California Department of Water Resources
WBZ = Water Budget Zone
WY = Water Year

DWR Water Year Type

(green)	= Wet
(light green)	= Above Normal
(light yellow)	= Below Normal
(light pink)	= Dry
(red)	= Critical

Notes:

(1) All values in acre-feet per year (AFY) unless otherwise noted.
(2) Water Year Types were developed from the DWR method defined in DWR, 2021 and are classified as follows: W = Wet, AN = Above Normal, BN = Below Normal, D = Dry, C = Critical. Colors indicate Water Year Type where green is wetter and red is drier.

Sources:

DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.

TABLE 6A-2

HISTORICAL ANNUAL GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Water Year (Oct-Sept)	DWR Water Year Type[3]	Recharge	Pumping	Net Cross-Boundary Flow (Presumed Freshwater)	Net Cross-Boundary Flow (Presumed Seawater)	Net Corral de Tierra Exchange	Annual Change in Groundwater Storage [AFY]	Cumulative Change in Groundwater Storage [AF]
2004	BN	3,268	-5,414	-5,742	0	1,604	-6,284	-6,284
2005	W	11,243	-4,886	-4,232	0	1,604	3,730	-2,554
2006	W	12,038	-4,748	-5,112	0	1,592	3,769	1,215
2007	D	1,099	-4,929	-5,462	0	1,633	-7,659	-6,444
2008	C	4,599	-4,482	-5,848	0	1,607	-4,123	-10,568
2009	BN	6,723	-4,351	-5,678	0	1,520	-1,786	-12,354
2010	AN	10,384	-4,446	-3,514	0	1,646	4,070	-8,284
2011	AN	7,471	-4,369	-3,648	0	1,706	1,159	-7,125
2012	BN	1,023	-4,427	-4,241	0	1,649	-5,997	-13,122
2013	C	2,780	-4,584	-4,109	0	1,592	-4,321	-17,443
2014	C	1,040	-4,534	-5,804	0	1,426	-7,873	-25,316
2015	D	4,433	-3,606	-5,266	0	1,465	-2,974	-28,289
2016	AN	9,398	-3,278	-6,160	0	1,283	1,244	-27,046
2017	W	15,176	-3,417	-5,885	0	1,212	7,087	-19,959
2018	AN	1,489	-3,712	-3,924	0	1,628	-4,519	-24,478
AVERAGE (AFY)	**-**	**6,144**	**-4,346**	**-4,975**	**0**	**1,544**	**-1,632**	**-**

Abbreviations

AF = acre-feet
AFY = acre-feet per year
DWR = California Department of Water Resources
WBZ = Water Budget Zone
WY = Water Year

DWR Water Year Type

= Wet
= Above Normal
= Below Normal
= Dry
= Critical

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.
(2) All values in acre-feet per year (AFY) unless otherwise noted.
(3) Water Year Types were developed from the DWR method defined in DWR, 2021 and are classified as follows: W = Wet, AN = Above Normal, BN = Below Normal, D = Dry, C = Critical. Colors indicate Water Year Type where green is wetter and red is drier.

Sources:

DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.

TABLE 6A-3

HISTORICAL ANNUAL GROUNDWATER BUDGET - CORRAL DE TIERRA AREA WATER BUDGET ZONE[1]

Water Year (Oct-Sept)	DWR Water Year Type[3]	Recharge	Pumping	Net Cross-Boundary Flow (Presumed Freshwater)	Net Cross-Boundary Flow (Presumed Seawater)	Net Marina-Ord Exchange	Annual Change in Groundwater Storage [AFY]	Cumulative Change in Groundwater Storage [AF]
2004	BN	3,289	-1,053	-5,083	0	-1,604	-4,450	-4,450
2005	W	6,779	-1,053	-4,818	0	-1,604	-696	-5,146
2006	W	7,031	-1,053	-4,603	0	-1,592	-216	-5,362
2007	D	1,037	-1,053	-4,493	0	-1,633	-6,141	-11,504
2008	C	3,991	-1,053	-4,664	0	-1,607	-3,333	-14,837
2009	BN	3,982	-1,053	-4,393	0	-1,520	-2,984	-17,821
2010	AN	6,062	-1,053	-3,670	0	-1,646	-306	-18,127
2011	AN	4,789	-1,053	-3,146	0	-1,706	-1,117	-19,244
2012	BN	752	-1,053	-3,511	0	-1,649	-5,461	-24,705
2013	C	2,355	-1,052	-3,556	0	-1,592	-3,845	-28,550
2014	C	846	-1,820	-3,817	0	-1,426	-6,217	-34,767
2015	D	2,502	-924	-3,366	0	-1,465	-3,252	-38,019
2016	AN	5,696	-1,881	-3,656	0	-1,283	-1,124	-39,143
2017	W	8,310	-2,092	-3,403	0	-1,212	1,604	-37,539
2018	AN	1,233	-2,188	-1,917	0	-1,628	-4,500	-42,039
AVERAGE (AFY)	**-**	**3,910**	**-1,296**	**-3,873**	**0**	**-1,544**	**-2,803**	**-**

Abbreviations

AF = acre-feet
AFY = acre-feet per year
DWR = California Department of Water Resources
WBZ = Water Budget Zone
WY = Water Year

DWR Water Year Type

= Wet
= Above Normal
= Below Normal
= Dry
= Critical

Notes:

(1) Corral de Tierra Area WBZ excludes the Reservation Road portion of the Corral de Tierra Management Area.
(2) All values in acre-feet per year (AFY) unless otherwise noted.
(3) Water Year Types were developed from the DWR method defined in DWR, 2021 and are classified as follows: W = Wet, AN = Above Normal, BN = Below Normal, D = Dry, C = Critical. Colors indicate Water Year Type where green is wetter and red is drier.

Sources:

DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.

TABLE 6A-4
HISTORICAL ANNUAL LAND SURFACE BUDGET - MONTEREY SUBBASIN

Water Year (Oct-Sept)	INFLOWS (AFY)				OUTFLOWS (AFY)						Change in Root Zone Storage (AFY)[d]
	Precipitation	Applied Water[b]	Leakage from Conveyance Systems [c]	TOTAL INFLOWS	Actual Evapotranspiration			Runoff	Recharge to Groundwater	TOTAL OUTFLOWS	
					Agricultural	Urban	Native				
2004	33,322	1,823	170	**35,315**	1,622	3,938	21,459	1,670	6,631	**35,320**	-4
2005	57,641	1,595	159	**59,395**	1,674	5,993	31,035	2,317	18,187	**59,206**	189
2006	52,700	1,343	142	**54,185**	1,410	5,130	26,649	1,521	19,243	**53,953**	232
2007	27,294	1,607	131	**29,031**	1,563	3,714	21,308	457	2,165	**29,206**	-175
2008	32,568	1,761	227	**34,556**	1,339	3,803	19,193	1,540	8,685	**34,560**	-4
2009	37,857	1,884	253	**39,994**	1,520	4,390	22,300	923	10,812	**39,946**	48
2010	53,817	1,715	253	**55,785**	1,464	5,180	29,400	2,923	16,597	**55,563**	222
2011	48,661	1,785	249	**50,695**	1,556	5,955	29,180	1,546	12,386	**50,623**	73
2012	30,385	2,161	251	**32,797**	1,794	4,161	24,417	802	1,794	**32,968**	-170
2013	28,578	2,017	258	**30,854**	1,580	3,668	19,050	1,340	5,194	**30,831**	23
2014	21,564	2,134	255	**23,953**	1,640	3,065	16,755	492	1,908	**23,861**	92
2015	33,237	1,853	201	**35,291**	1,549	3,570	19,983	3,170	7,006	**35,279**	12
2016	49,915	1,719	183	**51,818**	1,641	5,404	27,441	2,010	15,236	**51,731**	87
2017	60,649	1,741	200	**62,590**	1,672	5,498	29,130	2,492	23,685	**62,478**	112
2018	29,819	1,911	218	**31,948**	1,620	3,881	22,443	1,286	2,753	**31,982**	-34
AVERAGE	39,867	1,803	210	**41,881**	1,576	4,490	23,983	1,632	10,152	**41,834**	47
%	95%	4%	1%	--	4%	11%	57%	4%	24%	--	--

Abbreviations

AFY = acre-feet per year
WY = Water Year

Notes

(a) All values reported in acre-feet per year (AFY).
(b) Applied water includes deliveries from local water agencies and private groundwater used for irrigation.
(c) Leakage from water conveyance systems is assumed to contribute directly to groundwater recharge.
(d) Change in root zone storage calculated as the difference between inflows and outflows.

TABLE 6A-5

HISTORICAL ANNUAL LAND SURFACE BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[a]

Water Year (Oct-Sept)	INFLOWS (AFY)				OUTFLOWS (AFY)						Change in Root Zone Storage (AFY)[e]
	Precipitation	Applied Water[c]	Leakage from Conveyance Systems [d]	TOTAL INFLOWS	Actual Evapotranspiration			Runoff	Recharge to Groundwater	TOTAL OUTFLOWS	
					Agricultural	Urban	Native				
2004	20,394	1,017	113	**21,525**	907	2,727	13,709	868	3,315	**21,526**	-1
2005	36,519	933	113	**37,565**	971	4,183	19,641	1,326	11,343	**37,464**	101
2006	33,751	752	93	**34,597**	816	3,634	17,058	857	12,140	**34,505**	91
2007	17,106	896	80	**18,082**	892	2,517	13,340	237	1,119	**18,104**	-22
2008	19,973	1,097	178	**21,249**	752	2,744	12,358	725	4,658	**21,237**	12
2009	24,203	1,168	203	**25,574**	868	3,121	14,227	525	6,789	**25,529**	45
2010	34,322	1,090	208	**35,619**	838	3,691	18,784	1,703	10,476	**35,492**	127
2011	30,730	1,138	204	**32,072**	900	4,249	18,481	850	7,550	**32,030**	42
2012	19,323	1,360	207	**20,890**	1,041	2,896	15,522	439	1,039	**20,937**	-48
2013	18,064	1,258	215	**19,537**	888	2,639	12,444	728	2,817	**19,516**	21
2014	13,560	1,347	212	**15,120**	948	2,139	10,651	249	1,056	**15,045**	75
2015	21,187	1,127	166	**22,481**	879	2,507	12,681	1,926	4,479	**22,473**	8
2016	31,814	1,022	150	**32,986**	929	3,861	17,466	1,179	9,484	**32,920**	66
2017	38,922	1,031	157	**40,109**	952	3,885	18,520	1,409	15,293	**40,058**	51
2018	18,980	1,151	171	**20,302**	926	2,702	14,382	754	1,513	**20,276**	25
AVERAGE	25,257	1,093	165	**26,514**	900	3,166	15,284	918	6,205	**26,474**	40
%	95%	4%	1%	--	3%	12%	58%	3%	23%	--	--

Abbreviations

AFY = acre-feet per year
WBZ = Water Budget Zone
WY = Water Year

Notes

(a) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.
(b) All values reported in acre-feet per year (AFY).
(c) Applied water includes deliveries from local water agencies and private groundwater used for irrigation.
(d) Leakage from water conveyance systems is assumed to contribute directly to groundwater recharge.
(e) Change in root zone storage calculated as the difference between inflows and outflows.

TABLE 6A-6

HISTORICAL ANNUAL LAND SURFACE BUDGET - CORRAL DE TIERRA AREA WATER BUDGET ZONE[(a)]

Water Year (Oct-Sept)	INFLOWS (AFY)				OUTFLOWS (AFY)						Change in Root Zone Storage (AFY)[(e)]
	Precipitation	Applied Water[(c)]	Leakage from Conveyance Systems [(d)]	TOTAL INFLOWS	Actual Evapotranspiration			Runoff	Recharge to Groundwater	TOTAL OUTFLOWS	
					Agricultural	Urban	Native				
2004	12,928	805	57	**13,791**	715	1,210	7,750	802	3,316	**13,794**	-3
2005	21,122	662	47	**21,830**	703	1,810	11,395	991	6,844	**21,742**	89
2006	18,948	591	49	**19,588**	594	1,497	9,592	664	7,102	**19,448**	141
2007	10,188	711	51	**10,949**	671	1,197	7,969	220	1,046	**11,102**	-152
2008	12,594	664	49	**13,307**	586	1,060	6,835	815	4,027	**13,324**	-16
2009	13,654	716	50	**14,420**	653	1,269	8,074	398	4,023	**14,417**	4
2010	19,496	625	45	**20,166**	626	1,488	10,616	1,220	6,121	**20,071**	95
2011	17,931	647	45	**18,623**	656	1,706	10,699	696	4,836	**18,592**	31
2012	11,062	801	44	**11,908**	753	1,265	8,895	363	755	**12,031**	-123
2013	10,514	758	44	**11,317**	692	1,028	6,606	612	2,377	**11,315**	1
2014	8,004	787	43	**8,834**	692	926	6,104	243	852	**8,817**	17
2015	12,050	726	35	**12,810**	670	1,063	7,302	1,244	2,527	**12,806**	4
2016	18,101	697	34	**18,832**	712	1,543	9,975	830	5,751	**18,811**	21
2017	21,728	710	43	**22,481**	720	1,614	10,610	1,083	8,392	**22,421**	60
2018	10,839	760	47	**11,646**	694	1,179	8,061	532	1,240	**11,705**	-59
AVERAGE	14,611	711	45	**15,367**	676	1,324	8,699	714	3,947	**15,360**	7
%	95%	5%	0%	--	4%	9%	57%	5%	26%	--	--

Abbreviations

AFY = acre-feet per year
WBZ = Water Budget Zone
WY = Water Year

Notes

(a) Corral de Tierra Area WBZ excludes the Reservation Road portion of the Corral de Tierra Management Area.
(b) All values reported in acre-feet per year (AFY).
(c) Applied water includes deliveries from local water agencies and private groundwater used for irrigation.
(d) Leakage from water conveyance systems is assumed to contribute directly to groundwater recharge.
(e) Change in root zone storage calculated as the difference between inflows and outflows.

Table 6A-7. Comparison of Projected Water Budget Results Under “No Project” Scenarios with Variable Climate Conditions and Measurable Objective Boundary Conditions, Marina-Ord Area

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows (b) Measurable Objective Boundary Conditions		
		Baseline Climate Conditions	2030 Climate Conditions	2070 Climate Conditions
Recharge				
● Rainfall, leakage, irrigation	6,144	6,356	6,823	7,509
	6,144	**6,356**	**6,823**	**7,509**
Well Pumping				
● Well Pumping	-4,346	-8,767	-8,767	-8,767
	-4,346	**-8,767**	**-8,767**	**-8,767**
Net Inter-Basin Flow				
● Seaside Subbasin	1,310	1,589	1,361	1,033
● 180/400 Foot Aquifer Subbasin	-8,633	-1,694	-1,927	-2,306
● Ocean (Presumed Freshwater)	-524	-721	-752	-804
● Ocean (Presumed Seawater)	2,872	2,288	2,369	2,534
	-4,975	**1,461**	**1,051**	**457**
Net Intra-basin Flow				
● From Corral de Tierra Area WBZ	1,544	998	1,026	1,063
	1,544	**998**	**1,026**	**1,063**
Net Surface Water Exchange				
● Salinas River Exchange	0	0	0	0
	0	**0**	**0**	**0**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-1,632**	**49**	**133**	**262**

Abbreviations:

AFY = acre-feet per year
WBZ = Water Budget Zone
WY = Water Year

Notes:

(a) The Marina-Ord Area Zone Budget includes inflows to and outflows from the Reservation Road portion of the Corral de Tierra Management Area.
(b) Positive values indicate a net inflow and negative values indicate a net outflow.

Table 6A-8. Comparison of Projected Water Budget Results Under "No Project" Scenarios with Variable Conditions and Measurable Objective Boundary Conditions, Corral de Tierra Area

Net Annual Groundwater Flows (a) (AFY)	Historical Annual Inflows/Outflows (WY 2004-2018)	Projected Annual Inflows/Outflows (b) Measurable Objective Boundary Conditions		
		Baseline Climate Conditions	2030 Climate Conditions	2070 Climate Conditions
Recharge				
● Rainfall, leakage, irrigation	3,910	3,796	4,105	4,443
	3,910	**3,796**	**4,105**	**4,443**
Well Pumping				
● Well Pumping	-1,296	-2,188	-2,188	-2,189
	-1,296	**-2,188**	**-2,188**	**-2,189**
Net Inter-Basin Flow				
● Seaside Subbasin	-392	-62	-103	-148
● 180/400 Foot Aquifer Subbasin	-3,632	-1,376	-1,485	-1,595
	-4,024	**-1,438**	**-1,588**	**-1,743**
Net Intra-basin Flow				
● From Marina-Ord Area WBZ	-1,544	-998	-1,026	-1,063
	-1,544	**-998**	**-1,026**	**-1,063**
Net Surface Water Exchange				
● Salinas River Exchange	151	259	254	249
	151	**259**	**254**	**249**
NET ANNUAL CHANGE IN GROUNDWATER STORAGE	**-2,803**	**-569**	**-443**	**-303**

Abbreviations:

AFY = acre-feet per year
WBZ = Water Budget Zone
WY = Water Year

Notes:

(a) The Corral de Tierra Area Zone Budget does not include inflows to and outflows from the Reservation Road portion of the Corral de Tierra Management Area
(b) Positive values indicate a net inflow and negative values indicate a net outflow.

TABLE 6A-A

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: 2030 Climate, no projects, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS[2]	**Dune Sand**	**Upper 180-Foot**	**Lower 180-Foot**	**400-Foot**	**Deep**	**TOTAL**
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)[3]	0	0	-2,752	-954	-5,060	-8,767
Net Cross-Boundary Flows (AFY)	-1,167	-472	649	3,160	-94	2,078
Seaside Subbasin	*-19*	*-2*	*-3*	*1,764*	*-380*	*1,361*
180/400 Subbasin	*-396*	*-598*	*245*	*-200*	*-979*	*-1,927*
Corral de Tierra WBZ	*0*	*0*	*0*	*-206*	*1,232*	*1,026*
Ocean	*-752*	*128*	*407*	*1,802*	*32*	*1,617*
Presumed Freshwater	*-752*	*0*	*0*	*0*	*0*	*-752*
Presumed Seawater	*0*	*128*	*407*	*1,802*	*32*	*2,369*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,017	2,183	102	3,927	8,228
Underlying Unit Exchange (AFY)	-1,996	-2,138	-71	-3,927	0	-8,132

CHANGE IN GROUNDWATER STORAGE	**Dune Sand**	**Upper 180-Foot**	**Lower 180-Foot**	**400-Foot**	**Deep**	**TOTAL**
ANNUAL AVERAGE (AFY)	**63**	**56**	**8**	**145**	**-43**	**230**
50-YEAR CUMULATIVE (AF)	*952*	*841*	*122*	*2,174*	*-638*	*3,451*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MO = Measurable Objectives

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-B

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[(1)]

Scenario: 2030 Climate, no projects, MT boundary conditions

NET ANNUAL GROUNDWATER FLOWS[(2)]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)[(3)]	0	0	-2,752	-954	-5,060	-8,767
Net Cross-Boundary Flows (AFY)	-1,121	-624	493	2,959	95	1,801
Seaside Subbasin	*-16*	*-1*	*-2*	*2,632*	*-101*	*2,513*
180/400 Subbasin	*-380*	*-900*	*-17*	*-1,547*	*-1,004*	*-3,849*
Corral de Tierra WBZ	*0*	*0*	*0*	*-238*	*1,161*	*923*
Ocean	*-725*	*276*	*512*	*2,112*	*38*	*2,214*
Presumed Freshwater	*-725*	*0*	*0*	*0*	*0*	*-725*
Presumed Seawater	*0*	*276*	*512*	*2,112*	*38*	*2,939*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,094	2,140	-92	3,653	7,795
Underlying Unit Exchange (AFY)	-2,052	-2,109	118	-3,653	0	-7,697

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**52**	**9**	**-1**	**23**	**-128**	**-44**
50-YEAR CUMULATIVE (AF)	*787*	*128*	*-10*	*347*	*-1,919*	*-667*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MT = Minimum Thresholds

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-C

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: 2030 Climate, no projects, seawater intrusion protective boundary conditions

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)[3]	0	0	-2,752	-954	-5,060	-8,767
Net Cross-Boundary Flows (AFY)	-1,227	-492	1,247	3,546	-752	2,323
Seaside Subbasin	*-24*	*-3*	*-4*	*454*	*-770*	*-347*
180/400 Subbasin	*-409*	*-350*	*1,042*	*2,084*	*-1,196*	*1,171*
Corral de Tierra WBZ	*0*	*0*	*0*	*-208*	*1,193*	*985*
Ocean	*-794*	*-138*	*209*	*1,216*	*21*	*514*
Presumed Freshwater	*-794*	*0*	*0*	*0*	*0*	*-794*
Presumed Seawater	*0*	*-138*	*209*	*1,216*	*21*	*1,308*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,922	2,090	609	4,676	9,298
Underlying Unit Exchange (AFY)	-1,920	-1,987	-565	-4,676	0	-9,148

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**79**	**92**	**20**	**290**	**48**	**529**
50-YEAR CUMULATIVE (AF)	*1,186*	*1,382*	*294*	*4,347*	*722*	*7,931*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-D

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE(1)

Scenario: 2030 Climate, with projects, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS(2)	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)(3)	0	0	-1,364	-476	-2,648	-4,488
Net Cross-Boundary Flows (AFY)	-1,183	-609	-261	623	-574	-2,005
Seaside Subbasin	*-21*	*-2*	*-3*	*1,173*	*-535*	*612*
180/400 Subbasin	*-398*	*-698*	*-590*	*-1,928*	*-1,287*	*-4,901*
Corral de Tierra WBZ	*0*	*0*	*0*	*-219*	*1,220*	*1,001*
Ocean	*-764*	*91*	*332*	*1,596*	*28*	*1,283*
Presumed Freshwater	*-764*	*0*	*0*	*0*	*0*	*-764*
Presumed Seawater	*0*	*91*	*332*	*1,596*	*28*	*2,047*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,994	1,932	286	2,017	6,228
Underlying Unit Exchange (AFY)	-1,976	-1,972	-293	-2,017	0	-6,257

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**67**	**61**	**14**	**180**	**-21**	**301**
50-YEAR CUMULATIVE (AF)	*1,005*	*911*	*210*	*2,696*	*-313*	*4,509*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MO = Measurable Objectives

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-E

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE(1)

Scenario: 2030 Climate, with projects, MT boundary conditions

NET ANNUAL GROUNDWATER FLOWS(2)	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)(3)	0	0	-1,364	-476	-2,648	-4,488
Net Cross-Boundary Flows (AFY)	-1,138	-761	-423	426	-384	-2,279
Seaside Subbasin	*-18*	*-2*	*-2*	*2,052*	*-253*	*1,776*
180/400 Subbasin	*-382*	*-999*	*-859*	*-3,280*	*-1,314*	*-6,833*
Corral de Tierra WBZ	*0*	*0*	*0*	*-251*	*1,149*	*898*
Ocean	*-738*	*239*	*438*	*1,906*	*34*	*1,879*
Presumed Freshwater	*-738*	*0*	*0*	*0*	*0*	*-738*
Presumed Seawater	*0*	*239*	*438*	*1,906*	*34*	*2,617*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,070	1,889	86	1,742	5,788
Underlying Unit Exchange (AFY)	-2,032	-1,945	-97	-1,742	0	-5,816

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**56**	**13**	**6**	**58**	**-106**	**27**
50-YEAR CUMULATIVE (AF)	*839*	*202*	*84*	*876*	*-1,591*	*410*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MT = Minimum Thresholds

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-F

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: 2030 Climate, with projects, seawater intrusion protective boundary conditi

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,226	648	0	1,764	1,184	6,823
Well Pumping (AFY)[3]	0	0	-1,364	-476	-2,648	-4,488
Net Cross-Boundary Flows (AFY)	-1,244	-630	340	1,006	-1,234	-1,762
Seaside Subbasin	*-26*	*-4*	*-4*	*-152*	*-928*	*-1,115*
180/400 Subbasin	*-411*	*-451*	*209*	*368*	*-1,503*	*-1,788*
Corral de Tierra WBZ	*0*	*0*	*0*	*-222*	*1,180*	*958*
Ocean	*-806*	*-175*	*135*	*1,011*	*17*	*182*
Presumed Freshwater	*-806*	*0*	*0*	*0*	*0*	*-806*
Presumed Seawater	*0*	*-175*	*135*	*1,011*	*17*	*989*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,899	1,840	798	2,768	7,305
Underlying Unit Exchange (AFY)	-1,900	-1,821	-791	-2,768	0	-7,280

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**83**	**97**	**25**	**324**	**70**	**598**
50-YEAR CUMULATIVE (AF)	*1,238*	*1,449*	*372*	*4,860*	*1,045*	*8,964*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-G

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: Baseline Climate, no projecs, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,020	605	0	1,627	1,104	6,356
Well Pumping (AFY)[3]	0	0	-2,752	-954	-5,060	-8,767
Net Cross-Boundary Flows (AFY)	-1,101	-439	660	3,348	-9	2,459
Seaside Subbasin	*-16*	*-2*	*-2*	*1,873*	*-265*	*1,589*
180/400 Subbasin	*-364*	*-556*	*273*	*-84*	*-962*	*-1,694*
Corral de Tierra WBZ	*0*	*0*	*0*	*-189*	*1,187*	*998*
Ocean	*-721*	*119*	*390*	*1,748*	*31*	*1,567*
Presumed Freshwater	*-721*	*0*	*0*	*0*	*0*	*-721*
Presumed Seawater	*0*	*119*	*390*	*1,748*	*31*	*2,288*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,916	2,076	7	3,889	7,888
Underlying Unit Exchange (AFY)	-1,887	-2,029	24	-3,889	0	-7,781

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**31**	**53**	**8**	**139**	**-76**	**156**
50-YEAR CUMULATIVE (AF)	*472*	*802*	*116*	*2,087*	*-1,142*	*2,334*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MO = Measurable Objectives

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-H

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: Baseline Climate, with projects, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,020	605	0	1,627	1,104	6,356
Well Pumping (AFY)[3]	0	0	-1,364	-476	-2,648	-4,488
Net Cross-Boundary Flows (AFY)	-1,118	-576	-250	810	-489	-1,623
Seaside Subbasin	*-18*	*-2*	*-3*	*1,283*	*-420*	*840*
180/400 Subbasin	*-366*	*-656*	*-563*	*-1,813*	*-1,271*	*-4,668*
Corral de Tierra WBZ	*0*	*0*	*0*	*-202*	*1,174*	*972*
Ocean	*-734*	*82*	*315*	*1,542*	*27*	*1,233*
Presumed Freshwater	*-734*	*0*	*0*	*0*	*0*	*-734*
Presumed Seawater	*0*	*82*	*315*	*1,542*	*27*	*1,966*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,893	1,825	192	1,979	5,889
Underlying Unit Exchange (AFY)	-1,867	-1,863	-198	-1,979	0	-5,908

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**35**	**58**	**14**	**174**	**-54**	**226**
50-YEAR CUMULATIVE (AF)	*523*	*873*	*204*	*2,609*	*-816*	*3,393*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MO = Measurable Objectives

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-I

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[(1)]

Scenario: 2070 Climate, no projects, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS[(2)]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,606	710	0	1,932	1,261	7,509
Well Pumping (AFY)[(3)]	0	0	-2,752	-954	-5,060	-8,767
Net Cross-Boundary Flows (AFY)	-1,293	-537	633	2,908	-191	1,521
Seaside Subbasin	*-25*	*-3*	*-3*	*1,576*	*-512*	*1,033*
180/400 Subbasin	*-464*	*-677*	*199*	*-363*	*-1,001*	*-2,306*
Corral de Tierra WBZ	*0*	*0*	*0*	*-225*	*1,289*	*1,063*
Ocean	*-804*	*143*	*437*	*1,920*	*34*	*1,730*
Presumed Freshwater	*-804*	*0*	*0*	*0*	*0*	*-804*
Presumed Seawater	*0*	*143*	*437*	*1,920*	*34*	*2,534*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,199	2,353	254	3,986	8,792
Underlying Unit Exchange (AFY)	-2,192	-2,312	-225	-3,986	0	-8,714

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**122**	**61**	**9**	**154**	**-4**	**341**
50-YEAR CUMULATIVE (AF)	*1,823*	*916*	*134*	*2,306*	*-62*	*5,117*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

MO = Measurable Objectives

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-J

AVERAGE ANNUAL PROJECTED GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

Scenario: 2070 Climate, with projects, MO boundary conditions

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,606	710	0	1,932	1,261	7,509
Well Pumping (AFY)[3]	0	0	-1,364	-476	-2,648	-4,488
Net Cross-Boundary Flows (AFY)	-1,310	-675	-277	371	-671	-2,562
Seaside Subbasin	*-27*	*-3*	*-4*	*985*	*-668*	*283*
180/400 Subbasin	*-466*	*-777*	*-636*	*-2,091*	*-1,309*	*-5,279*
Corral de Tierra WBZ	*0*	*0*	*0*	*-238*	*1,276*	*1,038*
Ocean	*-817*	*106*	*363*	*1,714*	*30*	*1,396*
Presumed Freshwater	*-817*	*0*	*0*	*0*	*0*	*-817*
Presumed Seawater	*0*	*106*	*363*	*1,714*	*30*	*2,213*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,176	2,101	437	2,075	6,790
Underlying Unit Exchange (AFY)	-2,171	-2,145	-446	-2,075	0	-6,837

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**125**	**66**	**15**	**188**	**17**	**411**
50-YEAR CUMULATIVE (AF)	*1,876*	*987*	*221*	*2,827*	*262*	*6,172*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet
AFY = acre-feet per year
DWR = California Department of Water Resources
MO = Measurable Objectives
WBZ = Water Budget Zone
WY = DWR Water Year (October - September)

TABLE 6A-K

AVERAGE ANNUAL CURRENT GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE[1]

DWR Water Years 2015 - 2018

NET ANNUAL GROUNDWATER FLOWS[2]	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	3,360	791	0	2,207	1,266	7,624
Well Pumping (AFY)[3]	0	0	-581	-198	-2,723	-3,503
Net Cross-Boundary Flows (AFY)	-855	-855	-935	-872	-394	-3,912
Seaside Subbasin	*-12*	*0*	*1*	*2,515*	*-788*	*1,715*
180/400 Subbasin	*-268*	*-1,344*	*-1,470*	*-5,204*	*-1,421*	*-9,707*
Corral de Tierra WBZ	*0*	*0*	*0*	*-379*	*1,776*	*1,397*
Ocean	*-574*	*489*	*534*	*2,196*	*39*	*2,684*
Presumed Freshwater	*-574*	*0*	*0*	*0*	*0*	*-574*
Presumed Seawater	*0*	*489*	*534*	*2,196*	*39*	*3,258*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	2,044	1,919	376	1,428	5,767
Underlying Unit Exchange (AFY)	-1,854	-2,029	-397	-1,428	0	-5,709

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**651**	**-48**	**5**	**83**	**-423**	**267**
WY 2004 - 2018 CUMULATIVE (AF)	*2,604*	*-194*	*18*	*334*	*-1,694*	*1,069*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 285 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)

TABLE 6A-L

AVERAGE ANNUAL HISTORICAL GROUNDWATER BUDGET - MARINA/ORD AREA WATER BUDGET ZONE(1)

DWR Water Years 2004 - 2018

NET ANNUAL GROUNDWATER FLOWS(2)	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
Recharge (AFY)	2,557	639	0	1,794	1,154	6,144
Well Pumping (AFY)(3)	0	0	-1,336	-467	-2,543	-4,346
Net Cross-Boundary Flows (AFY)	-886	-840	-656	-1,242	194	-3,431
Seaside Subbasin	*-13*	*0*	*0*	*2,268*	*-945*	*1,310*
180/400 Subbasin	*-349*	*-1,236*	*-1,115*	*-5,071*	*-861*	*-8,633*
Corral de Tierra WBZ	*0*	*0*	*0*	*-421*	*1,965*	*1,544*
Ocean	*-524*	*396*	*459*	*1,982*	*35*	*2,348*
Presumed Freshwater	*-524*	*0*	*0*	*0*	*0*	*-524*
Presumed Seawater	*0*	*396*	*459*	*1,982*	*35*	*2,872*
Salinas River Exchange (AFY)	0	0	0	0	0	0
Overlying Unit Exchange (AFY)	0	1,894	1,705	-273	276	3,602
Underlying Unit Exchange (AFY)	-1,595	-1,778	258	-276	0	-3,392

CHANGE IN GROUNDWATER STORAGE	Dune Sand	Upper 180-Foot	Lower 180-Foot	400-Foot	Deep	TOTAL
ANNUAL AVERAGE (AFY)	**76**	**-87**	**-29**	**-464**	**-918**	**-1,422**
WY 2004 - 2018 CUMULATIVE (AF)	*1,138*	*-1,299*	*-442*	*-6,963*	*-13,768*	*-21,334*

Notes:

(1) Marina/Ord Area WBZ includes the Reservation Road portion of the Corral de Tierra Management Area.

(2) All values in acre-feet per year (AFY) unless otherwise noted.

(3) Includes 287 AFY of pumping from the Reservation Road portion of the Corral de Tierra Management Area.

Abbreviations:

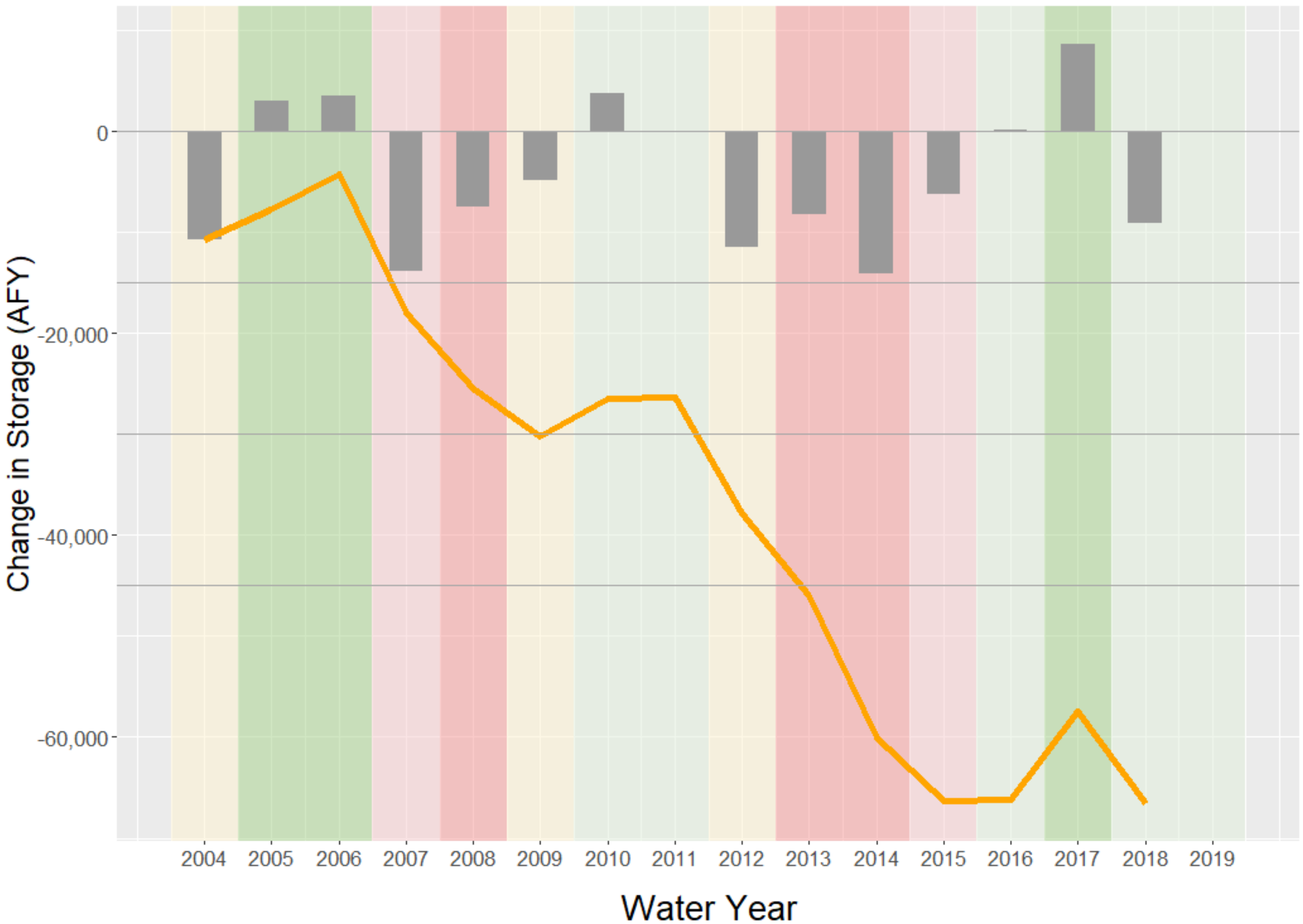
AF = acre-feet

AFY = acre-feet per year

DWR = California Department of Water Resources

WBZ = Water Budget Zone

WY = DWR Water Year (October - September)



Legend

Water Year Type

- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Annual Change in Storage

Cumulative Change in Storage

Abbreviations

AFY = acre-feet per year

DWR = California Department of Water Resources

Notes

1. All values reported in units of acre-feet per year (AFY).
1. Water Year Types were developed from the DWR method defined in DWR, 2021.

Sources

DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.

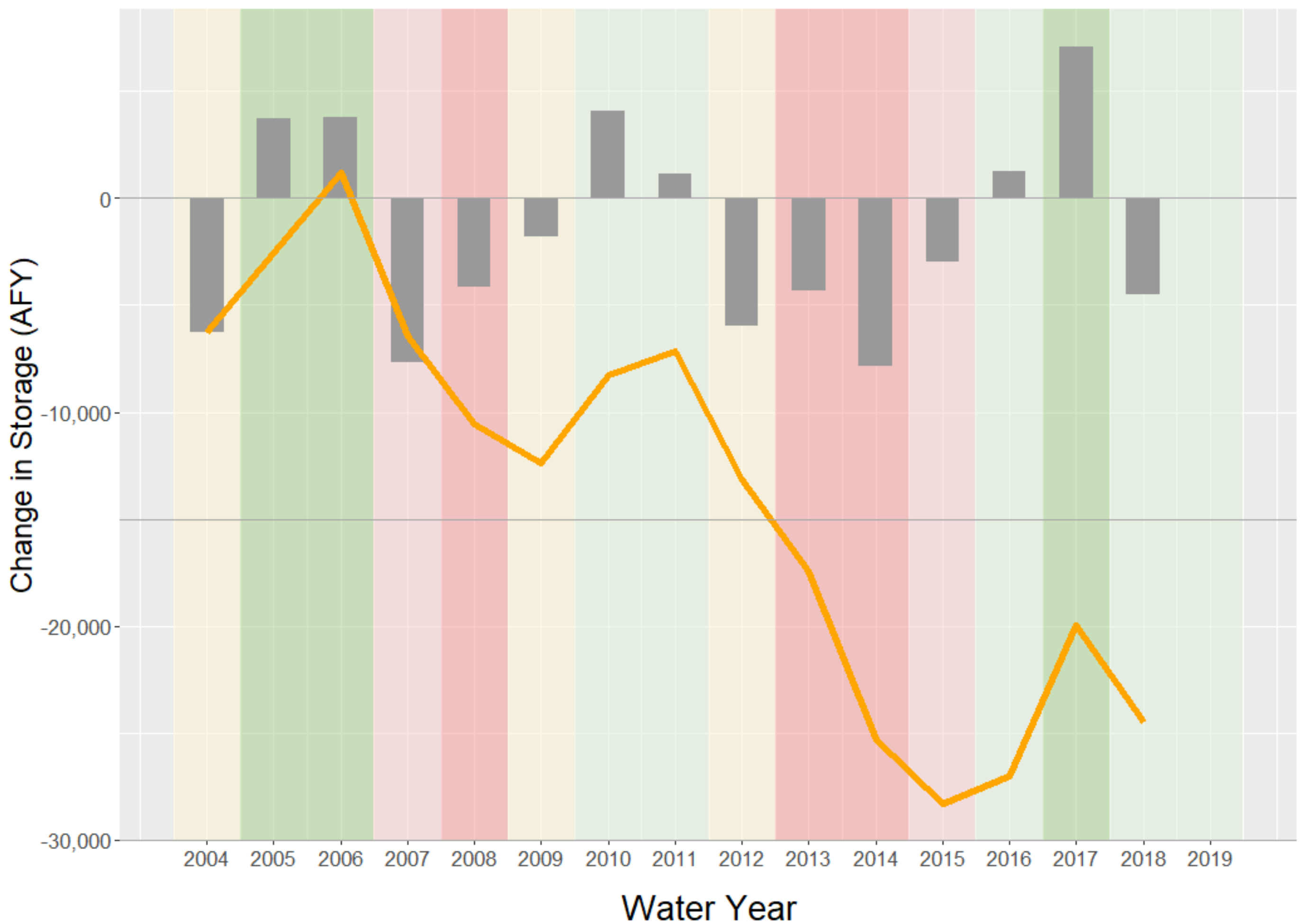
Monterey Subbasin Groundwater Flow Model (MBGWFM).

eki environment & water

Historical Annual and Cumulative Change in Groundwater Storage – Monterey Subbasin

Monterey Subbasin
Monterey Subbasin Sustainability Plan
January 2022

Figure 6A-1



Legend

Water Year Type
- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Annual Change in Storage

Cumulative Change in Storage

Abbreviations

AFY = acre-feet per year

DWR = California Department of Water Resources

Notes

1. All values reported in units of acre-feet per year (AFY).
1. Water Year Types were developed from the DWR method defined in DWR, 2021.

Sources

DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.

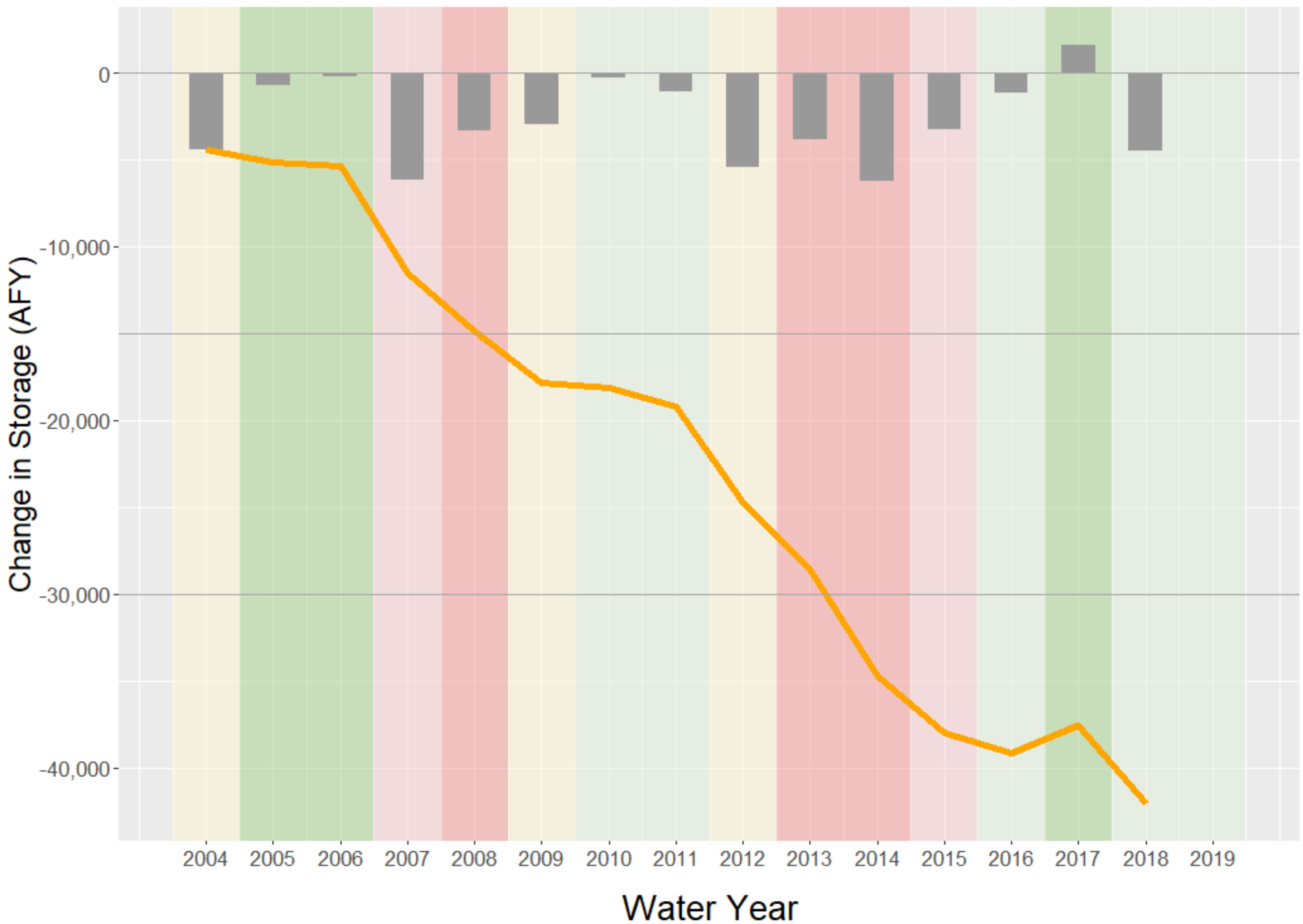
Monterey Subbasin Groundwater Flow Model (MBGWFM).

eki environment & water

Historical Annual and Cumulative Change in Groundwater Storage – Marina-Ord Area – Water Budge Zone

Monterey Subbasin
Monterey Subbasin Sustainability Plan
January 2022

Figure 6A-2



Legend

Water Year Type
- Wet
- Above Normal
- Below Normal
- Dry
- Critical

Annual Change in Storage

Cumulative Change in Storage

Abbreviations
AFY = acre-feet per year
DWR = California Department of Water Resources

Notes
1. All values reported in units of acre-feet per year (AFY).
1. Water Year Types were developed from the DWR method defined in DWR, 2021.

Sources
DWR, 2021. Sustainable Groundwater Management Act Water Year Type Dataset Development Report. 17pp.
Monterey Subbasin Groundwater Flow Model (MBGWFM).

eki environment & water

Historical Annual and Cumulative Change in Groundwater Storage – Corral de Tierra Area – Water Budget Zone

Monterey Subbasin
Monterey Subbasin Sustainability Plan
January 2022

Figure 6A-3

Appendix 6-B

Monterey Subbasin Groundwater Flow Model Documentation

MONTEREY SUBBASIN GROUNDWATER FLOW MODEL DOCUMENTATION

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

ABBREVIATIONS AND ACRONYMS

AF	acre-feet
AFY	acre-feet per year
BAS	MODFLOW Basic Package
CalVeg	USDA Forest Service Region 5 Classification and Assessment with Landsat of Visible Ecological Groupings
CCR	California Code of Regulations
CIMIS	California Irrigation Management Information System
CVHM	Central Valley Hydrologic Model
CWS	California Water Service
DEM	Digital Elevation Model
DWR	California Department of Water Resources
EKI	EKI Environment & Water, Inc.
ET	Evapotranspiration
ETo	Reference evapotranspiration
ft	feet
ft bgs	feet below ground surface
ft/d	feet per day
ft/yr	feet per year
GHB	MODFLOW General-Head Boundary Package
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HCM	Hydrogeological Conceptual Model
Kh	Horizontal Hydraulic Conductivity
Kv	Vertical Hydraulic Conductivity
MBGWFM	Monterey Subbasin Groundwater Flow Model
MCWD	Marina Coast Water District
MCWRA	Monterey County Water Resources Association
NMGWM	North Marina Groundwater Model
MT	Minimum Threshold
MO	Measurable Objective
PEST	Model-Independent Parameter Estimation and Uncertainty Analysis
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RCH	MODFLOW Recharge package
RIV	MODFLOW River package
RMSE	root mean square error
SMB	Soil moisture budget accounting model
Ss	Specific Storage
SSURGO	USDA Soil Survey Geographic Database

STR	MODFLOW Stream Package
SVBGSA	Salinas Valley Basin Groundwater Sustainability Agency
SVIHM	Salinas Valley Integrated Hydrologic Model
SWI	Seawater Intrusion
Sy	Specific Yield
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VIC	Variable Infiltration Capacity
WEL	MODFLOW Well Package
WY	Water Year

1. MODEL DEVELOPMENT OVERVIEW

The Monterey Subbasin Groundwater Flow Model (MBGWFM or "model") is an approximation of the spatial extent and variability of the groundwater system in the Monterey Subbasin (Basin) and can be used to quantitatively evaluate local hydrogeologic conditions associated with water inflows, outflows, and associated connectivity between the adjacent Seaside Subbasin, 180/400-Foot Aquifer Subbasin, and the Pacific Ocean. The purpose of the MBGWFM is to quantify the historical, current, and projected water budgets for the Basin and their uncertainties, and to evaluate the impacts of future land use, hydrologic, and water supply/demand projections as well as any proposed management decisions on groundwater conditions within the Basin. The model can also help identify gaps in available data and deficiencies in the conceptual understanding of groundwater conditions in the Basin. These results help prioritize plans for future data collection and other Groundwater Sustainability Plan (GSP) implementation activities.

1.1 Use of Information from SVIHM

Some results from the Salinas Valley Integrated Hydrologic Model (SVIHM) were used in developing the MBGWFM or to compare with results from the MBGWFM. It is important to note that the SVIHM results utilized are preliminary and draft. The SVIHM is being developed by the U.S. Geological Survey (USGS). A written disclaimer for the SVIHM has been provided by the USGS and is excerpted below:

> *This data (model and/or model results) are preliminary or provisional and are subject to revision. This model and model results are being provided to meet the need for timely best science. The model has not received final approval by the USGS. No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the model and related material nor shall the fact of release constitute any such warranty. The model is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the model.*

2. METHODOLOGY AND APPROACH

2.1 Model Source Code

The MBGWFM utilizes the United States Geological Survey (USGS) computer code MODFLOW-NWT (Niswonger et al., 2011); MODFLOW is a widely used model code and is publicly available and supported by the USGS. MODFLOW-NWT is a Newton formulation of MODFLOW-2005 which excels at solving models whose cells have active drying and rewetting in the unconfined groundwater flow equation (Niswonger et al., 2011). As the Basin has variable degrees of confinement depending on aquifer formation and location, MODFLOW-NWT is an appropriate and effective computer code to solve the groundwater flow equation.

MODFLOW-NWT's utility is enhanced by additional software processes for model development, processing, and analysis of results. Specifically, ZONEBUDGET version 3 (Harbaugh, 1990) is a post-processor used to extract water budget results for user-defined model subareas.

As discussed in more detail in *Section 3.1* and ***Attachment 2***, a soil moisture balance code was developed to represent the root zone processes and ultimately create the recharge datasets within the MBGWFM.

2.2 Discretization

When employing numerical models, the spatial domain is discretized into "model cells" and time is discretized into "stress periods". The discretization of the spatial domain is referred to as the spatial approach and the discretization of time is referred to as the temporal approach. Both approaches are further discussed below.

2.2.1 Spatial Approach

MODFLOW represents the groundwater system as a set of discrete, rectangular blocks (cells) forming a grid in space. MODFLOW then computes an approximate solution to the groundwater flow mathematical equations at each model cell. The model grid consists of 260 rows and 214 columns of cells that cover the entire extent of the California Department of Water Resources (DWR) Basin boundary (DWR No. 3-004.01) as well as areas on the periphery of the boundary (**Figure 1**). The rectangular cells have a variable dimension of 200 feet (ft) up to 675 ft on a side, with the most resolved (200 x 200 ft) grid cells located in the Marina-Ord area where the majority of groundwater extraction and monitoring occurs within the Basin. The coordinates of the lower left corner of the grid are 5,740,227 E., 2,169,843 N. (CA State Plane Zone 4, NAD83, Feet). The grid is rotated 240 degrees counterclockwise so that the columns align approximately with the 180/400-Foot Aquifer Subbasin boundary to the north and the Seaside Subbasin boundary to the south, consistent with the alignment of the Seaside Basin Groundwater Model (*Hydrometrics 2009 & 2019,* see *Section 2.4.2.2*).

The rectangular model grid has been further segmented into an active area (i.e., where groundwater flow is explicitly simulated) and an inactive area (where cells are assigned no-flow boundary conditions). The active area covers the entirety of the Basin as well as the small portion of the 180/400-Foot Aquifer Subbasin south of the Salinas River. The northern boundary of the active grid is the Salinas River, the western boundary is the Pacific Ocean, the southern boundary is the Seaside Subbasin boundary, and the eastern boundary is the Basin edge (i.e., where aquifer sediments come in contact with low permeability bedrock). Transient groundwater conditions along each of the active model boundaries are represented using unique boundary conditions as further described in *Section 2.4*. The number and location of active cells varies by model layer based on previously mapped aquifer extents as further described in *Section 2.2.3*.

2.2.2 Temporal Approach

2.2.2.1 Historical Simulation

The historical simulation is discretized temporally into 240 monthly stress periods, representing a 20-year simulation period from DWR Water Year (WY) 1999 (i.e., October 1998) through WY 2018 (i.e., September 2018). All 20 years of the historical simulation period were used for model calibration as further described in *Section 4*.

GSPs are required to "*provide a quantitative assessment of the historical water budget, starting with the most recently available data and extending back a minimum of 10 years, or as is sufficient to calibrate and reduce the uncertainty of the tools and methods used to estimate and future water budget information and future aquifer response to proposed sustainable groundwater management practices over the planning and implementation horizon*" (23-California Code of Regulations [CCR] §354.18(b)(2)). The historical water budget accounting period is WY 2004 – 2018, which allows for a five-year pre-conditioning period (i.e., WY 1999 – 2003) to minimize the influence of uncertainty in the specified initial conditions.

2.2.2.2 Projected Simulations

Projected water budgets are required "*to estimate future baseline conditions of supply, demand, and aquifer response to Plan implementation*" (23-CCR §354.18(b)(3)). The projected water budget "*must use 50 years of historical precipitation, evapotranspiration (ET), and streamflow information as the basis for evaluating future conditions under baseline and climate-modified scenarios"* (23-CCR §354.18(e)(2)(A)).

Several projected scenarios were developed from the historical model to evaluate aquifer response to future climate, land use, and water supply and demand conditions (See GSP *Section 6.5 Projected Water Budget* for further details). To develop the required 50 years-worth of hydrologic input information, first an "analog period" was created from the 20 years of historical information (WY 1999-2018) by combining the years in a specific way that, on average, maintained the long-term average hydrologic conditions. This approach allowed for the creation of a complete 50-year period to inform the projected water budget analysis, even when certain component datasets were not available for that length of time. The sequence of historical years that were combined to create the 50-year analog period is as follows:

- Analog Years 1-20: Based on historical years 1999-2018
- Analog Years 21-40: Based on historical years 1999-2018
- Analog Years: 41-50: Based on historical years 1999-2008

The above mapping of historical years to analog years within the required 50-year projected water budget period applies to precipitation and ET datasets.

The projected simulations are discretized temporally into 600 monthly stress periods, representing a simulated analog period from WY 2019 (i.e., October 2018) through WY 2068 (i.e., September 2068). This 50-year simulation was used to develop projected water budget estimates and to evaluate the benefits of proposed projects and management actions over the 50-year planning and implementation period following GSP submittal.

2.2.3 Vertical Geometry

The model is discretized vertically into eight layers as described below:

- **Layer 1** represents Dune Sand Aquifer;
- **Layer 2** represents the Fort Ord/Salinas Valley Aquitard;
- **Layer 3** represents the Upper 180-Foot Aquifer;
- **Layer 4** represents the 180-Foot Aquitard;
- **Layer 5** represents the Lower 180-Foot Aquifer;
- **Layer 6** represents the 180/400-Foot Aquitard;
- **Layer 7** represents the 400-Foot Aquifer; and
- **Layer 8** represents the Deep Aquifer / El Toro Primary Aquifer[1]

[1] The El Toro Primary Aquifer is defined as the only Principal Aquifer unit within the Corral de Tierra Management Area and is generally consistent in hydrogeology to the lower 400-Foot and Deep Aquifers within the Main Basin. See GSP *Section 4.2.2.* for further details.

Each layer of the MBGWFM represents a unique Principal Aquifer or Aquitard unit defined in the GSP and is consistent with previous hydrogeologic conceptualizations of the Basin. A more detailed description of the hydrogeology, geometry, and current groundwater conditions of each Principal Aquifer and Aquitard unit within the Basin is provided in *Sections 4 and 5* of the GSP. A summary table of the geologic-hydrogeologic relationships of each Principal Aquifer and Aquitard unit is provided in **Table 1** below:

Table 1. Generalized Geologic – Hydrogeologic Relationships

<table>
<tr><th>Period/Epoch</th><th>Geological Unit</th><th>Principal Aquifers and Aquitards</th></tr>
<tr><td>Holocene</td><td>Recent Dune Sand (Qd)
Older Dune Sand (Qod)</td><td>Dune Sand Aquifer</td></tr>
<tr><td rowspan="8">Pleistocene</td><td rowspan="2">Old Alluvium / Valley Fill Deposits (Qo/Qvf)</td><td>Fort Ord-Salinas Valley Aquitard</td></tr>
<tr><td rowspan="2">180-Foot Aquifer (1)</td></tr>
<tr><td rowspan="3">Aromas Sand (Qae)</td></tr>
<tr><td>180/400-Foot Aquitard</td></tr>
<tr><td rowspan="2">400-Foot Aquifer</td></tr>
<tr><td rowspan="3">Paso Robles Formation (QT)</td></tr>
<tr><td>400-Foot/Deep Aquitard(2)</td></tr>
<tr><td rowspan="4">Deep Aquifers</td></tr>
<tr><td rowspan="2">Pliocene</td><td>Purisima Formation (Ppu)</td></tr>
<tr><td rowspan="2">Santa Margarita Formation (Msm)</td></tr>
<tr><td rowspan="2">Miocene</td></tr>
<tr><td>Monterey Formation (Mmd)</td><td>N/A
(Minimally Water-Bearing)</td></tr>
</table>

Notes:

(1) The 180-Foot Aquifer is separated into “upper” and “lower” zones, separated by a thin clay layer known as the “180-Foot Aquitard”. Data collected within the former Fort Ord show that significant head differences exist between the upper and lower zones of the 180-Foot Aquifer.

(2) The presence and extent of the “400-Foot/Deep Aquitard” is not well understood within the Monterey Subbasin and thus is not represented by a unique layer in the MBGWFM. The Deep Aquifer (MGWFM Layer 8) has been parameterized to reflect zones of low vertical hydraulic conductivity where this aquitard is presumed to exist in the subbasin (see Section 2.5.1 for further details).

As described in detail in GSP *Sections 4 and 5*, Principal Aquifer units within the Basin have varied spatial extent, thickness, and degrees of confinement. As part of GSP development, a three-dimensional (3D) hydrostratigraphy model of the Basin was prepared using the Leapfrog Geo[2] geologic modeling software program to provide for a more accurate representation of Principal Aquifer and Aquitard geometries and to facilitate MBGWFM grid development. The Leapfrog hydrostratigraphy model of the Basin was originally developed as part of two Airborne Electromagenetic (AEM) geophysical surveys conducted by Marina Coast Water District (MCWD) in 2017 and 2019 (*Stanford/Aqua Geo Frameworks, 2017; Aqua Geo Frameworks, 2019*) to help characterize seawater intrusion within the Basin. The Leapfrog hydrostratigraphy model was revisited and modified by EKI in 2020 to incorporate additional lithologic and hydrostratigraphy data from various well and borehole logs and well as several cross-sections previously developed for the Basin (*Harding ESE, 2001; GeoSyntec, 2007; GeoSyntec, 2010*). The updated Leapfrog hydrostratigraphy model was used as the basis to inform the spatial extents, elevations, and thicknesses of each layer within the MBGWFM. **Figure 2** shows a representative cross-section of the Marina-Ord area of the Basin derived from the Leapfrog hydrostratigraphy model and corresponding MBGWFM layers.

One limitation of the Leapfrog hydrostratigraphy model is that it does not extend into the southern portion of the Corral de Tierra Management Area on the southeastern side of the Basin. Within the southern Corral de Tierra area, aquifers have historically been described by their geologic names, such as the Aromas Sand, Paso Robles Formation, and Santa Margarita Sandstone (*Geosyntec, 2007; Yates 2005*). Based on best available information, these geologic formations are grouped together to form the "El Toro Primary Aquifer System" for the Corral de Tierra Area as described in further detail in GSP *Section 4*. These geologic formations also comprise the lower portions of the 400-Foot Aquifer and the Deep Aquifers in the northern Salinas Valley including the Marina-Ord Area. As such, the El Toro Primary Aquifer was represented using model Layer 8, which is the only active model layer within the Corral de Tierra Management Area (see **Figure 3**).

Another limitation of the Leapfrog hydrostratigraphy model is that it does not effectively map the bottom of the Basin, which is defined as the top of the Monterey Formation (see GSP *Section 4*). As such, the bottom of MBGWFM Layer 8 (Deep Aquifer / El Toro Primary Aquifer) was delineated in the MBGWFM using a surface representing the Top of Monterey Formation Elevations previously developed by the Seaside Basin Watermaster (see GSP *Figure 4-3*).

Figure 3 shows the active extents of each layer within the MBGWFM and the uppermost active Principal Aquifer units encountered across the model domain. **Figure 4** and **Figure 5** show the top elevations of each model layer, while **Figure 6** and **Figure 7** show the layer thicknesses. These figures demonstrate that the MBGWFM reasonably represents the geometry and extent of each Principal Aquifer unit defined within the Basin as described in detail in *Section 4* of the GSP.

As described in *Section 5* of the GSP, each Principal Aquifer unit may experience varied degrees of confinement depending on location within the Basin, presence of overlying aquitard units, and current groundwater level conditions. As such, each layer was assigned a "convertible" layer type in the Upstream Weighting Package (UPW) of the MODFLOW-NWT program to allow for continued transition between confined and unconfined conditions throughout the model simulation depending on transient groundwater head conditions. Similarly, as mentioned in *Section 2.1,* the Newton formulation version of MODFLOW-2005 (MODFLOW-NWT) was employed for the MBGWFM because it allows for rewetting of cells (i.e., keeping them active as opposed to deactivating them) in the event the water table drops below the bottom elevation of a given cell at any point during the transient simulation.

[2] https://www.seequent.com/products-solutions/leapfrog-geo/

Finally, there are areas of the Basin where certain aquifer or aquitard units pinch out to zero thickness and terminate, resulting in direct connectivity between non-sequential aquifer units. An example of this is the Fort Ord/Salinas Valley Aquitard (Layer 2), which only exists in a portion of the Marina-Ord Area. Where the aquitard is not present, the Dune Sand Aquifer (Layer 1) is in direct contact with the Upper 180-Foot Aquifer (Layer 3). Pinch-out geometries are challenging to accurately represent in MODFLOW-NWT because cells with zero thickness and inactivated cells will act as no-flow boundaries and prevent vertical hydraulic connection between overlying and underlying model layers. A minimum cell thickness of five feet was applied to model cells in these pinch-out areas to allow for continued hydraulic connectivity between non-sequential model layers. As described further in *Section 2.5,* these cells were assigned the same aquifer parameters as the nearest overlying active model layer such that they essentially act as "flow-through" cells allowing vertical groundwater flow between non-sequential model layers. The location of these "flow-through" cells are shown by layer on **Figure 6** and **Figure 7.**

2.3 Initial Conditions

2.3.1 Historical Simulation

The availability and density of historical groundwater elevation data varies substantially throughout the Basin, both spatially and temporally. While the Monterey County Water Resources Association (MCWRA) maintains a database of water level records throughout the entire Salinas Valley Groundwater Basin, available records before WY 1999 were generally limited to the Marina-Ord Management Area of the Basin. As such, initial heads in the MBGWFM were derived from Fall 1998 water level data wherever available and supplemented with historical water level contour maps previously created for the Corral de Tierra Management Area to provide for complete coverage of the Basin.

Fall 1998[3] water levels were compiled from MCRWA records for 362 wells within the Basin and in the surrounding Seaside and 180/400-Foot Aquifer Subbasins and used to create preliminary surfaces (i.e., rasters) of initial heads for the MBGWFM historical simulation. Initial head rasters were created in Surfer using the Kriging interpolation method, whereby a Gaussian model variogram was fitted to the water level datasets and applied to create rasters of Fall 1998 water levels for each Principal Aquifer unit.

As mentioned previously, initial heads in the Corral de Tierra Management Area were also informed by contoured water level maps previously created by Geosyntec Consultants as part of the El Toro Groundwater Study (*Geosyntec, 2007*). Specifically, a contour map of January 2001 groundwater elevations (Figure 4-5 of *Geosyntec, 2007*) was digitized (i.e., converted into a series of point elevations) and subsequently used to refine and extend the initial head rasters so that they covered the entirety of the Basin.

Groundwater elevations were subsequently extracted from the initial head rasters at every active grid cell for each aquifer layer of the MBGWFM (i.e., layers 1, 3, 5, 7, and 8) to populate the initial head arrays in the Basic (BAS) package of MODFLOW-NWT. Initial heads were assigned to the aquitard layers (i.e., layers 2, 4, and 6) using water level surfaces from the overlying aquifer unit where applicable.

[3] Seasonal average water levels were calculated for each well, where Fall includes measurements from August 15th to November 15th and Spring includes measurements from January 15th to April 15th.

2.3.1 Projected Simulations

Initial heads for all projected simulations in the MBGWFM were defined using the final head outputs from the historical simulation (i.e., simulated heads from September 30, 2018).

2.4 Boundary Conditions

Boundary conditions represent flow constraints in the model domain. Three types of boundary conditions are specified in the MBGWFM: 1) no-flow boundary, 2) general-head boundary, and 3) river boundary. Each of these boundary conditions are discussed in greater detail below. A schematic summarizing all boundary conditions employed in the model is presented in **Figure 8**.

2.4.1 No-Flow Boundary

A no-flow boundary is employed wherever groundwater flow is assumed to be zero within a cell, effectively removing it from the groundwater flow simulation. No-flow boundaries are commonly used to represent contacts with impermeable (non-water bearing) formations or to inactivate a portion of the model grid that is outside the study area. The following areas are represented as no-flow boundaries within the MBGWFM:

- The eastern Basin boundary, where aquifer sediments of the El Toro Primary Aquifer (Layer 8) come in contact with impermeable bedrock outcrops;
- The model bottom, which coincides with the top of the Monterey Formation (i.e. bedrock); and
- The western Basin boundary within the Deep Aquifer (Layer 8), as it is assumed the Deep Aquifer is not hydraulically connected to the Pacific Ocean (see *Section 2.4.2.3*).

All other cells outside the active model area are also assigned as no-flow cells such that they are excluded from the MODFLOW simulation.

2.4.2 General-Head Boundary

The general-head boundary (GHB) is a head-dependent flow boundary, and the flow across this boundary is proportional to the difference between the model-calculated head at the boundary and a general head located a certain distance from the boundary. The proportionality constant used to calculate the flow is the conductance, which is calculated from the hydraulic conductivity of the boundary cell, the area of the face of the boundary cell, and the distance from the boundary cell to the general head location.

As described in more detail in GSP *Sections 4 and* 5, the northern, southern, and western boundaries of the Basin are hydraulically connected to aquifer units of the 180/400-Foot Aquifer Subbasin, Seaside Subbasin, and the Pacific Ocean, respectively. As such, the northern, southern, and western boundaries of the active model domain are represented by GHBs[4].

The general process for developing GHBs in the MBGWFM was to: (1) identify GHB cells for each active model layer, (2) gather transient general head data from nearby locations to the GHB cells outside the

[4]Two exceptions to this are: (1) the northern boundary of Layers 1 and 2, where the Salinas River is directly simulated using a River boundary (see *Section 2.4.3*), and (2) the western boundary of Layer 8, which is represented as a no-flow boundary because is assumed the Deep Aquifer is not hydraulically connected to the Pacific Ocean.

active model domain, (3) calculate distances and associate GHB cells with their nearest general head location, and (4) assign transient general heads and conductance properties to each GHB cell[5]. The methods and datasets used to develop GHBs at each boundary are further described below.

2.4.2.1 *Northern Boundary (Salinas River / 180-400-Foot Aquifer Subbasin)*

As mentioned in *Section 2.2.1,* the active model area extends north of the Basin boundary up to the Salinas River, thus including a small portion of the 180/400-Foot Aquifer Subbasin. While the Salinas River is explicitly simulated in MBGWFM layers 1 and 2 (see *Section 2.4.3*), the northern boundary in underlying layers (i.e., layers 3-8) is represented by GHBs in the model to simulate groundwater exchanges between the Monterey Subbasin the neighboring 180/400-Foot Aquifer Subbasin.

2.4.2.1.1 Historical Simulation

Transient general heads were assigned to northern boundary GHB cells using historical groundwater elevation monitoring data provided by MCWRA. Groundwater elevation measurements from the historical simulation period (i.e., October 1999 – September 2018) were compiled from all monitoring wells to the immediate north of the Salinas River and examined for quality. A subset of these wells were ultimately selected as “representative” monitoring wells to assign transient general heads at GHB cells along the northern boundary for model layers 3–8. The selection of representative wells to use for GHB parameterization was informed by the availability, frequency, and quality of historical monitoring data as well as the location and distribution of wells along the northern boundary.

The final network of representative monitoring wells includes seven wells in the Upper 180-Foot Aquifer (Layer 3), 12 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7)[6], and three wells in the Deep Aquifer (Layer 8). Each active GHB cell in model layers 3–8 was associated to the nearest representative well[7] and the distance between the GHB cell and its associated representative well was calculated to inform the GHB conductance term. GHB cells along the northern model boundary and their associated representative monitoring wells are shown for each model layer in **Figure 9.**

Historical groundwater elevation data from each representative monitoring well was pre-processed to create a continuous monthly timeseries of general heads to assign to its associated GHB cells. Where multiple records existed for a well within a given month, an average groundwater elevation was calculated for that month. Where data was unavailable at a well for a particular month, the monthly water level was either estimated via (Pearson) correlation[8] to nearby monitoring wells with data for that month or, when

[5] GHB conductance parameters were adjusted during calibration as described in *Section 4.3*.

[6] Along most of the northern MBGWFM boundary, the 180-Foot Aquitard is present while the 180/400-Foot Aquitard is absent (see **Figures 6 and 7**). Historical water level observations collected in this area indicate that groundwater elevations within the Lower 180-Foot Aquifer closely resemble water levels in the 400-Foot Aquifer along the northern basin boundary. Furthermore, water level contour maps for the Lower 180-Foot Aquifer created by EKI closely resemble MCWRA contour maps of the 400-Foot Aquifer along the boundary. As such, northern GHB heads were assigned to MBGWFM Layers 5 and 7 using water levels collected from MCWRA wells characterized in the “180/400-Foot Aquifer.”

[7] Specified heads were assigned to GHB cells in aquitard units (i.e., model layers 4 and 6) using water level data from representative wells in the overlying aquifer unit (i.e., model layers 3 and 5, respectively).

[8] A linear regression (Pearson) correlation matrix was developed for all representative wells within a Principal Aquifer unit to identify “well-correlated” wells for use in data-gap filling. A correlation coefficient (R) threshold of $R \geq 0.8$ was used to determine if wells were well-correlated and thus suitable for use in estimating missing water level data. The final linear regression equations used to estimate missing water level records were derived from the nearby well with the highest R value (where $R \geq 0.8$) to the representative well in question.

no well-correlated data was available, via linear interpolation between measurements at the well. The final (post-processed) monthly water level datasets from each representative monitoring well were subsequently used to assign transient general heads at all associated GHB cells throughout the historical model simulation period.

2.4.2.1.2 Projected Simulations

The same approach described above was used to set up the northern boundary GHB in the projected simulations, except now the general heads were informed by groundwater elevation Sustainability Criteria defined in the 180/400-Foot Aquifer Subbasin GSP ("180/400 GSP", *SVBGSA, 2020)* as opposed to historical monitoring data. Specifically, the "representative" monitoring well network used to inform historical general heads at nearby GHB cells was updated to include all SGMA monitoring network wells located immediately north of the Salinas River in the 180/400-Foot Aquifer Subbasin. In many cases, these SGMA monitoring wells were the same representative wells employed in the historical simulation.

The final network of SGMA monitoring wells used for projected simulations includes seven wells in the Upper 180-Foot Aquifer (Layer 3), 10 wells in the Lower 180/400-Foot Aquifer (Layers 5 and 7), and three wells in the Deep Aquifer (Layer 8). Each active GHB cell in model layers 3–8 was reassociated to the nearest SGMA monitoring well[9] and assigned a GHB conductance term from the calibrated historical model. GHB cells along the northern model boundary and their associated SGMA monitoring wells are shown for each model layer in **Figure 10.**

Depending on the projected scenario, GHB cells were then assigned general heads based on one of the following three ranges in future groundwater level conditions that could be encountered at the 180/400-Foot Aquifer Subbasin while maintaining SGMA compliance:

- **"Minimum Threshold" (MT)** water levels (as defined in the 180/400 GSP)
- **"Measurable Objective" (MO)** water levels (as defined in the 180/400 GSP)
- **"Seawater Intrusion (SWI) Protective"** water levels (see *Section 2.4.2.3* for further details).

For all projected scenarios, initial general heads at the GHB cells were informed by final head outputs from the historical simulation (i.e., simulated heads from September 30, 2018)[10]. General heads were then adjusted using a 20-year "ramp up" period to reach the projected water level conditions described above. For the "MT" and "SWI Protective" water level scenarios, the ramp up period was applied linearly over 20 years. For the "MO" water level scenario, the ramp up period was informed by five-year interim milestones defined at each SGMA monitoring well in the 180/400 GSP. All projected water levels at the GHB cells were then held constant for the remaining 30 years of the projected simulations, under the assumption that these water levels would be maintained in perpetuity after the 20-year SGMA implementation deadline.

[9] *Ibid [6].*

[10] Review of historical groundwater level data indicates that September water levels represent a reasonable annual average condition (i.e., between seasonal high and low conditions) within the 180/400-Foot Aquifer subbasin and are thus appropriate to use as a starting point for developing projected heads at the northern GHB boundary.

2.4.2.2 Southern Boundary (Seaside Subbasin)

As mentioned in *Section 2.2.1,* the southern boundary of the active model area is aligned with the Seaside Subbasin boundary. This boundary was represented as a GHB in the MBGWFM to simulate groundwater exchanges between the Monterey Subbasin the neighboring Seaside Subbasin.

2.4.2.2.1 Historical Simulation

Transient general heads were assigned for southern boundary GHB cells in the MBGWFM historical simulation using head outputs from the Seaside Basin Groundwater Model ("Seaside Model") (*Hydrometrics, 2009 & 2019*). The Seaside Model simulates groundwater flow within the Seaside Subbasin from January 1987 – January 2018 and extends partially into the Monterey Subbasin. A copy of the Seaside Model was provided to EKI by the Seaside Basin Watermaster in early 2020 to facilitate direct incorporation of simulated head outputs from the Seaside Model along the Basin boundary into the MBGWFM.

EKI extracted simulated head outputs from the Seaside Model at a series of 20 regularly spaced "proxy" monitoring locations distributed along the south side of the Seaside boundary. Each active GHB cell along the Seaside boundary in the MBGWFM was subsequently associated to its nearest proxy monitoring location, and transient general heads were assigned to the GHB cells using the monthly simulated head outputs from the Seaside Model at their respective proxy monitoring locations[11]. GHB cells along the Seaside boundary and their associated proxy monitoring locations are shown in **Figure 11.**

While employing the Seaside Model to develop Seaside boundary GHBs in the MBGWFM provides for a common set of assumptions regarding historical heads along the boundary, there are notable differences in hydrogeologic conceptualization and geometry between the two models that will result in imperfect matching of head conditions and unique estimates of cross-boundary flows. Notably, the Seaside Model defines aquifer units differently than the MBGWFM and includes a different number of layers. The Seaside Model is comprised of five layers that represent the following aquifer units (*Hydrometrics, 2009*):

- Layer 1 represents the Older Dune deposits and Aromas Red Sands
- Layer 2 represents the upper Paso Robles Aquifer
- Layer 3 represents the "brown sand layer" of the lower Paso Robles Aquifer
- Layer 4 represents the "semi-continuous blue clays" encountered at the base of the Paso Robles Aquifer
- Layer 5 represents the Santa Margarita/Purisima Aquifer

As demonstrated in **Table 1** (see *Section 2.2.3*), these aquifer units are generally defined based on the geologic formations encountered in the region and are only loosely tied to the Principal Aquifer Units defined in the Monterey Subbasin. For example, Older Dune deposits and Aromas Red Sands deposits (Seaside Model layer 1) have been further stratified into the Dune Sand Aquifer (Layer 1), Upper 180-Foot Aquifer (Layer 3), Lower 180-Foot Aquifer (Layer 5), and 400-Foot Aquifer (Layer 7) in the MBGWFM. Previous hydrogeologic investigations (see *GSP Section 4*) indicate that the 400-Foot Aquifer is likely comprised of both Aromas Sands (Seaside Model layer 1) as well as upper portions of the Paso Robles

[11] As the Seaside Model historical simulation period ends in January 2018, simulated head outputs were estimated in the MBGWFM for Feb. 2018 – Sept. 2018 using Seaside Model head outputs for Feb. 2017 – Sept. 2017.

formation (Seaside Model layer 2) depending on location within the Monterey Subbasin. Similarly, the Deep Aquifer (Layer 8) of MBGWFM represents the combined lower Paso Robles (Seaside Model layers 3-4) and Santa Margarita / Purisima (Seaside Model layer 5) formations.

Given the imperfect match in conceptualization and layering between the two models, a few simplifying assumptions were needed to effectively link head outputs from the Seaside model to GHB cells along with southern boundary of the MBGWFM. Ultimately, the selection of which Seaside Model layers should be associated to GHB cells in the MBGWFM was informed by: (1) a comparison of Seaside Model head outputs along the boundary with recent (i.e., Spring and Fall 2017) contour maps of each Principal Aquifer Unit in the Monterey Subbasin; and (2) an iterative evaluation of water budget and simulated head outputs from MBGWFM to ensure cross-boundary flow estimates generally agreed with Seaside Model outputs, both in magnitude and in spatial trends. The final mapping of MBGWFM GHB cells to their corresponding Seaside Model layers is presented in **Table 2** below:

Table 2. Mapping of Seaside Model Layers to MBGWFM GHB Cells at the Seaside Boundary

MBGWFM GHB Layer	MBGWFM Principal Aquifer Unit	Seaside Model Layer	Seaside Model Aquifer Unit
1	Dune Sand Aquifer	1	Older Dune deposits and Aromas Red Sands
3	Upper 180-Foot Aquifer	1	Older Dune deposits and Aromas Red Sands
5	Lower 180-Foot Aquifer	1	Older Dune deposits and Aromas Red Sands
7	400-Foot Aquifer	2	Upper Paso Robles Aquifer
8	Deep Aquifer / El Toro Primary Aquifer	3 (Proxy Points 1-9)	Lower Paso Robles Aquifer
		4 (Proxy Point 10)[(1)]	Paso Robles Base (Blue Clays)
		5 (Proxy Points 11-20)[(2)]	Santa Margarita / Purisima Aquifer

<u>**Notes:**</u>

(1) Seaside Model layer 3 becomes dry moving east of proxy point 9 along the boundary, and thus the uppermost active unit is layer 4.

(2) Seaside Model layer 4 is either dry or constrained by dry cells and shows erroneously high-water levels (i.e., >200 feet above ground surface) moving east of proxy point 10. Thus, the only reliable layer to use east of proxy point 10 becomes layer 5.

Annual net cross-boundary flow estimates from the Seaside Model and the calibrated MBGWFM over the historical water budget period[12] are compared on **Figure 12.** Over like timeframes, the Seaside Model estimates an average net inflow from the Seaside Subbasin to the Monterey Subbasin of +935 acre-feet per year (AFY) while the MBGWFM estimates an average net inflow of +918 AFY. These results indicate that the calibrated MBGWFM reasonably recreates historical groundwater level conditions simulated by Seaside Model along the boundary and that resulting water budget estimates of historical cross-boundary flows between the two models are in very close agreement at the Basin-level. Further refinements could bring the historical models into closer agreement.

2.4.2.2.2 Projected Simulations

Unlike the 180/400-Foot Aquifer Subbasin, the Seaside Subbasin is an adjudicated groundwater basin and is not subject to many aspects of SGMA. As such, no Sustainability Criteria have been defined for groundwater elevations within the Seaside Subbasin, as the basin is required to manage to a groundwater budget as opposed to groundwater elevations. The adjudication also states that management of the Seaside Basin cannot result in "material injury" to the Basin, which could include low groundwater elevations that impact production rates.

For the projected simulations, a simplifying assumption was made that the Seaside Subbasin would be able to maintain Fall 2017 water levels over the long term, thus managing to a balanced water budget (i.e., no long-term depletion of groundwater storage). As such, September 2017 water level outputs from the Seaside Model were used to define reference heads along the southern GHB boundary for all MBGWFM projected simulations throughout the entire 50-year simulation period.

One exception to the assumption described above is along the southeastern edge of the Seaside-Monterey boundary (i.e., near Laguna Seca). In this area, simulated Fall 2017 water levels from the Seaside Model were already below the Minimum Thresholds (MTs) defined for wells in the Corral de Tierra Management Area on the Monterey Subbasin side of the boundary (i.e., 170 feet above mean sea level [ft msl], see GSP *Sections 7 and 8*). Projected GHB reference heads were set at the minimum threshold of 170 ft msl in the MBGWFM for all GHB cells in the Laguna Seca area whose simulated water levels were below 170 ft msl in the Seaside Model as of September 2017. This assumption was considered reasonable because Cal-Am ceased all its municipal pumping from the Laguna Seca area in 2021, reducing total pumping in that area by approximately 30%. While the effect of this pumping reduction is still to be established, it is likely that pumping in the Laguna Seca will not be the driver of lower groundwater levels. This adjustment was ultimately made to all GHB cells associated with "proxy" monitoring points 14 and 15 along the Seaside boundary (see **Figure 11**).

It is recognized that there is considerable uncertainty regarding future groundwater conditions within the Seaside Subbasin (particularly within the Laguna Seca area) and that groundwater management decisions in the Monterey Subbasin are likely to impact groundwater conditions within the Seaside Subbasin, and vice-a-versa. Various studies and projects have been proposed (see *GSP Section 9*) or are already being implemented by water management entities in both subbasins to better characterize and model local groundwater conditions and cross-boundary flows in the Laguna Seca area and across the entire Monterey-Seaside boundary. As more data and information is

[12] WY 2018 is excluded from the comparison as the Seaside Model only simulates historical groundwater conditions through January 2018

developed in the coming years, the MBGWFM will be revised and updated accordingly as part of the next five-year update to the GSP.

2.4.2.3 *Western Boundary (Pacific Ocean)*

As mentioned in *Section 2.2.1,* the western boundary of the active model area is aligned with the Pacific Ocean. This boundary was represented as a GHB in the MBGWFM to simulate exchanges between the Basin and the ocean and to inform estimates of potential seawater intrusion rates into the Basin.

The current version of the MBGWFM does not directly simulate variable-density groundwater flow and transport. Instead, the Pacific Ocean boundary is represented as a GHB using freshwater equivalent sea levels calculated at the aquifer-seafloor interface for each Principal Aquifer unit assumed to be in hydraulic connection with the ocean.

Freshwater equivalent sea levels are calculated based on the equivalent freshwater head formula for variable density groundwater flow presented in the USGS *User's Guide to SEAWAT* (*Guo and Langevin, 2002*), which states:

$$h_{fw} = \frac{\rho}{\rho_f} h - \frac{\rho - \rho_f}{\rho_f} Z$$

where h_{fw} = freshwater equivalent head, h = sea level, ρ = saline water density, ρ_f = freshwater density, and Z = elevation of measuring point. In this instance, since the equivalent freshwater head is being calculated at the (offshore) ocean-aquifer interface, Z represents the depth to the seafloor at the estimated seafloor-aquifer contact location.

Previous hydrogeologic investigations along the Monterey coastline indicate that the Recent and Older Dune Deposits, Aromas Red Sands, and Paso Robles Formations are at least partially in contact with the seafloor at varying distances offshore from the Basin, while the deeper Santa Margarita and Purisima Formations may be hydraulically restricted from the sea floor by the Monterey Bay Fault Zone (*Feeney, 2003).* More recent investigations of seawater intrusion conditions within the Basin (*Aqua Geo Frameworks, 2019,* see GSP *Section 5*) also indicate that the Deep Aquifer is not currently seawater intruded along the Monterey coastline. As such, GHB cells were assigned along the Pacific Ocean boundary for all layers in the MBGWFM apart from layer 8 (i.e., the Deep Aquifer), which was modeled as a no-flow boundary at the Monterey coastline.

2.4.2.3.1 Historical Simulation

For the historical simulation, freshwater equivalent sea levels were calculated for each model layer using the *Guo & Langevin, 2002* equation described above at a sea level elevation (*h*) of zero (0) ft msl and a saline water density of 1.025 grams per cubic centimeter (g/cm^3). Average elevations (i.e., depths below sea level) at which each Principal Aquifer unit are assumed to contact the seafloor were estimated using a previously developed geologic cross-section of the Monterey Bay coastal aquifer system (see Figure 5 of *Feeney, 2003*). Corresponding offshore distances to the assumed point of contact with the seafloor were then calculated at each GHB cell using a bathymetry map of seafloor elevations and used to inform conductance term at each cell. **Table 3** below presents a summary of freshwater heads assigned to each model layer for the historical simulation.

Table 3. Freshwater Equivalent Sea Levels – Historical Simulation

MBGWFM GHB Layer	Corresponding Geologic Formation from *Feeney, 2003*	Average Offshore Distance to Seafloor Contact (ft)	Average Elevation of Seafloor – Aquifer Contact (ft msl)	Calculated Freshwater Equivalent Head (ft msl)
1 – 6	Recent / Older Dune Deposits	9,000	-155	3.8
7	Aromas Red Sands / Paso Robles	26,800	-335	8.4

Calculated freshwater heads were held constant in Pacific Ocean GHB cells throughout the historical simulation under the assumption that the sea level did not change significantly between WY 1999 – 2018.

2.4.2.3.2 Projected Simulations

As further described in *Section 3.1*, three climate change scenarios were modeled in the MBGWFM projected simulations. Each of these scenarios employed unique assumptions regarding future sea level rise that were derived from the 180/400 GSP (*SVBGSA, 2020*). These included:

- **Baseline Conditions** – assumes no change in sea level (0 ft msl)
- **2030 Climate Change –** assumes a "moderate" increase in sea levels of 15 cm (+ 0.492 ft msl)
- **2070 Climate Change** – assumes a "severe" increase in sea levels of 45 cm (+ 1.475 ft msl)

Freshwater equivalent ocean heads were recalculated under each projected scenario using the same assumptions about offshore contact depths and distances employed in the historical simulation (see **Table 3** above). **Table 4** below presents a summary of freshwater heads assigned to Pacific Ocean GHB cells for each model layer under the various projected scenarios.

Table 4. Freshwater Equivalent Sea Levels – Projected Simulations

MBGWFM GHB Layer	"Baseline" Freshwater Equivalent Head (ft msl)	"2030 Climate Change" Freshwater Equivalent Head (ft msl)	"2070 Climate Change" Freshwater Equivalent Head (ft msl)
1 – 6	3.8	4.3	5.4
7	8.4	8.9	9.9

Calculated freshwater heads were held constant in Pacific Ocean GHB cells throughout each of the 50-year projected simulations.

As described in *Section 2.4.2.1.2*, projected simulations along the northern GHB boundary included a "Seawater Intrusion (SWI) Protective" water level scenario to estimate potential cross-boundary flows assuming the 180/400-Foot Aquifer Subbasin is able to maintain freshwater equivalent sea levels along the entire length of the 180/400-Monterey boundary. For this scenario, GHB cells along the northern boundary were assigned specified heads using the freshwater equivalent sea levels calculated under each climate scenario shown in **Table 4**. Consistent with the MT and MO scenarios, GHB cells along the northern boundary were allowed a 20-year "ramp up" period starting from their Fall 2018 heads to reach these SWI Protective water levels and were then held constant for the remaining 30 years of the projected simulation period.

2.4.3 River Boundary

The Salinas River was explicitly simulated in model layers 1 and 2 at the MBGWFM northern boundary using MODFLOW's River (RIV) package[13] (**Figure 9**). The RIV package is used to simulate head-dependent flux boundaries between a river and the underlying groundwater system.

RIV cells were identified in the MBGWFM using a shapefile of the Salinas River obtained from the National Hydrography Dataset (NHD). River segment lengths were calculated at each model cell from the NHD shapefile, and land surface elevations were estimated using a 30-meter USGS National Elevation Dataset (NED) raster. Streambed widths were assigned to each RIV cell using data obtained from the North Marina Groundwater Model (NMGWM) (*Hydrofocus, 2017)*. A streambed thickness of five (5) feet was assigned to each RIV cell consistent with the NMGWM and the Salinas Valley Integrated Ground and Surface Water Model (SVIGSM)[14] (MCWRA & *LSCE, 2006*), and river bottom elevations were calculated as the land surface elevation minus the streambed thickness. Riverbed conductance values were initially assigned to each RIV cell using parameters obtained from the NMGWM and were subsequently adjusted during model calibration (see *Section 0*).

2.4.3.1 Historical Simulation

For the historical simulation, river stages were assigned to each RIV cell using historical streamflow monitoring data obtained from the USGS Spreckels Gauge (Site No. 11152500)[15]. The Spreckels Gauge is conveniently located in the active MBGWFM domain at model cell [40,85] and thus serves as a reasonable proxy for estimating Salinas River stages along the length of the northern model boundary.

The Spreckels Gauge provides monthly discharge rates within the river and a series of field measurements that contain both stage and flow data at the monitoring station. These field measurements were used to develop a streamflow rating curve for the site, which was subsequently applied to estimate river stages at the Spreckels Gauge location from monthly discharge data for October 1998 – September 2018 (**Figure 13).** River stage elevations were subsequently assigned to each RIV cell upstream and downstream of the Spreckels Gauge location using differences in land surface elevations as an adjustment factor.

[13] A small number of RIV cells were also assigned to model layer 7 at the northeastern Basin boundary, where layer 7 is the uppermost active model unit (**Figure 9**).

[14] The SVIGSM was recently updated to the Salinas Valley Integrated Hydrologic Model (SVIHM) by the USGS, with preliminary outputs released to the public in mid-2021. The SVIHM was not available for use at the time of MBGWFM construction.

[15] https://waterdata.usgs.gov/nwis/uv?site_no=11152500

2.4.3.2 Projected Simulations

At the time of MBGWFM construction, no information was readily available to assign projected Salinas River flow conditions under future baseline or climate change conditions. As such, a simplifying assumption was made that Salinas River stages would mimic historical trends depending on water year type. Transient RIV stages were therefore estimated for all projected scenarios using historical stages calculated for the 50-year "analog" hydrologic period described in *Section 2.2.2.2*, where:

- Analog Years 1-20: Based on historical years 1999-2018
- Analog Years 21-40: Based on historical years 1999-2018
- Analog Years: 41-50: Based on historical years 1999-2008

2.5 Aquifer Properties

Aquifer properties were initialized in the MBGWFM using available pumping test data and relevant information from prior hydrogeological studies and were subsequently refined during model calibration (see *Section 4.3*). A summary of the initial model parameterization process for hydraulic conductivity and storage properties is provided below.

2.5.1 Hydraulic Conductivity

In alluvial aquifers, the spatial distribution of hydraulic conductivity is influenced by the distribution of sediment texture (i.e., the fraction of coarse-grained sand and gravel relative to the fraction of fine-grained silt and clay), the size and shape of the pores between the sediment grains, and the effectiveness of the interconnections between those pores. To better represent the spatial distribution in hydraulic conductivities within each Principal Aquifer unit, texture maps were constructed for each aquifer layer of the MBGWFM (i.e., layers 1, 3, 5, 7, and 8) based on lithologic descriptions from 332 boreholes distributed throughout the model domain[16]. The final texture maps assigned to each layer are shown on **Figure 14 through Figure 18**.

The texture maps are based on the lithologic descriptions from borehole logs. The borehore logs vary in depth and may be used to assign texture classifications to multiple layers. Layer 1 utilized 145 borehole logs, layer 3 utilized 212 borehole logs, layer 5 utilized 65 borehole logs, layer 7 utilized 178 borehole logs, and layer 8 utilized 144 borehole logs. The logs were coded on a 1-ft interval as either coarse-grained or fine-grained material, using a rubric consistent with the USGS' Central Valley Hydrologic Model (CVHM; *Faunt et al., 2009*). For each borehole, the average fraction of coarse-grained sediment was calculated over the total thickness of each model layer at the borehole location. Resultant values were interpolated in Surfer using the Kriging interpolation method to create rasters of coarse-grained fractions for each aquifer layer and were subsequently assigned to each active model cell by layer (**Figure 14 through Figure 18**). In general, the borehole data indicate that layer 1 has the greatest fraction of coarse-grained sediment, and the sediments generally become finer with depth.

Areas and depth intervals characterized with relatively coarse-grained sediments transmit water at a higher rate than areas and depth intervals characterized by fine-grained sediments. The resulting distributions in the fraction of coarse-grained sediment was therefore utilized to specify the spatial

[16] Texture maps were not created for the aquitard layers of the model (i.e., layers 2, 4, and 6) as it is assumed they are predominantly fine-grained in nature. Final hydraulic conductivities assigned to aquitard units were determined through model calibration as further discussed in *Section 4.2*.

distribution in horizontal and vertical hydraulic conductivity. The modeled horizontal hydraulic conductivity is calculated as the product of the fraction of coarse-grained sediment and specified coarse-grained horizontal hydraulic conductivity. Vertical hydraulic conductivity is typically less than horizontal hydraulic conductivity because fine-grained beds can impede the downward movement of water. The modeled vertical hydraulic conductivity is therefore calculated as the specified vertical hydraulic conductivity divided by the fraction of fine-grained sediment, where the fine-grained fraction is calculated as one minus the coarse-grained fraction.

Aquifer test results compiled from 161 pumping tests conducted throughout the Basin were used to inform initial estimates of coarse-grained horizontal hydraulic conductivities within the model.[17] The locations of pumping test wells within the Basin are shown on **Figure 19**. A summary of horizontal hydraulic conductivities estimated from pumping tests is provided in **Table 5** below.

Initial coarse-grained hydraulic conductivities were assigned to each aquifer layer using average hydraulic conductivities calculated from pumping tests for wells whose coarse-grained fractions were in the upper 50th percentile of the texture map for that layer. The final specified coarse-grained horizontal and vertical hydraulic conductivities vary by layer and were determined by calibration, as discussed below in *Section 4.3.*

Table 5. Horizontal Hydraulic Conductivity (Kh) Estimates from Pumping Tests

Principal Aquifer Unit	Horizontal Hydraulic Conductivity (Kh), [ft/d]		
	Minimum	Average	Maximum
Dune Sand Aquifer	2.7	72	750
180/400-Foot Aquifers	0.04	168	1110
Deep Aquifer	2.2	11.6	25.4

2.5.2 Storage

As mentioned above, each Principal Aquifer unit within the Basin may experience varied degrees of confinement depending on location within the Basin, presence of overlying aquitard units, and current groundwater level conditions. As such, both the specific yield (Sy) and specific storage (Ss) parameters must be specified in order to effectively simulate transient head conditions in the Basin.

Aquifer test results compiled from 40 pumping tests conducted throughout the Basin were used to inform initial estimates of specific storage (Ss) within the model[18]. The locations of pumping test wells within the

[17] Aquifer transmissivity (T) measurements from pumping test data were converted to effective hydraulic conductivities by dividing the T value by the entire length of well screen.

[18] Confined storativity (S) measurements from pumping test data were converted to specific storage by dividing the S value by the entire length of well screen.

Basin are shown on **Figure 19**. A summary of Ss values estimated from pumping tests is provided in **Table 6** below. Final Ss values were determined by calibration, as discussed below in *Section 4.3.*

Table 6. Specific Storage (Ss) Measurements from Pumping Tests

Principal Aquifer Unit	Specific Storage (Ss) [1/ft]		
	Minimum	Average	Maximum
Dune Sand Aquifer	1.6E-05	9.5E-04	4.8E-03
180/400-Foot Aquifers	9.9E-07	3.4E-05	2.6E-04
Deep Aquifer [(1)]	N/A	N/A	N/A

Notes:

(1) No Ss data is currently available from pumping tests for the Deep Aquifer.

Very little data exists to inform estimates of specific yield within individual aquifer units of the Basin. Specific yields have been estimated to range from 0.04 to 0.4 within the Dune Sand Aquifer, and a bulk specific yield of 0.12 was used for the El Toro Primary Aquifer in prior studies (*Todd, 2016*). As such, an initial specific yield (Sy) value of 0.12 was assigned to all aquifer units in the model, consistent with values reported for silty sands in the literature. Final Sy values were determined by calibration, as discussed below in *Section 4.3.*

3. STRESSES

3.1 Recharge

Recharge is simulated using the Recharge (RCH) Package. To quantify the spatial and temporal distribution of recharge across the MBGWFM domain, a Soil Moisture Budget accounting model (SMB) was developed using *MATLAB* programming code. The SMB simulates land surface processes (e.g., precipitation, applied water, and plant evapotranspiration [ET]) and root zone processes which ultimately determine the amount of deep percolation on a grid cell basis that is specified as groundwater recharge to the uppermost active layer of the MBGWFM grid. Detailed documentation of the SMB model and associated input datasets is provided in ***Attachment 2*****.**

The SMB uses a mass-balance approach to quantify the movement of water that arrives at the land surface from either precipitation or irrigation and subsequent movement into the subsurface or atmosphere. The water movement processes included in the SMB model are (1) precipitation, (2) interception, (3) evaporation from canopy and depression storage, (4) rainfall excess runoff, (5) applied water from District deliveries, (6) applied water from private pumping (deficit pumping), (7) ET by vegetation, (8) recharge, (9) saturation excess runoff, and (10) dynamic soil moisture storage.

The SMB calculates the above processes on a grid cell basis across the entire active MBGWFM grid. Spatially variable parameters within the SMB include:

- Soil types (**Figure 20**) and properties, including soil hydrologic group (**Figure 21**), vertical hydraulic conductivity (**Figure 22**), soil depth, field capacity, wilting point, and total porosity, from the United States Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO)[19]
- Spatial land use data from the U.S. Department of Agriculture (USDA) Forest Service Region 5 Classification and Assessment with Landsat of Visible Ecological Groupings (CalVeg) dataset for Zone 5 (Central Valley)[20] and from various historical and projected land use surveys (see *Sections 3.1.1 and 3.1.2* below)
- Gridded daily precipitation data from the 4-kilometer *Parameter-elevation Regressions on Independent Slopes Model* (PRISM)[21] dataset (**Figure 23**)
- Daily reference evapotranspiration (ETo) data measured at California Irrigation Management Information System (CIMIS) Salinas North #116 and Laguna Seca #229 stations
- Water service area boundaries for the five water service areas within the Basin, including MCWD, CalAm (Ambler, Hidden Hills and Toro Units) and California Water Service (CWS) (**Figure 24**)

Additional parameters to the SMB include:

- Curve numbers for runoff for agriculture, urban, and native vegetation classifications including conifer forest/woodland, hardwood forest/woodland, mixed conifer and hardwood forest/woodland, shrub, herbaceous, and barren (*USDA, 1986*)
- Monthly crop coefficients and canopy storage properties for native, agricultural, and urban land use types from California Polytechnic State University's Irrigation Training and Research Center (*Howes et al., 2015*)

The combination of soil type and land use type determines the Curve Number (runoff coefficient) that controls rainfall excess runoff. ET is calculated for each land use type from the crop coefficient method using daily CIMIS ETo rates and monthly crop coefficients specific to the land use type. ET is limited when soil moisture declines to the wilting point. Irrigation with private groundwater occurs for irrigated agricultural lands when the combination of precipitation, applied delivered water, and soil moisture storage is insufficient to meet vegetative water demand (ET). Private groundwater pumping rates are further adjusted to account for irrigation inefficiency[22].

The SMB calculates a running soil moisture balance for each grid cell on a daily timestep and is driven by daily spatially variable daily precipitation data from the PRISM dataset. Recharge is simulated to occur when the water content in the soil column after infiltration of precipitation, applied water, and ET uptake is greater than the field capacity of the soil. When this occurs, recharge is released from the soil column to the point where soil water content equals field capacity. Daily calculated recharge rates are summed into monthly totals for use as input to the MBGWFM.

In addition to the recharge calculated by the SMB, the MBGWFM also includes water distribution and conveyance system leakage in the RCH Package. Leakage was estimated as 5% of delivered water and was uniformly distributed across all cells within each of the five water service areas in the Basin (**Figure 24**).

[19] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627

[20] https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192

[21] https://prism.oregonstate.edu/recent/

[22] A uniform irrigation efficiency of 85% was assumed in the calculation of private groundwater pumping on agricultural lands in line with values commonly employed for high-efficiency (e.g., micro-drip) irrigation systems.

A more detailed description of the transient input datasets to the SMB for the historical and projected simulations is provided below.

3.1.1 Historical Simulation

3.1.1.1 Climate

The historical SMB simulation calculates recharge rates for the period October 1, 1998 through September 30, 2018 using daily precipitation data from PRISM and daily ETo data from CIMIS as described above.

3.1.1.2 Land Use

As limited historical land use information exists within the Basin, spatial land use classifications were derived from the CalVeg dataset (10x10 meter resolution). The CalVeg land use map was further supplemented with a map of 2014 land use classes prepared by DWR to identify irrigated agricultural parcels within the Basin and their respective crop types. A single historical land use class was subsequently assigned to each active grid cell based on the dominant land use type mapped within the cell area and was assumed to remain static throughout the duration of the 20-year historical simulation. The final historical land use map is shown in **Figure 25.**

3.1.1.3 Deliveries

Monthly historical delivery records were obtained for the three water suppliers within the Basin (MCWD, CalAm, and CWS) and used to estimate historical outdoor delivery rates within each of the five water service areas in the Basin. MCWD pumping records were obtained directly from MCWD, while monthly delivery records for the each of the CalAm and CWS service areas were provided by the Seaside Basin Watermaster. As no detailed breakdown of indoor vs. outdoor deliveries was available for any of the water agency delivery records, a simplifying assumption was made that 25% of total deliveries within the service area would be used for outdoor consumption (i.e., irrigation) over a 6-month growing season (i.e., April through September). This assumption generally consistent with information provided in MCWD’s 2020 Urban Water Management Plan (UWMP, *Schaff & Wheeler, 2021*) and assumptions used in the Seaside Model (*Hydrometrics, 2019)*. Monthly outdoor deliveries were uniformly distributed across all cells within each of the five water service areas in the Basin (**Figure 24**). As mentioned above, an additional 5% of total monthly deliveries were added to the recharge outputs from the SMB for all cells within a water service area to simulate leakage contributions to the Basin. Leakage was assumed to occur throughout the entire calendar year.

3.1.2 Projected Simulations

3.1.2.1 Climate

As mentioned in *Section 2.4.2.3.2*, three climate change scenarios were modeled in the MBGWFM projected simulations. These climate change scenarios were informed by climate change modeling completed by DWR (*DWR, 2020*) and include the following:

- **Baseline Conditions –** no climate change impacts
- **2030 Climate Change (Central Tendency) –** “moderate” climate change impacts
- **2070 Climate Change (Central Tendency) –** accounts for “severe” climate change impacts

For the Baseline scenario, projected daily precipitation and ETo datasets were developed using historical PRISM and CIMIS data for the 50-year "analog" hydrologic period described in *Section 2.2.2.2*, where:

- Analog Years 1-20: Based on historical years 1999-2018
- Analog Years 21-40: Based on historical years 1999-2018
- Analog Years: 41-50: Based on historical years 1999-2008

For the 2030 and 2070 climate change scenarios, DWR provided monthly scaling factors to account for impacts of climate change on precipitation and ET rates. Precipitation and ET climate change factors are spatially variable and mapped to a variable infiltration capacity (VIC) grid (**Figure 26**). These monthly climate change factors were extracted for VIC grid cells that intersect the Basin and used to modify the 50-year historical "analog" precipitation and ET datasets developed for the Baseline projected scenario.

On average, applying the 2030 climate change factors resulted in a -0.5% decrease in precipitation rates and a +3.1% increase in ET rates throughout the Basin relative to Baseline projected conditions, while applying the 2070 climate change factors resulted in a -2.2% decrease in precipitation rates and a 7.7% increase in ET rates throughout the Basin relative to Baseline projected conditions. Notably, the DWR climate change factors dataset appears to indicate that precipitation events within the Basin are projected to be less frequent and of significantly higher intensity as climate change impacts become more severe, with a single-month maximum change in precipitation rates of +56% under the 2030 climate scenario and +71% under the 2070 climate scenario. This could result in comparatively higher average recharge rates within the Basin relative to Baseline conditions, even though total precipitation rates are projected to remain nearly constant. On the other hand, the DWR climate change dataset appears to indicate that ET rates are projected to be marginally yet consistently higher as climate change impacts become more severe, with a single-month maximum change in ET rates of +7% under the 2030 climate scenario and +17% under the 2070 climate scenario.

3.1.2.2 Land Use

For all projected scenarios, the historical land use map was updated to reflect future planned urban development and expansion of the MCWD service area in line with future land use conditions specified in MCWD's 2020 Water Master Plan (*AKEL, 2020*). Specifically, a map of future land use (Figure 2.3 of the MCWD Master Plan) was used to adjust the urban footprint within the Marina-Ord Management Area to include all future residential, commercial, industrial, institutional, and mixed-use parcels designated for development over the next 20 years (i.e., by 2040)[23]. Land use in the remaining areas of the Basin was assumed to remain constant with current conditions, in line with the assumption of no future increases in water demands within the Corral de Tierra Management Area (see *Section 3.1.2.3*). The final future land use map is shown in **Figure 27.**

Additionally, for all projected scenarios a stormwater catchment area was delineated around the future MCWD service area boundary to track urban runoff rates in the SMB. Here, an adjustment was made to the SMB code that allowed runoff on urban lands within the future MCWD service area to be re-routed into recharge as a means of directly simulating MCWD's ongoing stormwater recharge management program (see GSP *Section 9.4.4., project M1)*. The SMB estimates that full implementation of this stormwater recharge management program could provide as much as ~1,100 AFY of additional recharge to the future MCWD service area under Baseline projected conditions. It is important to note however

[23] The future (i.e., 2040) MCWD land use map was applied over the entire 50-year projected simulation period to simulate future impacts to recharge rates under full buildout of the City of Marina.

that this added recharge from stormwater capture is at least partially offset by reduced recharge in newly urbanized areas. The MCWD stormwater catchment area is included on the future land use map (**Figure 27**).

3.1.2.3 Deliveries

Projected MCWD deliveries were estimated within the SMB using projected total future water demands from 2020 through 2040 specified in Table 4.10 of the 2020 UWMP (*Schaff & Wheeler, 2021)*. Projected deliveries within the future MCWD service area are detailed in **Table 7** below.

Table 7. Projected MCWD Deliveries

Year	Projected Demand (AFY)
2020	3,367
2025	6,001
2030	7,802
2035	8,879
2040	9,584

Projected MCWD deliveries were scaled linearly over five-year increments up through 2040 (i.e., projected model year 2022), and were then held constant through the remainder of the 50-year projected simulation period.

Deliveries from all other water service areas within the Basin (including CalAm and CWS service areas) were assumed to remain constant at current (i.e., WY 2018) rates throughout the entire 50-year projected simulation period.

Consistent with the historical model, it was assumed that 25% of total projected deliveries would be applied for outdoor uses between April – September, while the remainder of deliveries would be used to meet potable and non-potable indoor demands. It was also assumed that 5% of total projected deliveries would be lost to leakage and thus contribute directly to recharge within each water service area of the Basin.

3.2 Pumping

Pumping is simulated in the MBGWFM using the Well (WEL) Package. Monthly pumping rates were estimated for all known municipal/public supply, agricultural, and domestic wells within the Basin based on available data provided by MCWD (for the Marina-Ord Management Area) and SVBGSA (for the Corral de Tierra Management Area). All pumping was vertically distributed based on available well construction information (i.e., screened interval depths or total well depths). When well construction information was unavailable, pumping was distributed based on aquifer classifications previously determined by MCWD or SVBGSA. A subset of wells are presumed to screen multiple Principal Aquifer units; for these wells, pumping was assigned proportionally to model layers based on the total screen intervals within each layer.

A summary of the datasets and assumptions used to develop historical and projected pumping datasets is provided below. Locations of the pumping wells specified in the model and their relative historical average monthly pumping rates are shown on **Figure 28**.

3.2.1 Historical Simulation

Historical pumping within the Marina-Ord Management Area was estimated from records provided by MCWD. Monthly historical pumping rates from October 1998 – September 2018 were provided for all nine (9) MCWD-owned production wells within the Basin that were in operation over the historical period.

Historical pumping within the Corral de Tierra Management Area was estimated from records provided by SVBGSA. Annual historical pumping rates from October 1998 – September 2018 were estimated for 393 known public supply, agricultural, and domestic wells based on an analysis of public water system wells and information obtained from recent water demand studies within the Corral de Tierra (*Wallace Group, 2020)*.

Additional historical pumping records were obtained from MCWRA for five MCWRA-owned wells north of the Basin boundary.

3.2.2 Projected Simulations

Projected pumping within the Marina-Ord Management area was estimated using projected MCWD water demands specified in the 2020 UWMP (*Schaff & Wheeler, 2021)* and outlined in **Table 7** above. Specifically, two projected pumping scenarios were estimated for MCWD:

- **"No-Projects" Scenario –** assumes 100% of future water demands will be met by groundwater pumping from the MCWD well network
- **"Projects" Scenario –** assumes a portion of future water demands will be met by recycled water or other augmented water supplies (see GSP *Sections 6.5.2 and 9.4.6*)

Under the "Projects" scenario, it is assumed that a portion of MCWD's projected water demand will be satisfied through some form of water supply augmentation. For evaluation purposes, the current projections assume that all recycled water generated by MCWD will be used to augment water supplies within its service area. This project is consistent with the Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse project described in GSP *Section 9.4.6* (project M3). Practically, projected MCWD pumping is reduced from the total projected demands specified in the 2020 UWMP to account for increased availability of recycled water (or other augmented water supplies) over the 20-year planning period. These augmented water supplies are currently modeled as "in-lieu" of groundwater pumping, i.e., through direct, proportional reductions in groundwater pumping from MCWD-owned wells relative to the "no project" scenario pumping demands.

A summary of the projected pumping rates within MCWD under each scenario is provided in **Table 8** below. For both scenarios, pumping was distributed within individual MCWD wells based on historical monthly and total pumping rates at each well[24]. All pumping was scaled linearly over five-year increments

[24] One exception to this is that all historical pumping contributions from MCWD Well 12 will be redistributed to Well 34 since Well 12 was recently taken offline.

up through 2040 (i.e., projected model year 2022), and was then held constant through the remainder of the 50-year projected simulation period.

Table 8. Projected MCWD Pumping Rates

Year	"No Projects" Scenario Pumping (AFY)	Recycled / Augmented Water Supply Offset (AFY)	"Projects" Scenario Pumping (AFY)
2020	3,367	(0)	3,367
2025	6,001	(600)	5,401
2030	7,802	(4,571)	3,231
2035	8,879	(5,129)	3,880
2040	9,584	(5,495)	4,089

Consistent with information and projections provided by SVBGSA, projected pumping within the Corral de Tierra Management Area was assumed to remain constant at current (WY 2018) rates.

4. CALIBRATION

4.1 Calibration Approach

A primary goal of model calibration is to minimize the residual (i.e., difference) between simulated and observed water levels throughout the Basin. This is primarily achieved through systematic and reasonable modifications to model parameters such that simulated water levels match well with observed measurements, both spatially and temporally. Additionally, it is important to observe and account for water budget outputs during model calibration to ensure that groundwater inflows and outflows are within reasonable ranges based on prior available information and studies conducted within the Basin.

In total, 65 unique parameters are specified within the MBGWFM. Model parameters primarily relate to aquifer properties (i.e., hydraulic conductivity and storage) defined within each model layer and for each boundary condition (e.g., conductance terms for the RIV and GHB packages). Given the high complexity and parameterization of the model, calibration was primarily conducted using a software package for Model-Independent Parameter Estimation and Uncertainty Analysis (PEST)[25]. PEST manages the systematic changes to the model parameters, runs the model multiple times, evaluates the effect on simulated water levels, and attempts to minimize model error through use of an objective function. PEST calibration is guided by user input, including specifying priors, bounds, and relationships between model parameters, and can thus be systematically applied to achieve an acceptable model error while keeping the parameter space constrained within reasonable limits.

Further details regarding the model calibration process and results are provided below.

[25] https://pesthomepage.org/

4.2 Calibration Data

Historical groundwater elevation data collected from wells located throughout the Basin were used to calibrate the model. In total, 30,354 groundwater elevation observations collected from 603 wells between October 1998 and September 2018 were used for model calibration. Calibration well locations are shown in **Figure 29**.

4.3 Aquifer Properties

As described in *Section 2.5,* preliminary estimates of aquifer properties were used as initial conditions within the MBGWFM. Through an iterative approach, the modeled water-transmitting and storage properties were calibrated by systematically adjusting the parameter values in PEST to minimize water level residuals.

The calibrated distribution of horizontal hydraulic conductivities are mapped by model layer in **Figure 30** and **Figure 31**. The calibrated distribution of vertical hydraulic conductivities are mapped by model layer in **Figure 32** and **Figure 33**. **Table 9** presents the calibrated storage parameters (including specific yield and specific storage) by model layer.

Table 9. MBGWFM Calibrated Storage Parameters

MBGWFM Layer	Specific Yield (Sy) [-]	Specific Storage (Ss) [1/ft]
1	0.12	1.0E-05
2	0.12	1.0E-05
3	0.12	5.0E-06
4	0.12	5.0E-06
5	0.12	4.0E-06
6	0.12	1.0E-05
7	0.12	3.0E-05
8	0.12	1.0E-05

4.3.1 Evaluation of Calibrated Aquifer Properties

Horizontal hydraulic conductivities (Kh) differ substantially by model layer. Within aquifer units, Kh values are generally highest in model layers 3, 5, and 7 (the Upper 180-Foot, Lower 180-Foot, and 400-Foot Aquifer) and lowest in model layer 8 (the Deep Aquifer). Kh values in aquitard units (i.e., layers 2, 4, and 6) are almost always lower than in overlying and underlying aquifer layers. Boxplots showing a comparison of Kh values estimated from pumping tests (see *Section 2.5*) and model calibrated Kh values are shown in **Figure 34**. In nearly all cases, calibrated Kh values are within the range of values estimated from aquifer pumping tests and other previous hydrogeologic studies as presented in *Section 2.5*.

Vertical hydraulic conductivities (Kv) also differ substantially by layer. Within aquifer units, Kv values are generally highest in layers 5 and 7 (Lower 180-Foot and 400-Foot Aquifers) and lowest in layer 3 (Upper 180-foot aquifer). Kv values in aquitard units (i.e., layers 2,4, and 6) are almost always lower than in overlying and underlying aquifer layers. Kv values are always lower than their Kh counterparts for each model layer, which is indicative of the vertical anisotropy in transmissivity observed within the Basin. No field estimates are currently available to validate Kv values in the Basin, though the calibrated values are generally within the range for alluvial aquifer systems and aquitard units presented in the literature (*Freeze & Cherry, 1979*).

Specific storage (Ss) values differ by aquifer layer. Within aquifer units, Ss values are highest in model layer 7 (400-Foot Aquifer) and lowest in model layers 3 and 5 (Upper and Lower 180-Foot Aquifers). In most cases, calibrated Ss values fall within the range of values estimated from aquifer pumping tests and other previous hydrogeologic studies as presented in *Section 2.5*. Calibrated Ss in model layer 1 (Dune Sand Aquifer) looks to be somewhat low compared to pumping test measurements, though layer 1 is almost always unconfined and thus Ss is usually not employed in head and storage change calculations within this aquifer unit.

Specific yield (Sy) values were ultimately held constant at 0.12 after final model calibration. This is within the range of estimates provided from prior hydrogeologic studies as presented in *Section 2.5*.

4.4 GHB Conductance

GHB conductance terms along each model boundary were ultimately coupled with the Kh values by model layer to provide for a continuous distribution in horizontal hydraulic conductivity along the Basin boundaries.

As discussed in *Section 2.4.2.2.1*, calibrated GHB conductance terms along the southern model boundary result in a reasonable match in historical estimates of Seaside Subbasin cross-boundary flows with the Seaside Model. As discussed in GSP *Section 4,* MBGWFM estimates of historical cross-boundary flows with the 180/400-Foot Aquifer Subbasin are significantly higher than analogous estimates provided in the 180/400 GSP (*SVBGSA, 2016*), though both acknowledge a consistent outflow gradient from Monterey Subbasin to the 180/400-Foot Aquifer Subbasin. This discrepancy is not surprising and well founded. Due to time constraints, historical and current water budgets presented in the 180/400 Foot Aquifer GSP were developed by aggregating data and analyses from previous reports and other available sources. No numerical modeling was completed to develop the historical or current water budget. The limitations of the historical water budget analyses included in the 180/400 Foot Aquifer GSP are well acknowledged within the GSP and additional analyses are being conducted as part of the 5-year review process.

In fact, as noted in the 180/400 Foot Aquifer GSP, the estimated inflow from the Monterey Subbasin of 3,000 AFY/year was taken from a Montgomery Watson document produced in 1997. This document generally looks at data that pre-dates the Historical Period evaluated in the Monterey GSP (1994 through 2018). It is based on a very limited data set and does not reflect conditions within these subbasins over the last 15 years. The Salinas Valley Integrated Hydrologic Model (SVIHM), which was developed by the U.S. Geological Survey (USGS) for the entire Salinas Valley Groundwater, was used to develop projected water budgets in the 180/400 Foot Aquifer GSP and water budgets for other Salinas Valley subbasins. However, as discussed in detail in Montgomery & Associates 2 April 2021 Technical Memorandum to the SVBGSA Advisory Committee (GSP Appendix 6C) "SVIHM does not accurately reflect hydrologic conditions in the Monterey Subbasin. SVIHM calibration efforts primarily focus on other portions of the Salinas Valley Groundwater Basin where there is significant agricultural groundwater use. The SVIHM was not calibrated to any groundwater level data from the Seaside Subbasin and included only one calibration location in the Monterey Subbasin. M&A believes the SVIHM is not detailed or accurate in the Monterey Subbasin." Thus, any direct comparison between cross-boundary subbasin flow estimates developed using the MBGWFM and those presented in the 180/400 Subbasin GSP or developed using SVIHM are not useful. No prior estimates of volumetric exchanges between the Monterey Subbasin and the Pacific Ocean are available for comparison.

SVBGSA is in the process of developing a variable density driven groundwater model for the coastal regions of the greater Salinas Valley Basin. This model will incorporate the MBGWFM and be used to further assess volumetric exchanges between the ocean and the Salinas Valley groundwater basin. It will also aid in evaluating flows across subbasin boundaries and will be used evaluate impacts of potential regional projects that have been proposed in this GSP and other GSPs to address seawater intrusion in the Salinas Valley groundwater basin.

4.5 Streambed Conductance

Streambed conductance terms were adjusted in PEST and range from 0.1 ft/d to 10 ft/d depending on reach and uppermost active underlying model layer. Model results indicate the Salinas River is largely hydraulically disconnected from the Basin due to its presence on top of the largely impermeable Fort Ord/Salinas Valley Aquitard. An exception to this is in the northeastern corner of the Basin within the Corral de Tierra Management Area, where the Salinas River is directly underlain by the more permeable El Toro Primary Aquifer System. Here, the Salinas River is estimated to contribute a net inflow of ~150 AFY to the Basin during the historical model period.

4.6 Recharge

Unlike with aquifer storage properties, recharge rates are difficult to quantify with precision due to the general absence of direct monitoring data to support model calibration. Recharge inputs to the MBGWFM were not explicitly included as a parameter in the PEST calibration routine, but were rather manually adjusted through systematic modifications to parameters in the SMB to ensure recharge rates were within reasonable ranges when compared to other regional models and prior studies.

Annual, historical land surface water budget outputs from the calibrated SMB model are provided for the entire Basin and by Management Area in **Appendix 6A** of the GSP (see *Tables 6A-4 through 6A-6).* On average, the calibrated SMB calculates 10,055 AFY of recharge to the Basin, or 0.33 ft/yr. This represents a normalized recharge rate of 24% of total precipitation and applied water within the Basin, which is within the range of typical recharge rates estimated for the region. Recharge rates vary significantly by year, with most recharge occurring during wet years (e.g., 0.62 ft/yr in WY 2006) and very little occurring during dry years (e.g., 0.06 ft/yr in WY 2012). Recharge rates are typically highest in undeveloped areas of the Basin and are lowest in urbanized areas with significant impervious lands.

As part of SMB calibration, recharge outputs were compared to analogous outputs from the Salinas Valley Integrated Hydrologic Model (SVIHM)[26] (**Figure 35**). The SVIHM employs the MODFLOW Farm Package to estimate recharge rates, which functions similarly to the SMB developed for the MBGWFM. Comparison between the SMB and SVIHM indicates that average Basin-wide recharge rates calculated from the SMB are +12% higher than those calculated from the SVIHM over like timeframes. However, it is important to note that data and assumptions on land use classes, applied water, and other parameters differ between

[26] *Ibid [14].*

the two models, and thus a direct comparison of recharge volumes may be misleading. When looking closer at normalized recharge rates, it appears that the SMB and SVIHM track very closely in most areas of the Basin. For example, the SMB calculated ~25.3% of total precipitation and applied water as contributing to recharge in the Corral de Tierra Management Area, compared to ~25.6% calculated from the SVIHM. The most significant difference between the two models is within urban areas, where the SMB calculates ~11.6% recharge of precipitation and applied water compared to ~5.8% calculated from SVIHM. Notably, the SVIHM does not appear to account for deliveries from the various water suppliers within the basin in its Urban "farm", which may in part explain the discrepancy. The SVIHM also does not account for leakage from water conveyance systems within these areas. Therefore, it appears the discrepancy in Basin-level recharge between the two models can be primarily explained by differences in input datasets and assumptions between the two models rather than fundamental differences in recharge calculation methodologies.

4.7 Calibration Results

MBGWFM calibration was assessed using statistics calculated from the differences between observed and simulated water levels (residuals), a map of residuals, plots of calibration results, and hydrographs of observed and calculated water levels. Final model calibration statistics are summarized by aquifer layer and for the entire model in **Table 10**.

Table 10. MBGWFM Calibration Statistics

MBGWFM Layer	Water Level Count	Range in Observations (ft)	Mean Residual (ft)	Residual Standard Deviation (ft)	RMSE (ft)	Normalized RMSE (%)
1	11,941	123.2	-0.3	11.3	11.3	9.2%
3	9,032	98.7	-2.1	5.2	5.7	5.7%
5	4,785	74.6	-6.5	3.5	7.3	9.8%
7	1,836	119.9	-5.0	5.2	7.2	6.0%
8	3,210	728.4	7.1	19.6	20.8	2.9%
ALL	**30,354**	**728.4**	**-1.3**	**10.7**	**10.8**	**1.5%**

The root-mean square error (RMSE)[27] for the entire model is **10.8 ft** and the mean residual (error) is **-1.3 ft**, indicating that simulated water levels are underestimated by 1.3 ft on average. The normalized RMSE, expressed as a percent of the observed range in water levels, is below 10% within individual model layers and **1.5%** for the entire model. A generalized rule of thumb in model calibration is that the model is considered well-calibrated when the normalized RMSE is less than 10%.[28] The low normalized RMSEs are therefore an indicator that the model is well-calibrated as a whole and within individual layers given the range of observed data.

[27] RMSE is a quantitative measure of the closeness of fit and is calculated as the square root of the average squared residuals.

[28] If there is a large range in observed water levels, as is the case in the MBGWFM, normalized calibration metrics can be less reliable (Anderson and Woessner, 1991).

A scatter plot of calculated vs. observed water levels and a histogram of residuals are shown in **Figure 36**. In a perfect calibration, the points would plot exactly along the solid 1:1 match line. Points above the line represent simulated water levels that are overestimated relative to observed data and points below the line represent simulated water levels that are underestimated relative to observed data. The scatter plot shows a fairly equal distribution of points above and below the line. The slope of the regression line (0.97) and near-zero intercept (-0.68) indicates that there is a good match between calculated and observed water levels, with only a slight negative bias in the residuals. The histogram of residuals shown on **Figure 36** are roughly evenly distributed around a mean of -1.3 feet with a standard deviation of 10.7 feet. Most residuals lie within one standard deviation of the mean. The slight bias of residuals to the negative side of zero indicates that the simulated water levels tend to be slightly smaller than observed water levels.

Average residuals are shown by well on **Figure 37**. Residuals are representative of site-specific errors between the modeled and observed water. A positive value indicates simulated water levels are greater than observed water levels and a negative value indicates simulated water levels are less than observed water levels. Average residuals are spatially variable, though some patterns appear to exist within individual model layers:

- In Layer 1, simulated water levels are generally overestimated at wells located near the coast and underestimated at wells located east of the City of Marina;
- In Layer 3, simulated water levels are underestimated by ~13 feet on average at the cluster of wells located just south of the Salinas River, and by ~3 feet on average at the cluster of wells located along the coast;
- In Layer 5, simulated water levels are persistently underestimated by ~6 feet on average at all observation wells;
- In general, the greatest residuals occur within the Corral de Tierra Management Area in model Layer 8, where limited historical water level data are available to inform model calibration. Simulated water levels are overestimated by ~18 feet on average within the Corral de Tierra Management Area, though residuals range from +79 feet to -46 feet at individual wells.

The high residuals observed at calibration wells in the Corral de Tierra Management Area can in part be explained by the simplified conceptualization and model representation of the aquifer system in this portion of the Basin. As described in *Section 2.2.3*, a single principal aquifer unit (the “El Toro Primary Aquifer”) has been defined within the Corral de Tierra and is currently being represented in the MBGWFM using a single model layer (Layer 8). As further described in *Section 4* of the GSP, historical water level measurements collected from wells screening the El Toro Primary Aquifer can vary substantially with well depth, indicating the presence of vertical gradients. These depth-dependent trends in measured water levels within the El Toro Primary Aquifer Unit contribute to the high range and magnitude in residuals seen at Layer 8 wells within the Corral de Tierra portion of the MBGWFM. In general, the historical model tends to overestimate simulated water levels at calibration wells screening the shallow portion of the El Toro Primary Aquifer Unit (e.g., MPWMD FO-05S) and underestimate water levels at the deeper screened calibration wells (e.g., MPWMD FO-05D).

Hydrographs of simulated and observed water levels are included in ***Attachment 1*.** The locations of wells with hydrographs are shown on **Figure 29**. Hydrographs of measured and simulated water levels generally match well for most wells within the Basin, especially within model layers 1, 3, 5, and 7. As mentioned above, model errors are noticeably greater at certain wells in model layer 8, where less data is available to inform aquifer properties and their spatial and vertical distribution. A more complete discussion of model limitations and suggested future refinements is provided in *Section 6* below.

5. SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to evaluate the effects of changing model parameters on model calibration. The analysis was conducted by changing model parameters in a systematic way and assessing the impact on the simulated water levels. The sensitivity analysis was conducted using PEST. PEST manages the systematic changes to the model parameters, runs the model multiple times, evaluates the effect on simulated water levels, and calculates the composite sensitivities for each parameter of interest.

The composite sensitivity was calculated for **65** parameters representing horizontal hydraulic conductivity, vertical hydraulic conductivity, specific storage, specific yield, general-head boundary conductance, and streambed conductance. The composite sensitivities were calculated for each layer represented by these parameters. Composite sensitivities for the 10 most sensitive parameters are shown in **Figure 38.** These 10 parameters represent 99.8% of the total composite sensitivities in the model. The composite sensitivities for the 54 parameters not shown in the figure are each less than 0.13%.

The most sensitive parameters in the MBGWFM are, by relative order: (1) the vertical hydraulic conductivity of Layer 2 (the Fort Ord/Salinas Valley Aquitard); (2) the specific storage values for all layers; and (3) the specific yield values for layer 1.

Vertical conductivity (Kv) in layer 2 appears to govern how much recharge enters the lower layers of the model versus being withheld within layer 1 (i.e., the Dune Sand Aquifer). As such, it is to be expected that Kv of layer 2 will have a substantial influence on simulated water levels in all layers. The final calibrated Kv of layer 2 was set at 2.0E-4 ft/d, in line with typical vertical conductivities for a clay-rich confining unit (*Freeze & Cherry, 1979)*. Additional data collection regarding seepage rates through the Salinas Valley Aquitard and interconnectivity between the Dune Sand and underlying 180-Foot Aquifer could help further constrain this parameter and thus improve model calibration.

There are very little data characterizing specific storage or specific yield values in the Basin apart from a limited number of pumping test measurements (see *Section 2.5.2*), which are in themselves quite variable. Given the uncertainty in measured values of specific storage and specific yield and the high sensitivity of these parameters, additional data collection (e.g., more pumping tests) could help constrain the range of values specified in the model.

Sensitivity analysis was performed on inputs to the SMB to determine which inputs have the largest impacts on recharge outputs. Recharge calculations in the SMB were found to be most sensitive to precipitation and ET inputs. Precipitation input to the SMB was estimated using PRISM data and ET input was estimated using crop coefficients and CIMIS reference evapotranspiration data (see *Section 3.1)*. A 10% change in precipitation input to the SMB model resulted in a 7% change in recharge. A 10% change in ET input to the SMB resulted in a 7% change in recharge. Recharge is less sensitive to other parameters and assumptions in the SMB such as soil depth, depression storage, and the ET stress function multiplier.

6. MODEL LIMITATIONS AND SUGGESTED FUTURE REFINEMENTS

Numerical models are mathematical representations of physical systems. They have limitations in their ability to represent physical systems exactly and due to limitations in the data inputs used. There is also inherent uncertainty in groundwater flow modeling itself, since mathematical (or numerical) models can only approximate physical systems and have limitations in how they compute results. However, DWR recognizes that although models are not exact representations of physical systems because mathematical depictions are imperfect, they are powerful tools that can provide useful insights (*DWR, 2018*).

The MBGWFM was developed using established scientific practices and principals for groundwater flow simulation and calibrated using the best available data within the Basin. Inputs to the models are carefully selected using best available data, the model's calculations represent established science for groundwater flow, and the model calibration error is within acceptable bounds. Therefore, the models are the best available tools for estimating water budgets and simulating projected groundwater conditions. As demonstrated by the calibration error statistics summarized in *Section 4.7* the MBGWFM reasonably represents historical groundwater conditions within the Subbasin using a set of parameters that are within the range of real-world observations and established scientific principles.

As is the case with any numerical groundwater flow model, the MBGWFM is subject to uncertainties and data gaps in hydrogeologic conceptualization (e.g., depth and extent of principal aquifer units), model parameterization (e.g., aquifer transmitting and storage properties) and calibration data (i.e., historical water level monitoring data), and simulated stresses (e.g., recharge, pumping, and boundary conditions). Here, "uncertainty" refers to the incomplete understanding of the physical setting, characteristics, and current conditions that significantly affect calculation of the water budgets presented above. "Data gaps" refer to limitations in the spatial coverage of measured data, or periods of time when no data are available. Each of these main categories of uncertainty and/or data gaps contribute to overall uncertainty in the water budget outputs from MBGWFM.

A summary of the main limitations of the model and corresponding water budgets identified from this analysis is provided below.

- **Uncertainty in Simulated Boundary Conditions.** As described in *Section 2.4.2*, inter-basin cross-boundary flows were simulated at the 180/400 Foot Aquifer Subbasin boundary based on historical groundwater elevation measurements from nearby wells, at the Seaside Subbasin boundary based on outputs from the historical Seaside Basin Groundwater Flow Model (*Hydrometrics 2009 & 2018*), and at the Monterey Coast based on freshwater equivalent sea levels. The datasets and assumptions used to model boundary conditions at each Subbasin boundary are subject to their own uncertainties, data gaps, and limitations, including:
    - *Lack of Deep Aquifer wells with historical data in the 180/400 Foot Aquifer Subbasin.* As described in *Section 2.4.2.1*, only a small number of wells exist in the Deep Aquifer within the 180/400 Foot Aquifer Subbasin with observed water level data spanning the full duration of the Historical Period. As such, simulated Deep Aquifer heads along the northern model boundary are subject to the limitations in available data to the north of the boundary, which may impact resulting calculations of 180/400 Foot Aquifer Subbasin exchanges within the water budget.
    - *Incomplete conceptualization of Principal Aquifer units in the Seaside Basin Groundwater Flow Model.* As described in *Section 2.4.2.2*, The Seaside model does not explicitly simulate groundwater flow from each Principal Aquifer unit defined in the Monterey Subbasin GSP, but rather uses a unique conceptualization of aquifer units that is primarily based on the main geologic formations encountered in the Seaside Area Subbasin (i.e., the Aromas Sands, Paso Robles Formation, and Santa Margarita/Purisima Formations). As such, there is considerable uncertainty surrounding the assumptions employed to link outputs from the Seaside model to individual layers of the MBGWFM, which may impact resulting calculations of Seaside Area Subbasin exchanges within the water budget.

- *Uncertainty in freshwater equivalent head calculations at the Monterey Coast.* As discussed in *Section 2.4.2.3*, freshwater equivalent sea levels at the Monterey Coastline are calculated based on the USGS equivalent freshwater head formula (*Guo & Langevin, 2002)*. The depths and distances at which principal aquifer units outcrop along the seafloor were estimated to inform corresponding freshwater equivalent heads at the aquifer-seafloor interface. There is considerable uncertainty surrounding the depths and distances at which each principal aquifer unit comes in contact with the sea floor, which may impact resulting calculations of Ocean exchanges within the water budget.

- **Uncertainty in Pumping Estimates within the Corral de Tierra (CDT) Management Area.** Very limited historical groundwater pumping data are available for the CDT Management Area. As such, CDT groundwater pumping demands were estimated for small water systems and domestic wells by SVBGSA using extraction reported to MCWRA and SWRCB where available, and approximated based on the number of deliveries for the small water systems and parcel size for the *de minimis* users (i.e., domestic wells). Therefore, the accuracy of CDT groundwater pumping estimates included in the water budget is limited by the lack of available pumping data and uncertainty in the CDT pumping estimates provided by SVBGSA.

- **Uncertainty in Deep Aquifer Representation.** Groundwater elevation data collected from the Deep Aquifer and the El Toro Primary Aquifer System (both represented by model layer 8) show heterogeneous conditions in the upper and lower portions of these aquifers. As discussed in GSP *Section 5*, a vertical gradient exists between the Paso Robles and Santa Margarita formations of the El Toro Primary Aquifer System. In addition, heterogeneous groundwater elevations were observed in the shallow and deep screens of Deep Aquifer well clusters as shown in GSP Figure 5-14. However, currently there is not enough spatial coverage of data to characterize the upper and lower portions of these aquifers as separate aquifers. Refining representation of the Deep Aquifer(s) and the El Toro Primary Aquifer System will facilitate connectivity between the MBGWFM and the Seaside Subbasin Model, and therefore refine calculation of inter-basin flows. Additional data is needed within both (a) the Monterey Subbasin to characterize and calibrate upper and lower portions of these aquifers and (b) the adjacent subbasins to establish boundary conditions.

- **Lack of Water Level Calibration Data.** Though the MCWD service area, former Fort Ord Site, and CWS/Cal-Am water service areas within CDT are well monitored, very limited historical groundwater elevation data exists in other portions of the Basin including near the Reservation Road area, in the Fort Ord Hills, and within the Deep Aquifer unit. As such, MBGWFM calibration in these areas is limited by the lack of available calibration data to quantify model error and inform localized adjustments to model parameterization.

- **Climate Change Uncertainty.** As described in *Section 3.1.2.1*, climate change scenarios were developed based on DWR's 2030 and 2070 Central Tendency climate modeling scenarios (DWR, 2020). These climate scenarios provide a standard framework for defining what might be considered the most likely future climate conditions within the Basin; however, they are inherently subject to considerable uncertainty. As stated in DWR (2018):

  - *"Although it is not possible to predict future hydrology and water use with certainty, the models, data, and tools provided [by DWR] are considered current best available* science *and, when used appropriately should provide GSAs with a reasonable* point *of reference for future planning."*

  - *"All models have limitations in their interpretation of the physical system and the types of data inputs used and outputs generated, as well as the interpretation of outputs. The climate models used to generate the climate and hydrologic data for use in water budget development were recommended by [the DWR Climate Change Technical Advisory Group] for their applicability to California water resources planning."*

- **Uncertainty in Aquifer Parameters.** As described in *Section 5*, a sensitivity analysis was performed to identify the most sensitive aquifer parameters that will impact simulated water levels and was subsequently used to direct further calibration efforts. In general, it was discovered that the model was most sensitive to specific storage parameters in each principal aquifer unit as well as the vertical hydraulic conductivity in the Fort Ord/Salinas Valley Aquitard. These aquifer parameters were further calibrated using a combination of PEST calibration procedures and professional judgement. As described in *Section 4*, all final calibrated aquifer parameters fall within their respective ranges reported in available pumping test data collected from wells within the Basin.

7. REFERENCES

AKEL Engineering Group, 2020. Marina Coast Water District Water Master Plan, dated May 2020.

Aqua Geo Frameworks, 2019. Final Report Entitled 2019 Airborne Electromagnetic Survey of Selected Areas Within the Marina Coast Water District, dated 11 December 2019.

DWR, 2018. Guidance Document for the Sustainable Management of Groundwater – Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development, dated July 2018.

DWR, 2020. DWR climate change datasets, available online at https://data.cnra.ca.gov/dataset/sgma-climate-change-resources.

Faunt CC, Hanson RT, Belitz K, 2009. *Groundwater Availability of the Central Valley Aquifer, California. Chapter A Introduction, Overview of Hydrogeology, and Textural Model of California's Central Valley*: U.S. Geological Survey Professional Paper 1766.

Feeney, 2003. Deep Aquifer Investigation—Hydrogeologic Data Inventory, Review, Interpretation and Implications, dated 31 March 2003.

Freeze, R.A. & Cherry, J.A., 1979. *Groundwater*. Englewood Cliffs, N.J. Prentice Hall. Print.

Geosyntec Consultants, 2007. El Toro Groundwater Study, dated July 2007.

Geosyntec, 2010. Geologic Map and Cross-Sections from El Toro to Salinas Valley, dated June 2010.

Guo, W., Langevin, C. 2002. User's Guide to SEAWAT: A Computer Program for Simulation of Three-Dimensional Variable-Density Ground-Water Flow. U.S. Geological Survey Report No. 06-A7.

Harding ESE, 2001. Hydrogeologic Investigation of the Salinas Valley Basin in the Vicinity of Fort Ord and Marina, Salinas Valley, California, dated 12 April 2001.

Howes, D.J, Fox, P., & Hutton, P. H., 2015. Evapotranspiration from Natural Vegetation in the Central Valley of California: Monthly Grass Reference-Based Vegetation Coefficients and the Dual Crop Coefficient Approach. *J. Hydrologic Engineering,* Vol. 20 Issue 10, dated 20 January 2015. https://doi.org/10.1061/(ASCE)HE.1943-5584.0001162

Hydrofocus, 2017. Draft North Marina Groundwater Model Review, Revision, and Implementation for Future Slant Well Pumping Scenarios, dated January 2017

HydroMetrics, 2009. Seaside Groundwater Basin Modeling and Protective Groundwater Elevations, dated November 2009.

HydroMetrics, 2019. 2018 Seaside Groundwater Model Update, dated January 2019.

MCWRA; LSCE, 2006. Monterey County Groundwater Management Plan, dated May 2006.

Niswonger RG, Panday S, and Ibaraki M, 2011. MODFLOW-NWT, A Newton formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6–A37, 44 p.

PRISM, 2019. Descriptions of PRISM Spatial Climate Datasets for the Conterminous United States. Last revised October 2019.

Schaaf & Wheeler, 2021. Marina Coast Water District 2020 Urban Water Management Plan, dated May 2021.

Stanford/Aqua Geo Frameworks, 2018. Interpretation of Hydrostratigraphy and Water Quality from AEM Data Collected in the Northern Salinas Valley, CA, dated 15 March 2018.

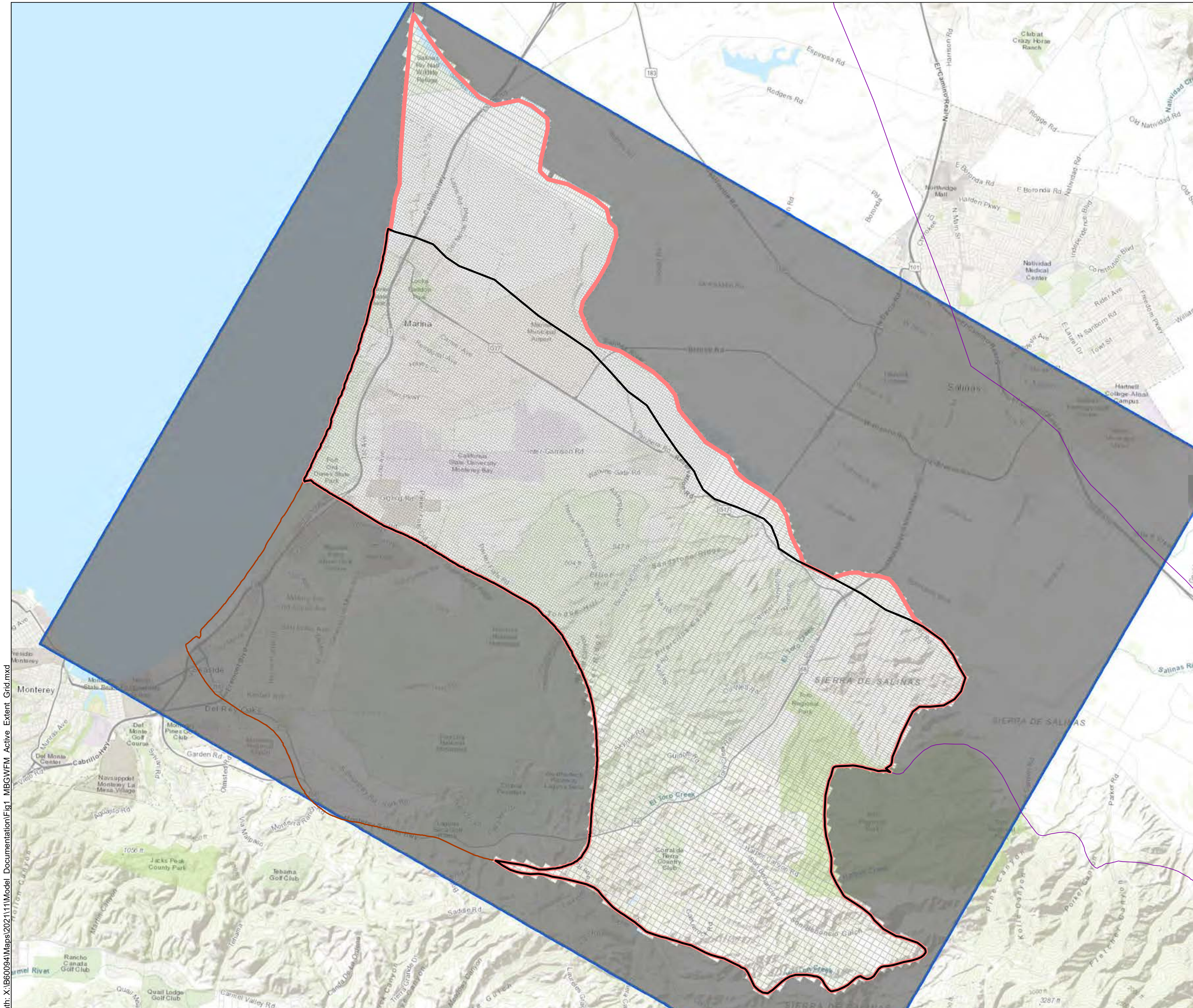
SVBGSA, 2020. Salinas Valley Groundwater Basin 180/400-Foot Aquifer Subbasin Groundwater Sustainability Plan, adopted 9 January 2020.

Todd, 2016. Final Engineering Report, Pure Water Monterey Groundwater Replenishment Project. Table 9-1.

USDA, 1986. Urban Hydrology for Small Watersheds. *TR-55*, dated June 1986.

Wallace Group, 2020. Corral de Tierra Subarea Water and Wastewater Usage Analysis, dated 30 October 2020.

Yates, 2005. Seaside Groundwater Basin: Update on Water Resource Conditions, dated 14 April 2005.



Legend

- Monterey Subbasin
- 180/400-Foot Aquifer Subbasin
- Seaside Subbasin
- Grid Extent
- MBGWFM Active Area

MBGWFM Grid

- Active Cells
- Inactive Cells

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2
(Scale in Miles)

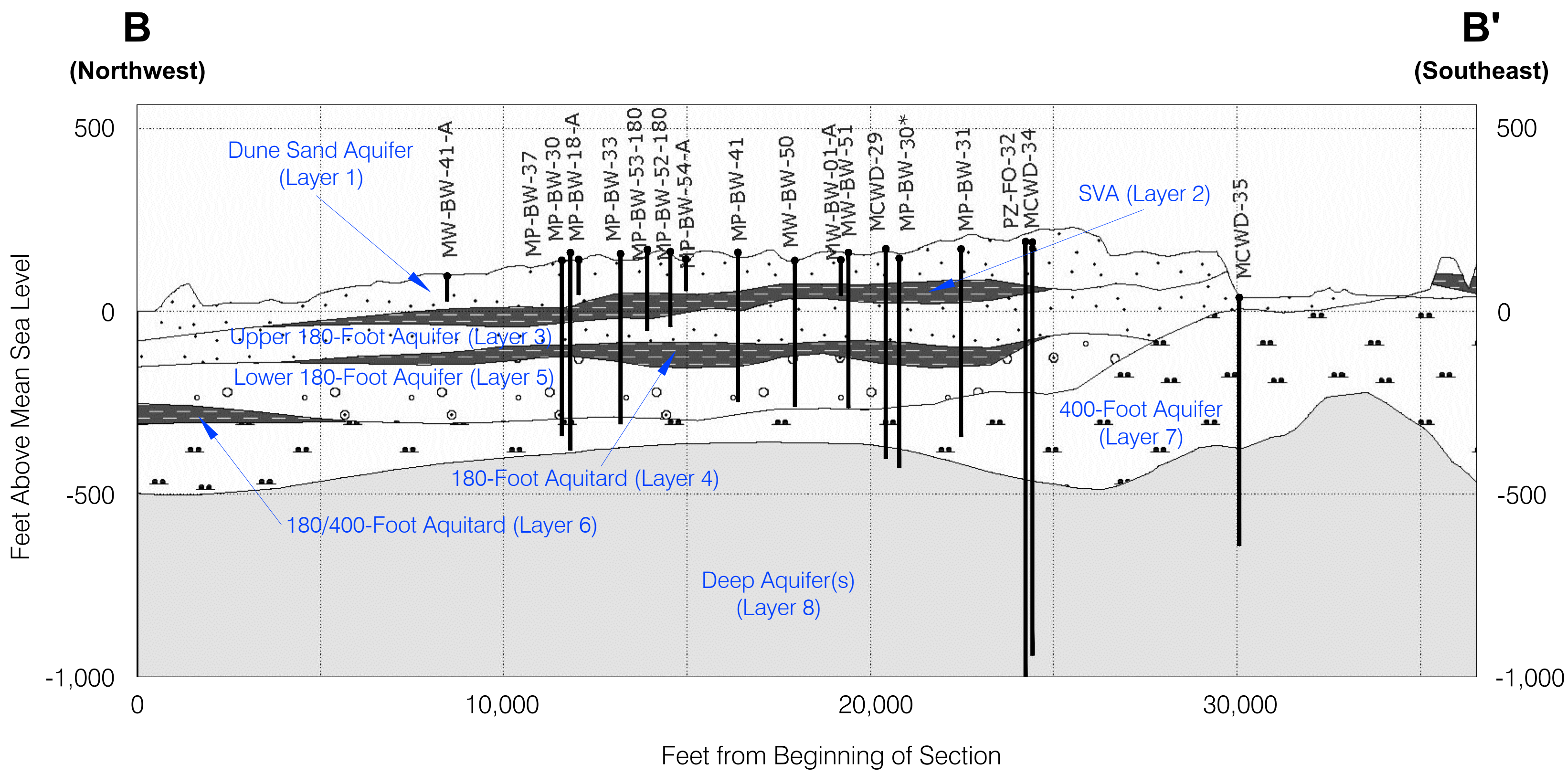
MBGWFM Active Extent and Grid

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 1

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig1_MBGWFM_Active_Extent_Grid.mxd



Key Map

Legend:

Hydrostratigraphy Model

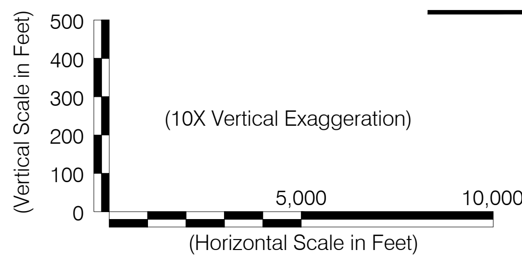
- Aquifers
- Aquitards
- Deep Aquitard / Deep Aquifer(s)
- Borehole

Abbreviations:

AEM	= airborne electromagnetic
mg/L	= milligrams per liter
SVA	= Salinas Valley Aquitard

Notes:

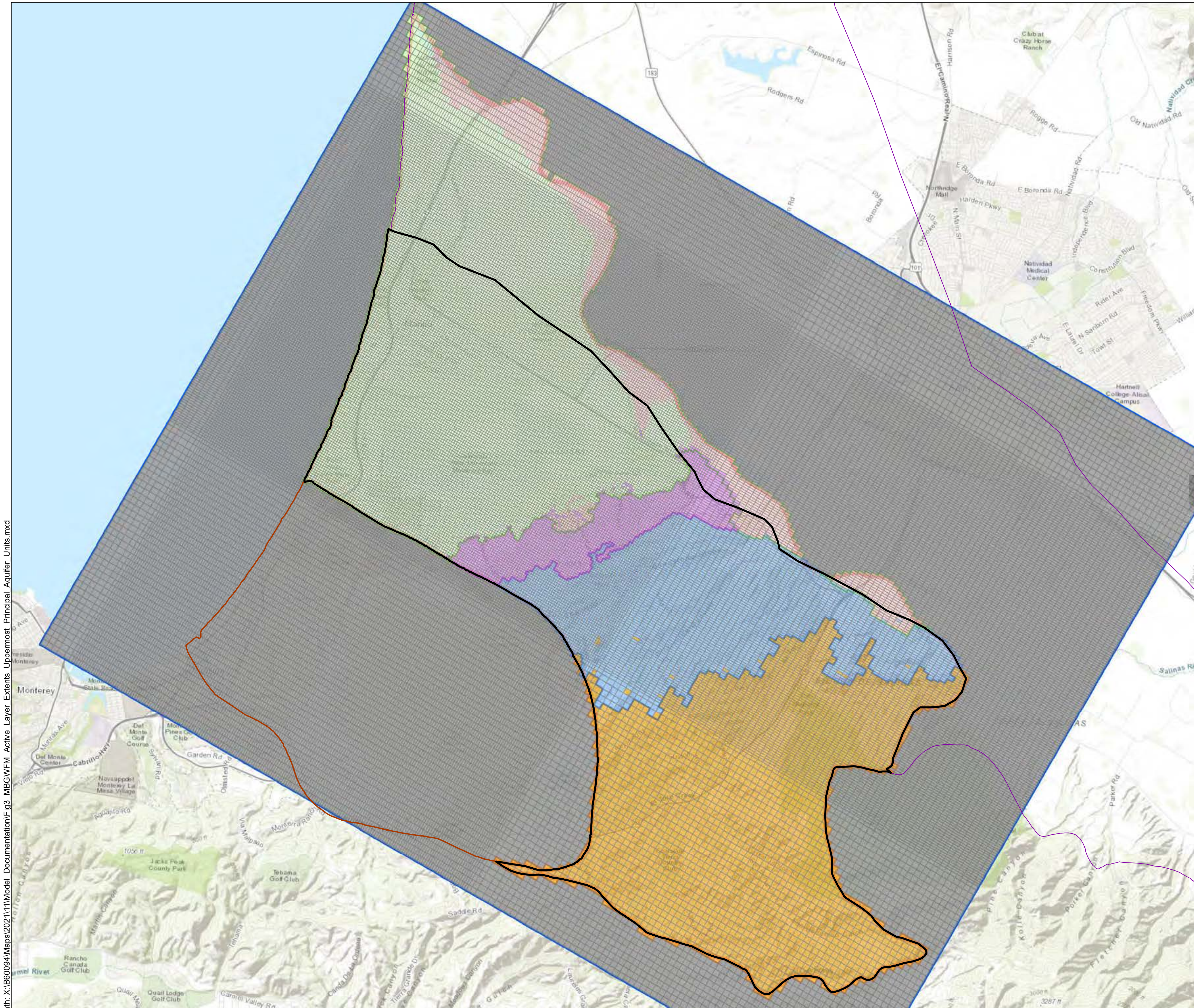
1. All locations are approximate.
2. The hydrostratigraphy model is Model A obtained from Stanford/Aqua Geo Frameworks (2018), developed based on cross-sections from previously published reports, borehole lithology logs, and 2017 AEM survey data. The hydrostratigraphy model is approximate.



Leapfrog Cross-Section and MBGWFM Layering within the Marina-Ord Management Area

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 2



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin

Uppermost Active Unit

- Layer 1
- Layer 2
- Layer 3
- Layer 6
- Layer 7
- Layer 8
- Inactive

MBGWFM Grid

- Active Cells
- Inactive Cells
- Grid Extent
- Layers 1-2 Extent
- Layers 3-6 Extent
- Layer 7 Extent
- Layer 8 Extent
- MBGWFM Active Area

Abbreviations

DWR = California Department of Water Resources

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

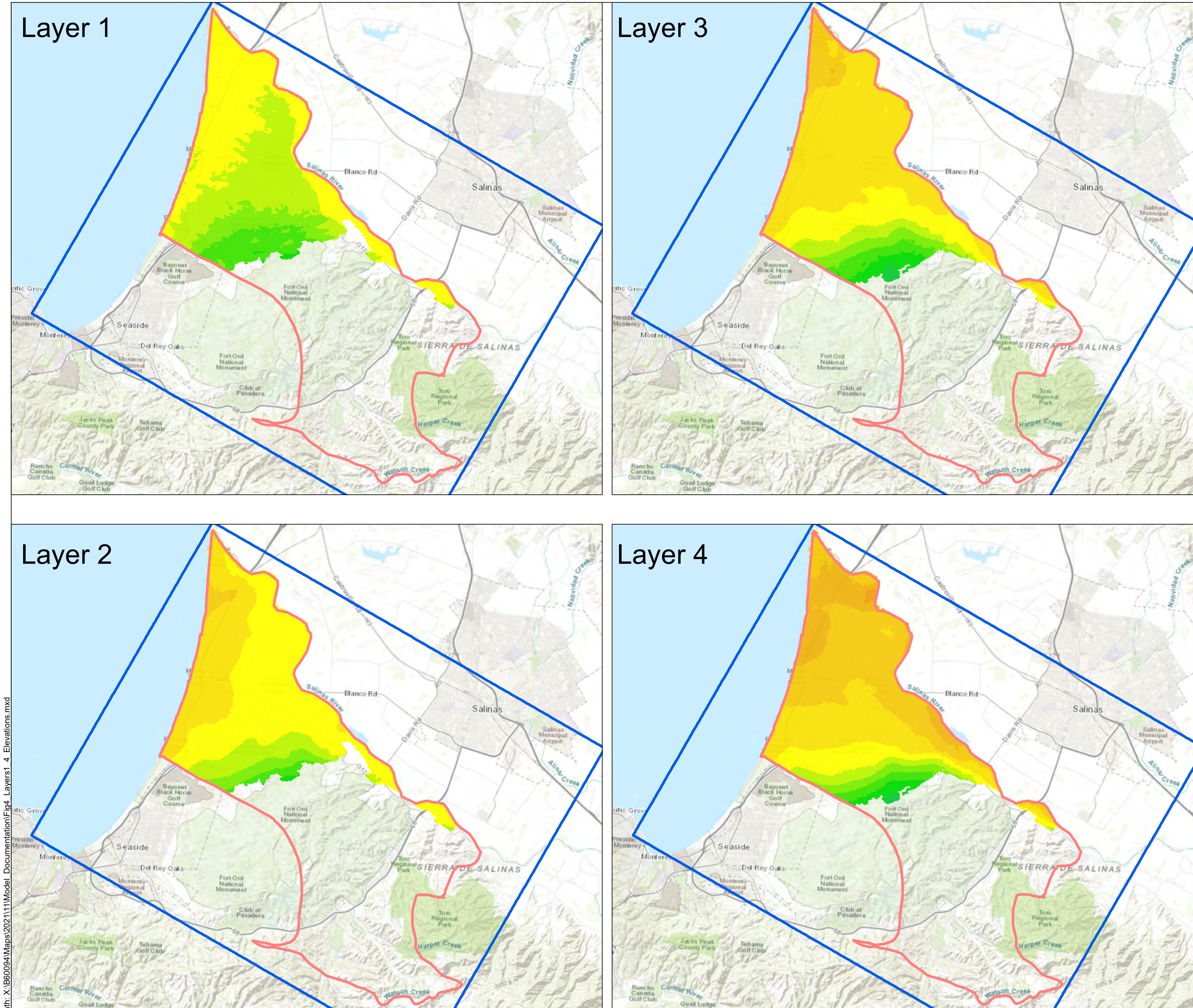
MBGWFM Active Layer Extents and Uppermost Principal Aquifer Units

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 3

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig3_MBGWFM_Active_Layer_Extents_Uppermost_Principal_Aquifer_Units.mxd



Legend

- Grid Extent
- MBGWFM Active Area

Layer Top Elevation (ft msl)

- <-700
- -699 - -600
- -599 - -500
- -499 - -400
- -399 - -300
- -299 - -200
- -199 - -100
- -99 - 0
- 1 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700
- 701 - 800
- 801 - 900
- 901 - 1000
- 1001 - 1100
- 1101 - 1200
- >1201

Abbreviations

ft msl = feet above mean sea level

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

0 3 6

(Scale in Miles)

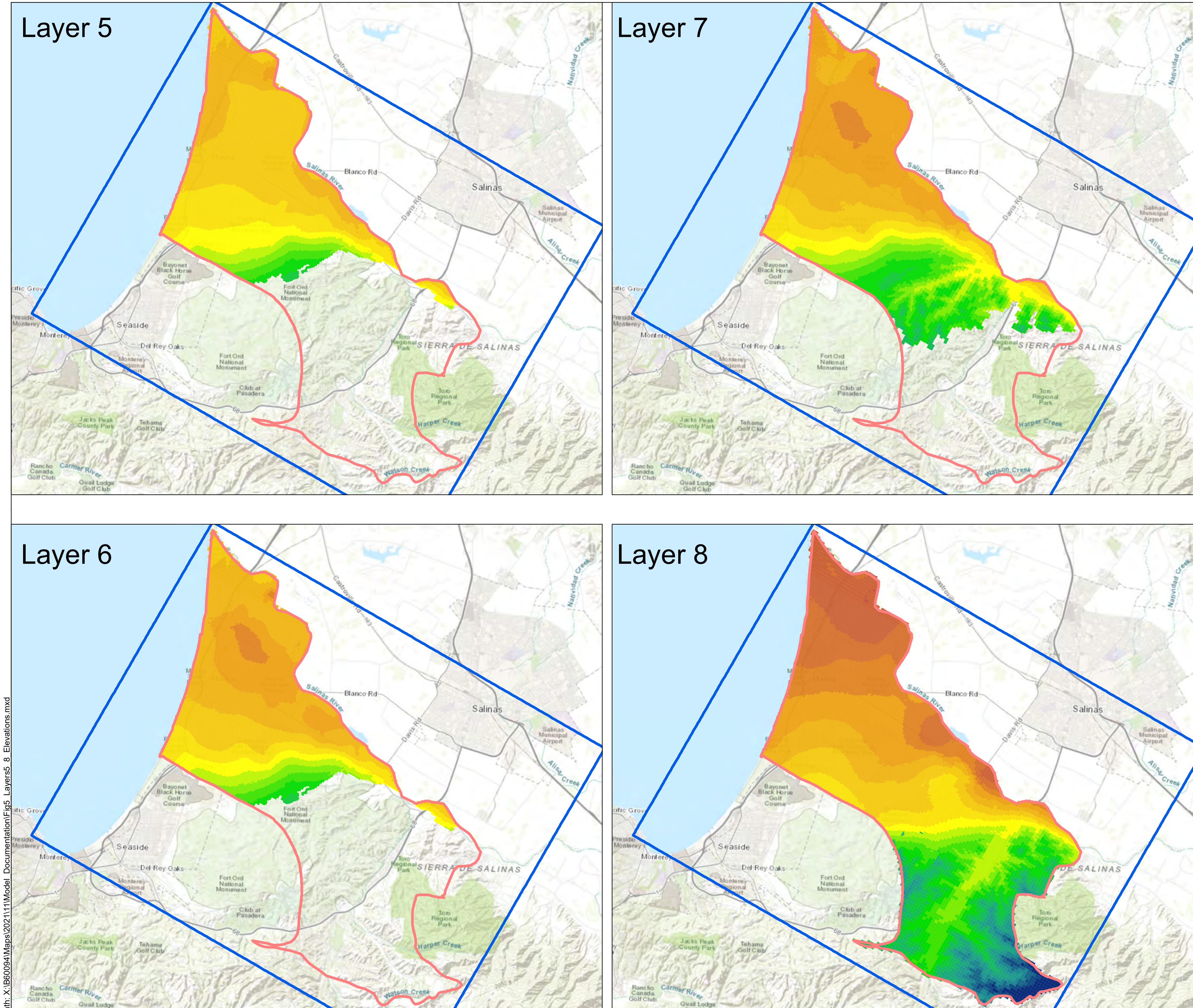
MBGWFM Layer Top Elevations
Layers 1 - 4

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

Figure 4

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig4_Layers1_4_Elevations.mxd



Legend

Grid Extent

MBGWFM Active Area

Layer Top Elevation (ft msl)

- <-700
- -699 - -600
- -599 - -500
- -499 - -400
- -399 - -300
- -299 - -200
- -199 - -100
- -99 - 0
- 1 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700
- 701 - 800
- 801 - 900
- 901 - 1000
- 1001 - 1100
- 1101 - 1200
- >1201

Abbreviations

ft msl = feet above mean sea level

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

0 3 6

(Scale in Miles)

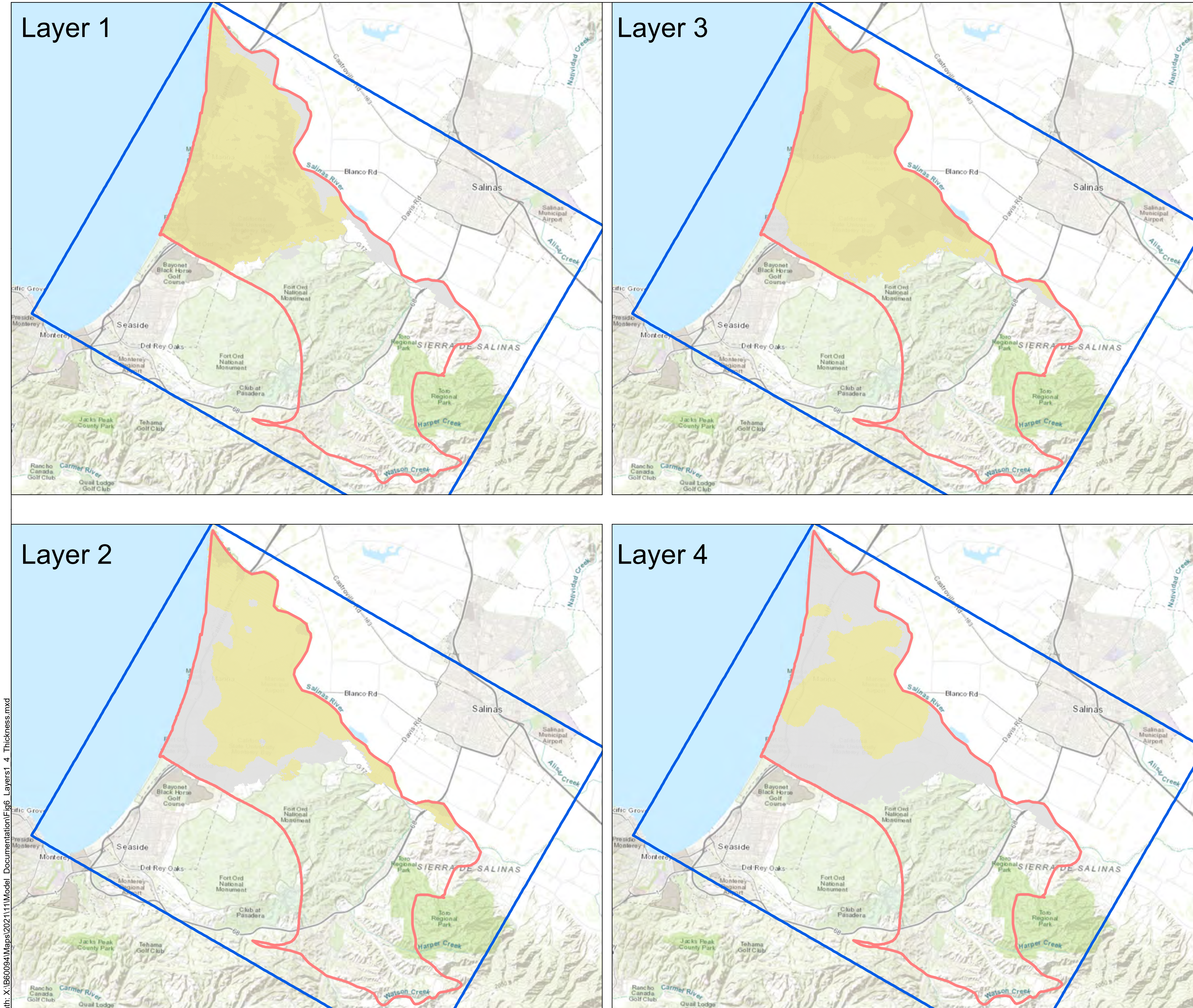
MBGWFM Layer Top Elevations
Layers 5 - 8

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

Figure 5

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig5_Layers5_8_Elevations.mxd



Legend

Grid Extent	
MBGWFM Active Area	

Layer Thickness (ft)

5 ft (flow-through cells)	1201 - 1300
6 - 100	1301 - 1400
101 - 200	1401 - 1500
201 - 300	1501 - 1600
301 - 400	1601 - 1700
401 - 500	1701 - 1800
501 - 600	1801 - 1900
601 - 700	1901 - 2000
701 - 800	2001 - 2015
801 - 900	2016 - 2200
901 - 1000	2201 - 2300
1001 - 1100	2301 - 2400
1101 - 1200	2401 - 2500
	>2501

Abbreviations
ft = feet
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 23 November 2021.

N
0 3 6
(Scale in Miles)

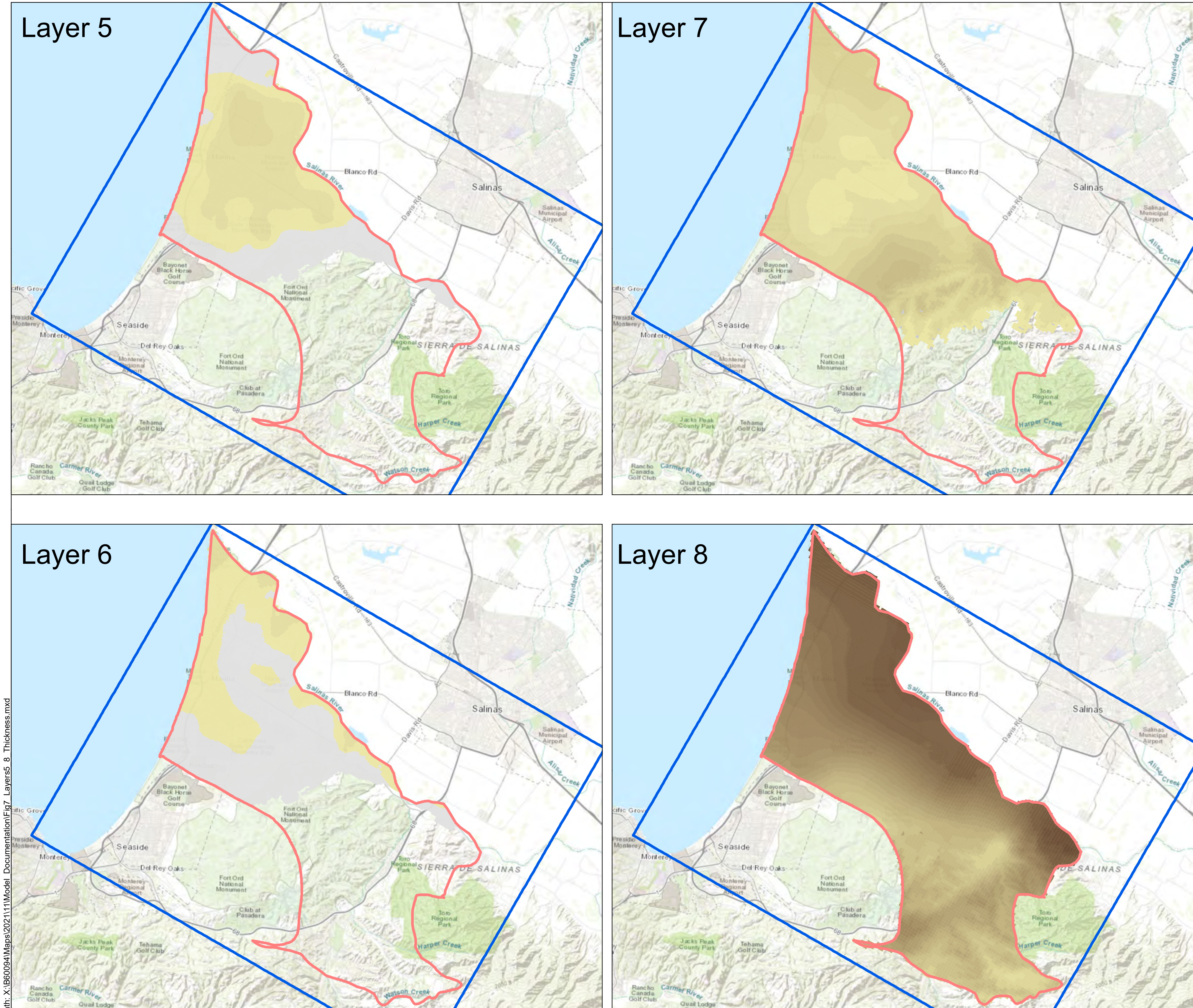
MBGWFM Layer Thickness
Layers 1 - 4

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

eki environment & water

Figure 6

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig6_Layers1_4_Thickness.mxd



Legend

Grid Extent

MBGWFM Active Area

Layer Thickness (ft)

- 5 ft (flow-through cells)
- 6 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700
- 701 - 800
- 801 - 900
- 901 - 1000
- 1001 - 1100
- 1101 - 1200
- 1201 - 1300
- 1301 - 1400
- 1401 - 1500
- 1501 - 1600
- 1601 - 1700
- 1701 - 1800
- 1801 - 1900
- 1901 - 2000
- 2001 - 2015
- 2016 - 2200
- 2201 - 2300
- 2301 - 2400
- 2401 - 2500
- >2501

Abbreviations

ft = feet

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

0 3 6

(Scale in Miles)

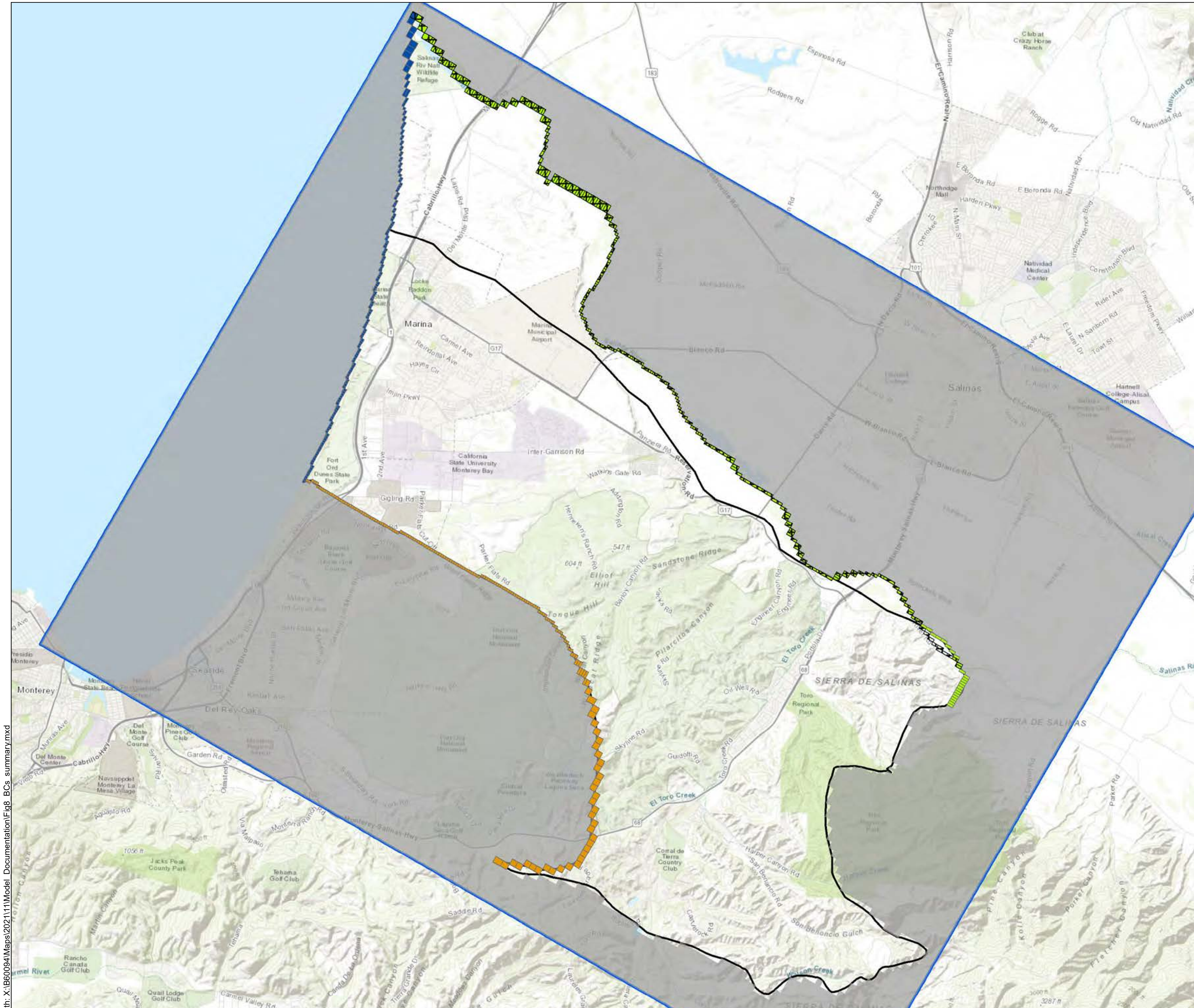
MBGWFM Layer Thickness
Layers 5 - 8

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

eki environment & water

Figure 7

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig7_Layers5_8_Thickness.mxd



Legend

- Monterey Subbasin
- Grid Extent
- River Cells (Layers 1-2,7)
- GHB Cells - Seaside Boundary (Layers 1-8)
- GHB Cells - Northern Boundary (Layers 3-8)
- GHB Cells - Pacific Ocean (Layers 1-7)
- No-Flow Cells

Abbreviations
DWR = California Department of Water Resources
GHB = General-Head Boundary
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

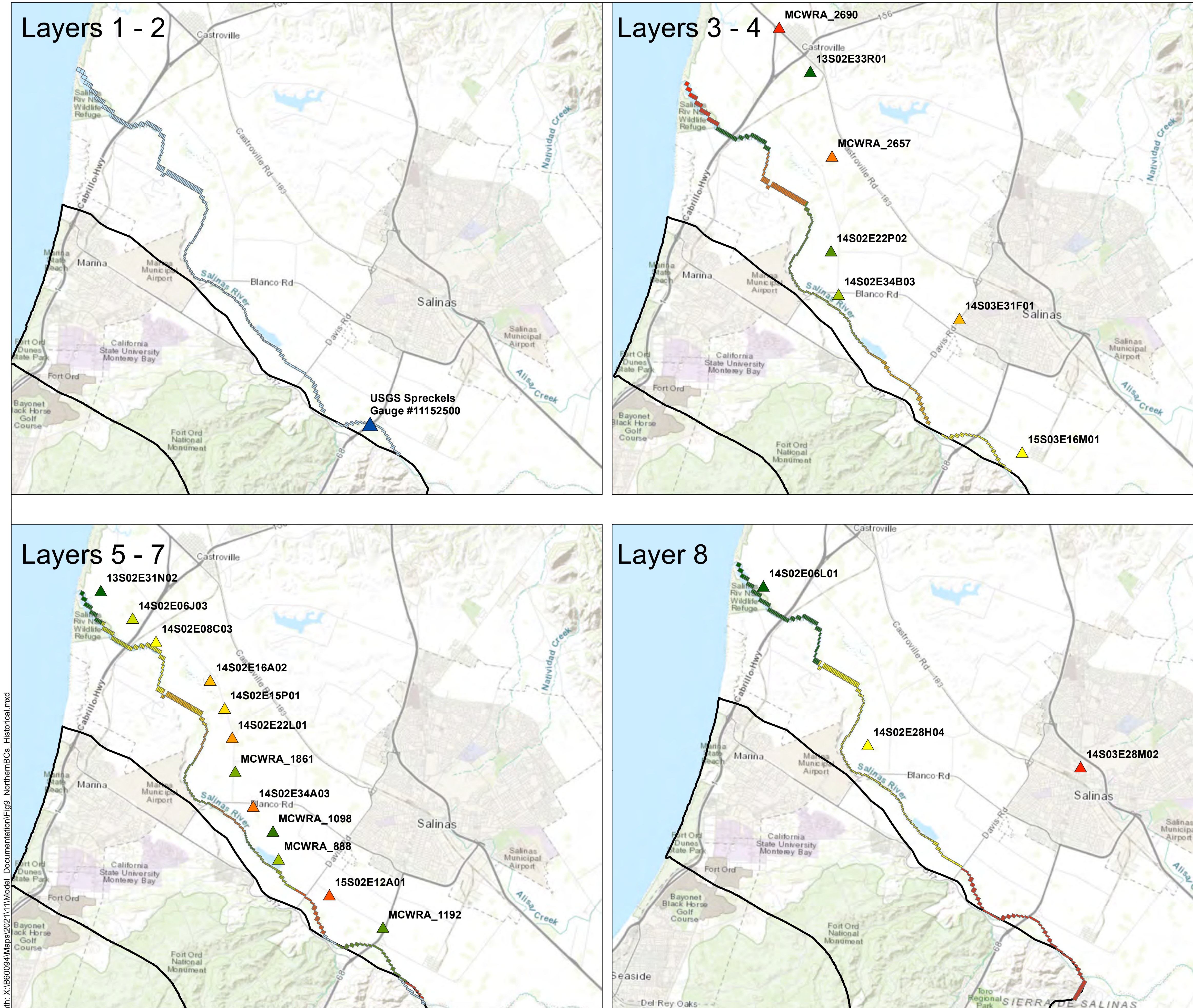
N 0 1 2
(Scale in Miles)

MBGWFM Boundary Conditions Summary

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 8

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig8_BCs_summary.mxd



Legend
- Monterey Subbasin
- Representative Monitoring Well (see Note 1)
- GHB Cells (see Note 1)
- River Cells

Abbreviations
ft msl = feet above mean sea level
GHB = General-Head Boundary
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. GHB cells are color-coded by their associated representative monitoring well that is used to inform specified heads.
2. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 7 January 2022.

N
0 2 4
(Scale in Miles)

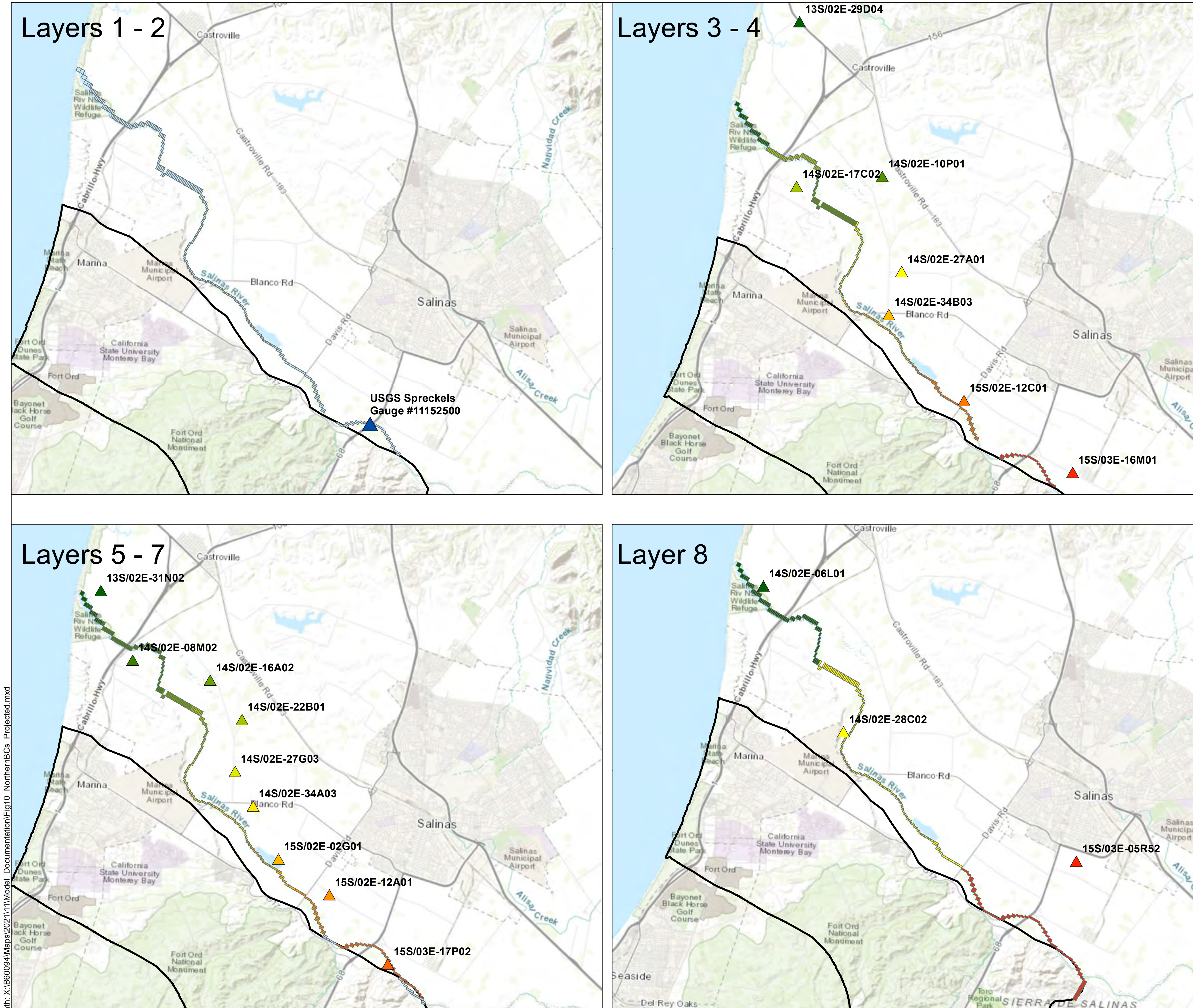
MBGWFM Northern Boundary Conditions - Historical Simulation

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

eki environment & water

Figure 9

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig9_NorthernBCs_Historical.mxd



Legend
- Monterey Subbasin
- SGMA Monitoring Well (see Note 1)
- GHB Cells (see Note 1)
- River Cells

Abbreviations
ft msl = feet above mean sea level
GHB = General-Head Boundary
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. GHB cells are color-coded by their associated representative monitoring well that is used to inform specified heads.
2. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 7 January 2022.

N
0 2 4
(Scale in Miles)

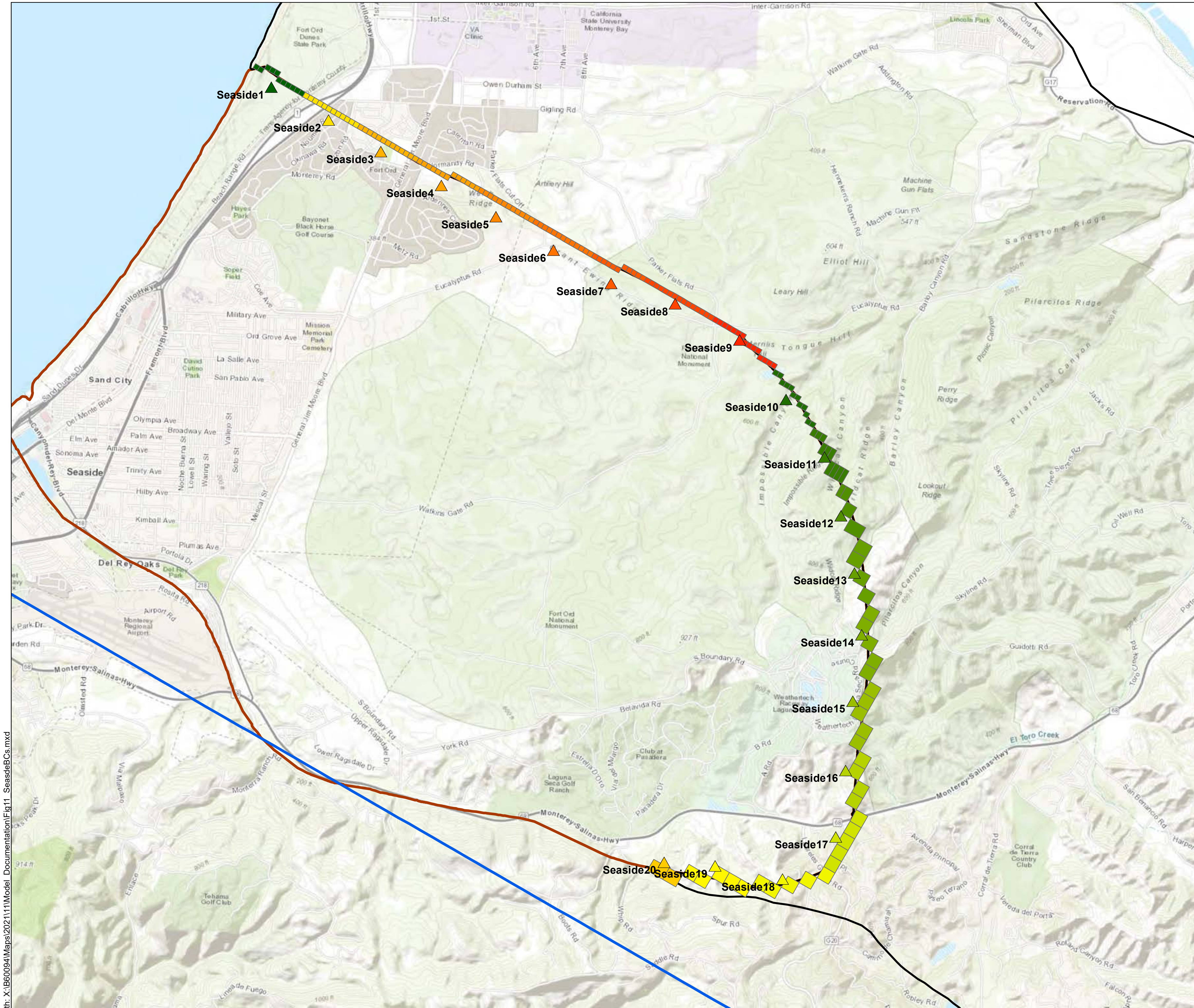
MBGWFM Northern Boundary Conditions - Projected Simulations

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.03

eki environment & water

Figure 10

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig10_NorthernBCs_Projected.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- Seaside Proxy Monitoring Location (see Note 1)
- GHB Cells (see Note 1)

Abbreviations

DWR = California Department of Water Resources
GHB = General-Head Boundary
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. GHB cells are color-coded by their associated Seaside proxy monitoring well that is used to inform specified heads.
2. All locations are approximate.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 0.5 1 (Scale in Miles)

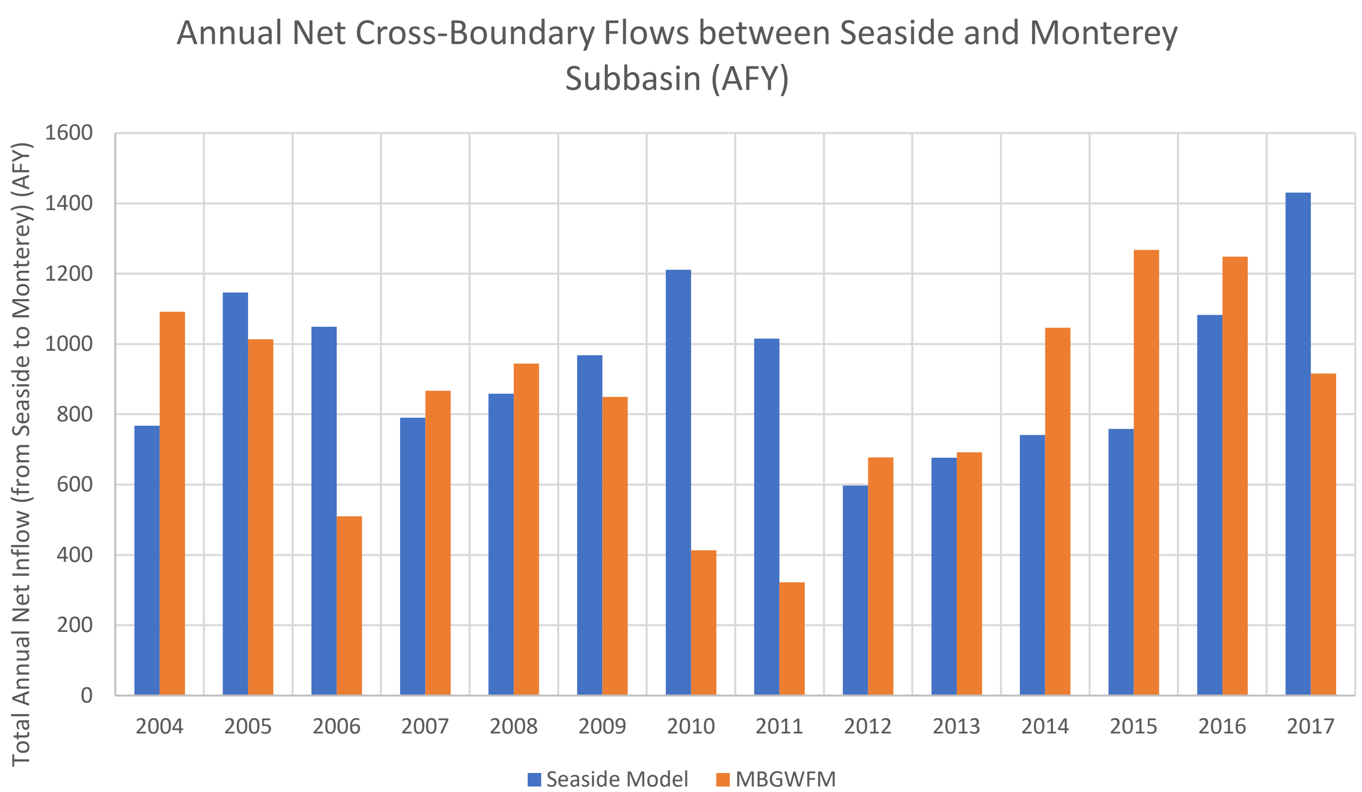
MBGWFM Southern Boundary Conditions

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 11

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig11_SeasideBCs.mxd



Legend
= Seaside Model
= MBGWFM

Abbreviations
AFY = acre-feet per year
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. Positive values indicate a net inflow from Seaside to the Monterey Subbasin.

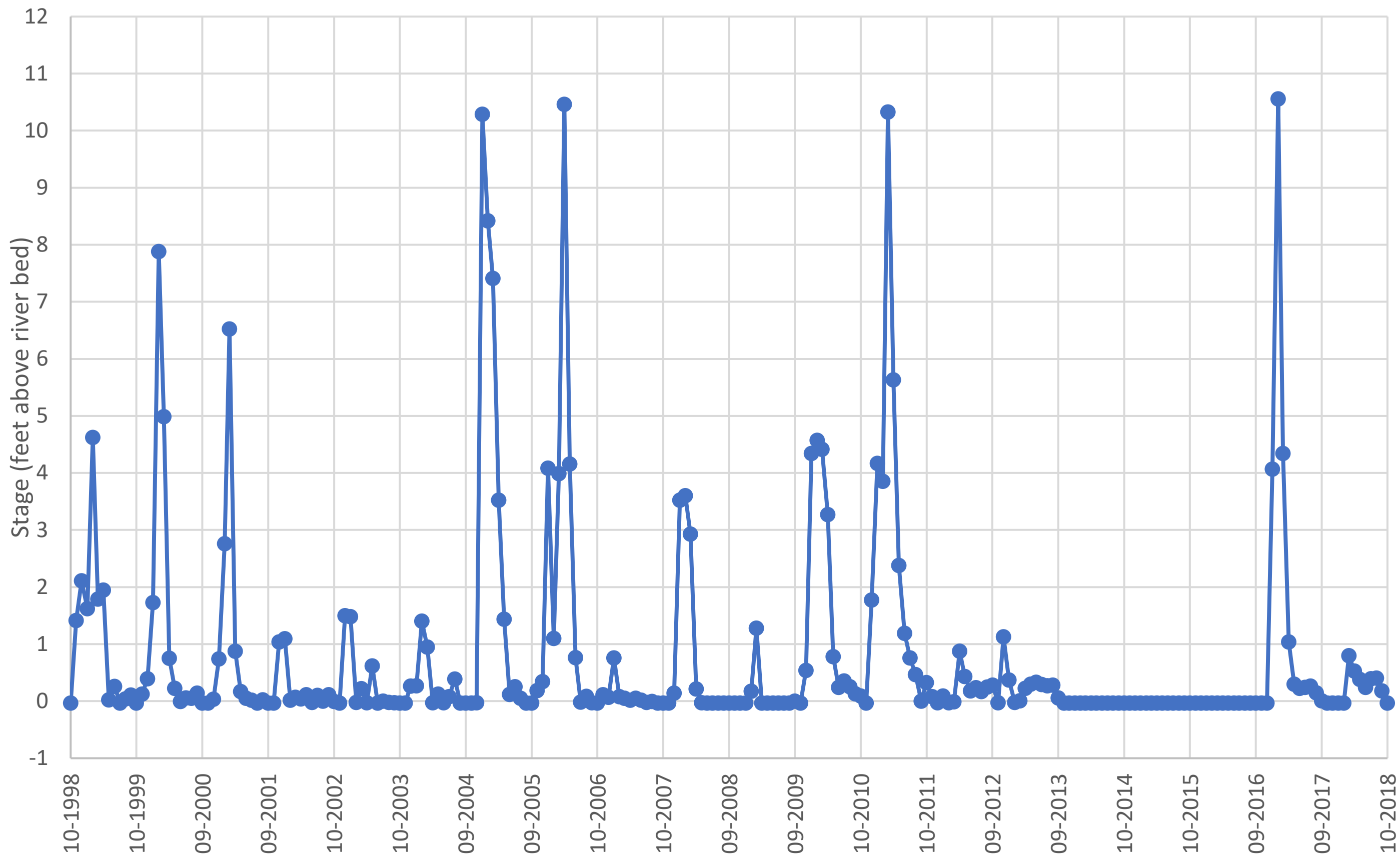
Sources
1. MBGWFM
2. Seaside Groundwater Flow Model

eki environment & water

Annual Net Cross-Boundary Flow Estimates between the Seaside and Monterey Subbasins

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.12
Figure 12

Salinas River Stages at USGS Spreckels Gauge (Site No. 11152500)



Legend

= Salinas River Stage (ft)

Abbreviations
ft = feet

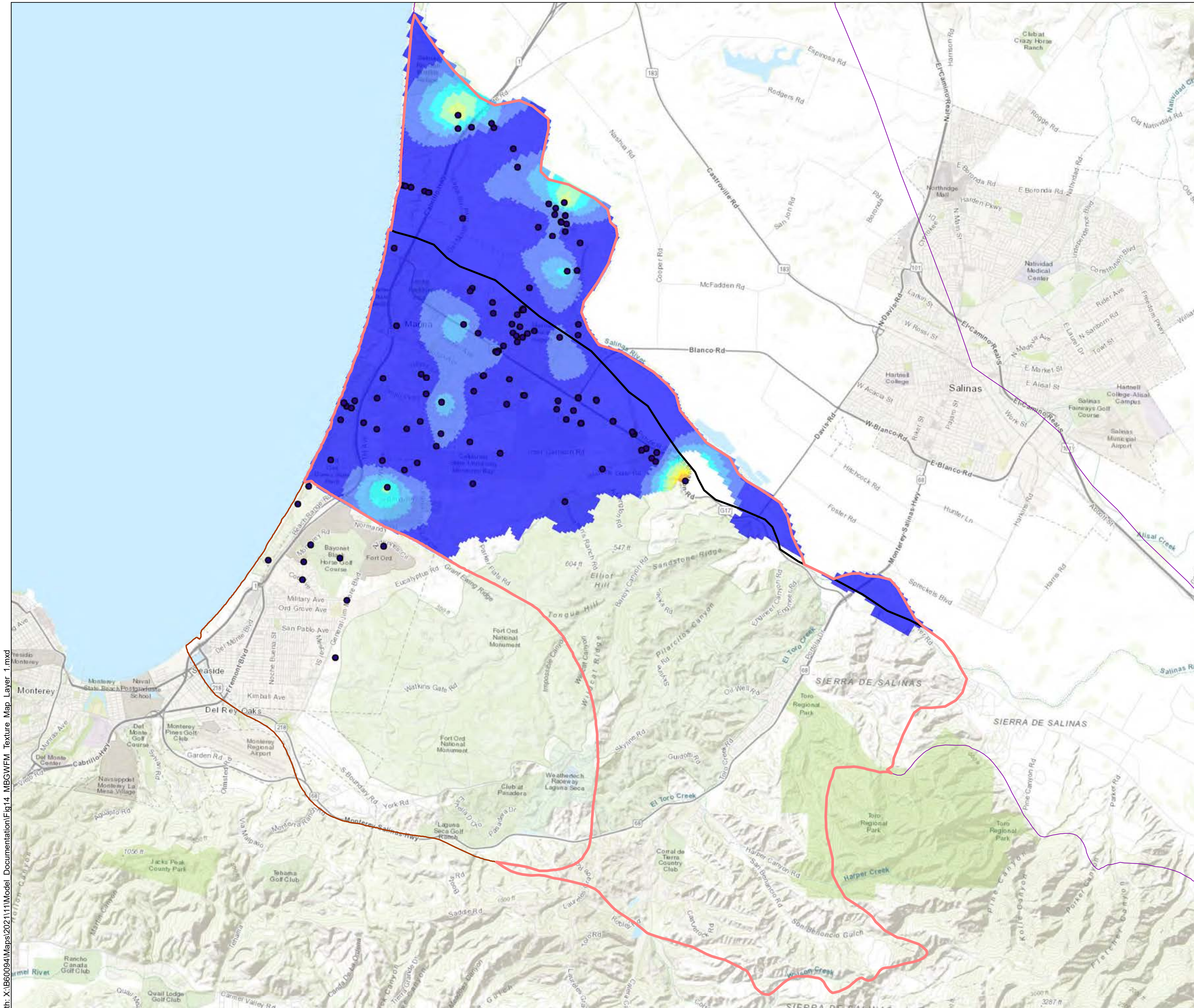
Notes
1. Salinas River stages are approximated from flow data (see *Section 2.4.3*).

Sources
1. Monterey Subbasin Groundwater Flow Model

eki environment & water

Salinas River Stages at USGS Spreckels Gauge

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.12
Figure 13



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Borehole Location

Layer 1 % Coarse

- 0.00 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

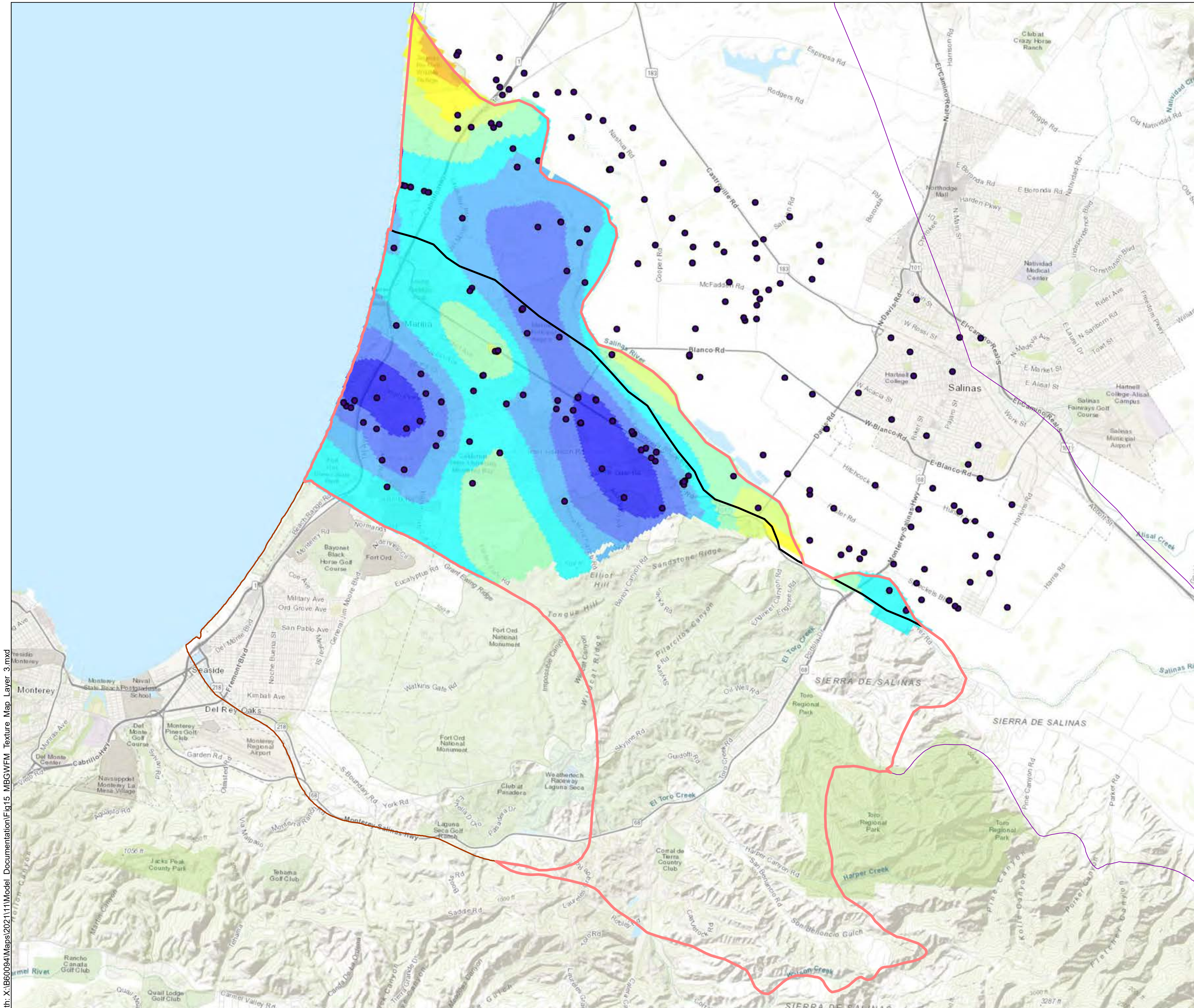
N 0 1 2 (Scale in Miles)

MBGWFM Texture Map - Layer 1

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 14

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig14_MBGWFM_Texture_Map_Layer_1.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Borehole Location

Layer 3 % Coarse

- 0.00 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

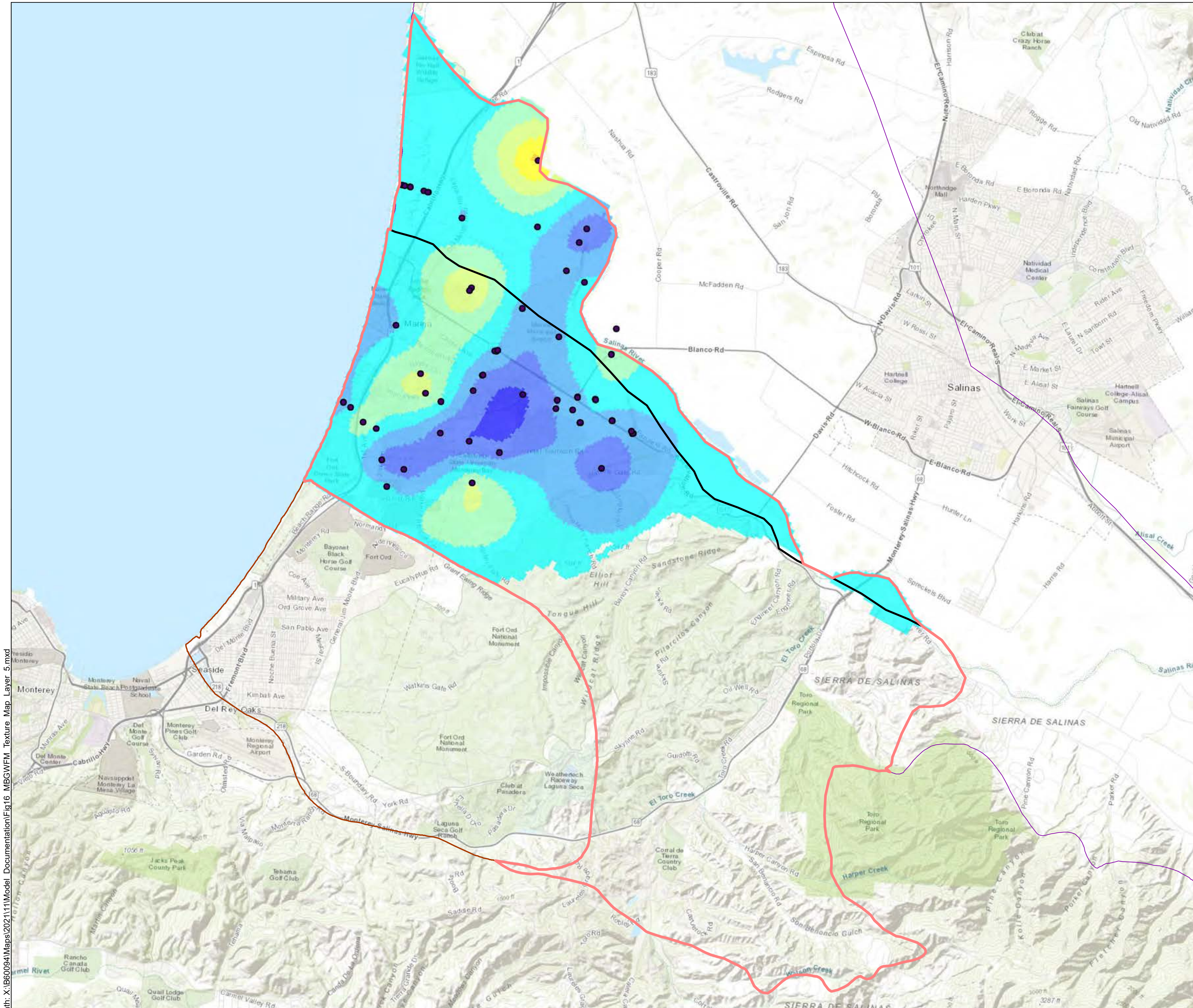
MBGWFM Texture Map - Layer 3

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 15

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig15_MBGWFM_Texture_Map_Layer_3.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Borehole Location

Layer 5 % Coarse

- 0.00 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

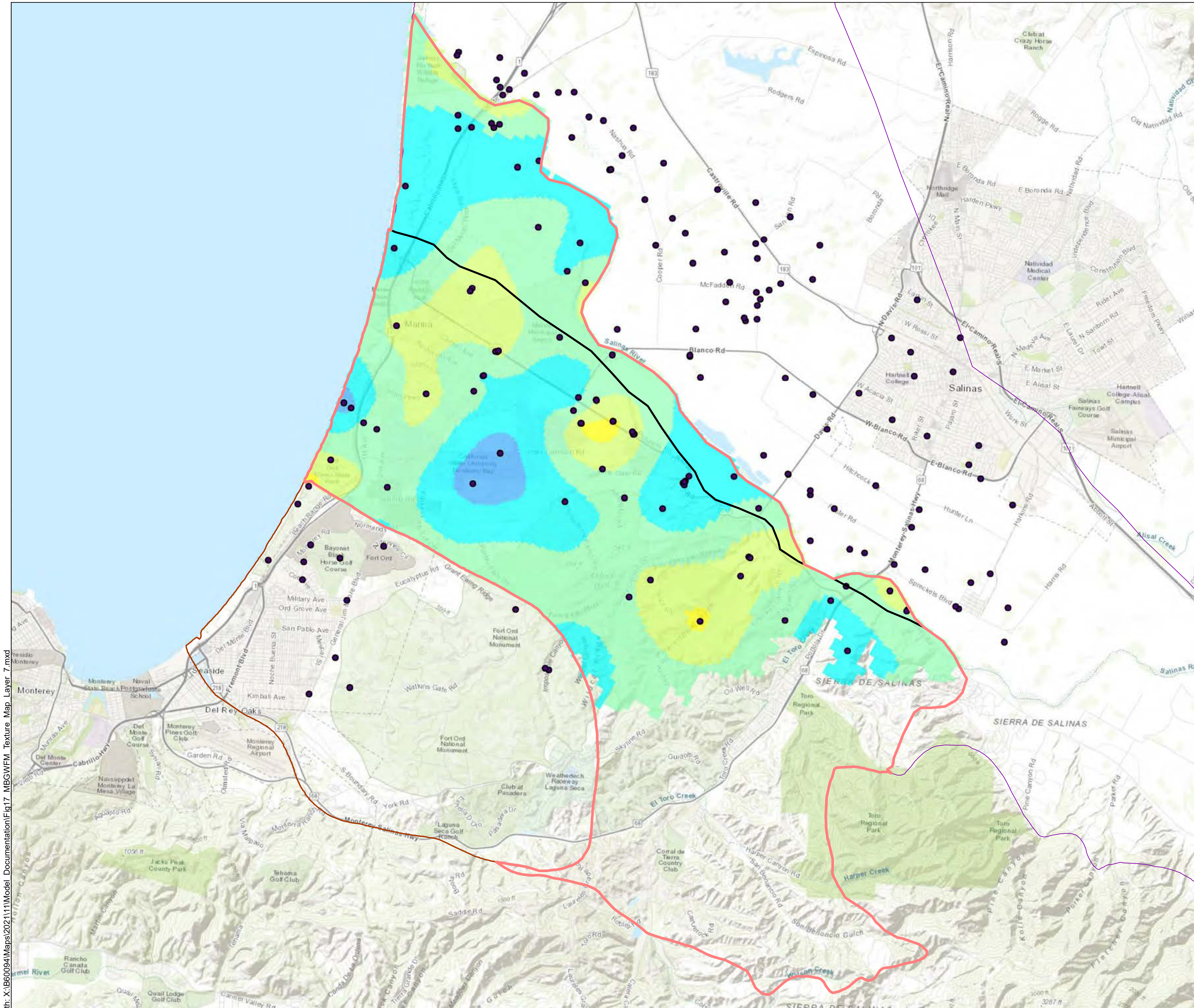
N 0 1 2 (Scale in Miles)

MBGWFM Texture Map - Layer 5

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 16

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig16_MBGWFM_Texture_Map_Layer_5.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Borehole Location

Layer 7 % Coarse

- 0.00 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

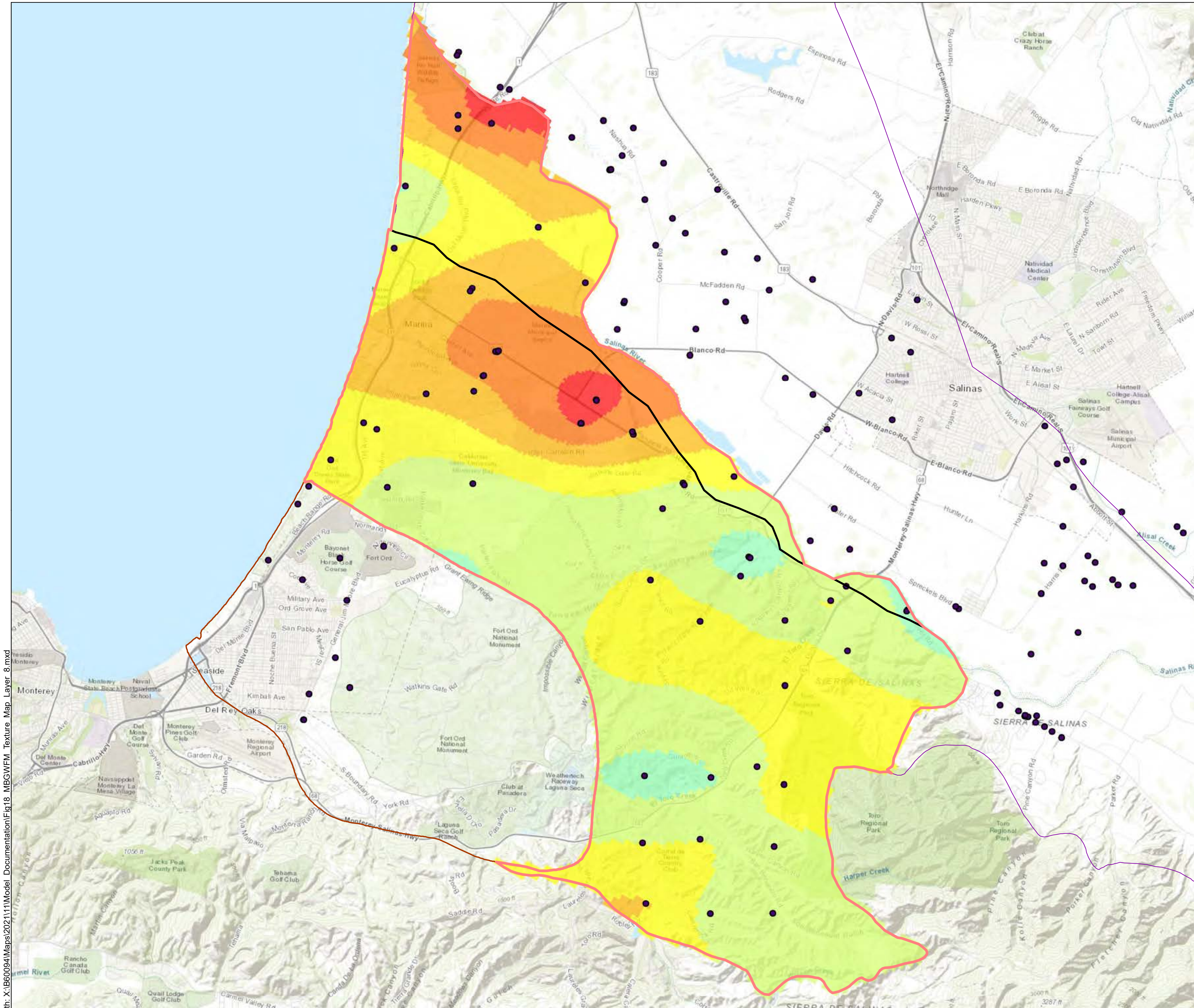
MBGWFM Texture Map - Layer 7

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 17

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig17_MBGWFM_Texture_Map_Layer_7.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Borehole Location

Layer 8 % Coarse

- 0.00 - 0.10
- 0.11 - 0.20
- 0.21 - 0.30
- 0.31 - 0.40
- 0.41 - 0.50
- 0.51 - 0.60
- 0.61 - 0.70
- 0.71 - 0.80
- 0.81 - 0.90
- 0.91 - 1.00

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

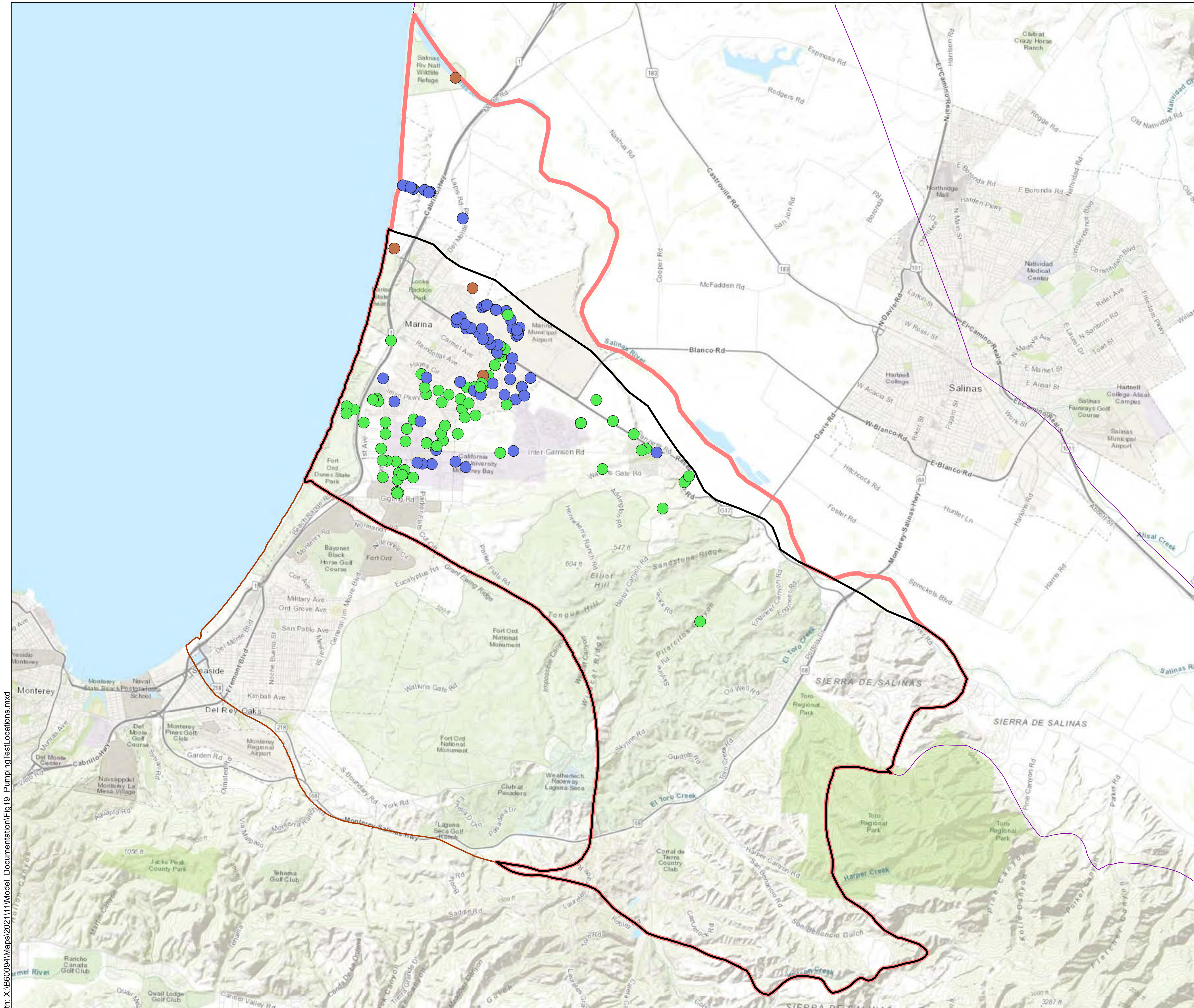
N 0 1 2
(Scale in Miles)

MBGWFM Texture Map - Layer 8

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 18

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig18_MBGWFM_Texture_Map_Layer_8.mxd



Legend

Monterey Subbasin
MBGWFM Active Area
Seaside Subbasin
180/400-Foot Aquifer Subbasin

Pumping Test Wells

Principal Aquifer Designation

- Dune Sand Aquifer
- 180/400-Foot Aquifer
- Deep Aquifer

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2
(Scale in Miles)

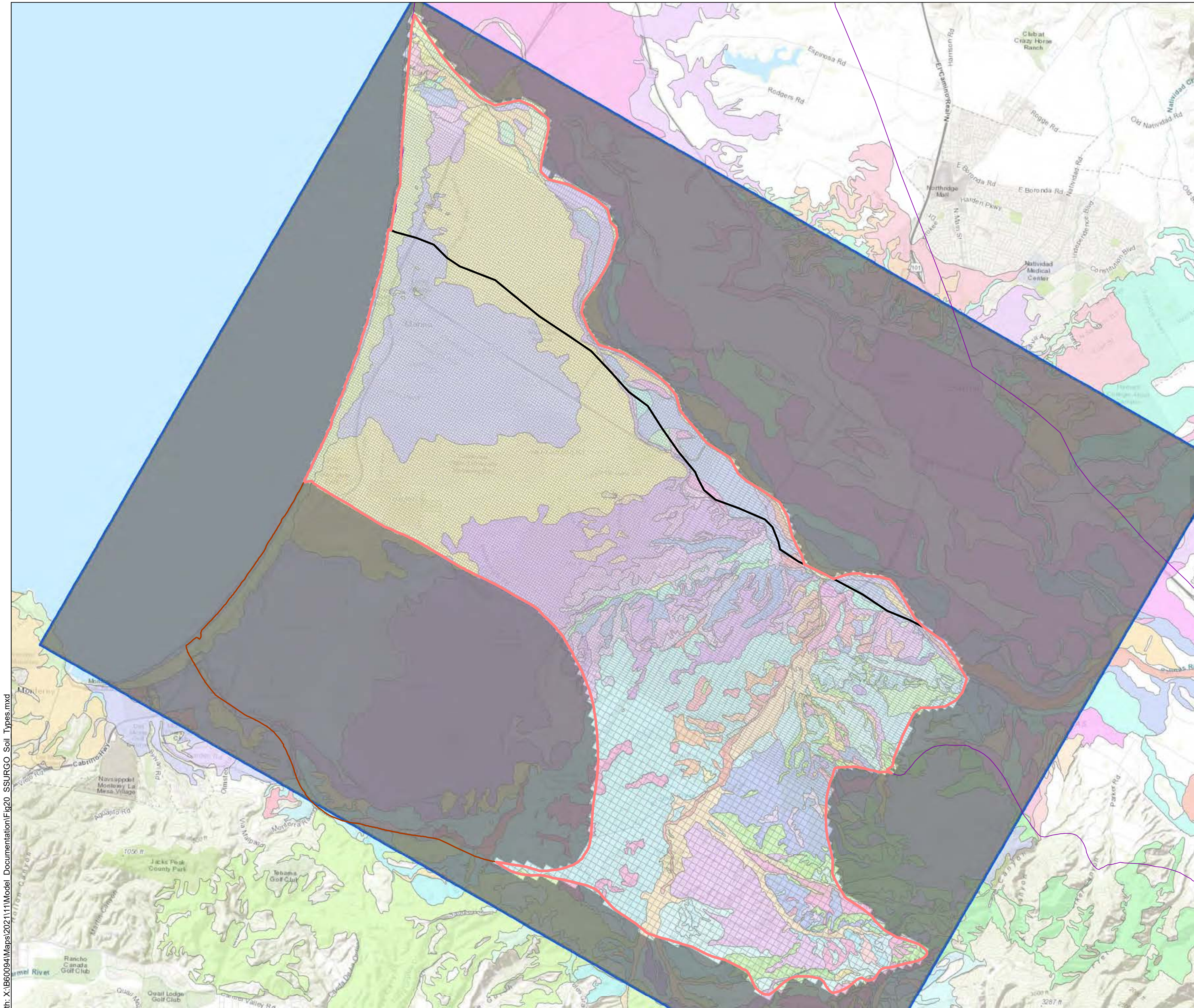
Pumping Test Well Locations

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 19

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig19_PumpingTestLocations.mxd



Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Grid Extent

MBGWFM Grid

- Active Cells
- Inactive Cells

SSURGO Soil Map Unit

300	CbA	GhD	Pm	SfE
Ac	CbB	GkB	PnA	SfF
Ad	CbC	HbB	PnC	Sg
AeA	CcG	LaE	PnD	ShC
AeC	Cf	LaF	PnE	ShD
AeD	Cg	LcG2	Pr	ShD2
Af	Cm	LhE	RaA	ShE
AkD	CnA	Me	RaC	SoD
AkF	CnC	Mf	RaD	SoG
Am	DaC	Mg	Rb	TaC
Ar	DbD	MnA	Rc	TbB
AsB	DbE	MoA	SaA	VaE
AsC	DbF	NcC	SbA	VaG
AvB	DdE	OaD	SbC	Vb
Ba	Df	Pa	ScE	W
BbC	EaA	PdC	ScG	Xb
CaE	EbC	PdD	SdF	Xc
CaF	GhC	Pf	SfD	Xd

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model
SSURGO = Soil Survey Geographic Database

Notes
1. All locations are approximate.
2. List of SSURGO soil unit keys and corresponding names can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid =nrcs142p2_053627.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2
(Scale in Miles)

SSURGO Soil Types

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 20

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig20_SSURGO_Soil_Types.mxd

Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Grid Extent

MBGWFM Grid

- Active Cells
- Inactive Cells

Hydrologic Soil Groups

- A
- A/D
- B
- C
- C/D
- D

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model
SSURGO = Soil Survey Geographic Database

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

SSURGO Hydrologic Soil Groups

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 21

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig21_SSURGO_Hydrologic_Soil_Groups.mxd

Legend

- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin
- MBGWFM Active Area
- Grid Extent

MBGWFM Grid

- Active Cells
- Inactive Cells

Saturated Hydraulic Conductivity (ft/d)

- 0.00 - 3.23
- 3.24 - 9.00
- 9.01 - 18.92
- 18.93 - 35.32
- 35.33 - 232.00

Abbreviations
DWR = California Department of Water Resources
ft/d = feet per day
MBGWFM = Monterey Subbasin Groundwater Flow Model
SSURGO = Soil Survey Geographic Database

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

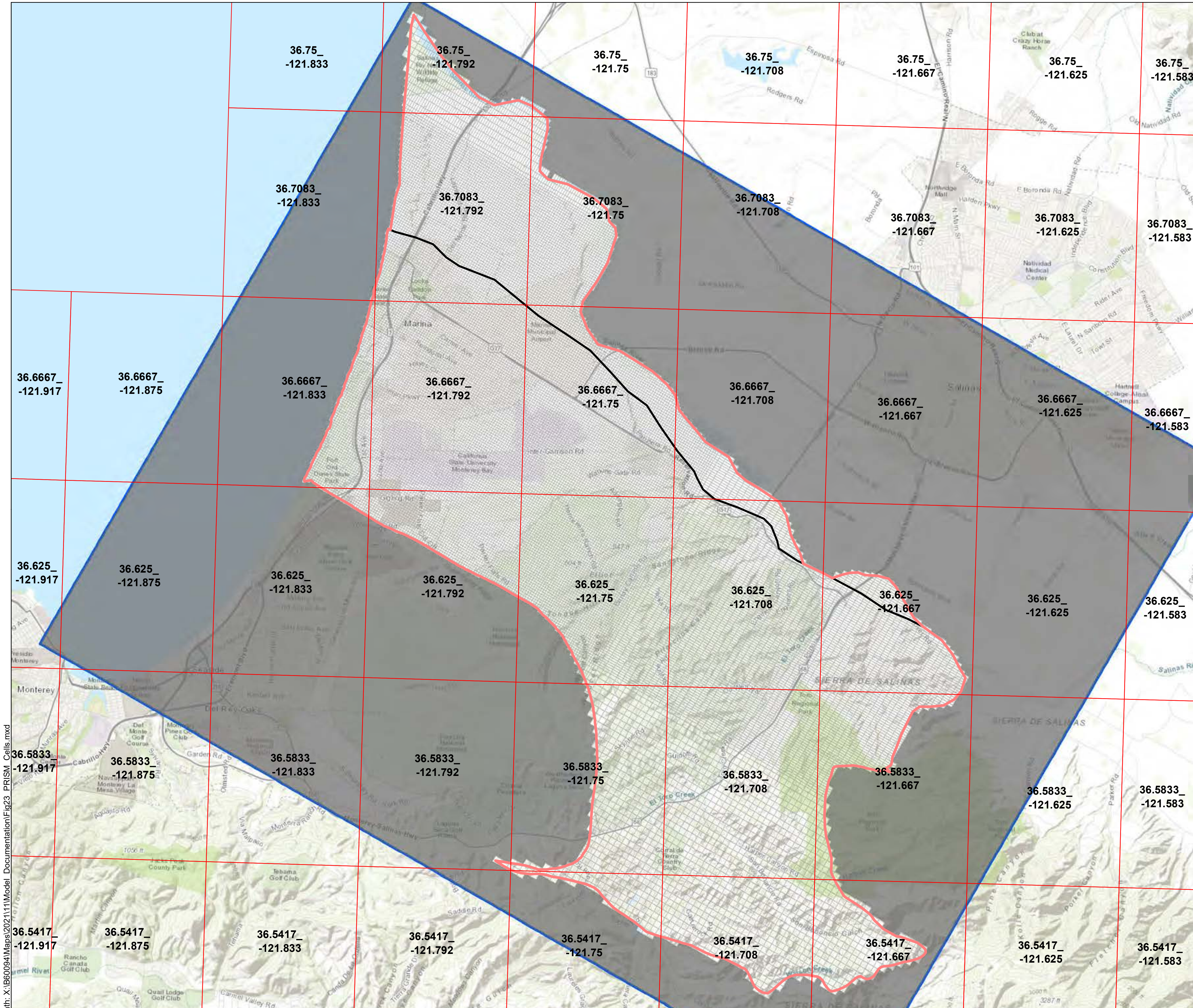
SSURGO Saturated Vertical Hydraulic Conductivity

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 22

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig22_SSURGO_Saturated_Hydraulic_Conductivity.mxd



Legend

PRISM Cells

MBGWFM Active Area

Monterey Subbasin

MBGWFM Grid

Active Cells

Inactive Cells

Grid Extent

Abbreviations

DWR = California Department of Water Resources
Lat/Long = latitude and longitude
MBGWFM = Monterey Subbasin Groundwater Flow Model
PRISM = Parameter-elevation Regressions on Independent Slopes Model

Notes

1. All locations are approximate.
2. Labels show PRISM cell identifiers in Lat_Long convention.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

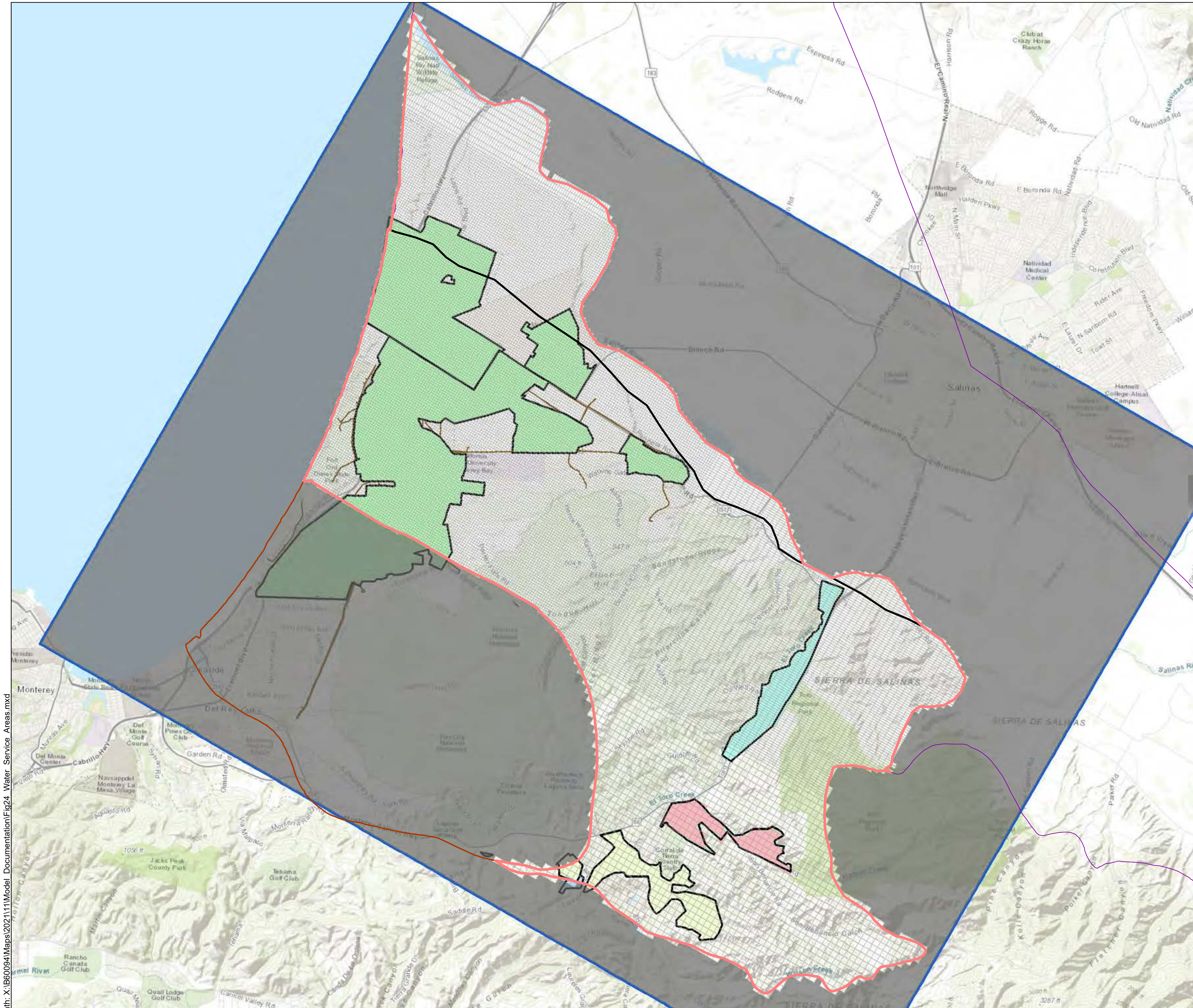
PRISM Cells

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 23

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig23_PRISM_Cells.mxd



Legend

- MBGWFM Active Area
- Monterey Subbasin
- Seaside Subbasin
- 180/400-Foot Aquifer Subbasin

MBGWFM Grid

- Active Cells
- Inactive Cells
- Grid Extent

Water Service Areas

- CAW Ambler
- CAW Hidden Hills
- CAW Toro
- CWS
- MCWD

Abbreviations

DWR = California Department of Water Resources
CAW = CalAm Water
CWS = California Water Service
MBGWFM = Monterey Subbasin Groundwater Flow Model
MCWD = Marina Coast Water District

Notes

1. All locations are approximate.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

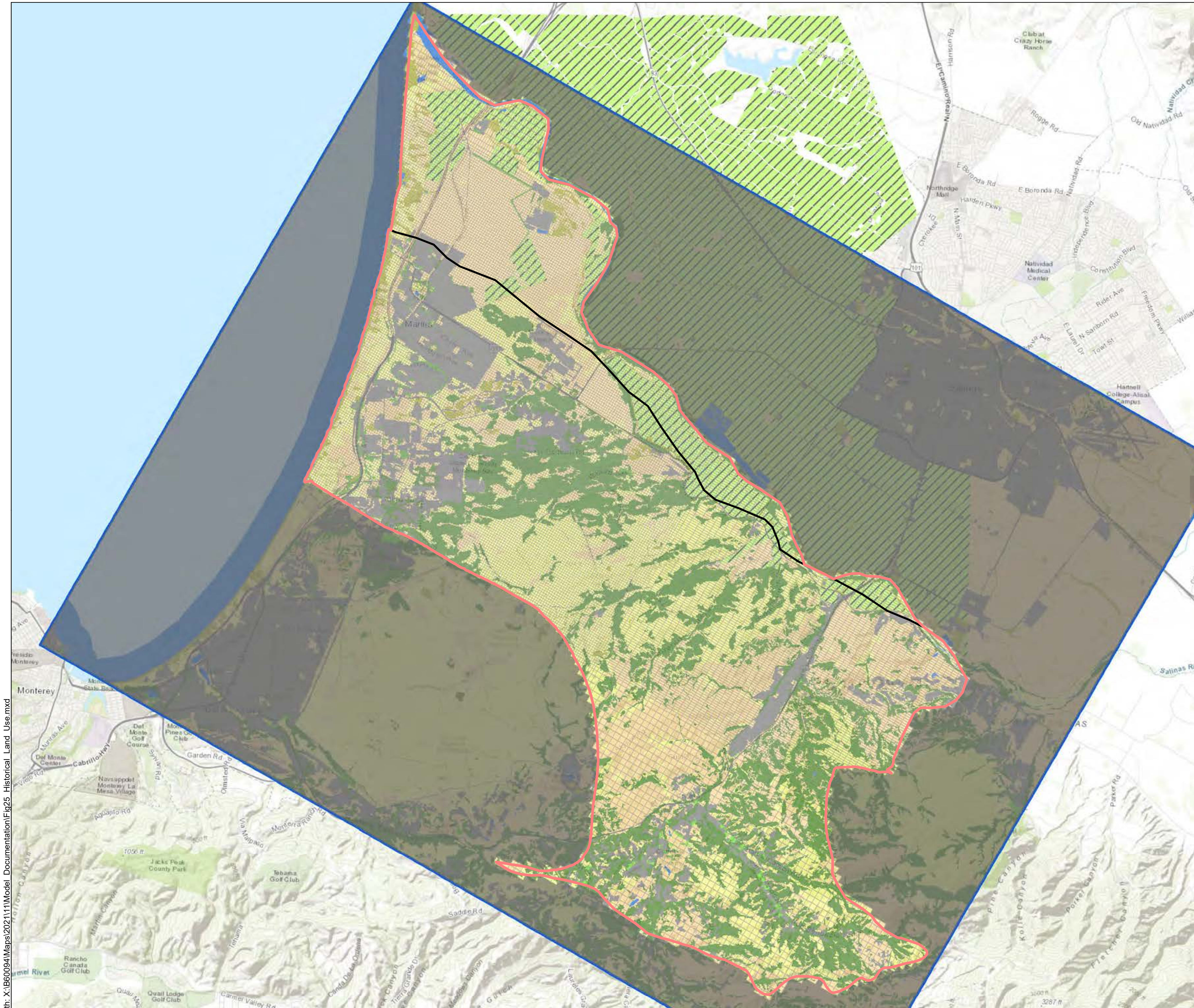
Water Service Areas

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 24

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig24_Water_Service_Areas.mxd



Legend

Monterey Subbasin
MBGWFM Active Area
Grid Extent

MBGWFM Grid

Active Cells
Inactive Cells

Agricultural Areas

Truck Nursery and Berry Crops

CalVeg Land Use Classes

Barren
Conifer / Woodland
Hardwood Forest/Woodland
Herbaceous
Mixed Conifer & Hardwood Forest
Shrub
Urban
Water

Abbreviations

CalVeg = Classification and Assessment with Landsat of Visible Ecological Groupings
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model
USDA FS = United States Department of Agriculture, Forest Service

Notes

1. All locations are approximate.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. CalVeg data sourced from the USDA FS website.
3. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

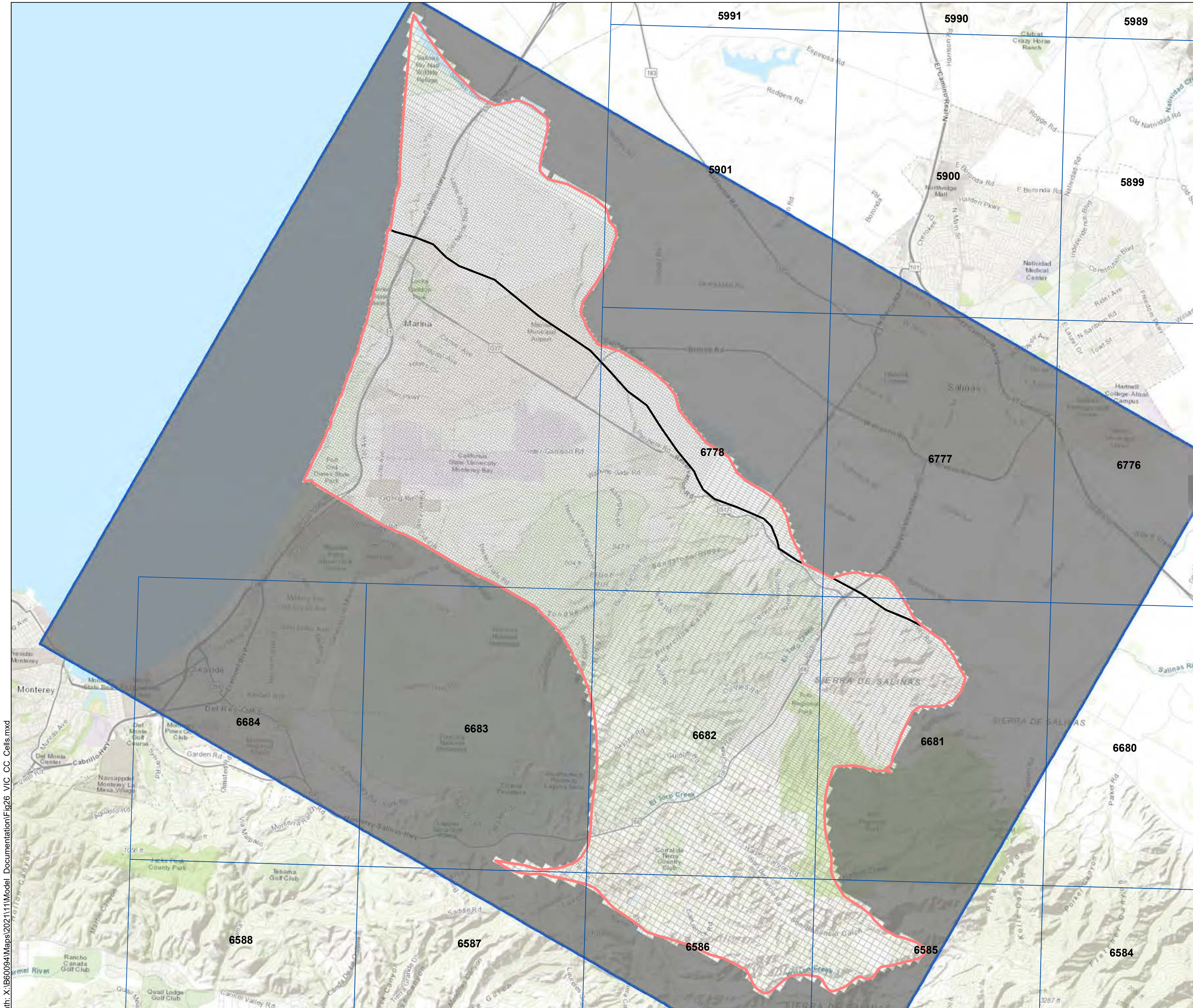
Historical Land Use

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 25

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig25_Historical_Land_Use.mxd



Legend

- VIC Grid Cells
- MBGWFM Active Area
- Monterey Subbasin

MBGWFM Grid

- Active Cells
- Inactive Cells
- Grid Extent

Abbreviations

DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model
VIC = Variable Infiltration Capacity

Notes

1. All locations are approximate.
2. Labels show VIC cell identifiers.
3. Climate change factors for areas within the active MBGWFM grid not covered by a VIC grid cell were estimated by taking an average from VIC cells 5901 and 6778.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

N 0 1 2
(Scale in Miles)

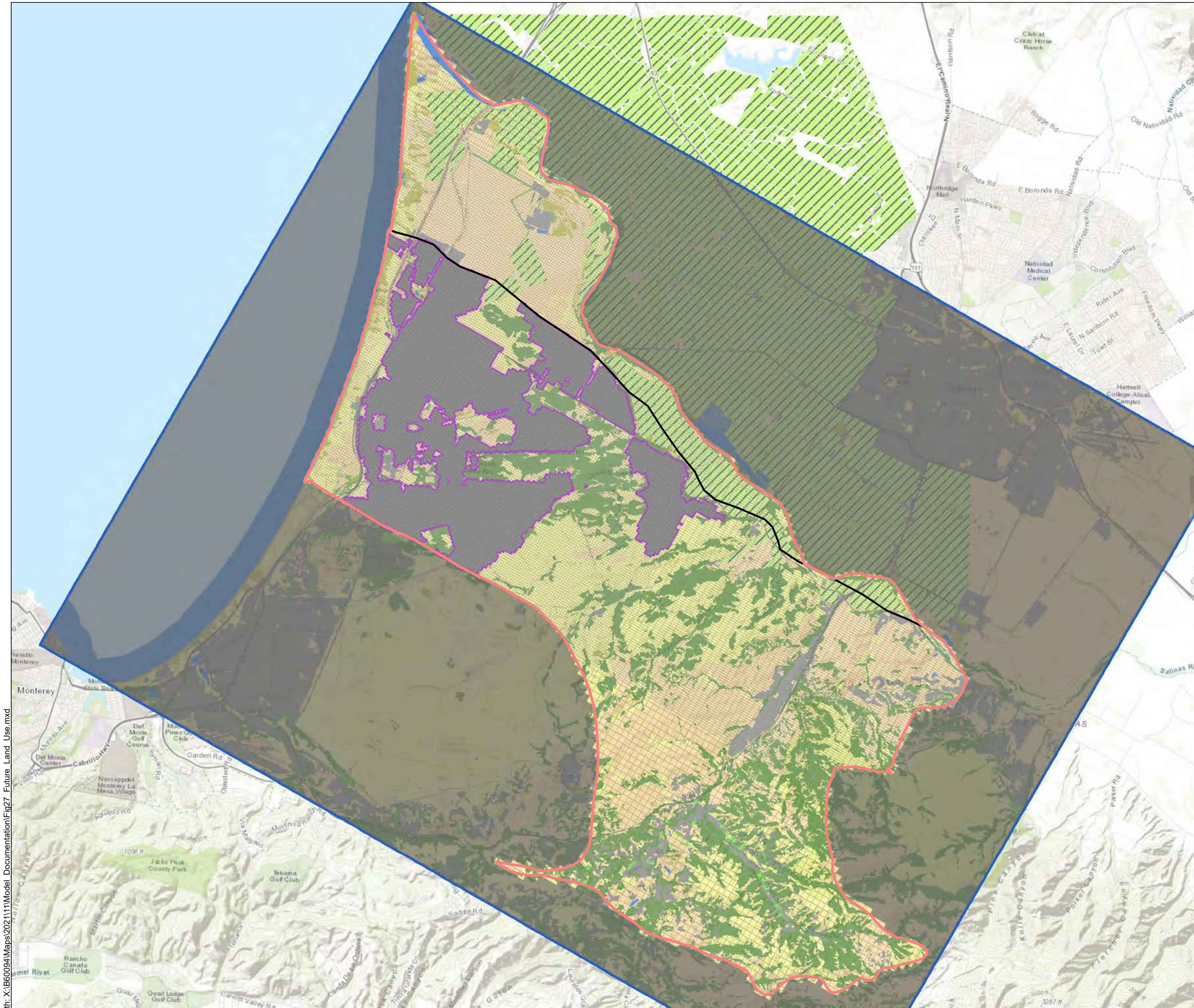
VIC Grid Cells Used for Climate Change Scenarios

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

eki environment & water

Figure 26

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig26_VIC_CC_Cells.mxd



Legend

- Monterey Subbasin
- MBGWFM Active Area
- Grid Extent
- MCWD Future Stormwater Catchment Area

MBGWFM Grid

- Active Cells
- Inactive Cells

Agricultural Areas

- Truck Nursery and Berry Crops

CalVeg Land Use Classes

- Barren
- Conifer / Woodland
- Hardwood Forest/Woodland
- Herbaceous
- Mixed Conifer & Hardwood Forest
- Shrub
- Urban
- Water

Abbreviations

CalVeg = Classification and Assessment with Landsat of Visible Ecological Groupings
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model
MCWD = Marina Coast Water District
USDA FS = United States Department of Agriculture, Forest Service

Notes

1. All locations are approximate.

Sources

1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. CalVeg data sourced from the USDA FS website.
3. Future MCWD land use based on map obtained from 2019 Water Master Plan
4. Basemap courtesy of ESRI.

N 0 1 2 (Scale in Miles)

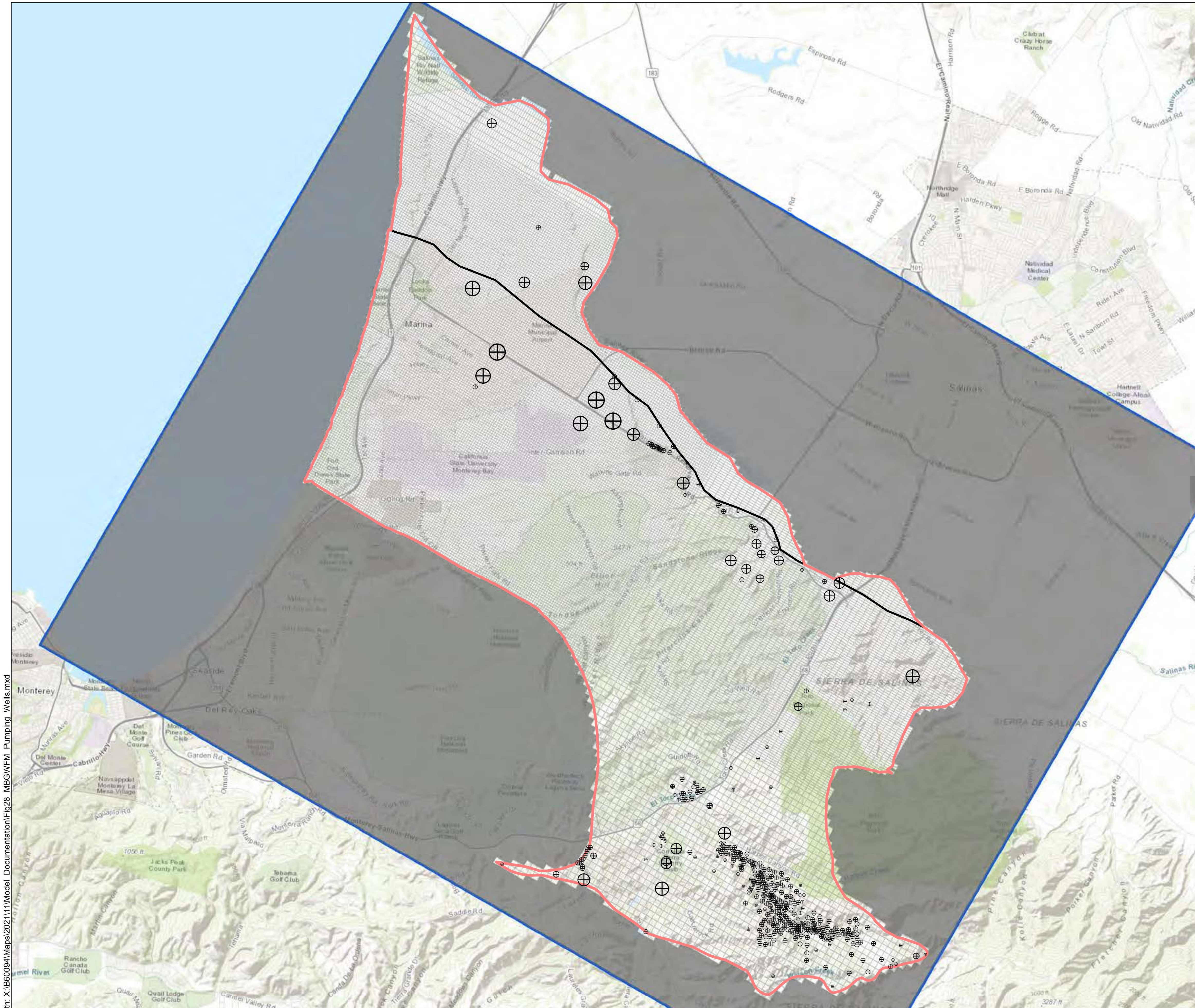
Future Land Use

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 27

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig27_Future_Land_Use.mxd



Legend

- Monterey Subbasin
- MBGWFM Active Area
- Grid Extent

MBGWFM Grid

- Active Cells
- Inactive Cells

Pumping Wells

Average Monthly Pumping Rate (AF/month)

- 0.00 - 0.02
- 0.03 - 0.31
- 0.32 - 1.11
- 1.12 - 2.22
- 2.23 - 4.49
- 4.50 - 8.62
- 8.63 - 15.80
- 15.81 - 22.45
- 22.46 - 49.40
- 49.41 - 74.28

Abbreviations
AF = acre-feet
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.
2. Pumping well symbol size reflects average historical pumping rate in units of acre-feet per month.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

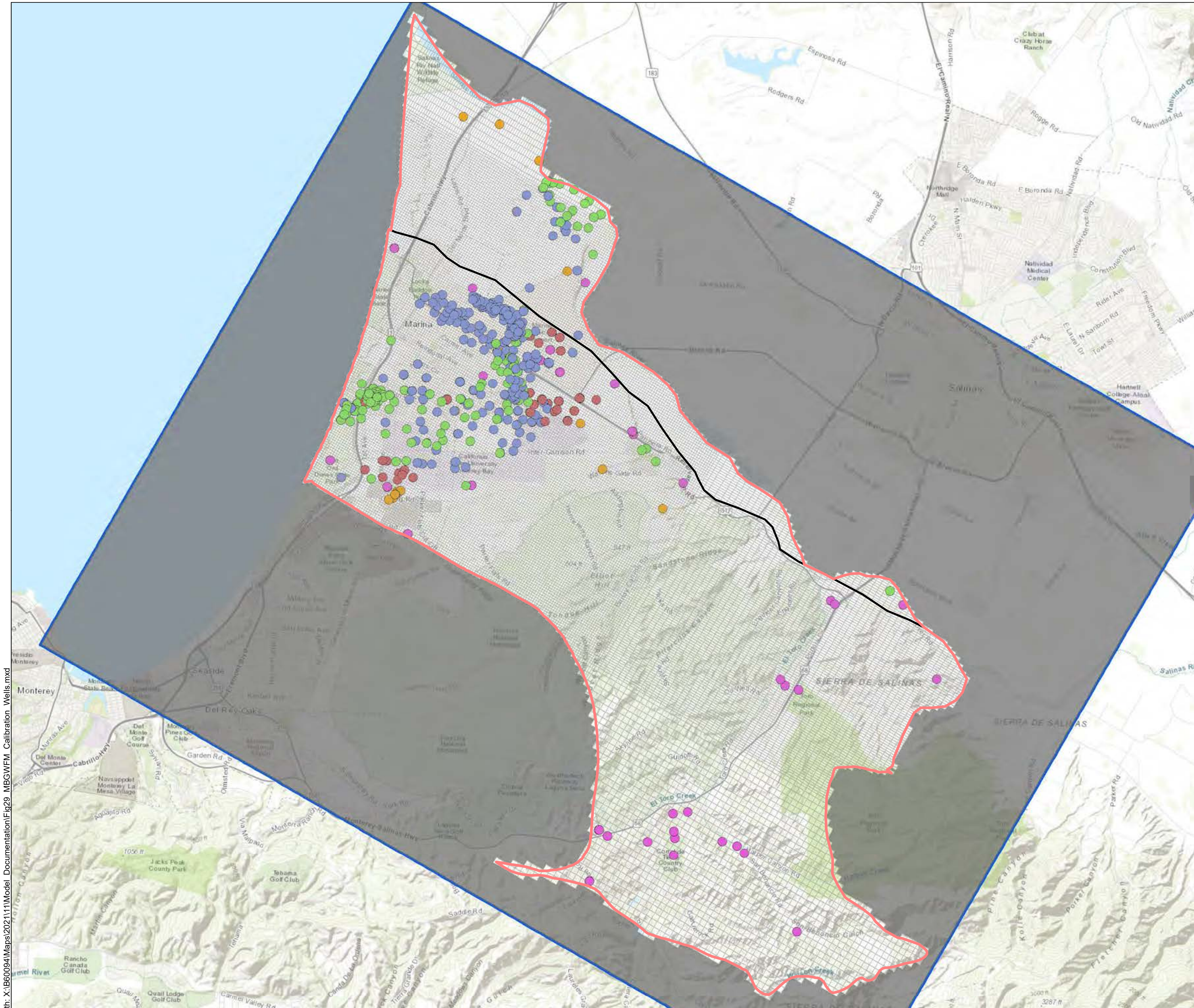
N 0 1 2 (Scale in Miles)

MBGWFM Pumping Wells

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 28

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig28_MBGWFM_Pumping_Wells.mxd



Legend

Monterey Subbasin
MBGWFM Active Area
Grid Extent

MBGWFM Grid

Active Cells
Inactive Cells

Calibration Wells

Layer 1
Layer 3
Layer 5
Layer 7
Layer 8

Abbreviations
DWR = California Department of Water Resources
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

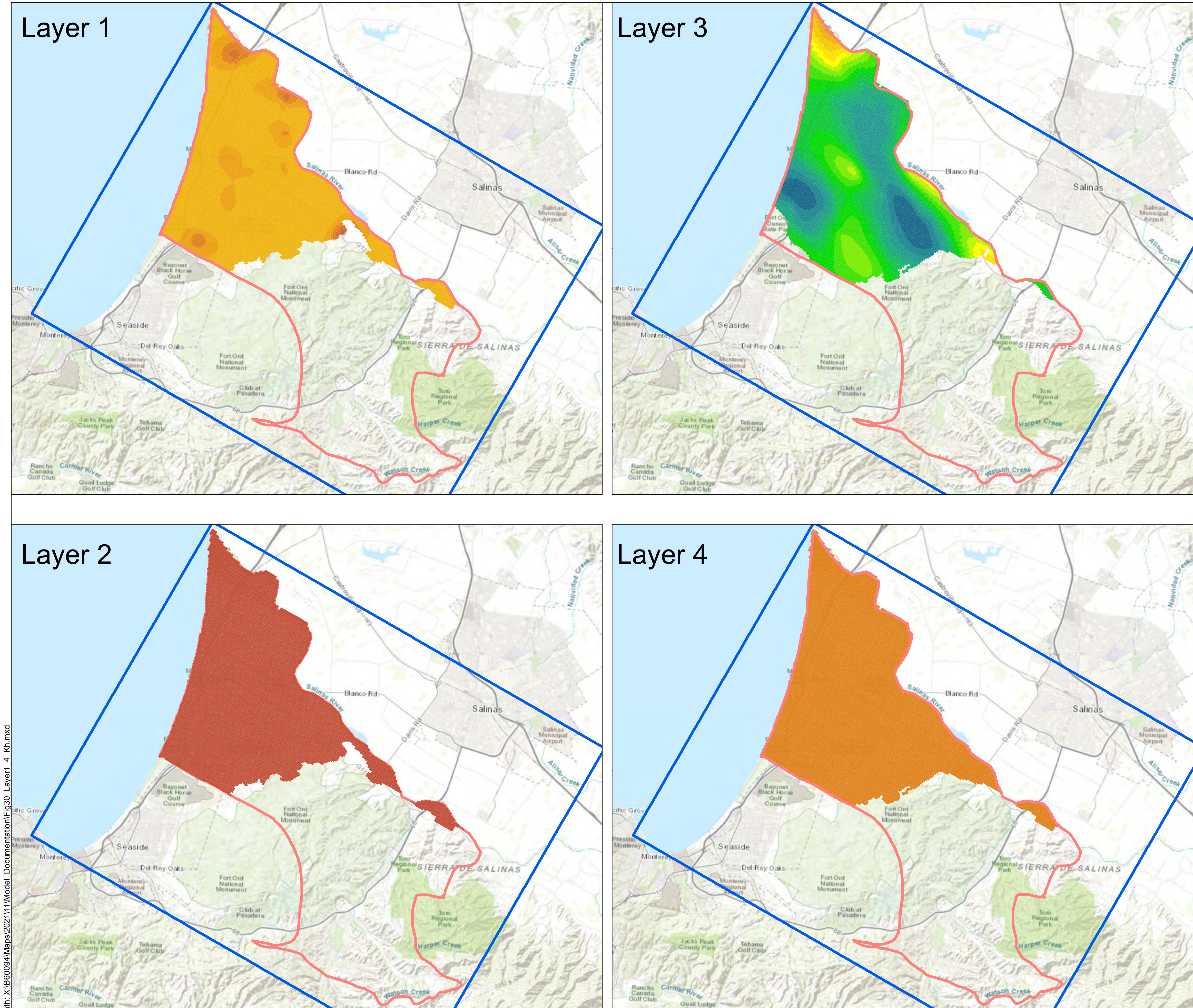
N 0 1 2 (Scale in Miles)

MBGWFM Calibration Wells

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 29

eki environment & water

Path: X:\B60094\Maps\2021\11\Model_Documentation\Fig29_MBGWFM_Calibration_Wells.mxd



Legend

- Grid Extent
- MBGWFM Active Area

Horizontal Hydraulic Conductivity (ft/d)

- < 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- 61 - 65
- 66 - 70
- 71 - 75
- 76 - 80
- 81 - 85
- 86 - 90
- 91 - 95
- 96 - 100
- > 100

Abbreviations
ft/d = feet per day
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

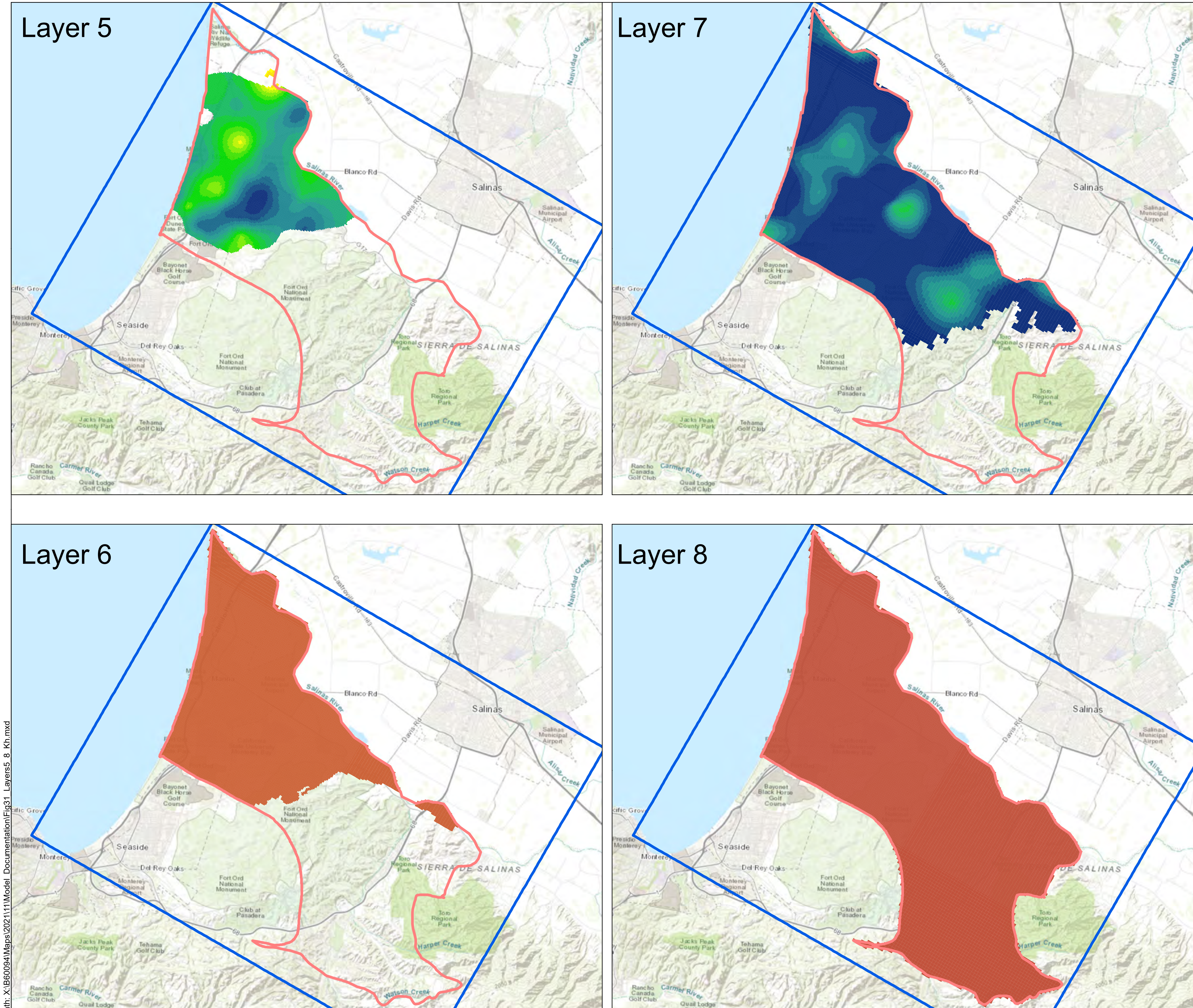
N
0 3 6
(Scale in Miles)

Horizontal Hydraulic Conductivity
Layers 1 - 4

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.12
Figure 30

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig30_Layer1_4_Kh.mxd



Legend

Grid Extent

MBGWFM Active Area

Horizontal Hydraulic Conductivity (ft/d)

- < 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 - 60
- 61 - 65
- 66 - 70
- 71 - 75
- 76 - 80
- 81 - 85
- 86 - 90
- 91 - 95
- 96 - 100
- > 100

Abbreviations

ft/dl = feet per day

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

0 3 6

(Scale in Miles)

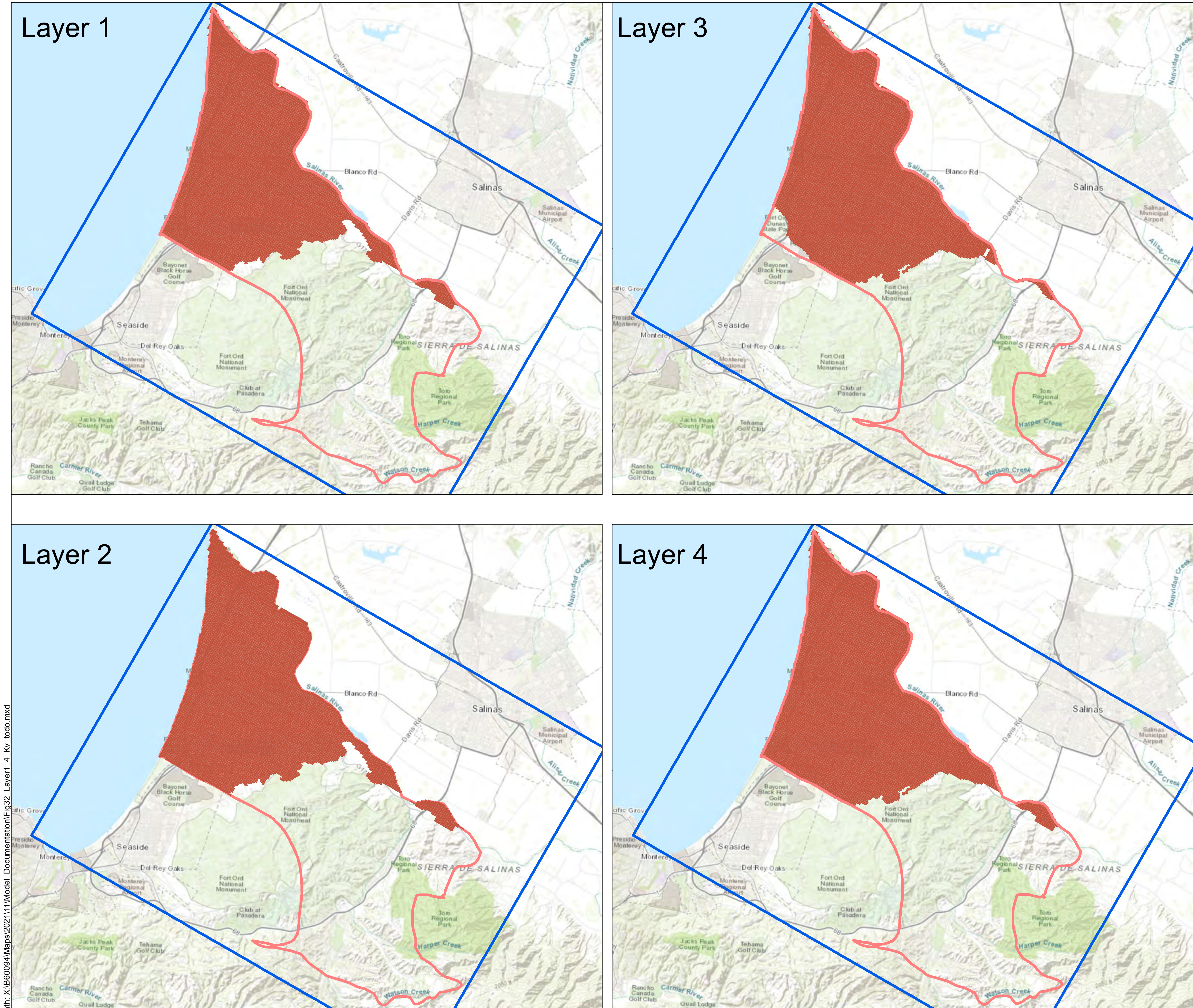
Horizontal Hydraulic Conductivity
Layers 5 – 8

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.12

Figure 31

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig31_Layers5_8_Kh.mxd



Legend

Grid Extent

MBGWFM Active Area

Vertical Hydraulic Conductivity (ft/d)

- < 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- > 60

Abbreviations

ft/d = feet per day

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

0 3 6

(Scale in Miles)

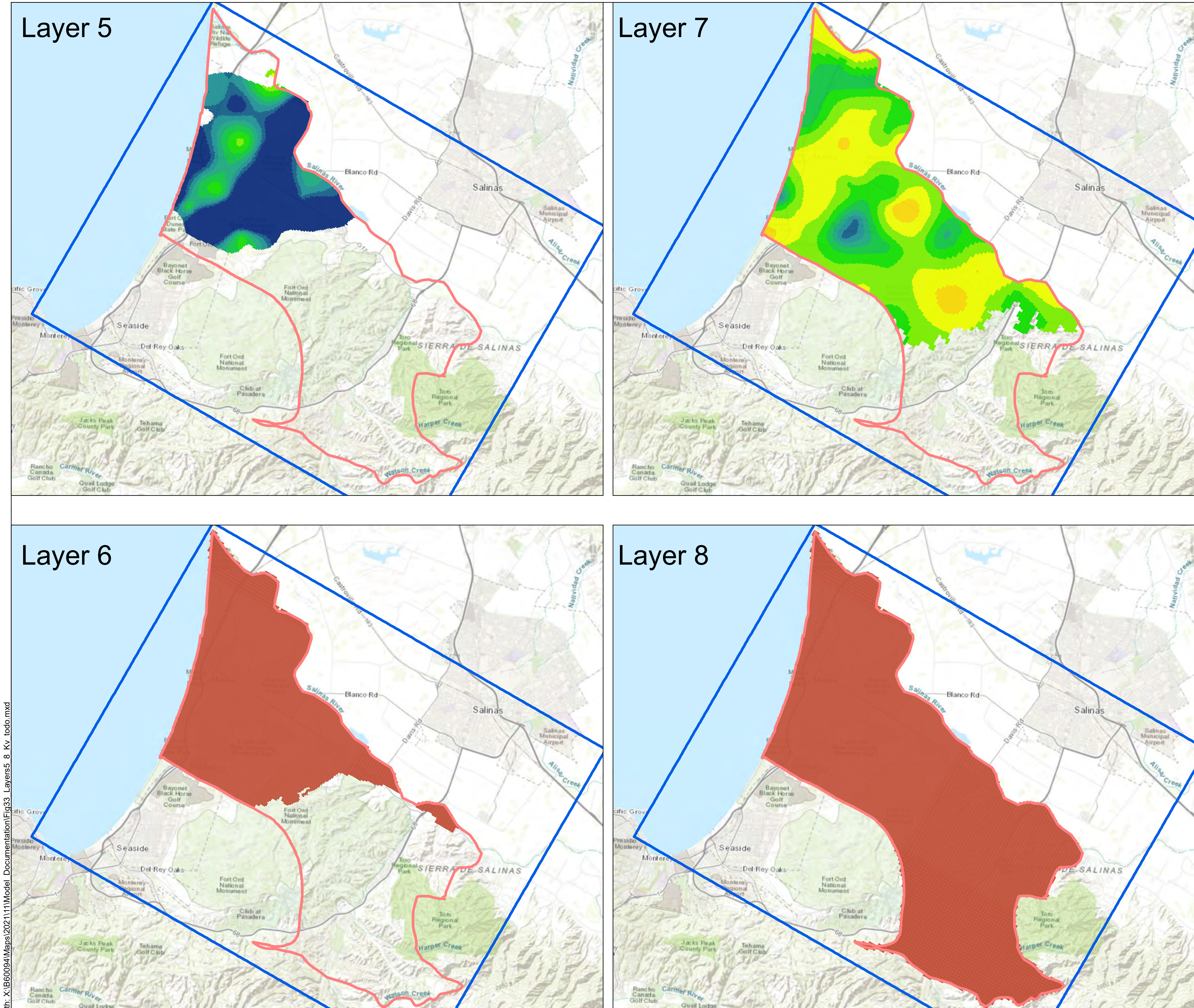
Vertical Hydraulic Conductivity Layers 1 - 4

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.12

eki environment & water

Figure 32

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig32_Layer1_4_Kv_todo.mxd



Legend

- Grid Extent
- MBGWFM Active Area

Vertical Hydraulic Conductivity (ft/d)

- < 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- > 60

Abbreviations
ft/dl = feet per day
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.

Sources
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 9 November 2021.

N

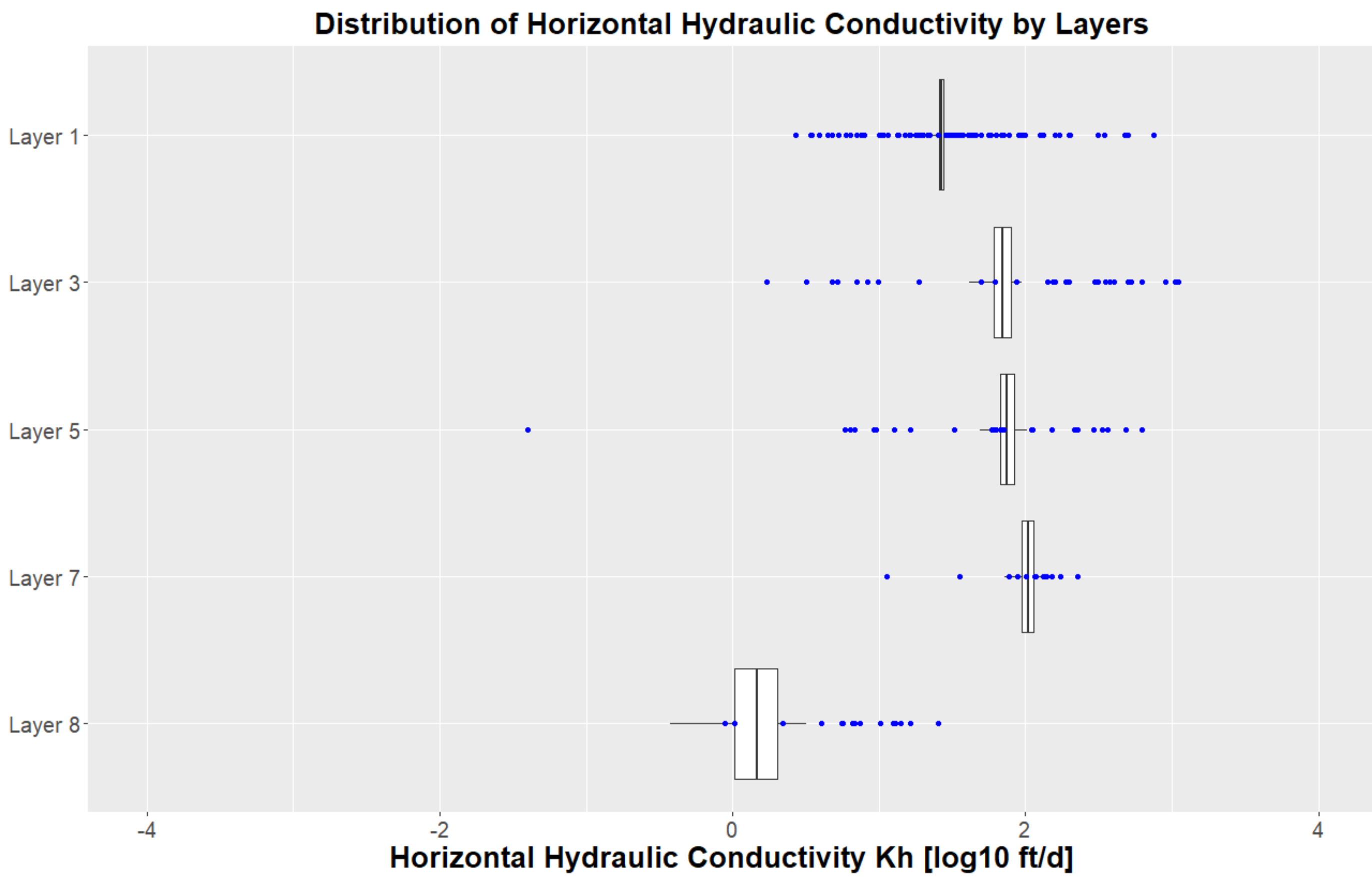
0 3 6
(Scale in Miles)

Vertical Hydraulic Conductivity
Layers 5 – 8

Marina Coast Water District
Monterey County, CA
November 2021
EKI B60094.12
Figure 33

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig33_Layers5_8_Kv_todo.mxd

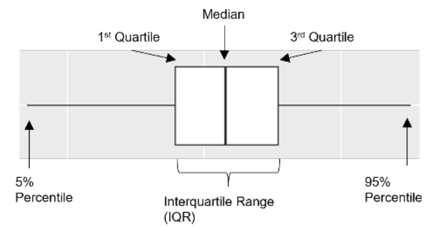


Legend

Observed:

Pumping Test Measurement

Modeled:



Abbreviations

Kh: Horizontal Hydraulic Conductivity

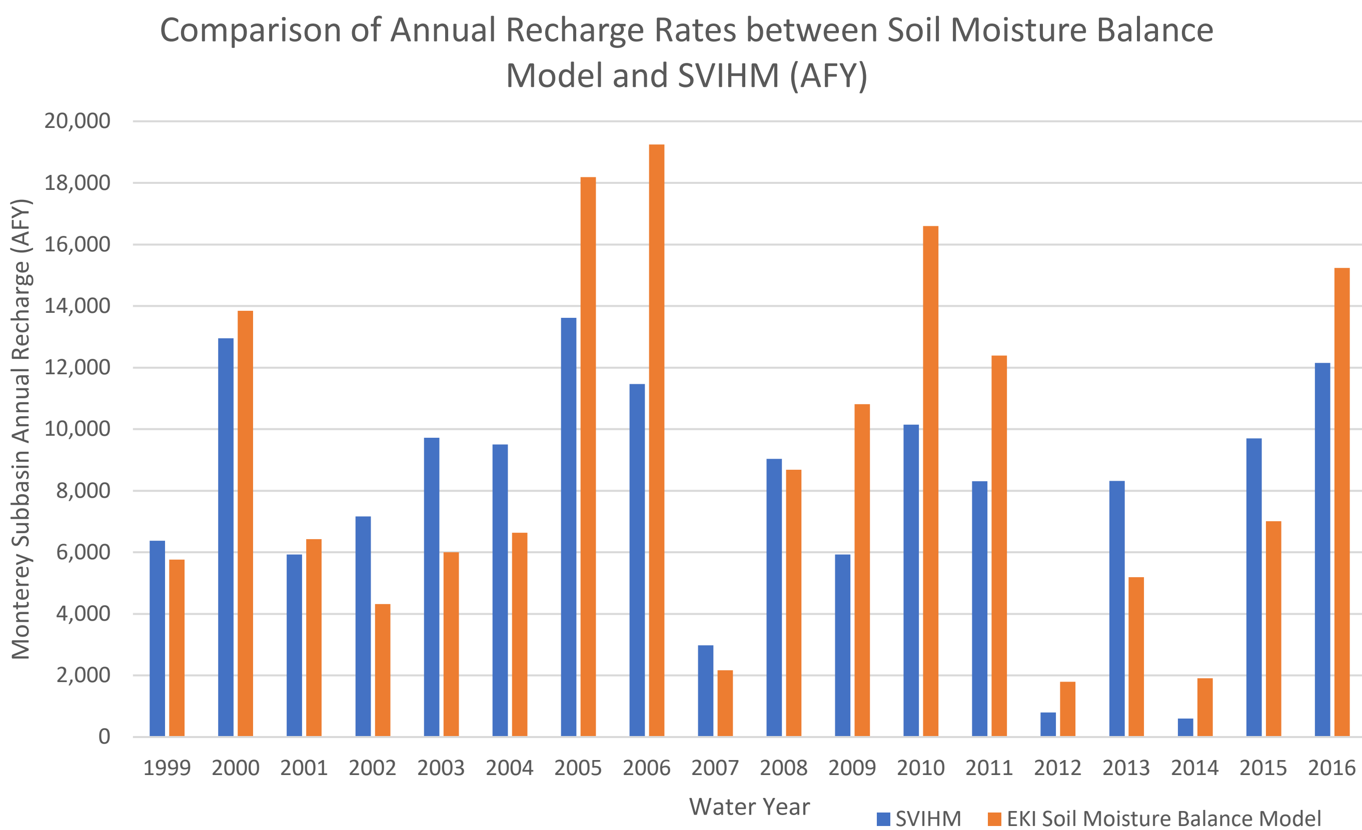
Notes

eki environment & water

Comparison of Modeled and Observed Horizontal Hydraulic Conductivity

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03

Figure 34



Legend
= SVIHM (USGS)
= Soil Moisture Balance Model (EKI)

Abbreviations
AFY = acre-feet per year
SVIHM = Salinas Valley Integrated Hydrologic Model
USGS = United States Geological Survey

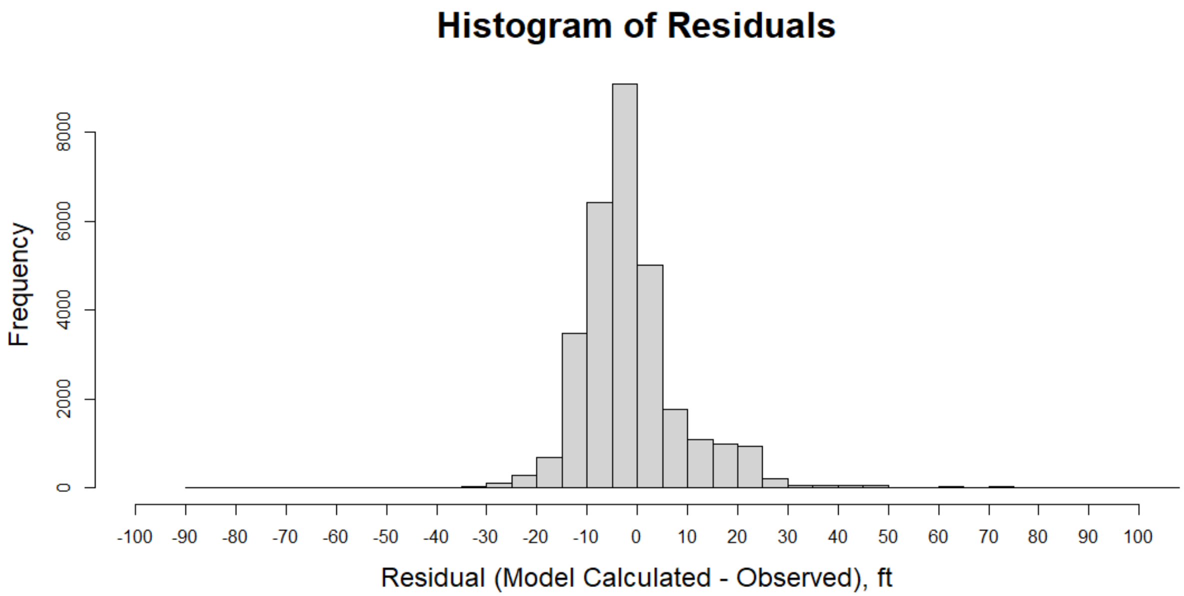
Notes
1. Reported annual recharge rates are for the entire Monterey Subbasin.

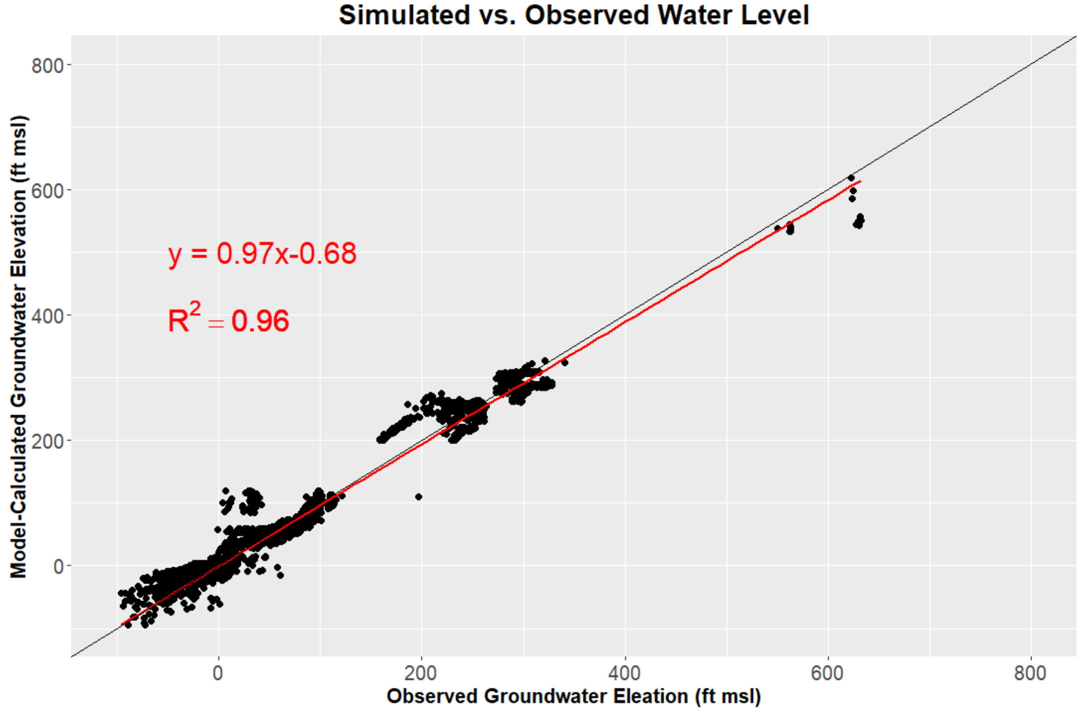
Sources
1. Soil Moisture Balance Model (EKI)
2. SVIHM (USGS)

eki environment & water

Comparison of Annual Recharge Rates between Soil Moisture Balance Model and SVIHM

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.12
Figure 35





Legend

= 1:1

= Linear (Observed)

= Oberved Groundwater Elevation

Abbreviations

ft = feet

ft msl = feet above mean sea level

Notes

1. Residual is calculated as model-calculated minus observed groundwater elevation

Sources

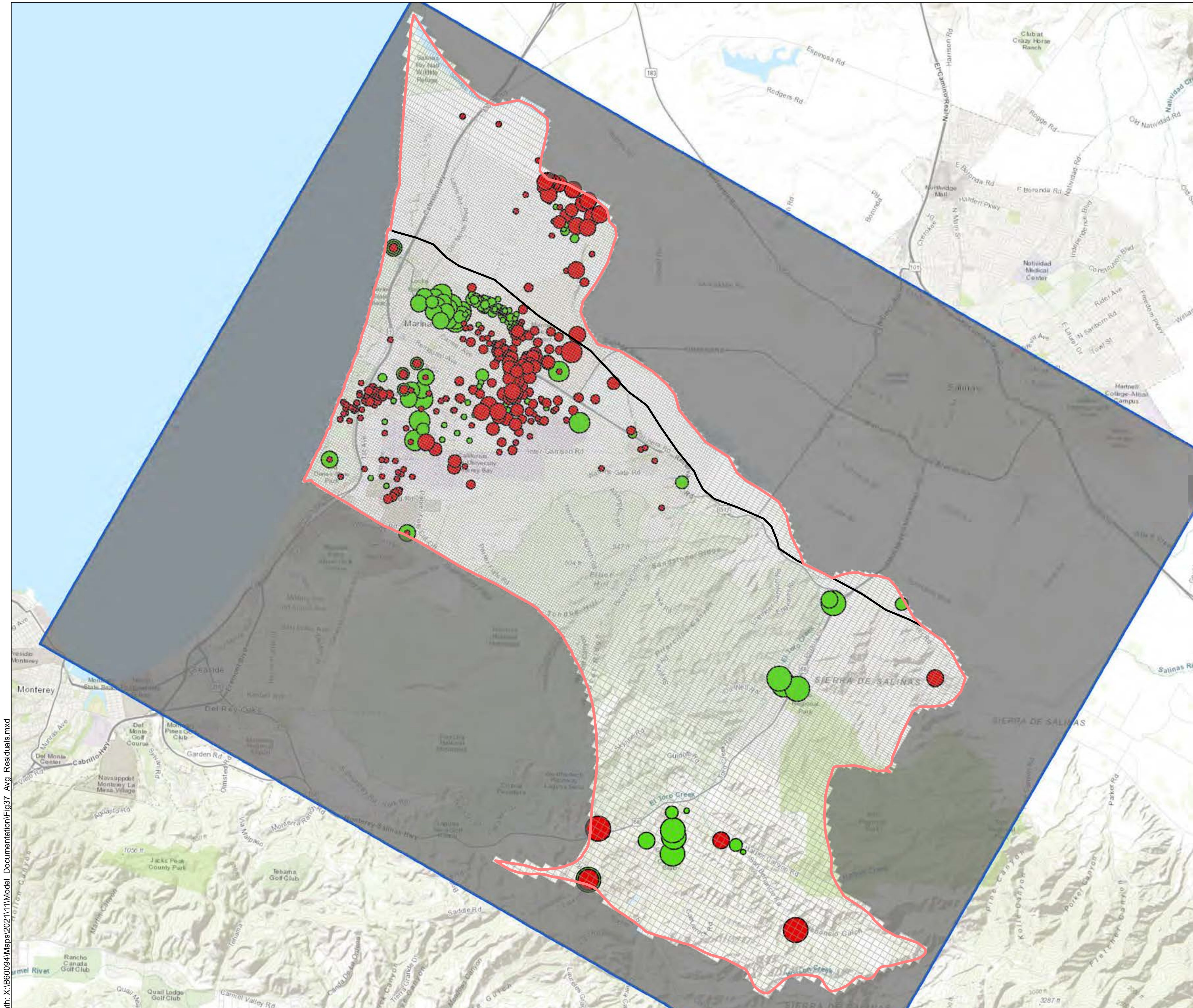
1. Monterey Subbasin Groundwater Flow Model

eki environment & water

Calibration Statistics

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.12

Figure 36



Legend

Monterey Subbasin
MBGWFM Active Area
Grid Extent

MBGWFM Grid

Active Cells
Inactive Cells

Average Water Level Residual (ft)

- < - 25
- -25 to -20
- -20 to -15
- -15 to -10
- -10 to -5
- -5 to 0
- 0 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- >25

Abbreviations
DWR = California Department of Water Resources
ft = feet
MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes
1. All locations are approximate.
2. Average residuals are calculated as the difference between model-calculated and observed water levels. A larger residual magnitude equates to a larger model error at the well.

Sources
1. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.
2. Basemap courtesy of ESRI.

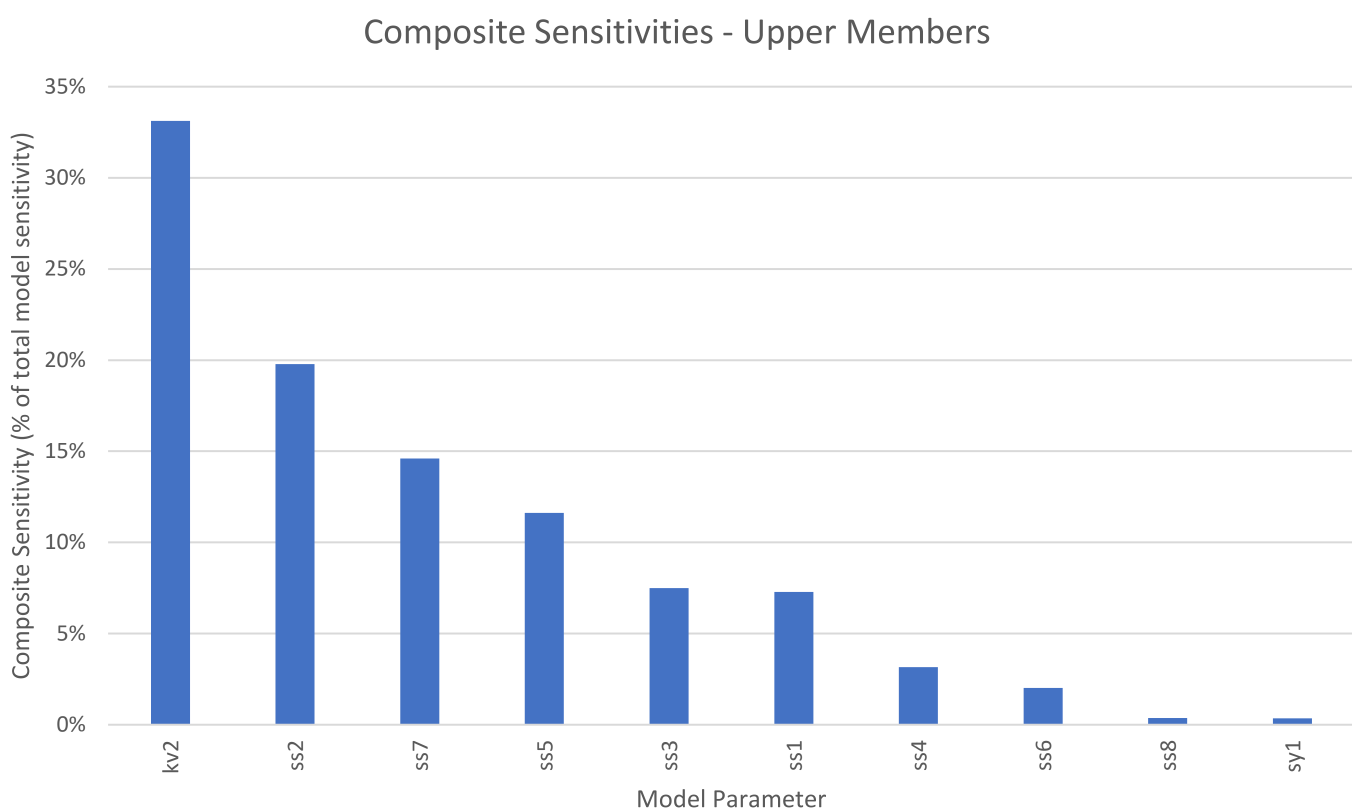
N 0 1 2
(Scale in Miles)

Average Residuals by Well

Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.03
Figure 37

eki environment & water

Path: X:\B60094\Maps\2021\11\Model Documentation\Fig37_Avg_Residuals.mxd



Legend

= Composite Sensitivity

Abbreviations

MBGWFM = Monterey Subbasin Groundwater Flow Model

Notes

1. Composite Sensitivites are calculated by dividing the parameter sensitivity by the total sensitivity of all model parameters.

Sources

1. MBGWFM

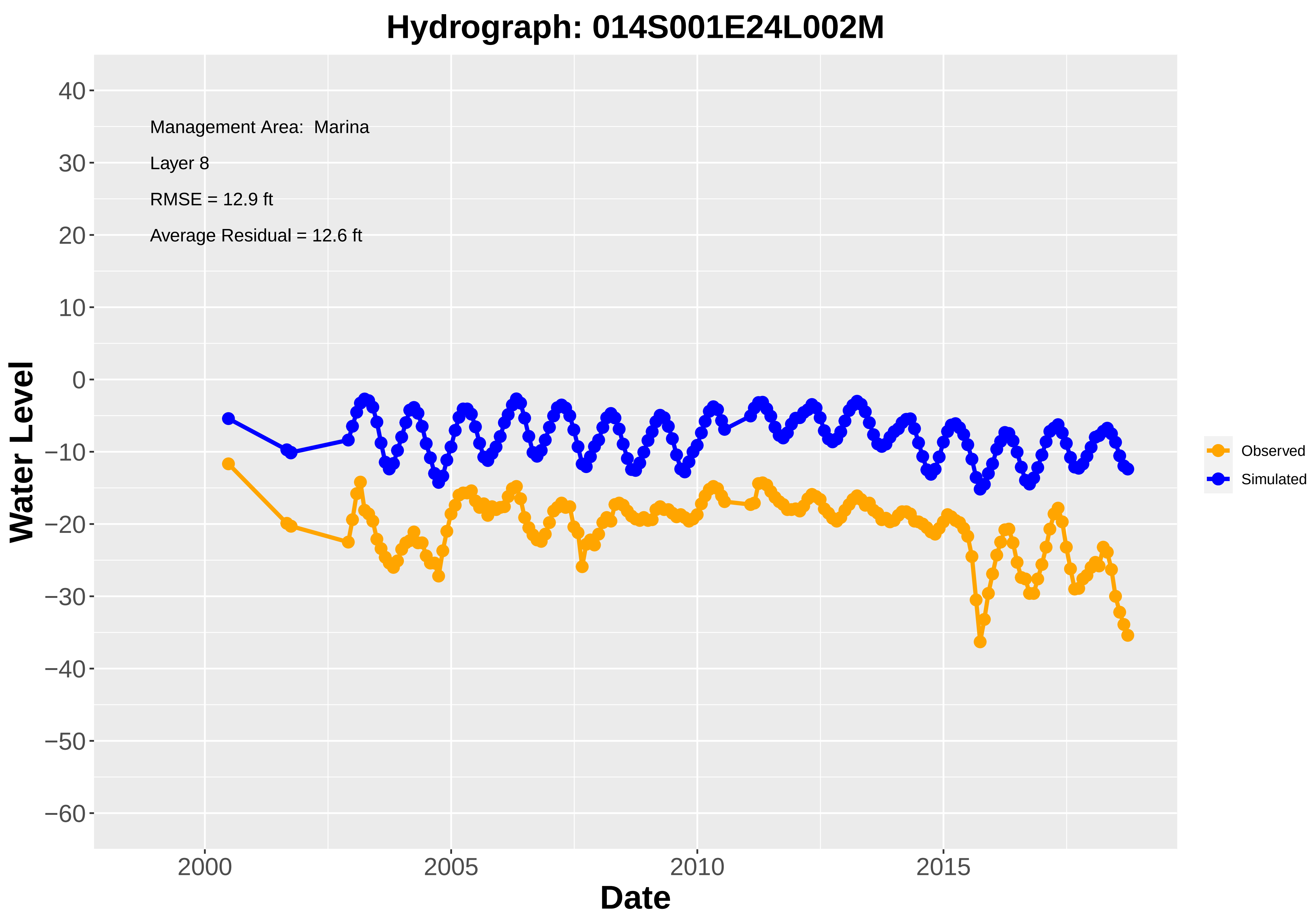
eki environment & water

Composite Sensitivities for the Most Sensitive Model Parameters

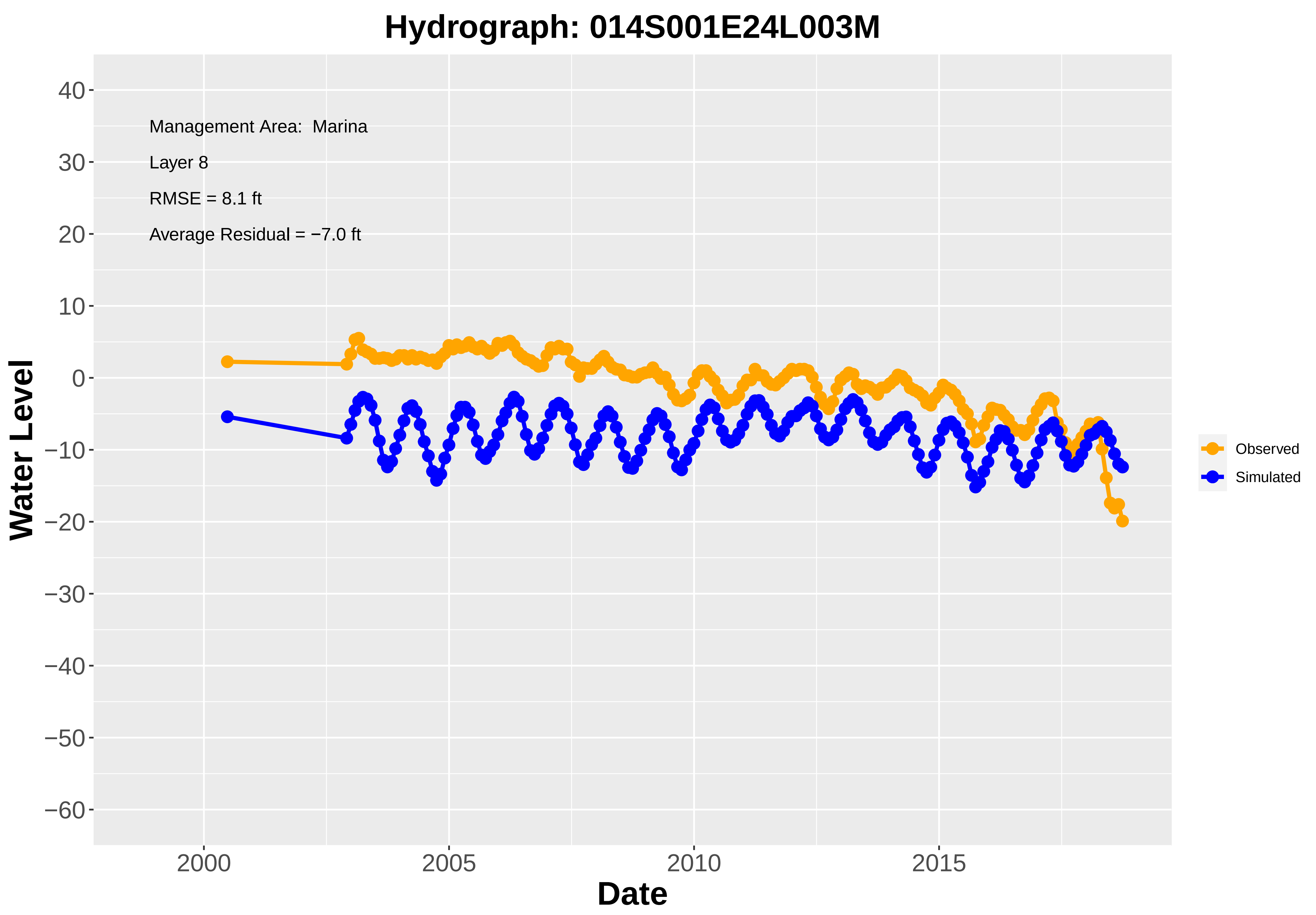
Marina Coast Water District
Monterey County, California
November 2021
EKI B60094.12

Figure 38

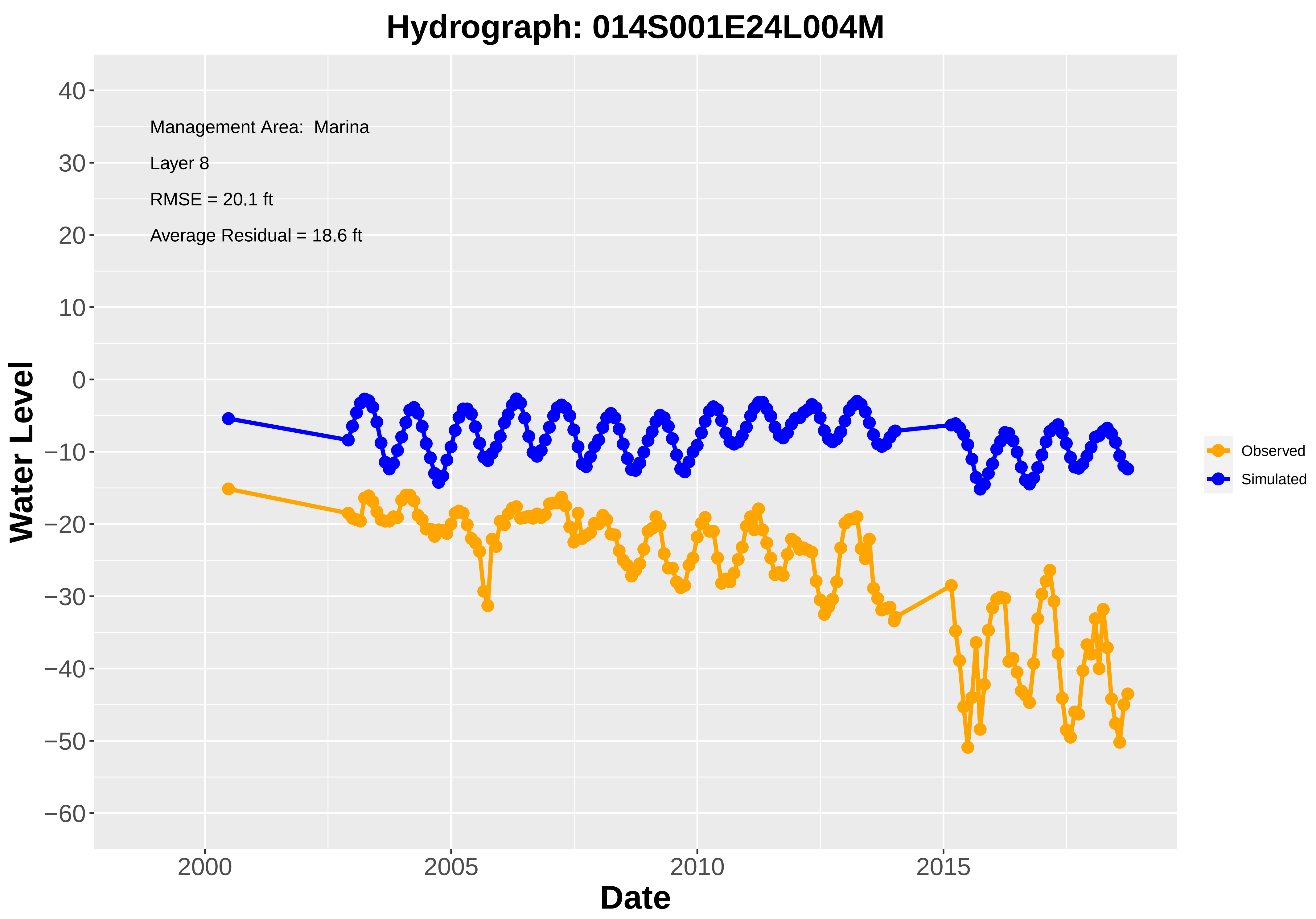
Attachment 1. Hydrographs



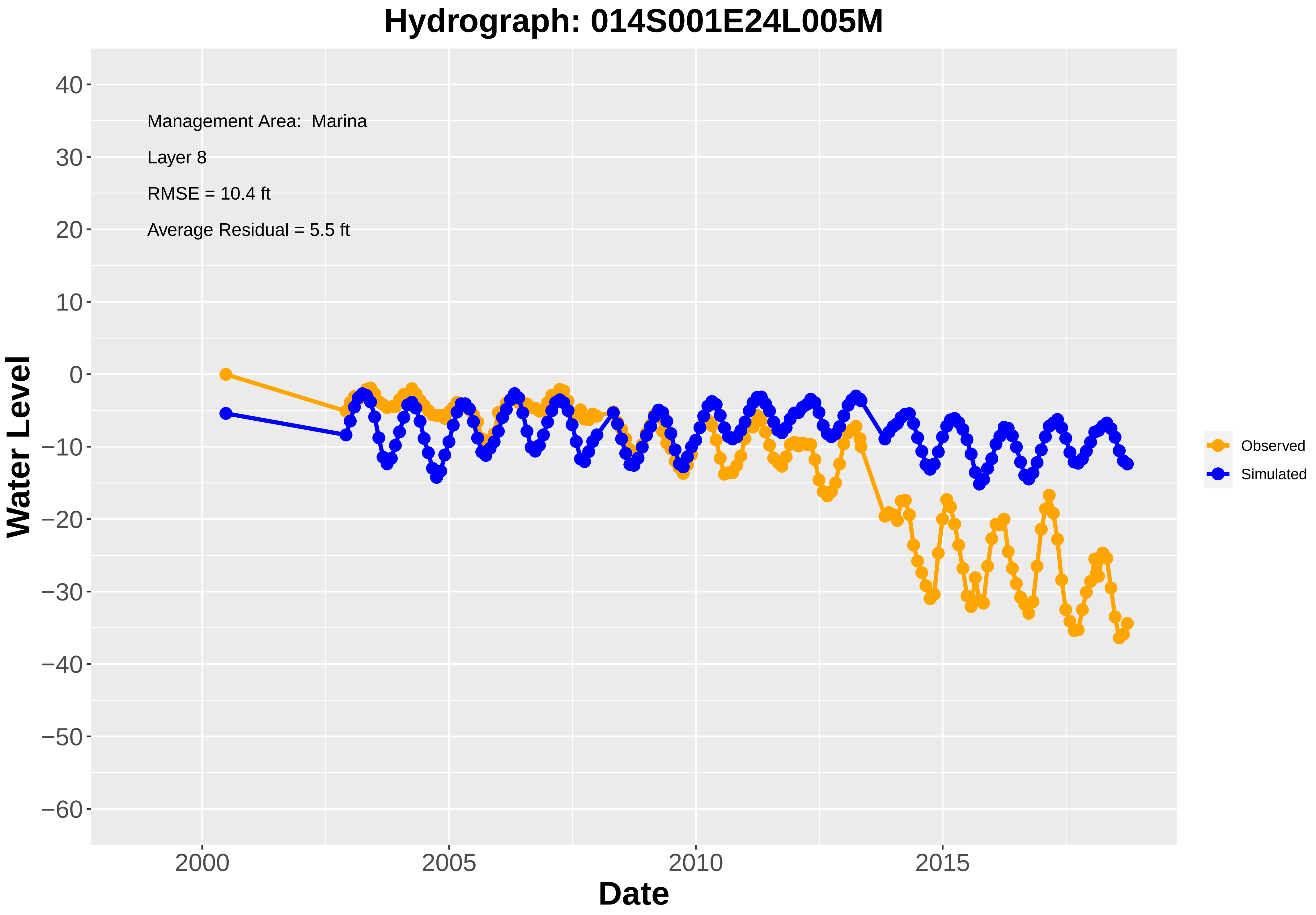
Hydrograph: 014S001E24L002M
Management Area: Marina
Layer 8
RMSE = 12.9 ft
Average Residual = 12.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



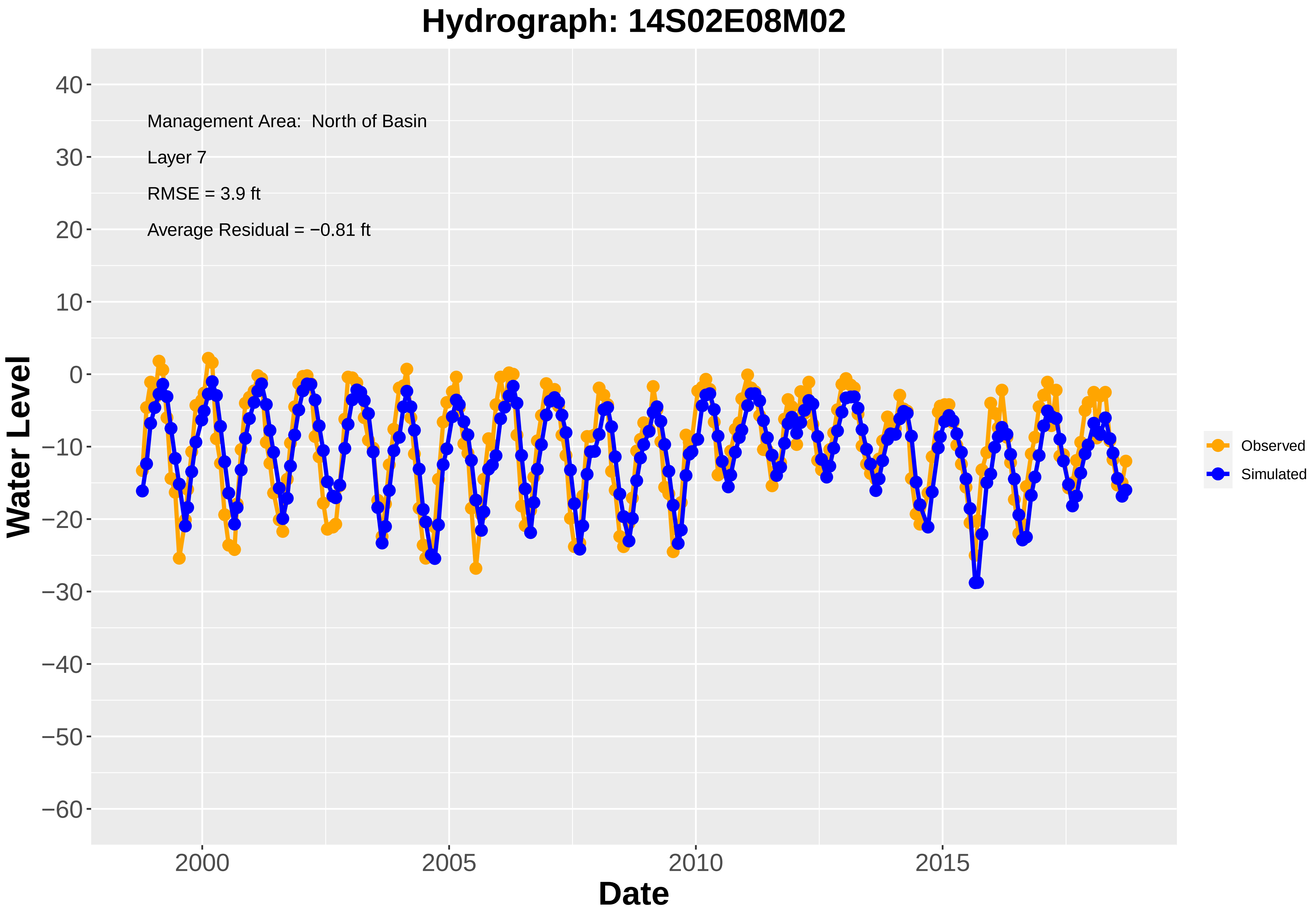
Hydrograph: 014S001E24L003M
Management Area: Marina
Layer 8
RMSE = 8.1 ft
Average Residual = −7.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

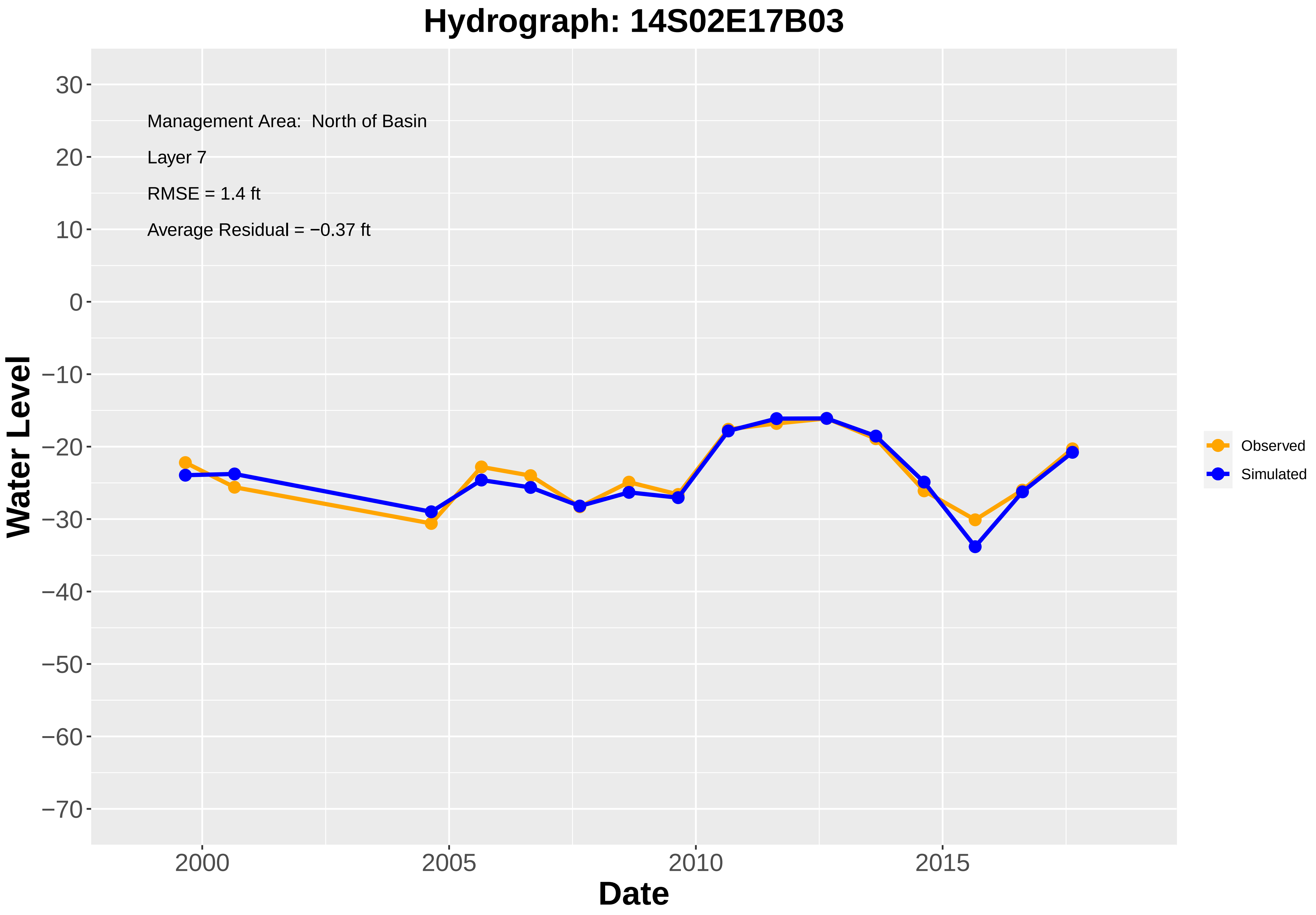


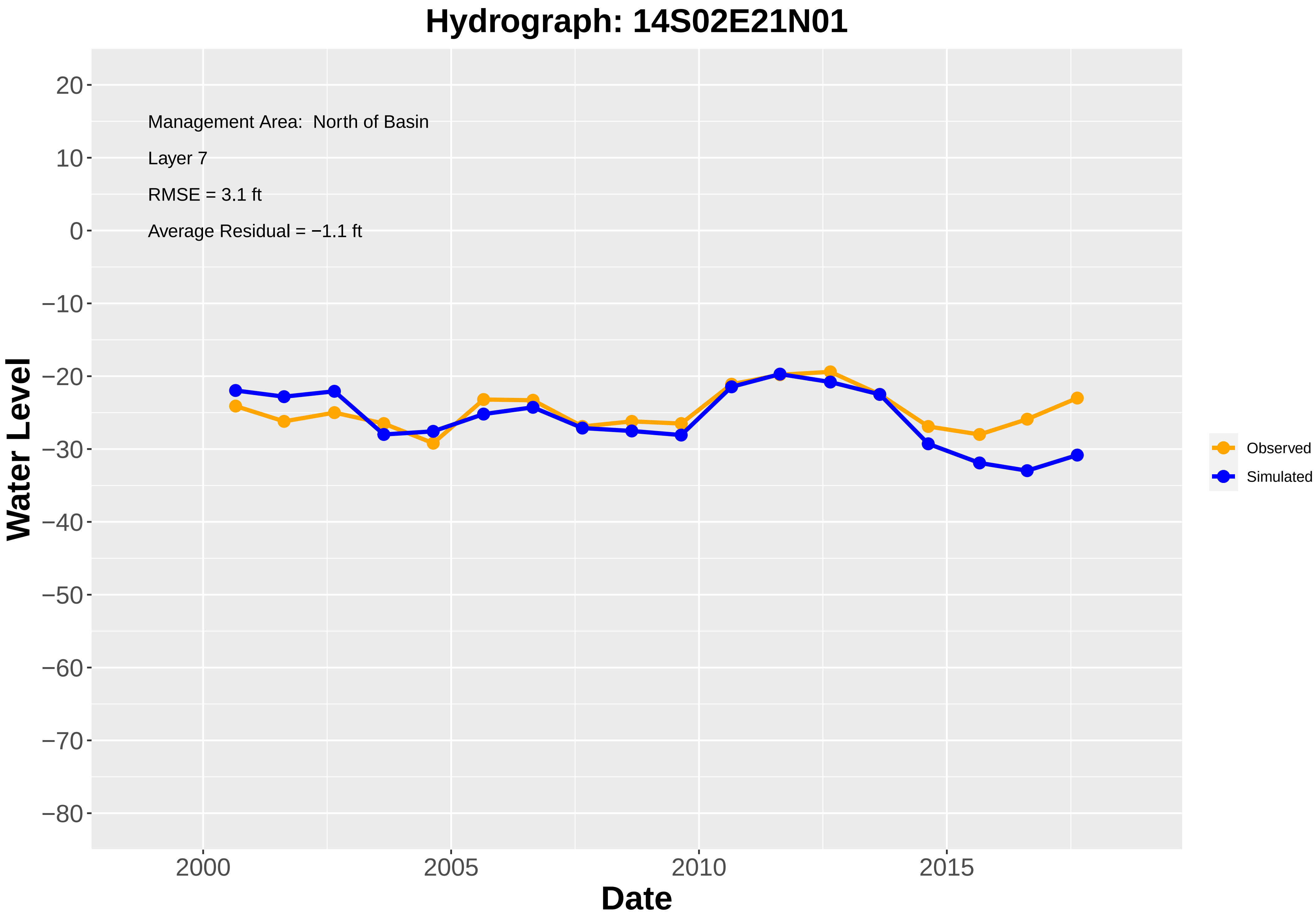
Hydrograph: 014S001E24L004M
Management Area: Marina
Layer 8
RMSE = 20.1 ft
Average Residual = 18.6 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



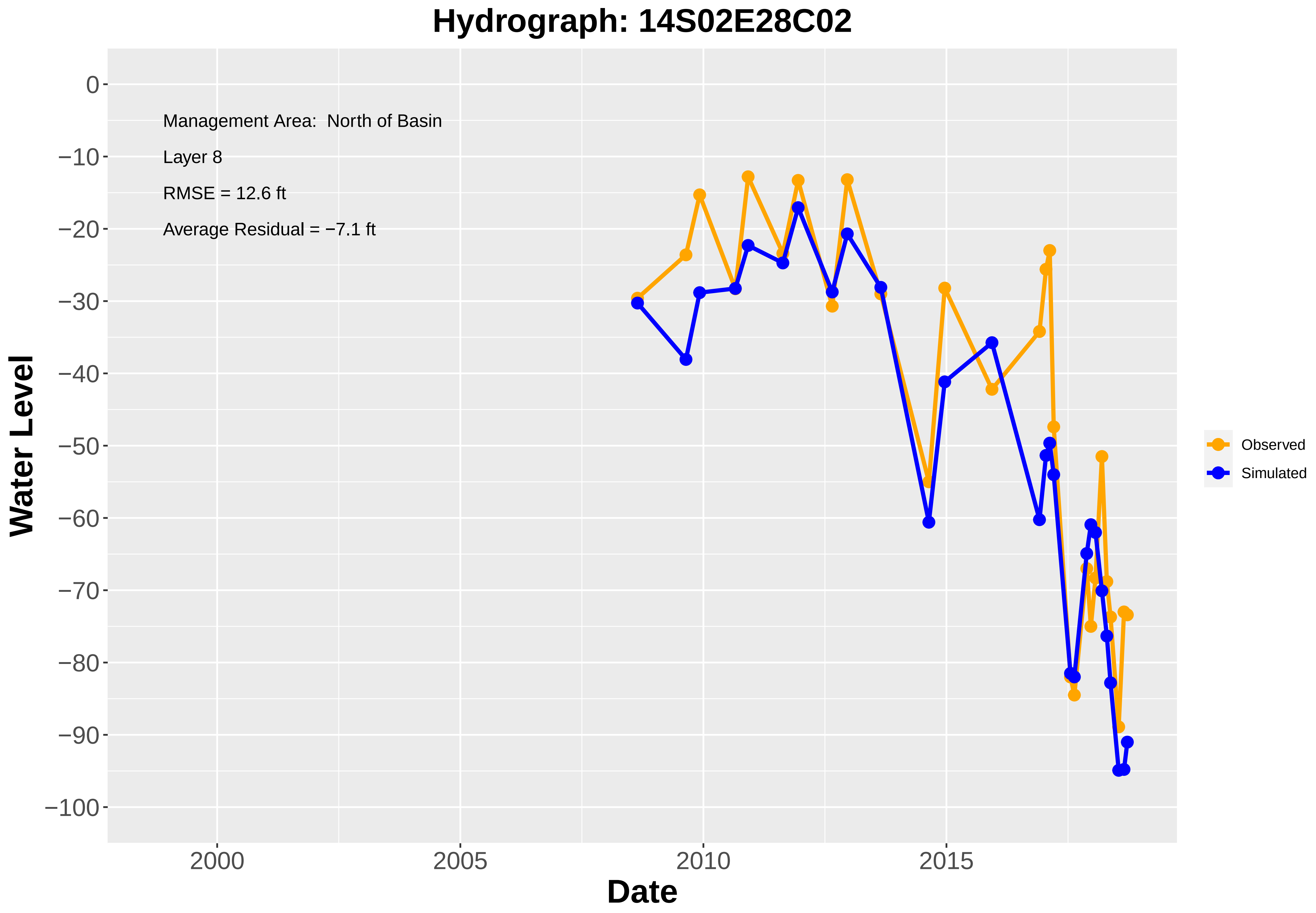
Hydrograph: 014S001E24L005M
Management Area: Marina
Layer 8
RMSE = 10.4 ft
Average Residual = 5.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

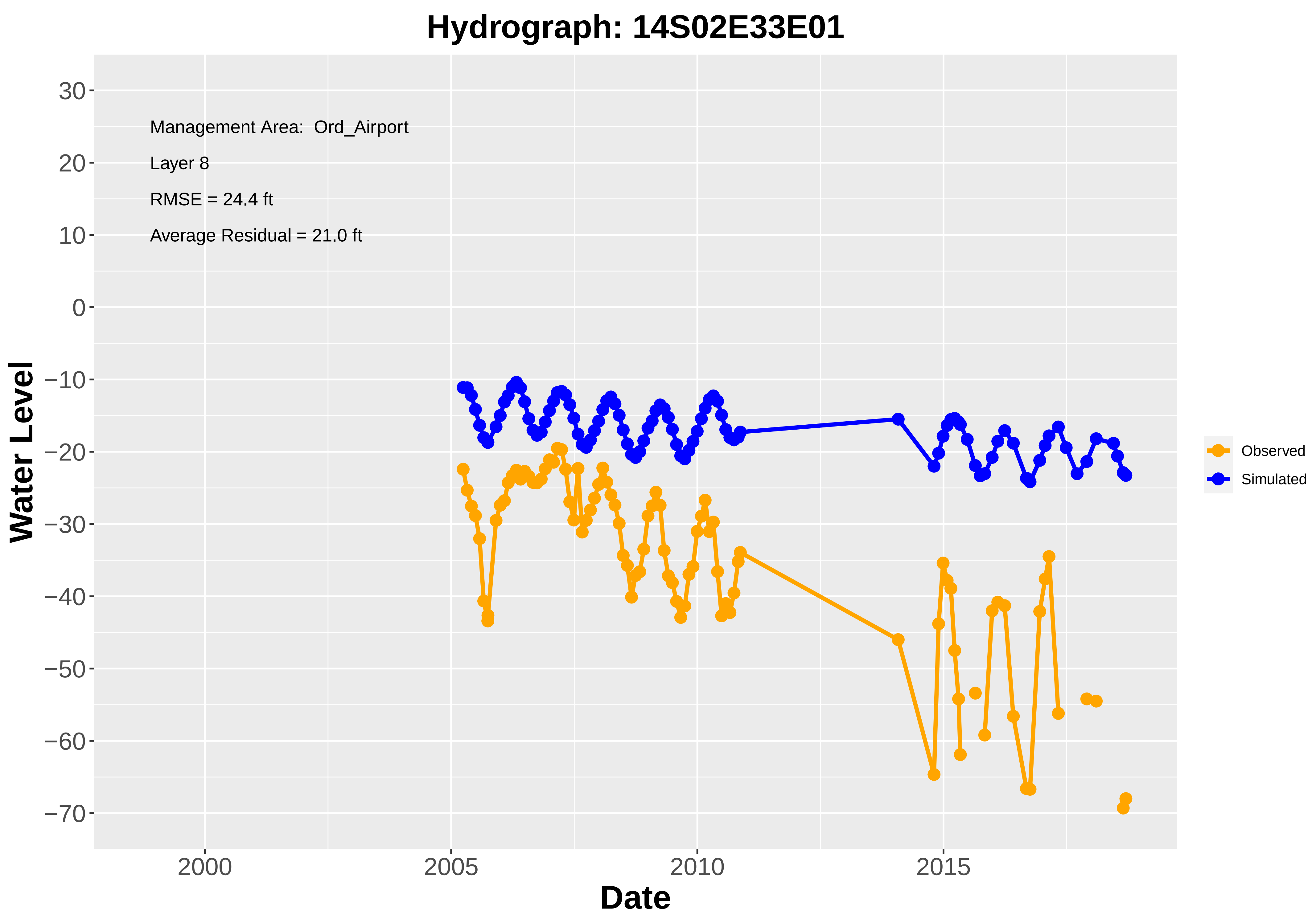

Hydrograph: 14S02E08M02
Management Area: North of Basin
Layer 7
RMSE = 3.9 ft
Average Residual = −0.81 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: 14S02E17B03
Management Area: North of Basin
Layer 7
RMSE = 1.4 ft
Average Residual = −0.37 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

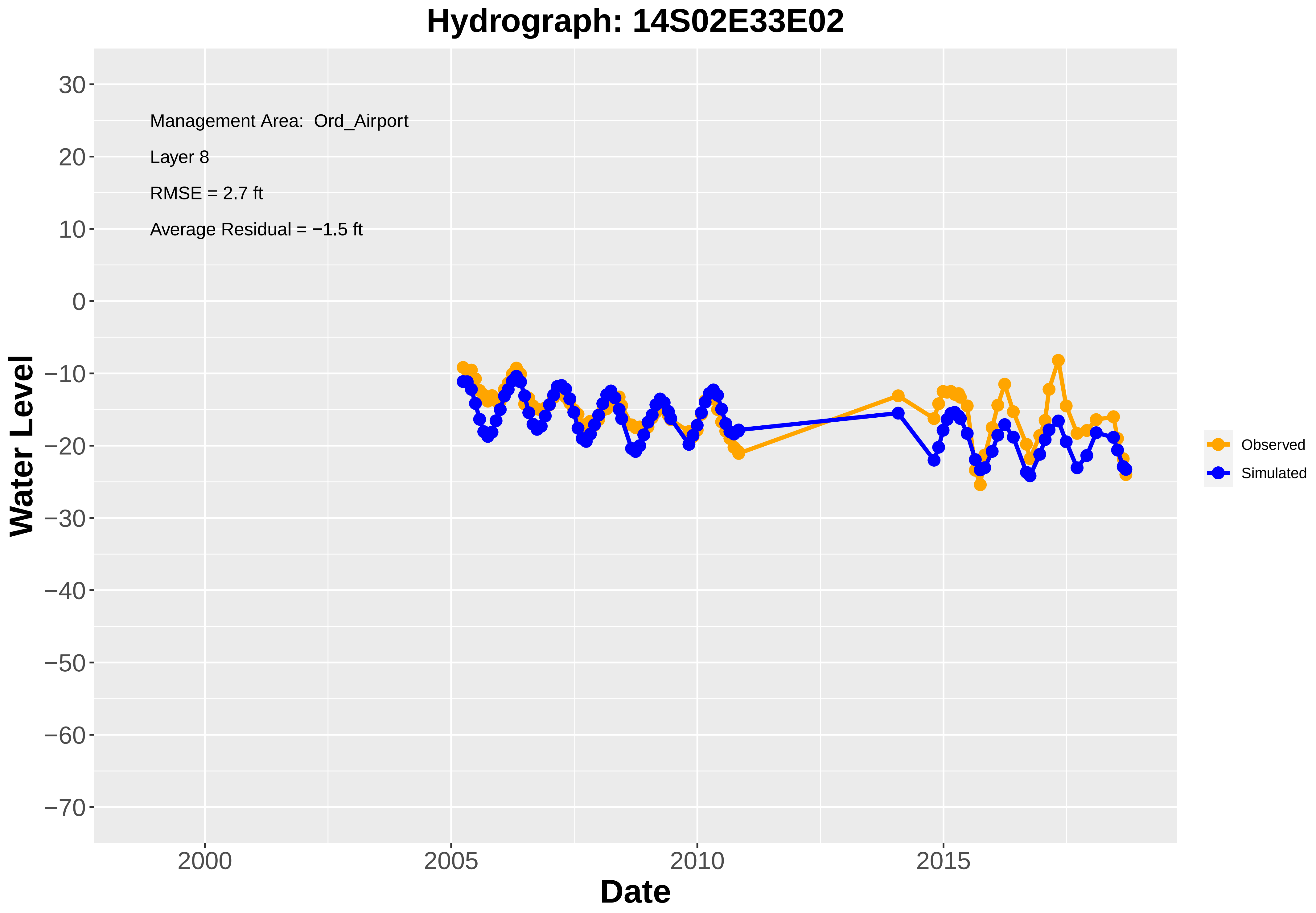


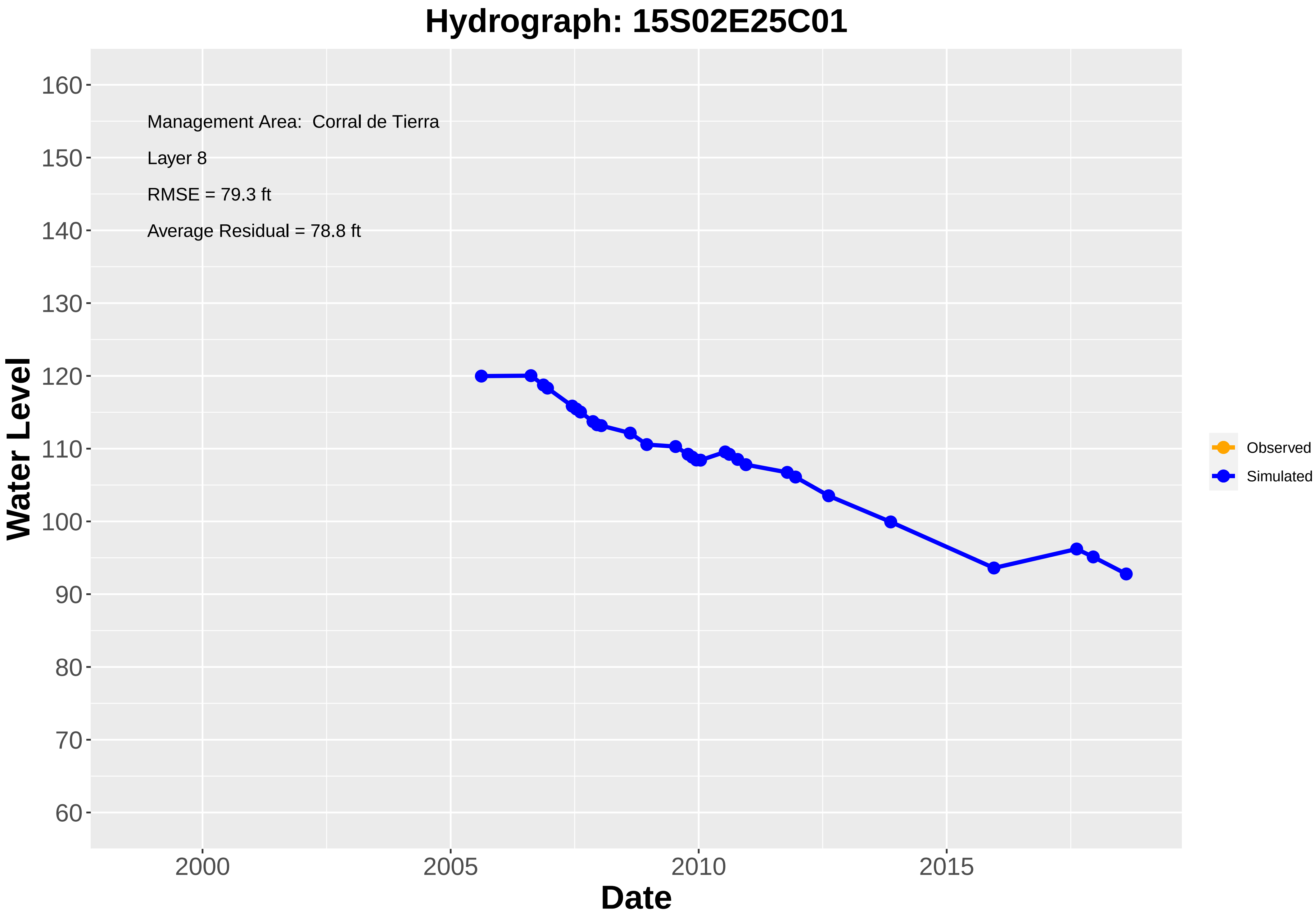
Hydrograph: 14S02E21N01
Management Area: North of Basin
Layer 7
RMSE = 3.1 ft
Average Residual = −1.1 ft
Water Level
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
Date
2000
2005
2010
2015
Observed
Simulated

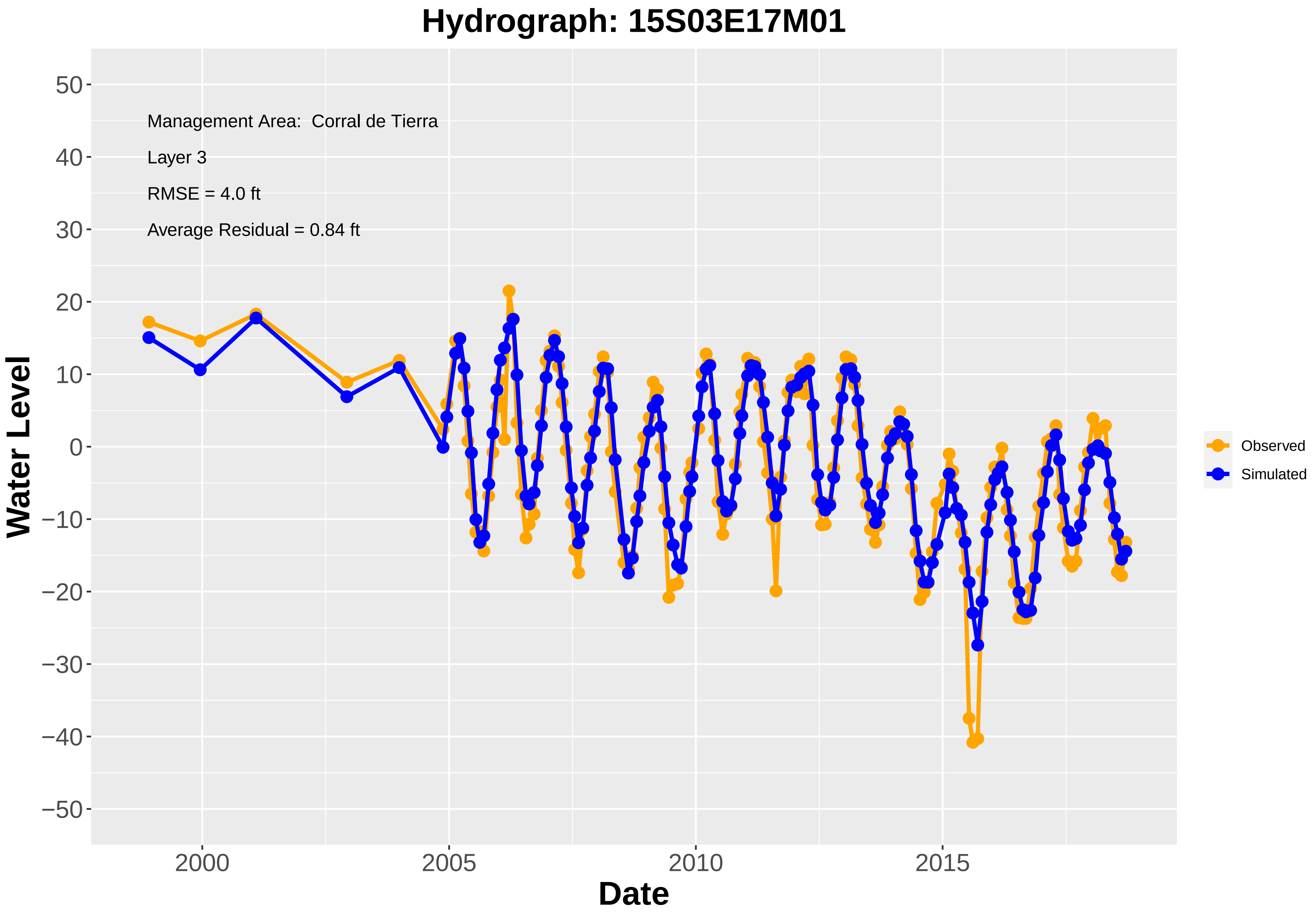

Hydrograph: 14S02E28C02
Management Area: North of Basin
Layer 8
RMSE = 12.6 ft
Average Residual = −7.1 ft
Water Level
Date
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
2000
2005
2010
2015
Observed
Simulated

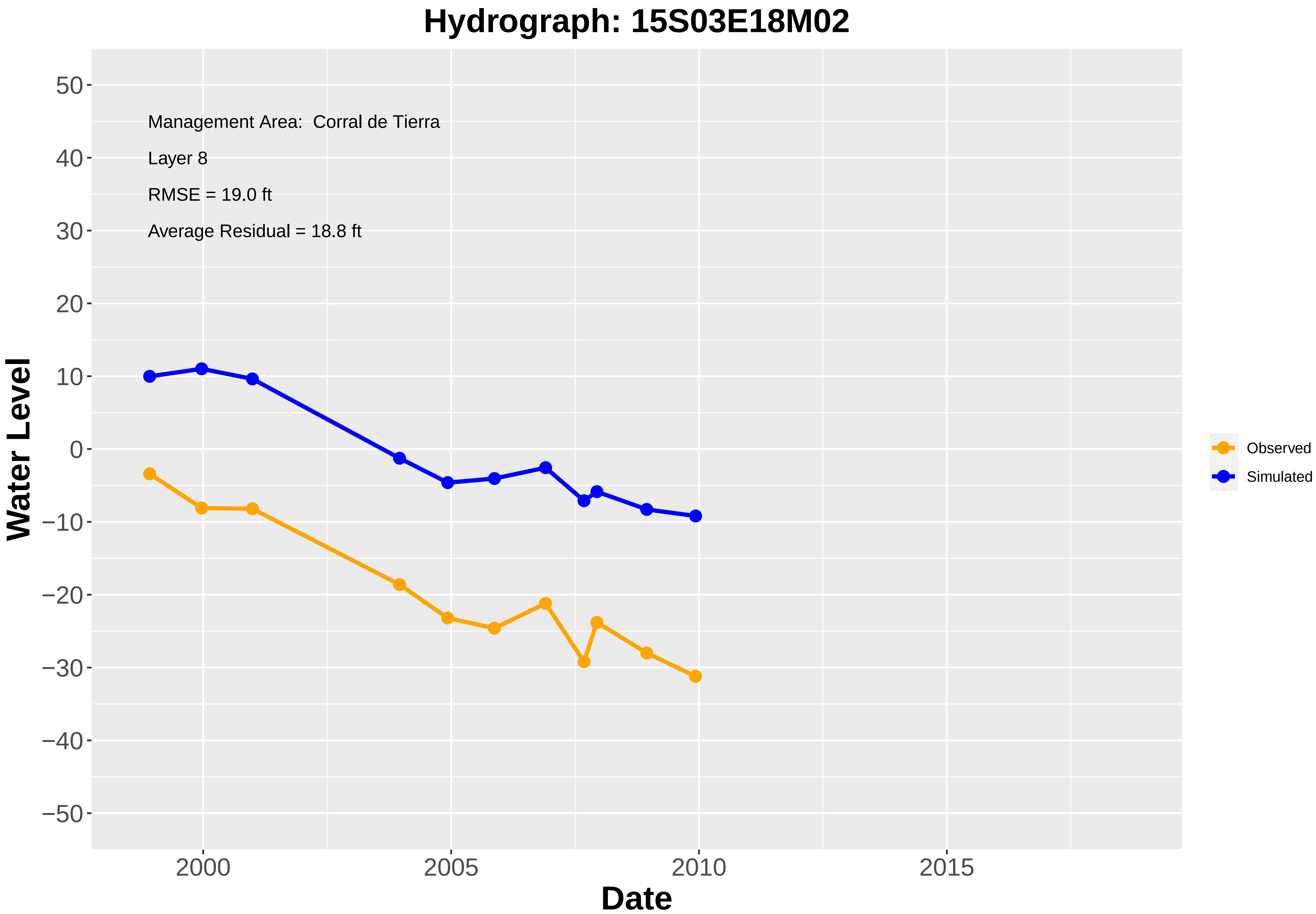


Hydrograph: 14S02E33E01
Management Area: Ord_Airport
Layer 8
RMSE = 24.4 ft
Average Residual = 21.0 ft
Water Level
Date
Observed
Simulated
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015

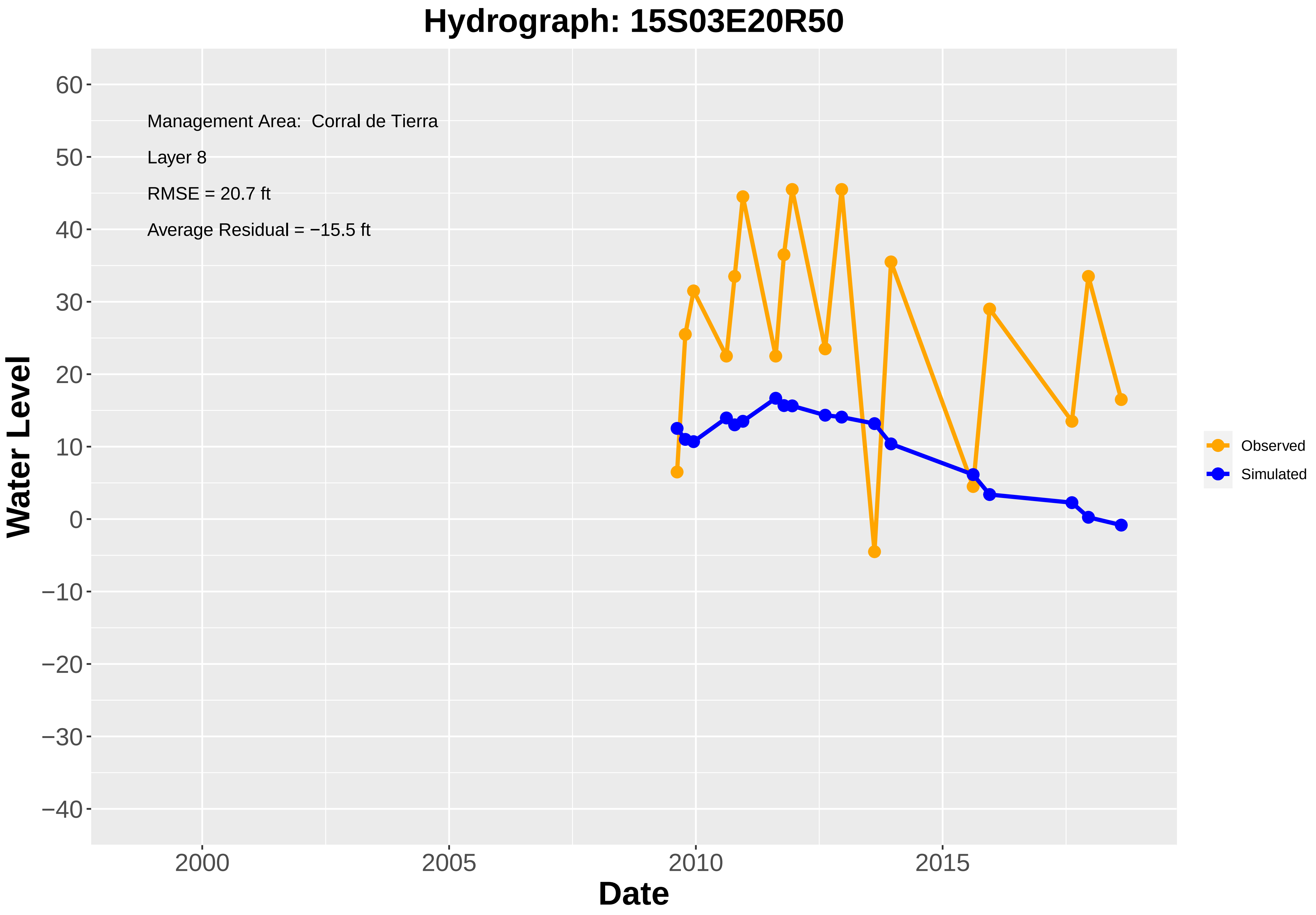

Hydrograph: 14S02E33E02
Management Area: Ord_Airport
Layer 8
RMSE = 2.7 ft
Average Residual = −1.5 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

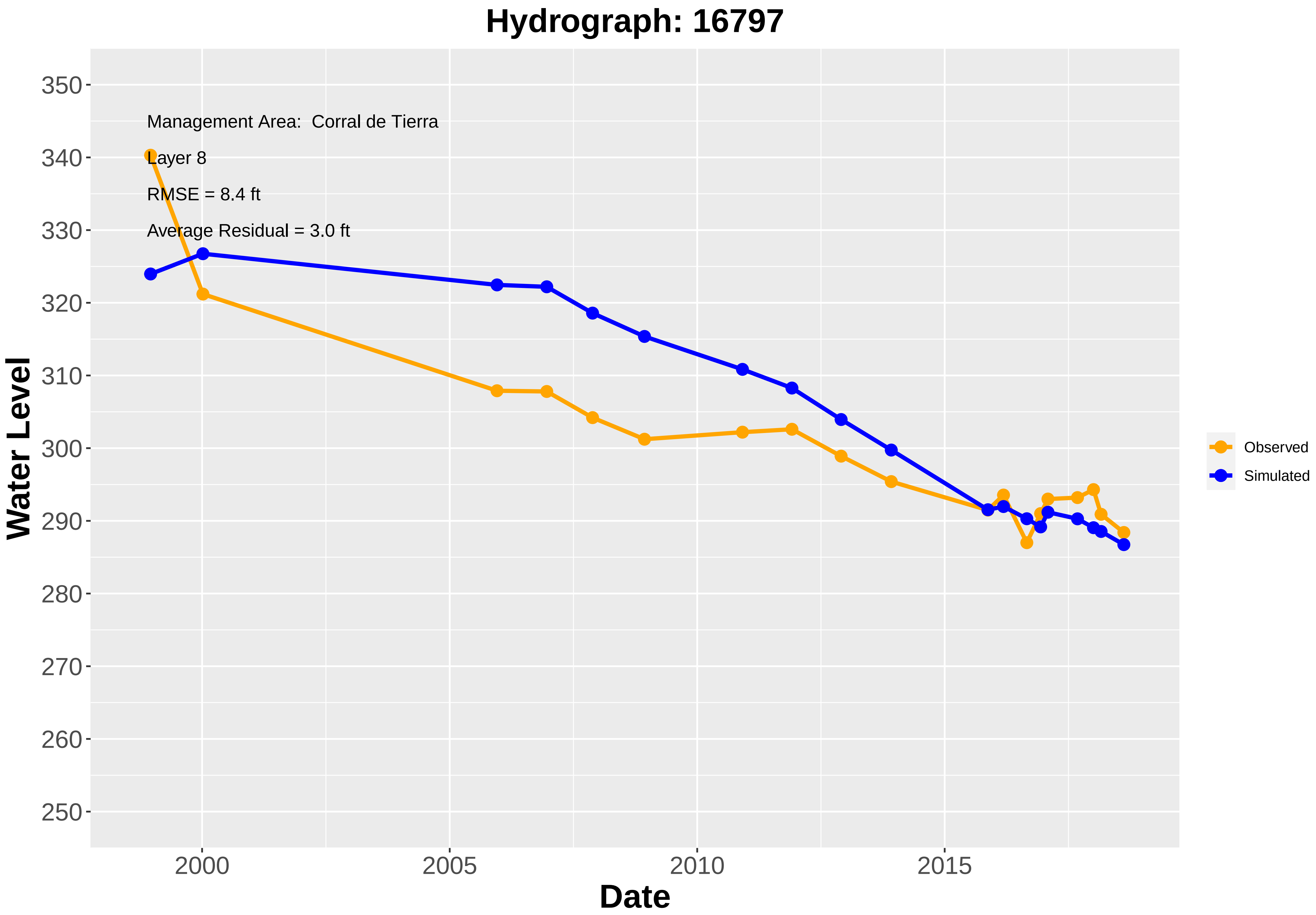

Hydrograph: 15S02E25C01
Management Area: Corral de Tierra
Layer 8
RMSE = 79.3 ft
Average Residual = 78.8 ft
Water Level
Date
160
150
140
130
120
110
100
90
80
70
60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: 15S03E17M01
Management Area: Corral de Tierra
Layer 3
RMSE = 4.0 ft
Average Residual = 0.84 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

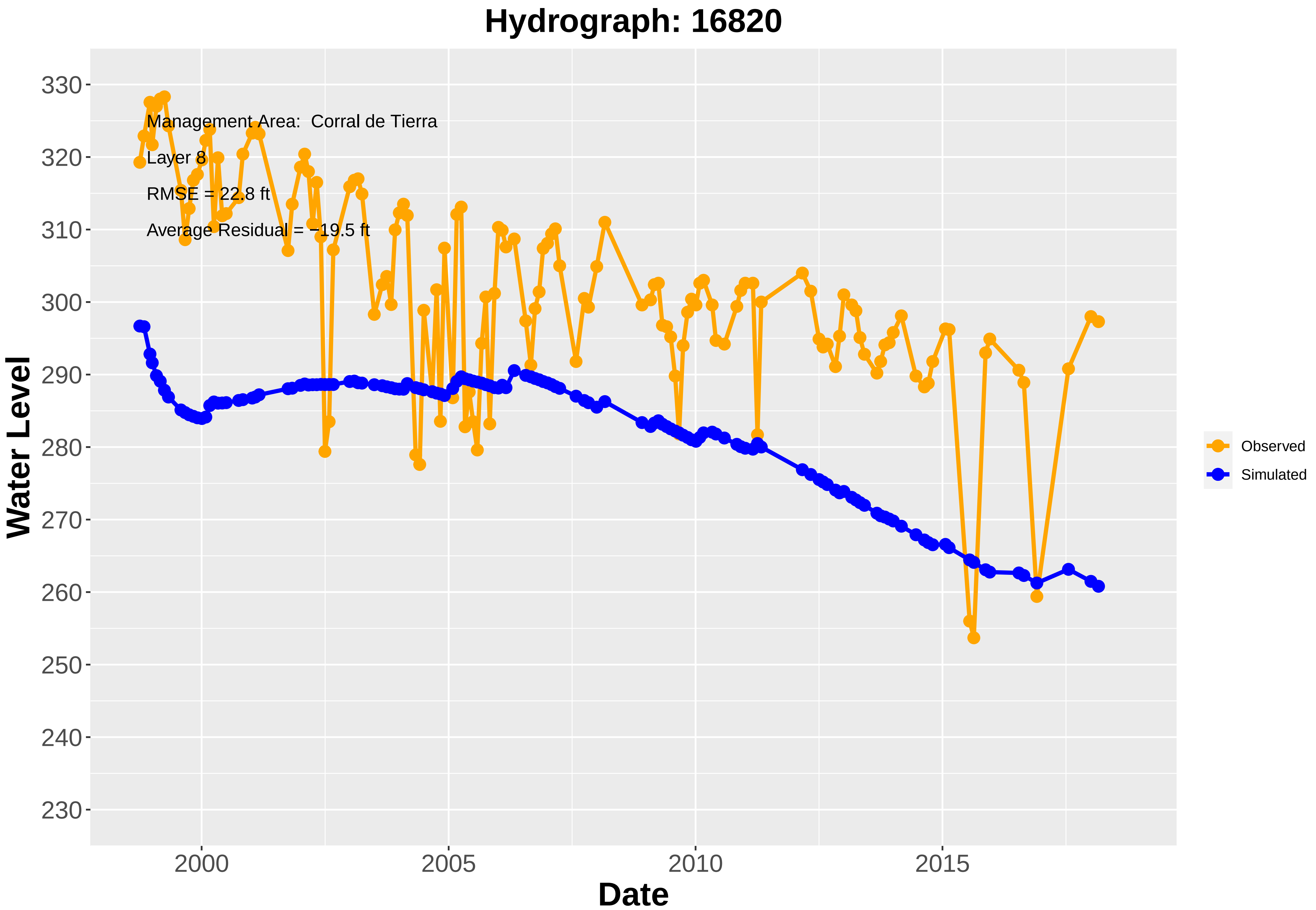


Hydrograph: 15S03E18M02
Management Area: Corral de Tierra
Layer 8
RMSE = 19.0 ft
Average Residual = 18.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

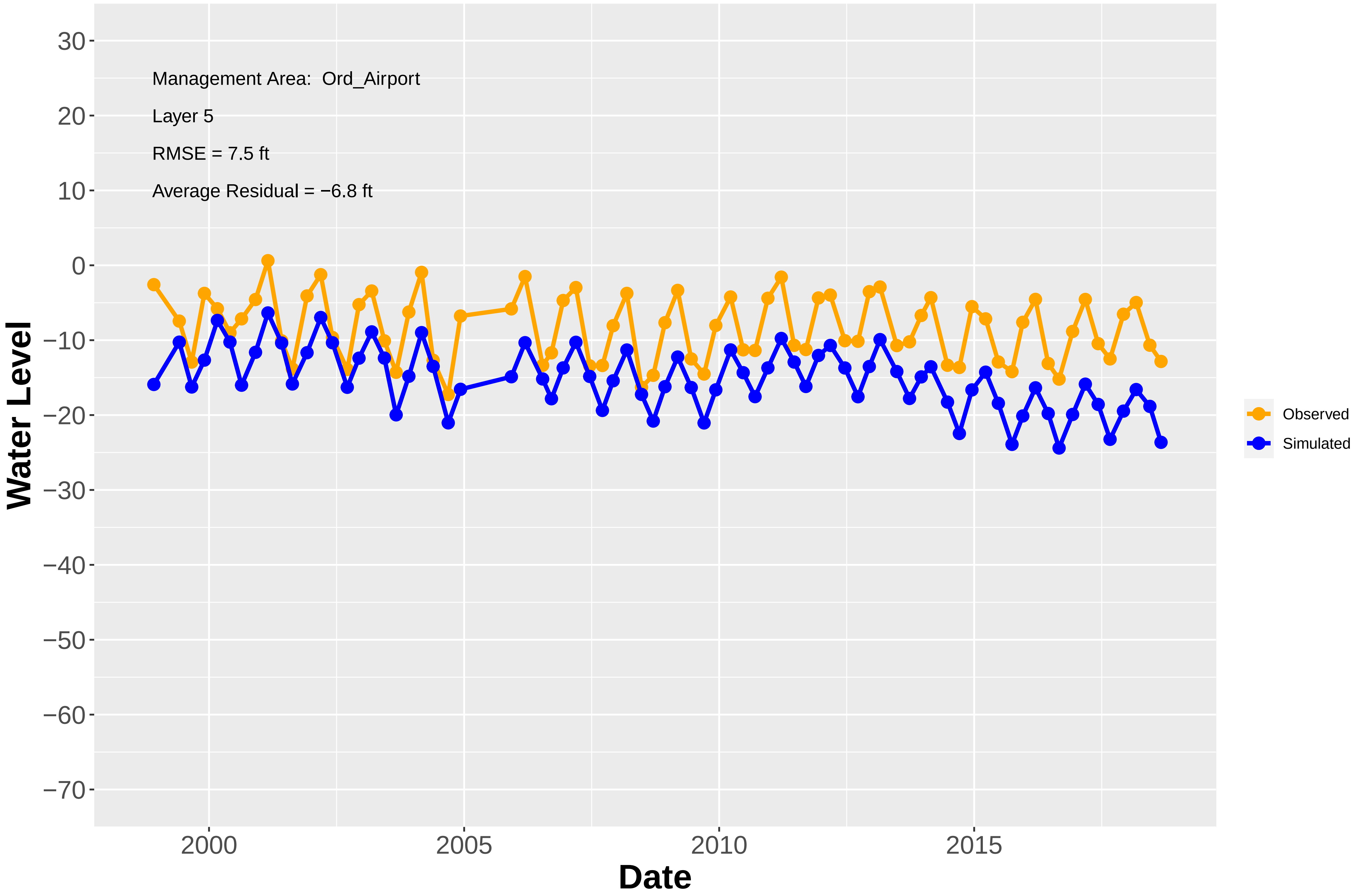

Hydrograph: 15S03E20R50
Management Area: Corral de Tierra
Layer 8
RMSE = 20.7 ft
Average Residual = −15.5 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

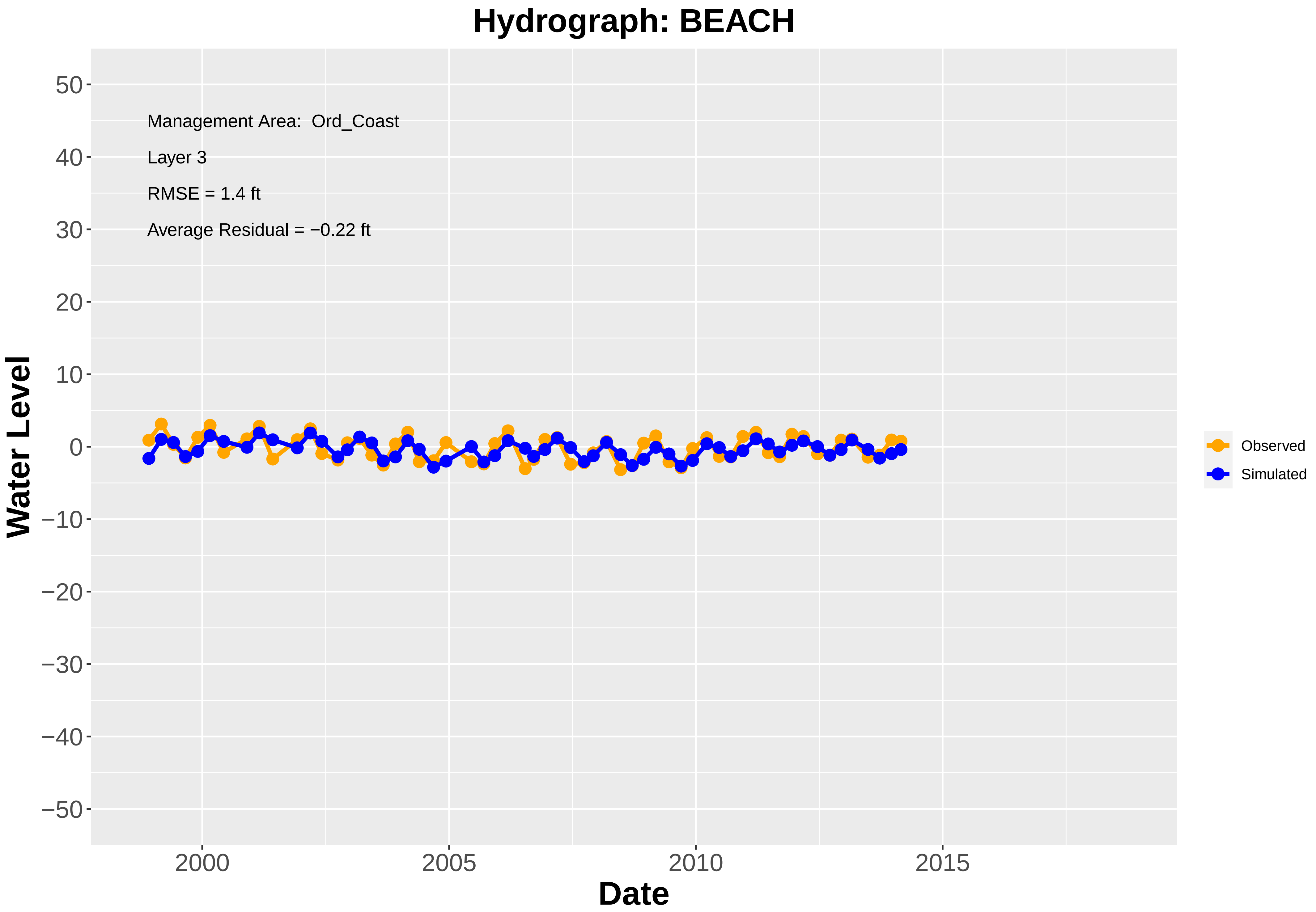


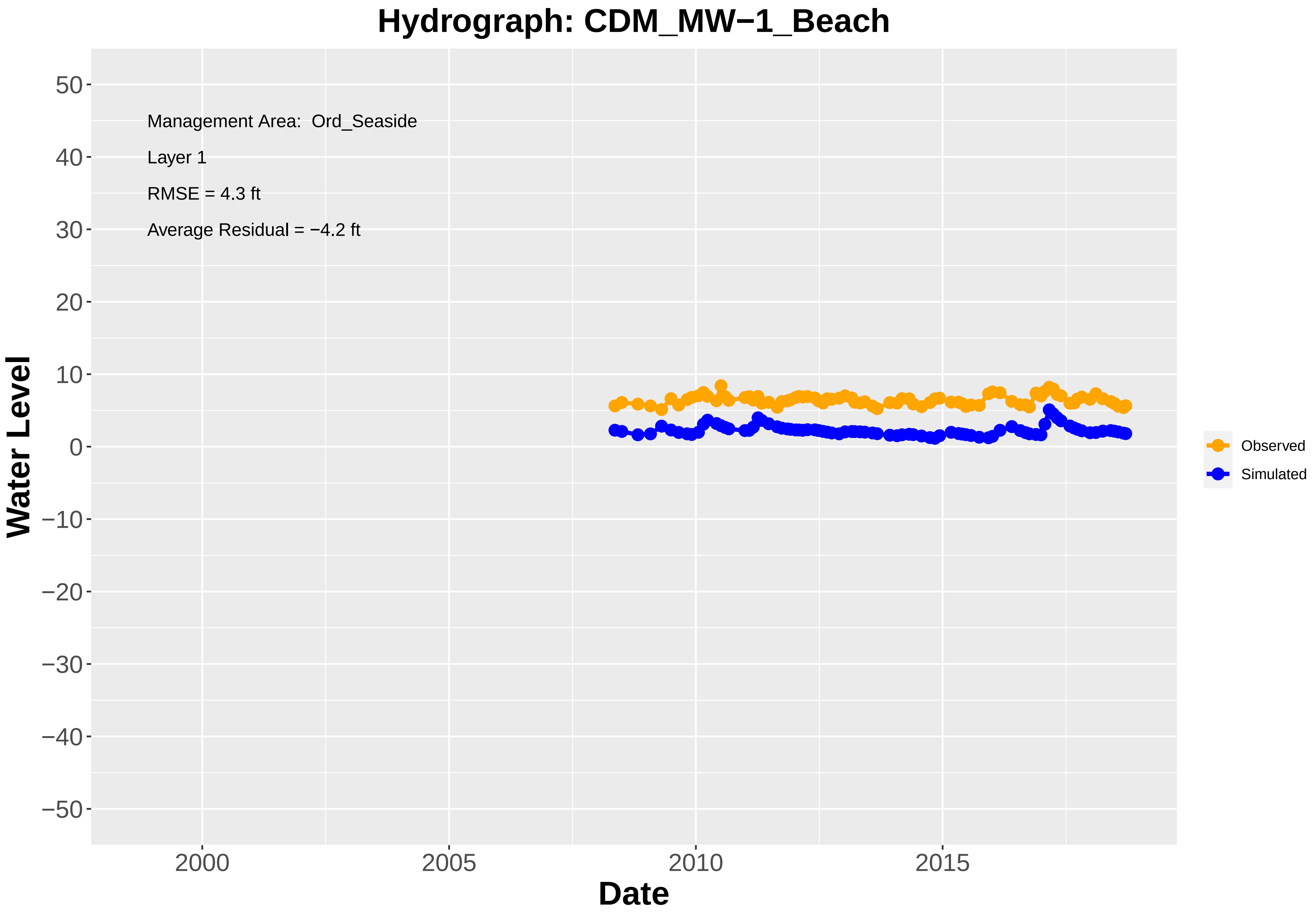
Hydrograph: 16797
Management Area: Corral de Tierra
Layer 8
RMSE = 8.4 ft
Average Residual = 3.0 ft
Water Level
350
340
330
320
310
300
290
280
270
260
250
2000
2005
2010
2015
Date
Observed
Simulated

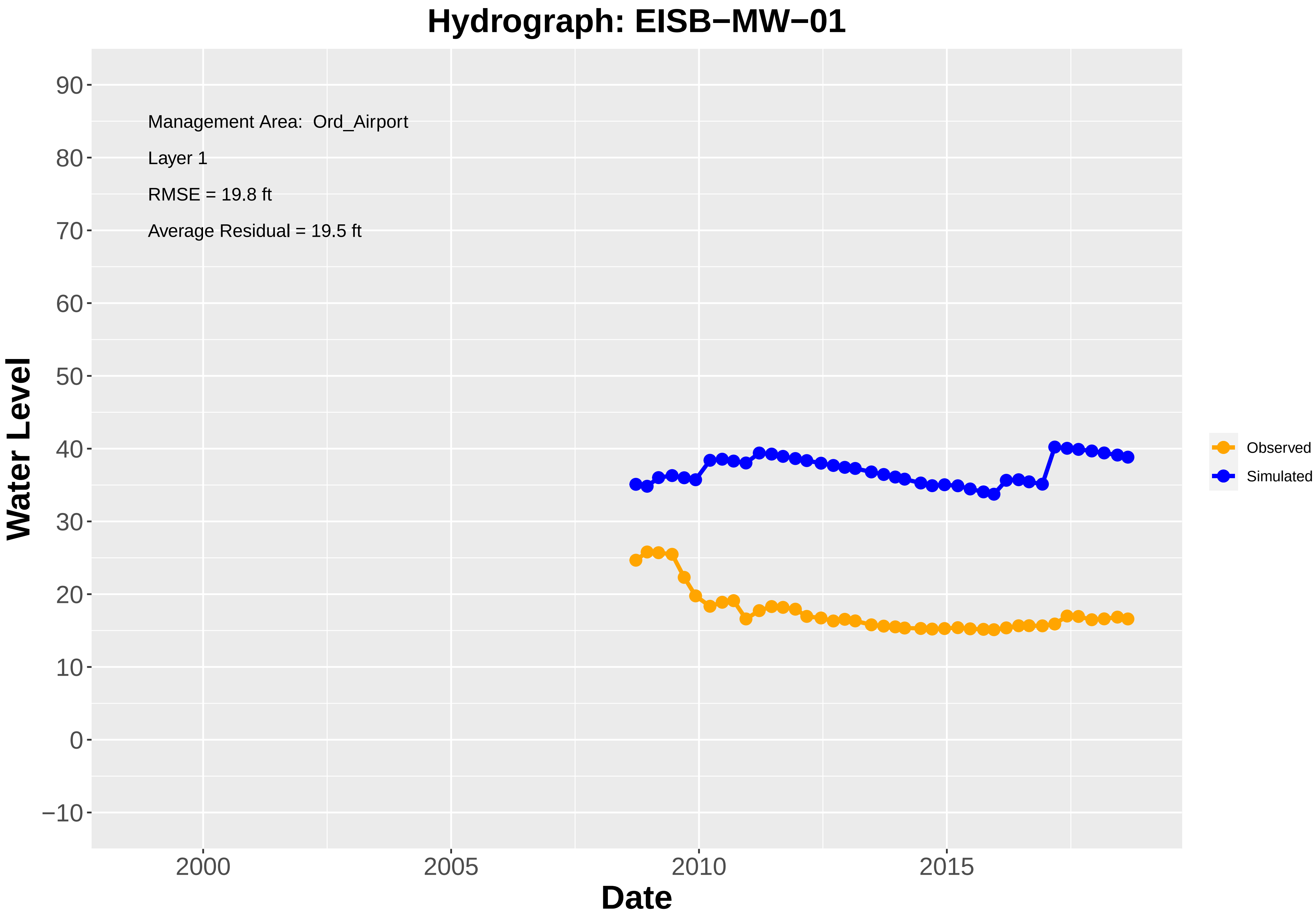

Hydrograph: 16820
Management Area: Corral de Tierra
Layer 8
RMSE = 22.8 ft
Average Residual = −19.5 ft
Water Level
330
320
310
300
290
280
270
260
250
240
230
Date
2000
2005
2010
2015
Observed
Simulated

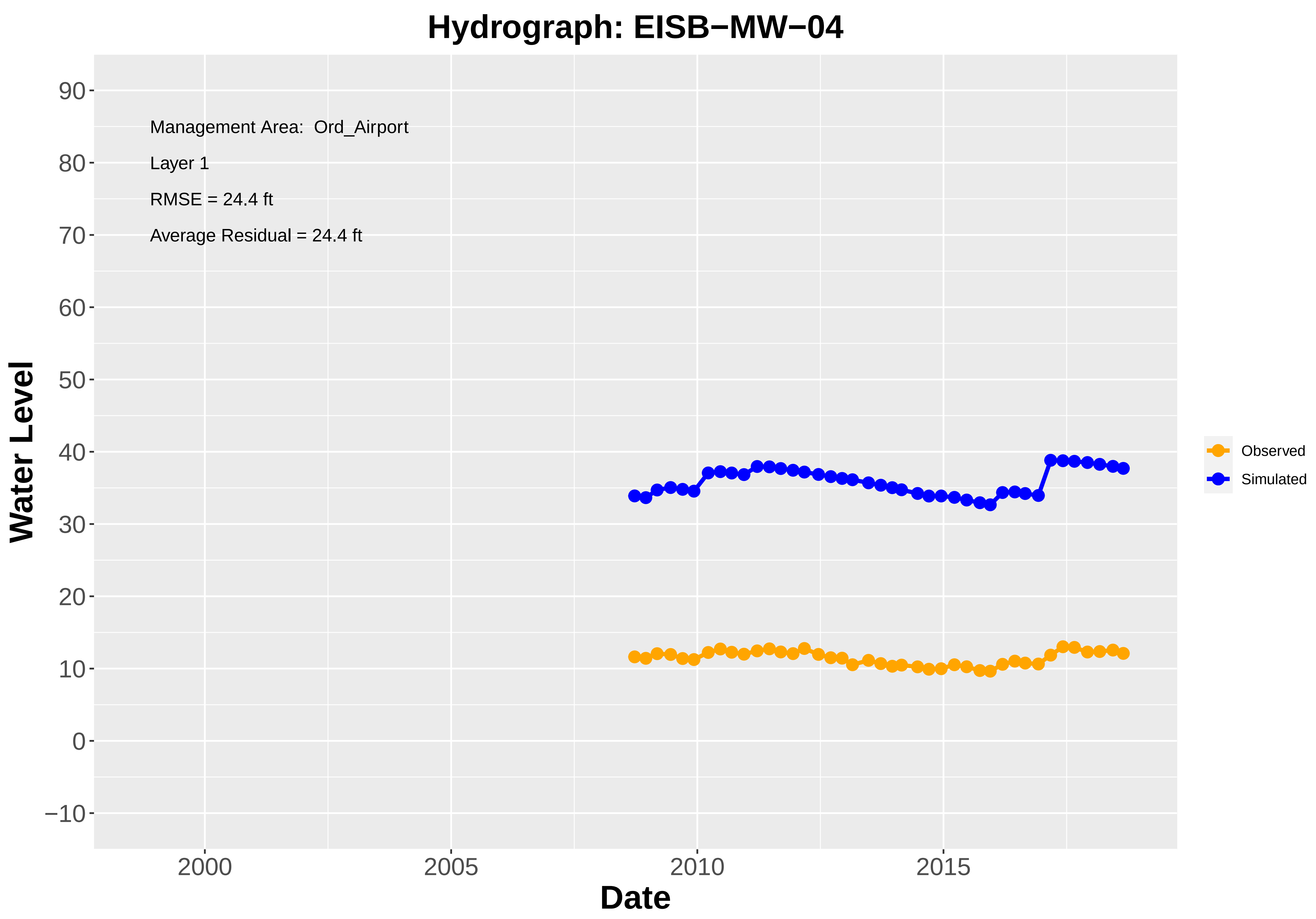
Hydrograph: Airfield



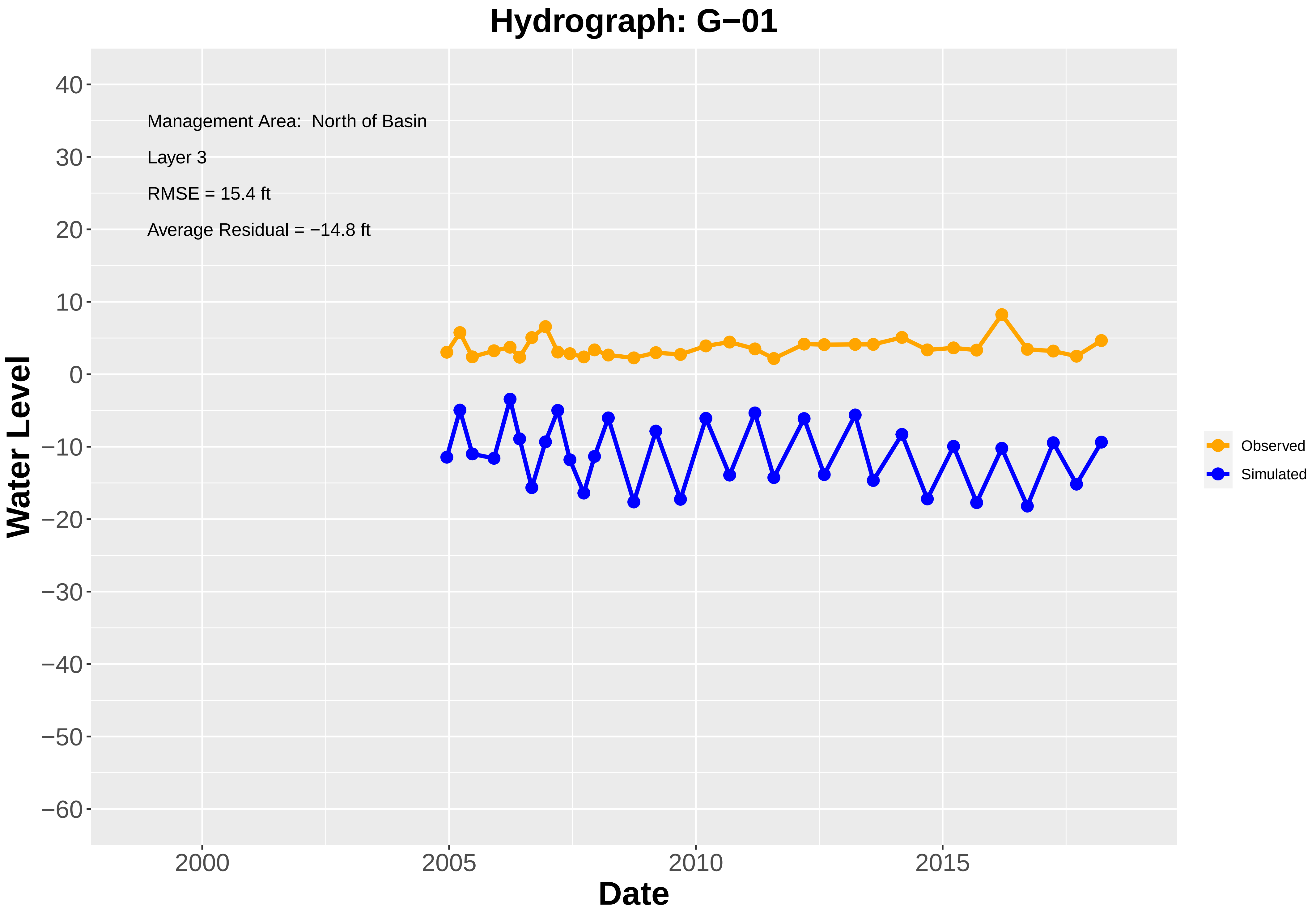

Hydrograph: BEACH
Management Area: Ord_Coast
Layer 3
RMSE = 1.4 ft
Average Residual = −0.22 ft
50
40
30
20
10
0
−10
−20
−30
−40
−50
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

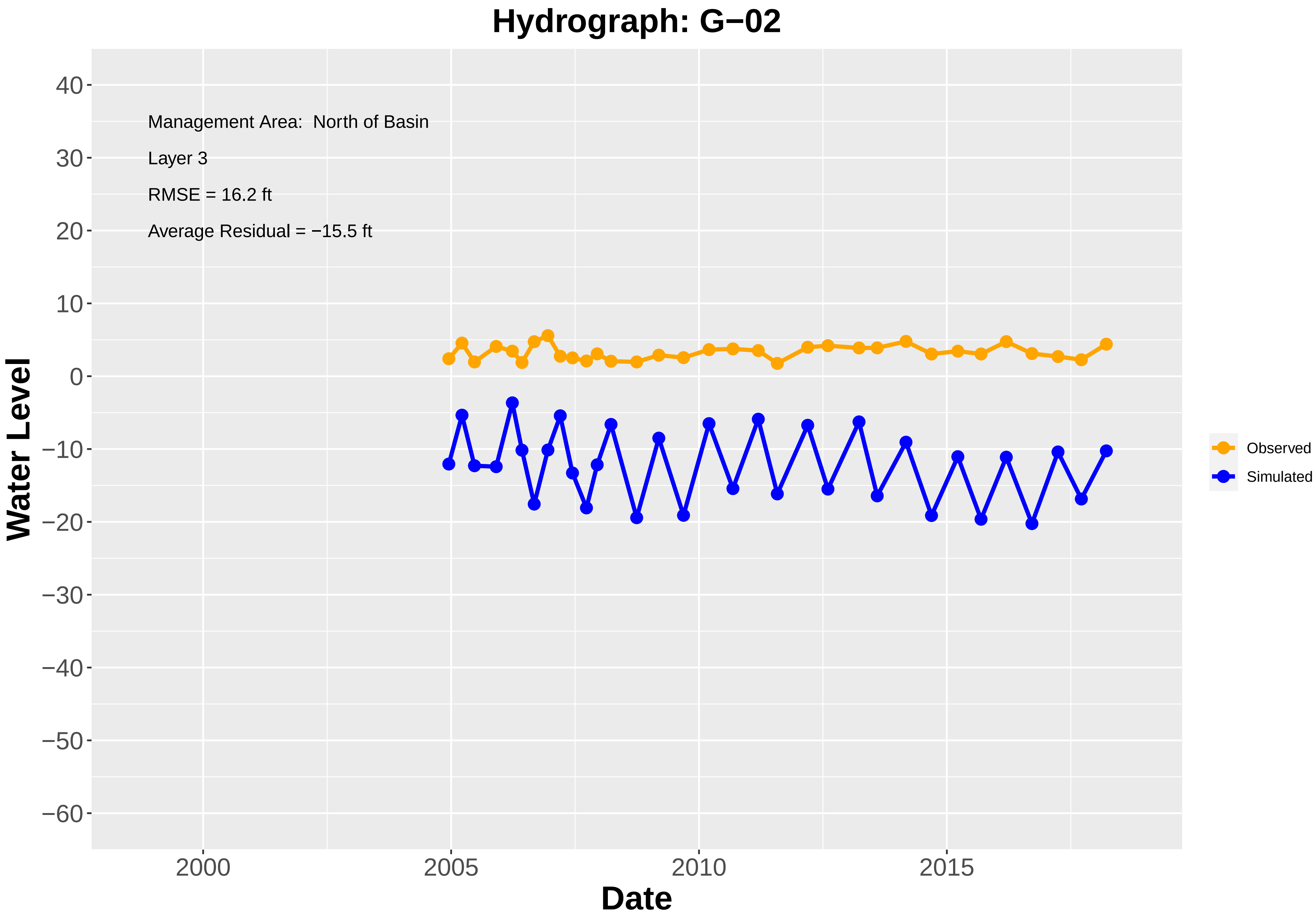

Hydrograph: CDM_MW−1_Beach
Management Area: Ord_Seaside
Layer 1
RMSE = 4.3 ft
Average Residual = −4.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: EISB−MW−01
Management Area: Ord_Airport
Layer 1
RMSE = 19.8 ft
Average Residual = 19.5 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

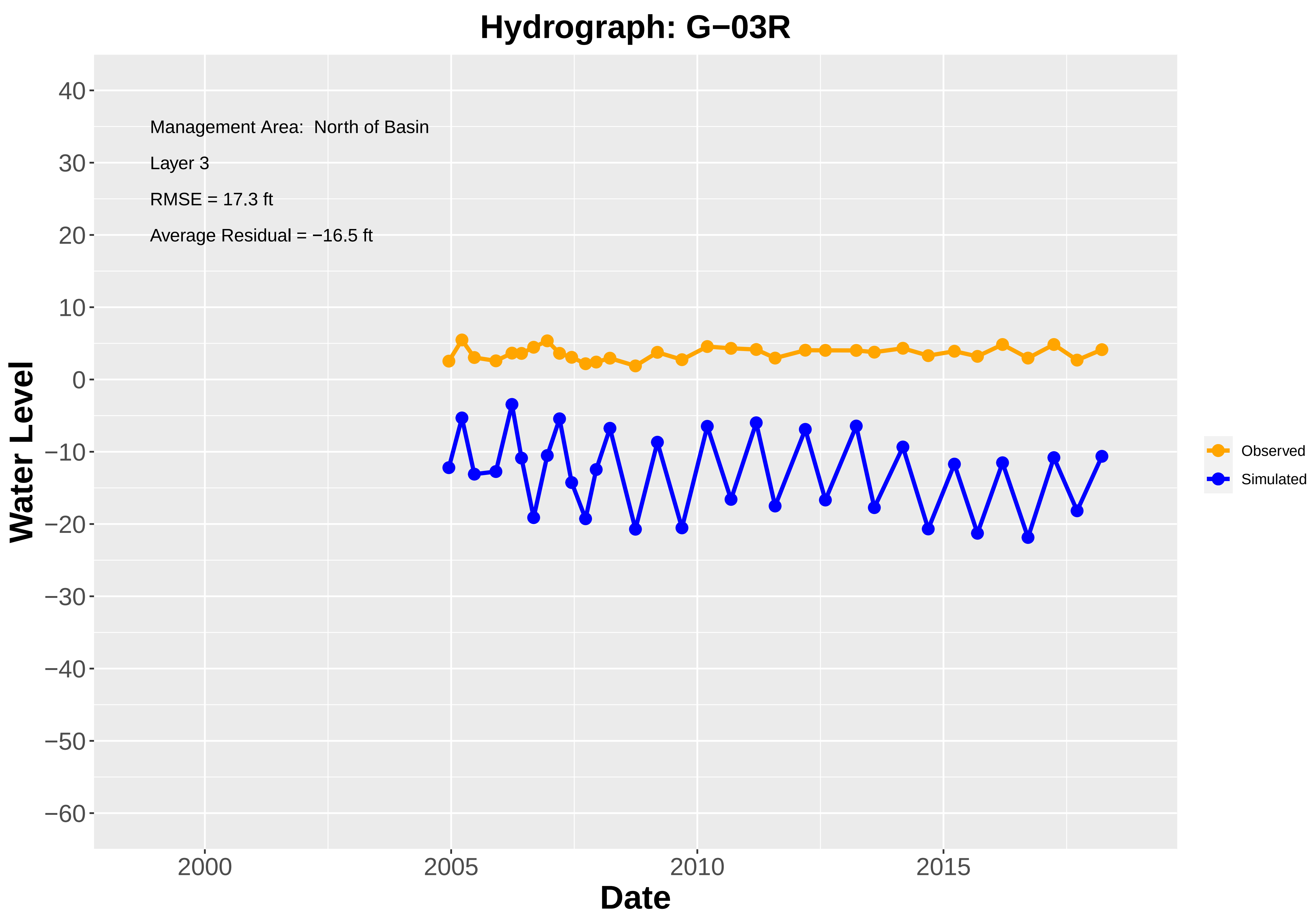


Hydrograph: EISB−MW−04
Management Area: Ord_Airport
Layer 1
RMSE = 24.4 ft
Average Residual = 24.4 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

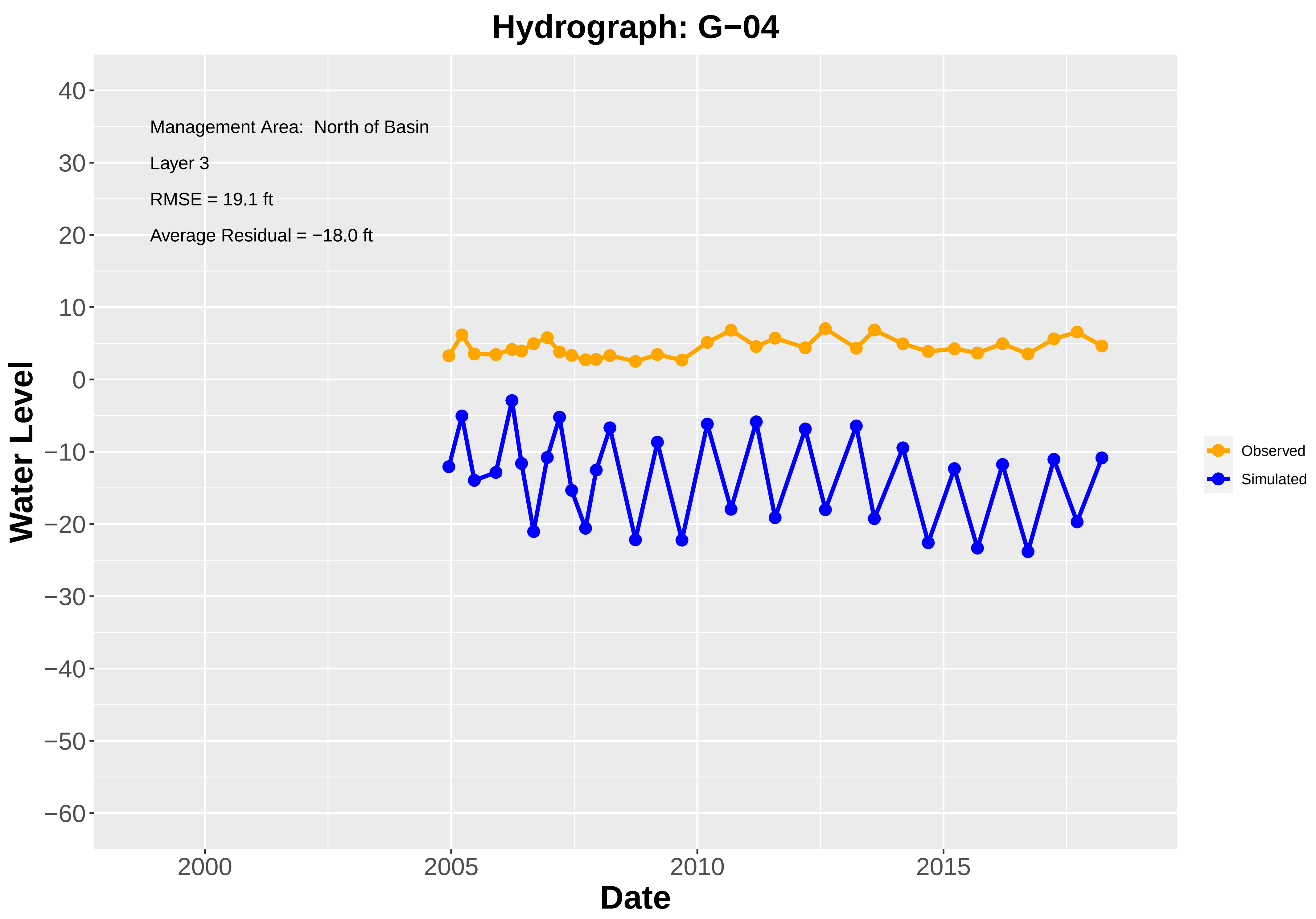

Hydrograph: G−01
Management Area: North of Basin
Layer 3
RMSE = 15.4 ft
Average Residual = −14.8 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

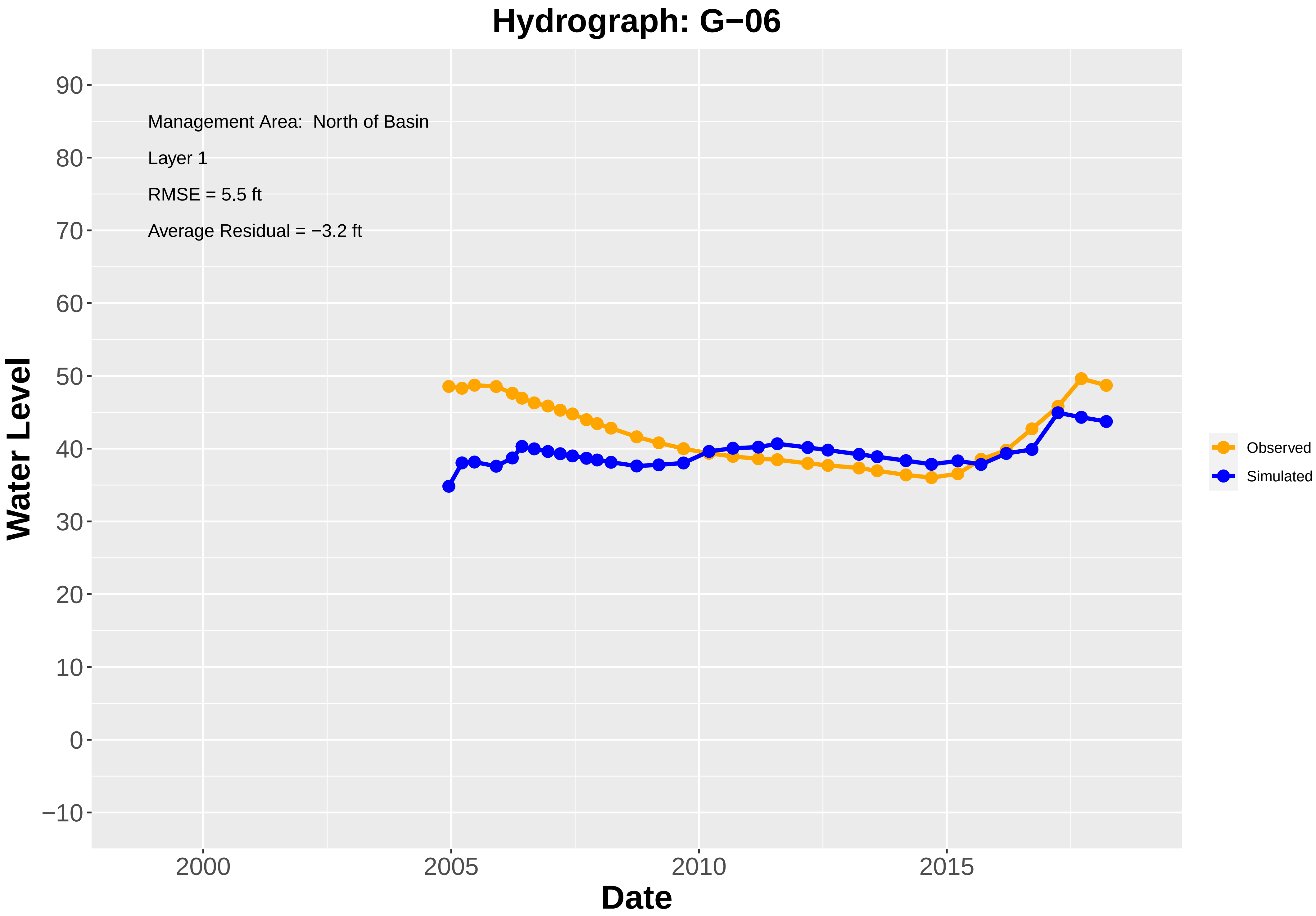


Hydrograph: G−02
Management Area: North of Basin
Layer 3
RMSE = 16.2 ft
Average Residual = −15.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

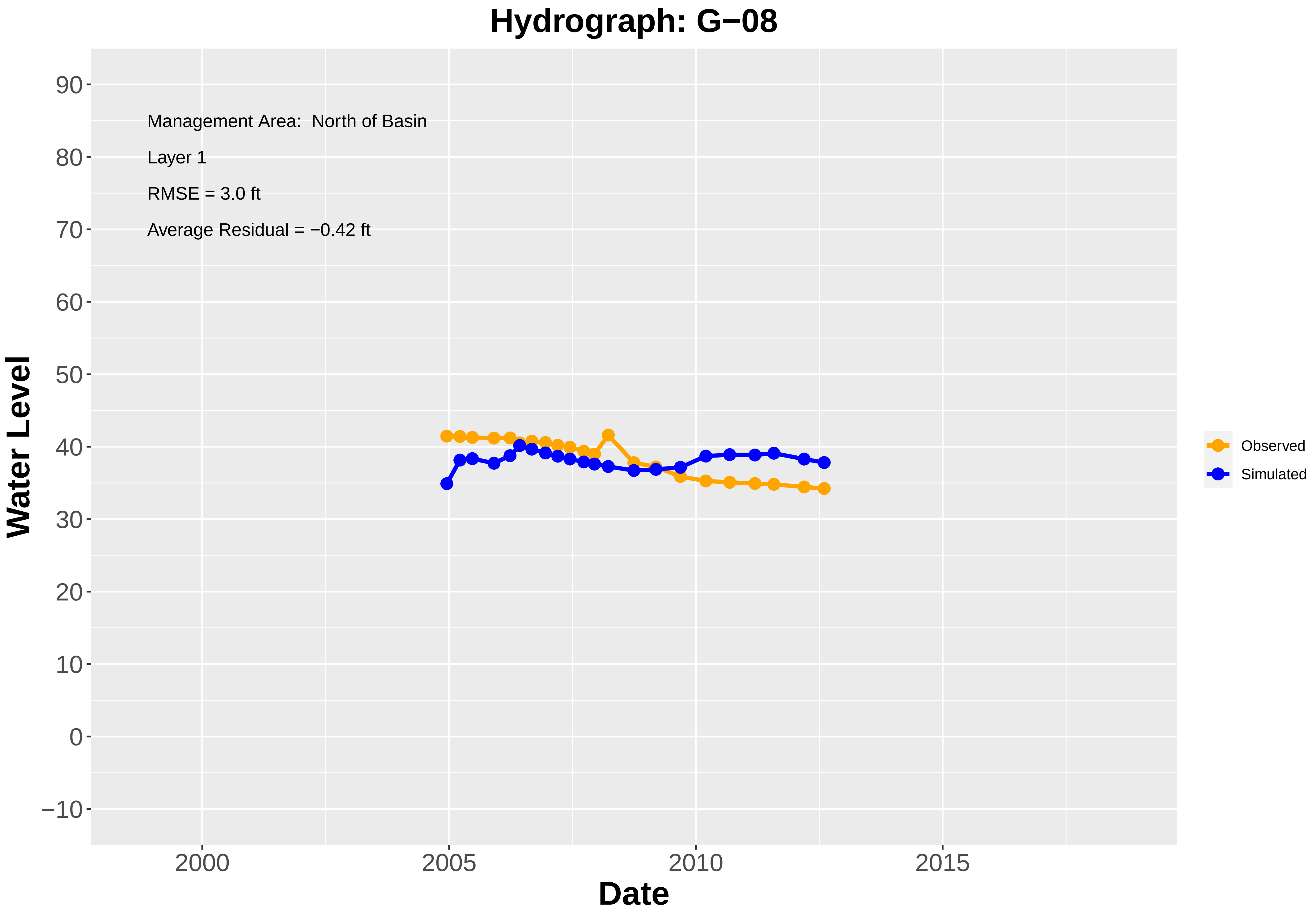


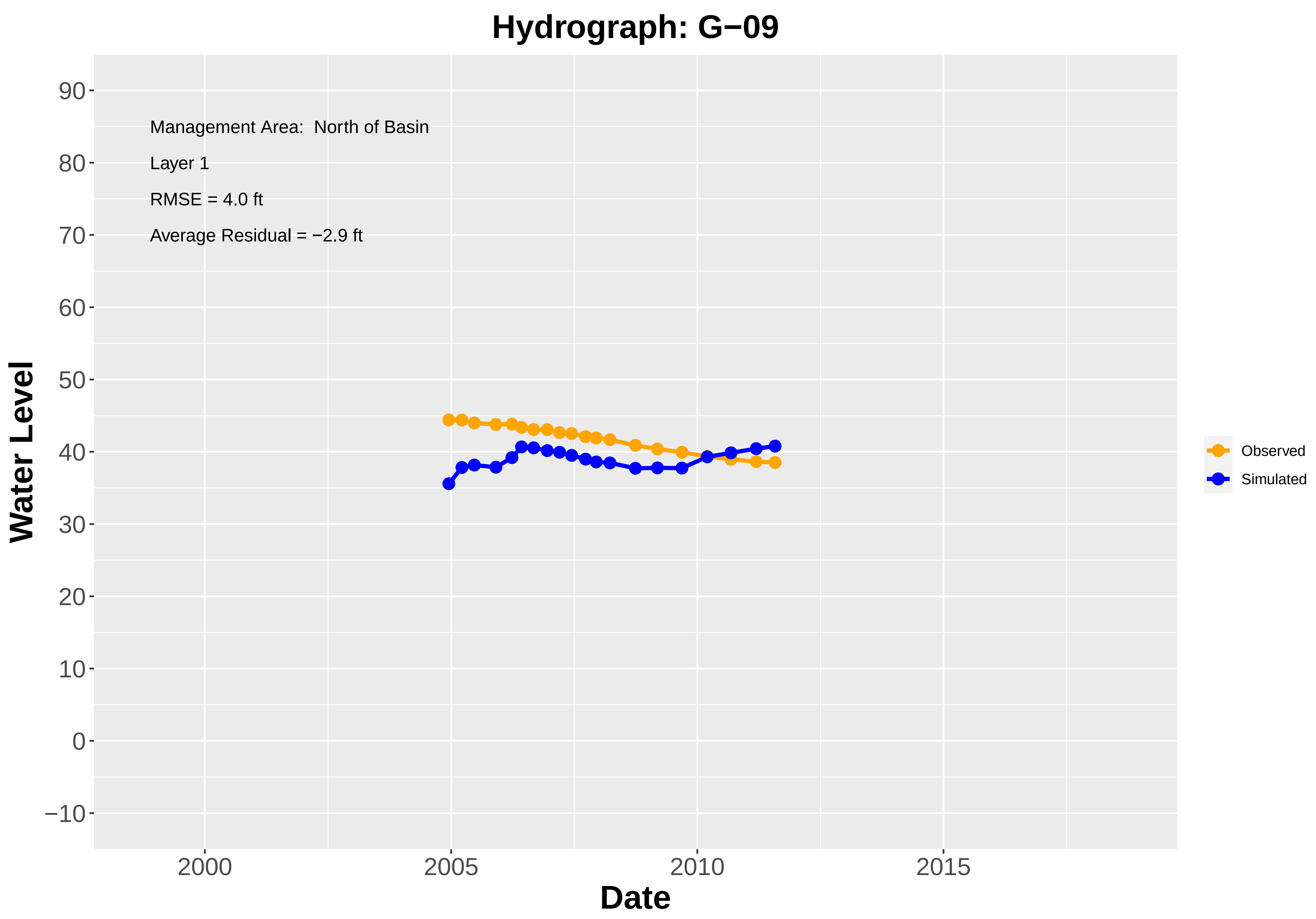
Hydrograph: G−03R
Management Area: North of Basin
Layer 3
RMSE = 17.3 ft
Average Residual = −16.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: G−04
Management Area: North of Basin
Layer 3
RMSE = 19.1 ft
Average Residual = −18.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

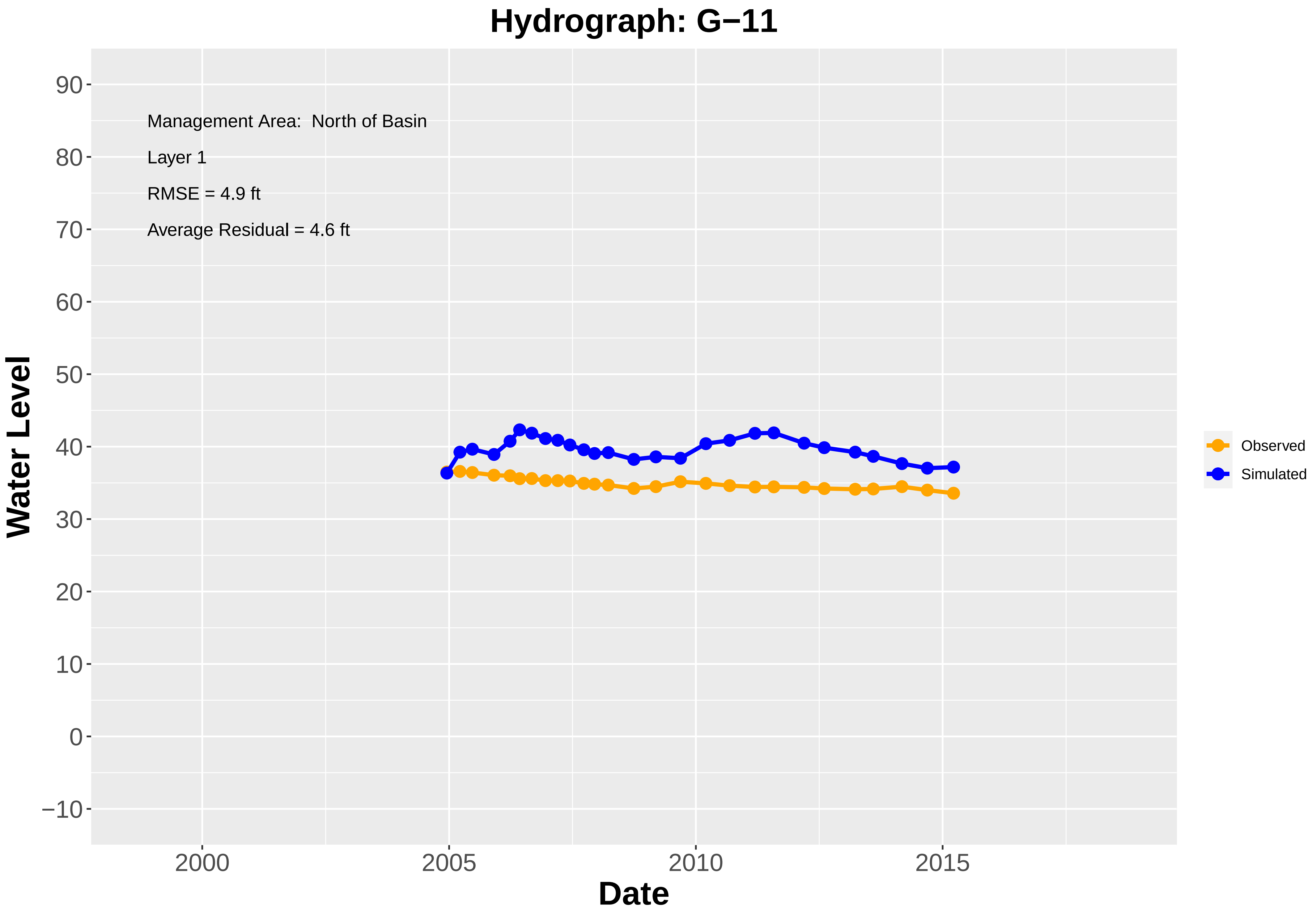


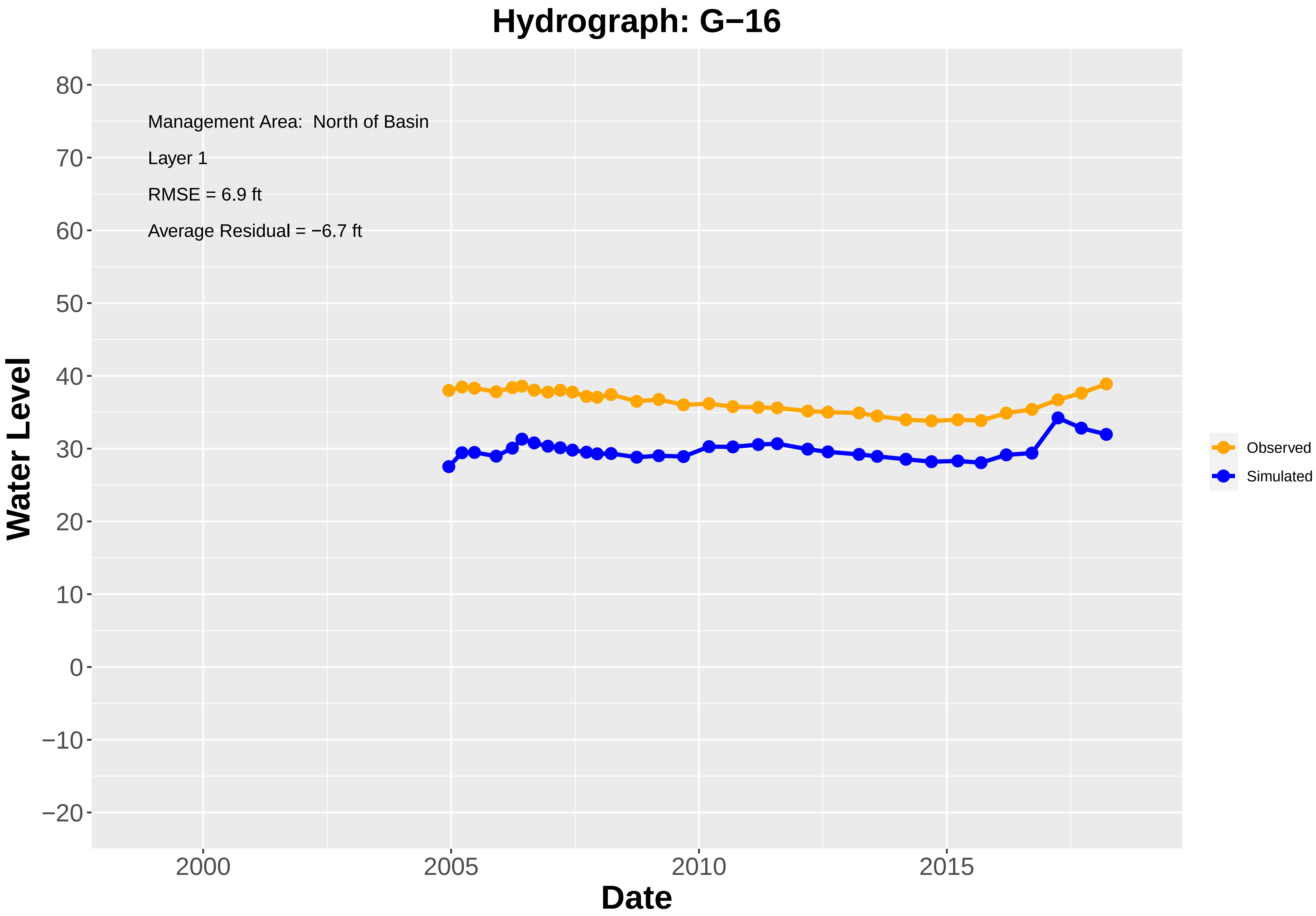
Hydrograph: G−06
Management Area: North of Basin
Layer 1
RMSE = 5.5 ft
Average Residual = −3.2 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: G−08
Management Area: North of Basin
Layer 1
RMSE = 3.0 ft
Average Residual = −0.42 ft
Water Level
Date
Observed
Simulated
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015

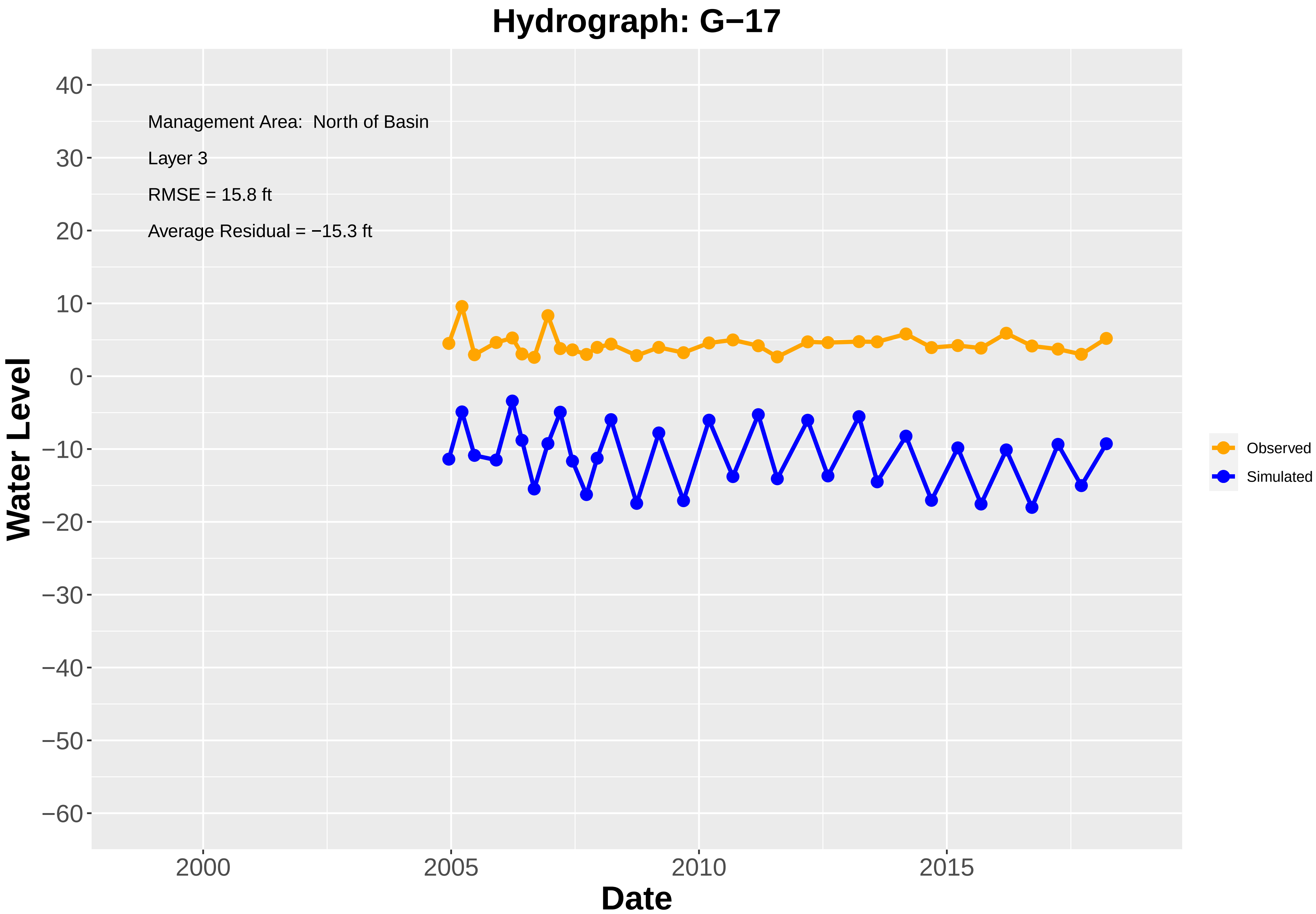


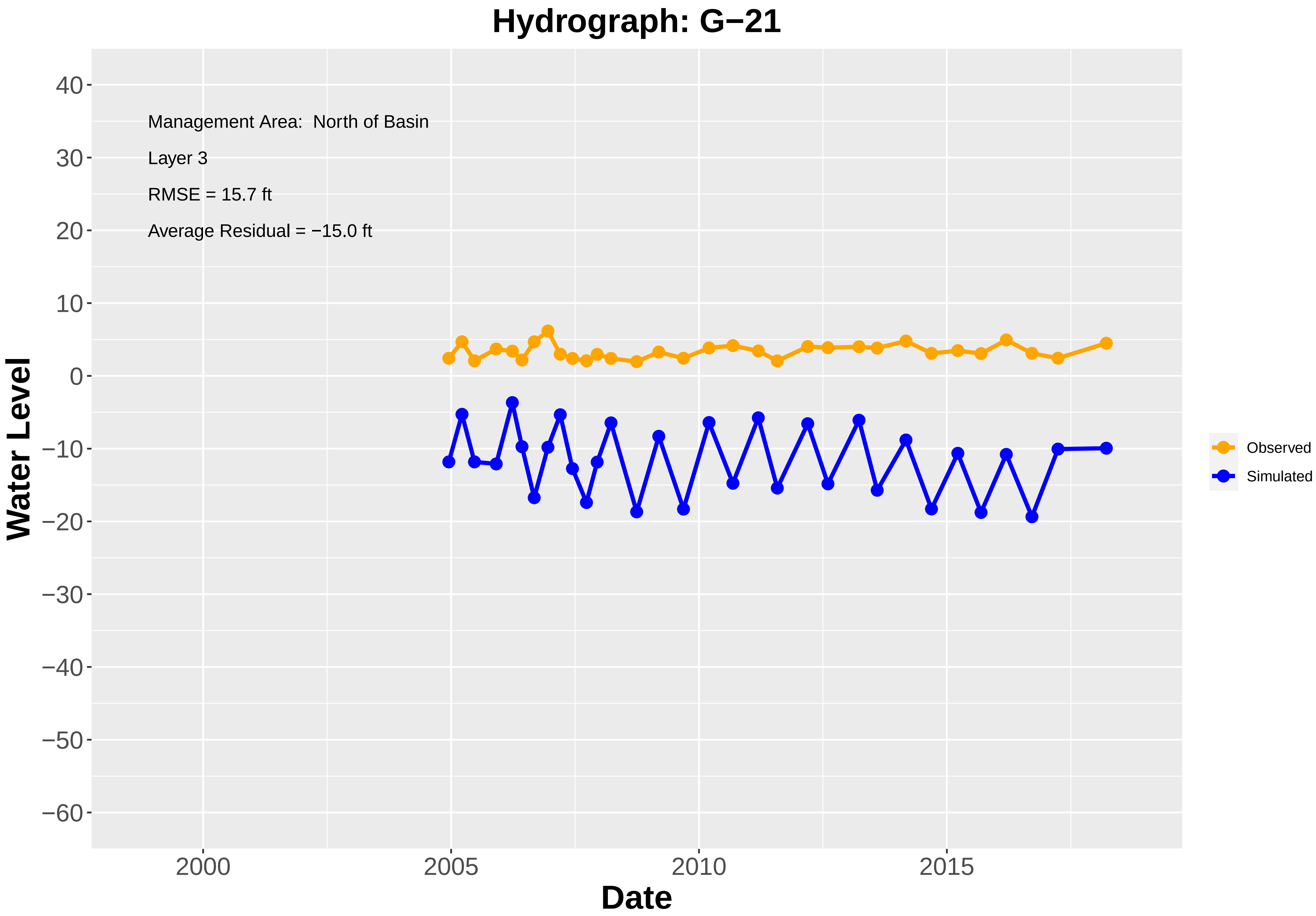
Hydrograph: G−09
Management Area: North of Basin
Layer 1
RMSE = 4.0 ft
Average Residual = −2.9 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

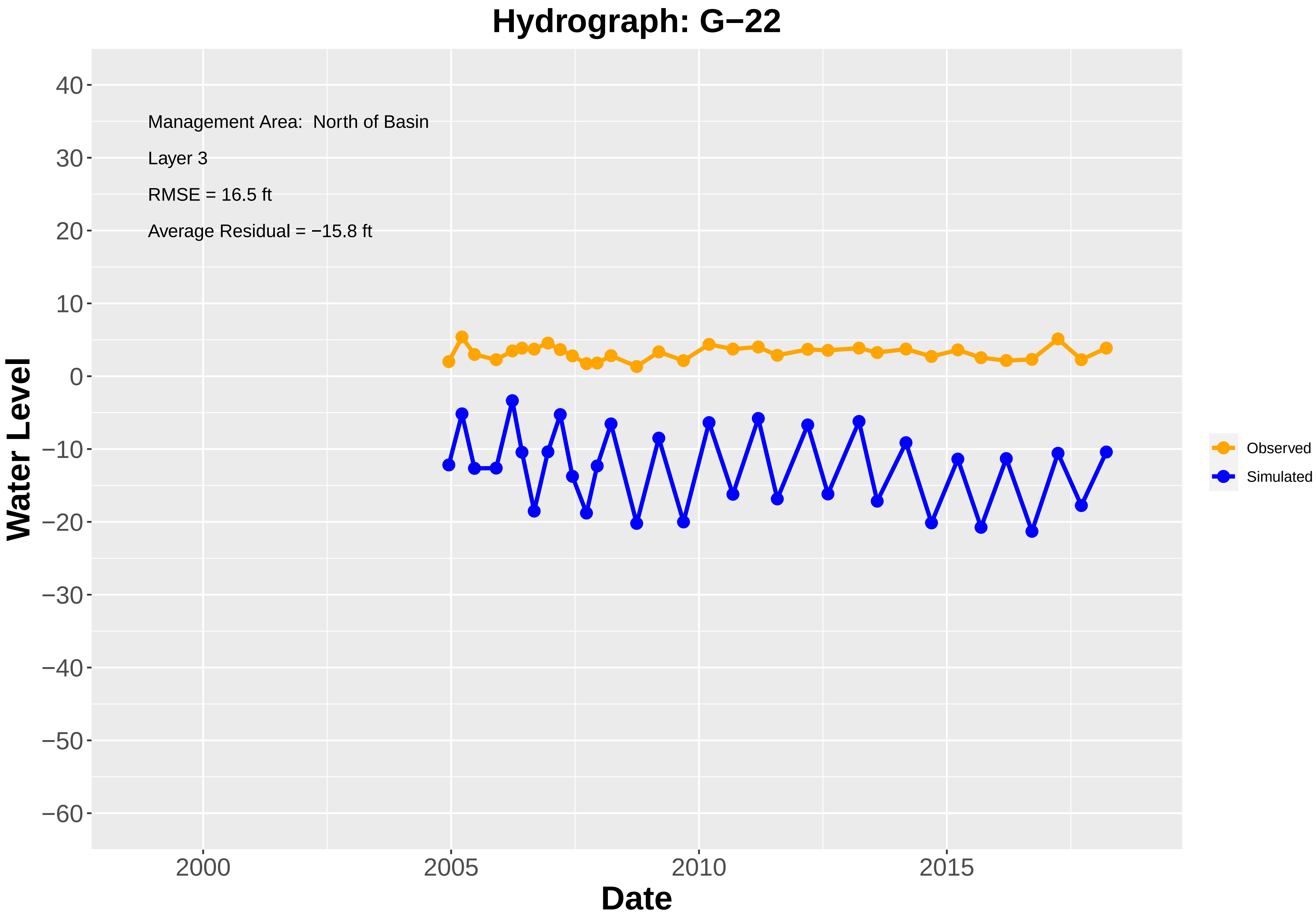

Hydrograph: G−11
Management Area: North of Basin
Layer 1
RMSE = 4.9 ft
Average Residual = 4.6 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

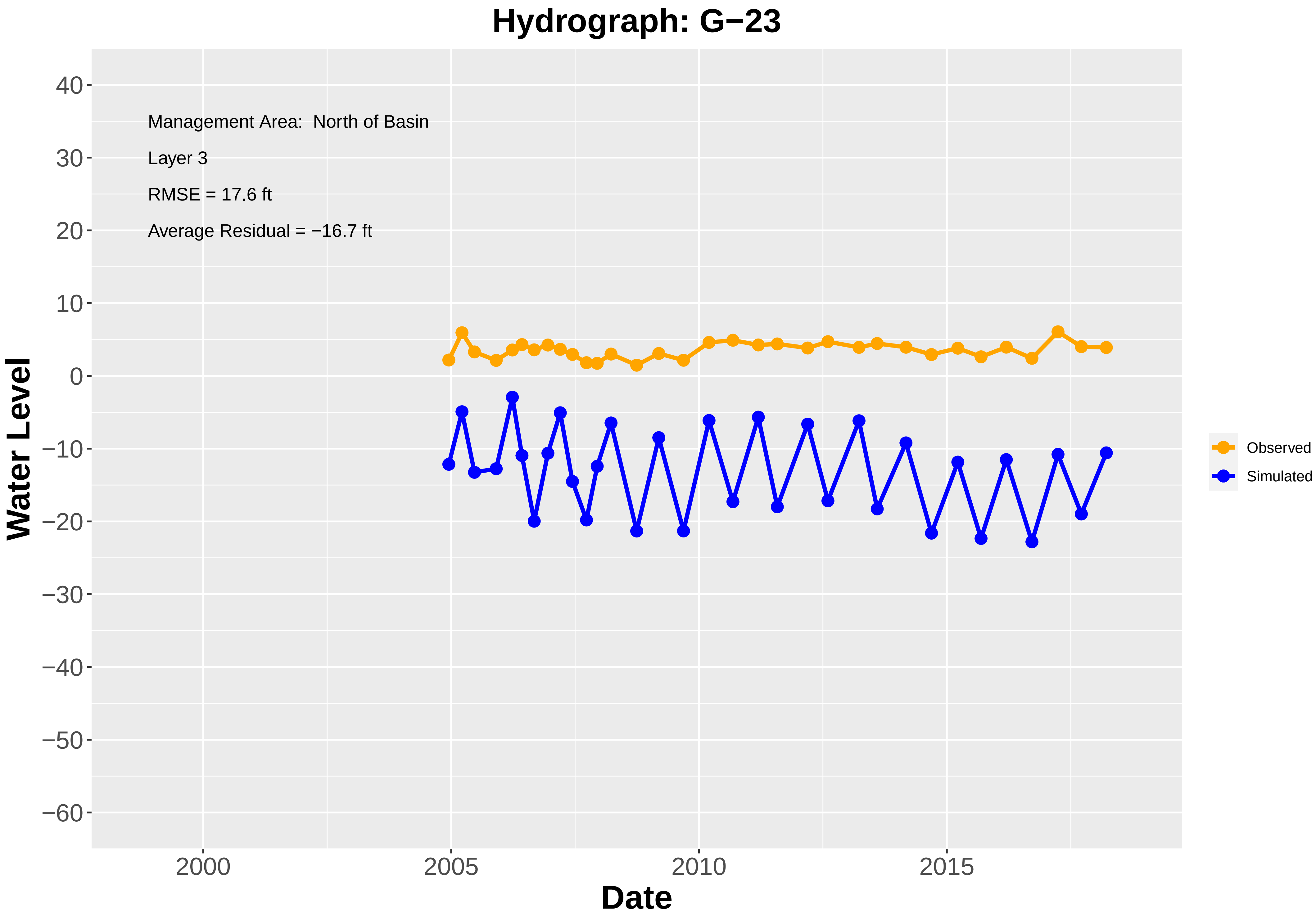


Hydrograph: G−16
Management Area: North of Basin
Layer 1
RMSE = 6.9 ft
Average Residual = −6.7 ft
Water Level
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Date
Observed
Simulated

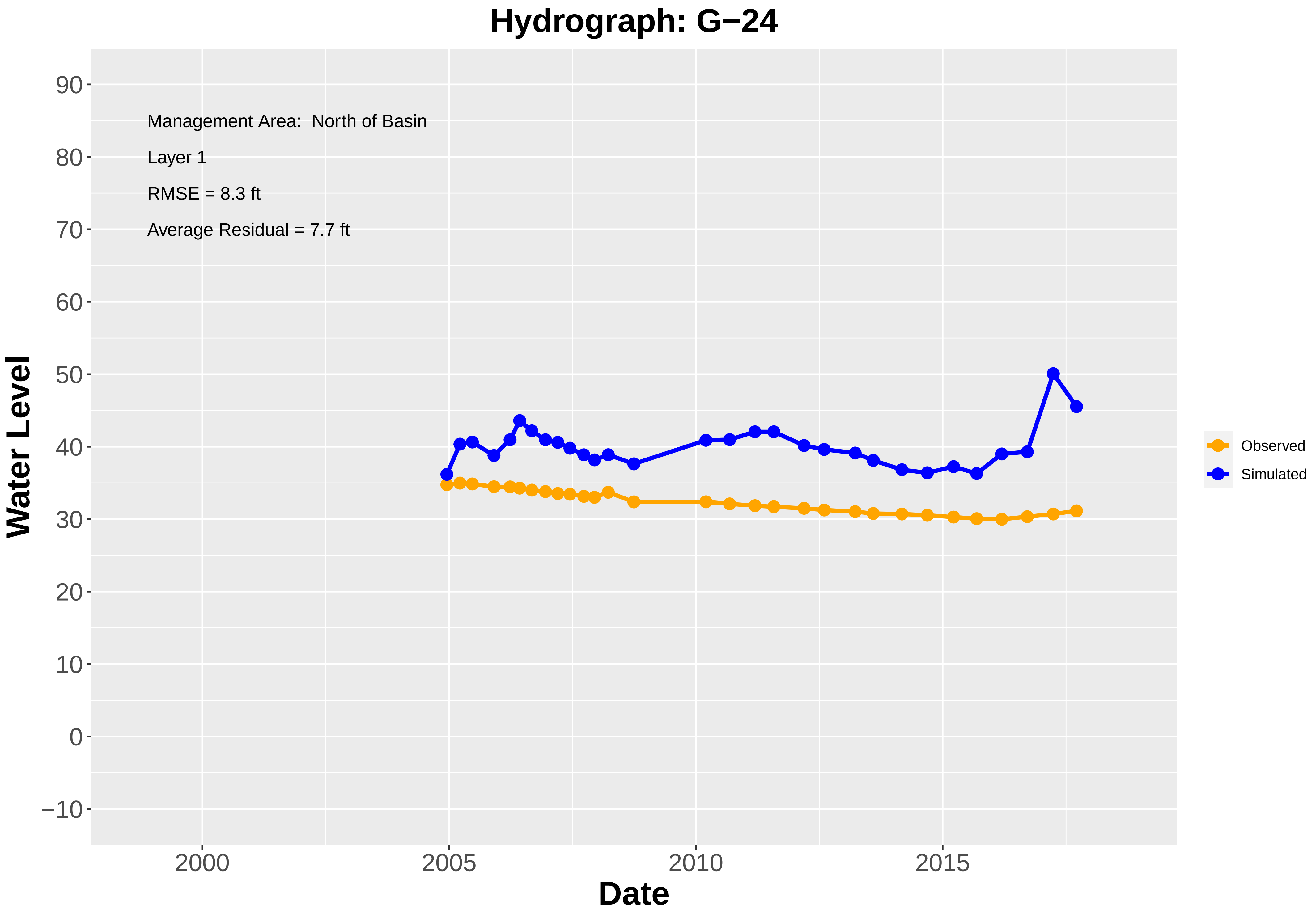

Hydrograph: G−17
Management Area: North of Basin
Layer 3
RMSE = 15.8 ft
Average Residual = −15.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

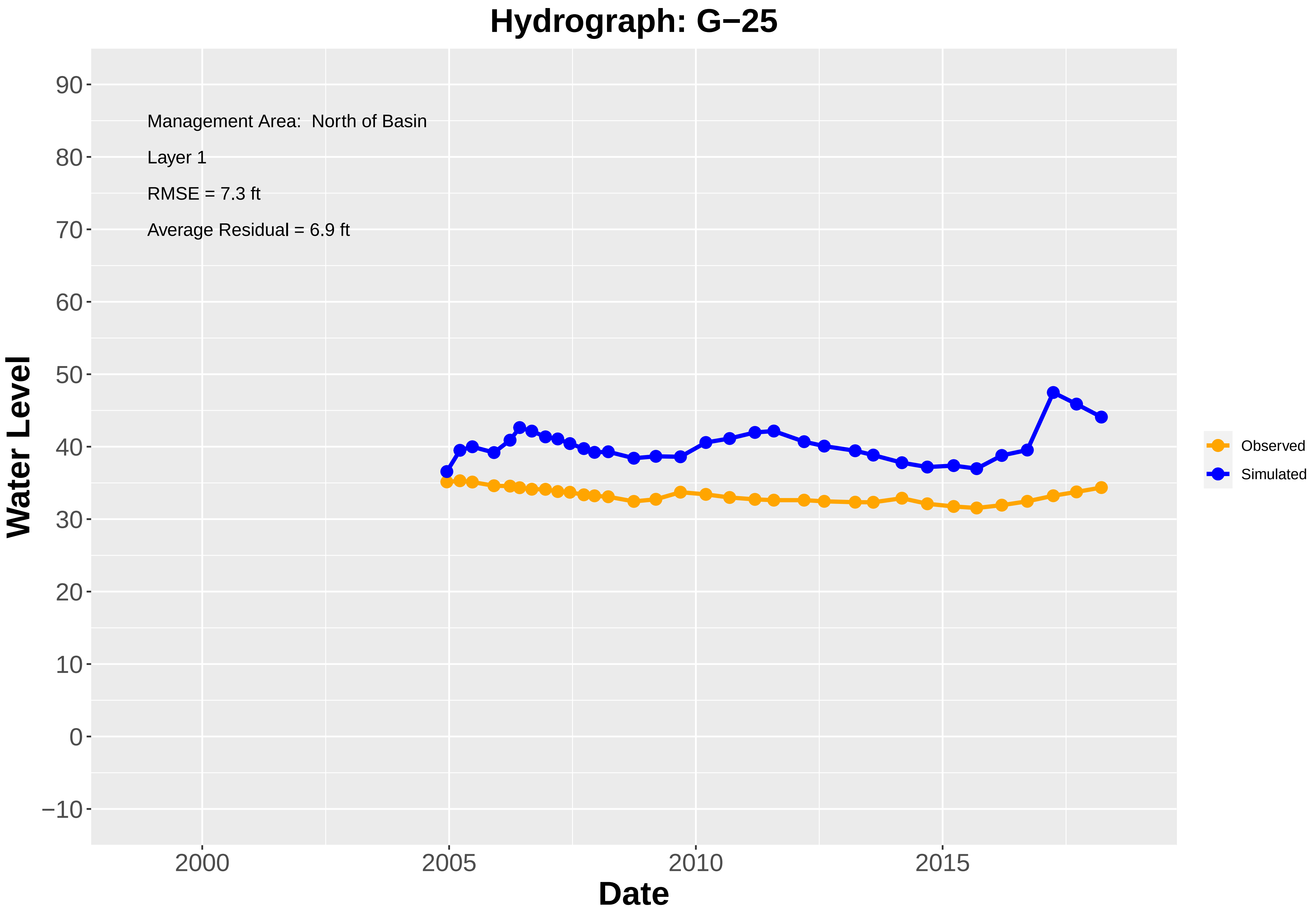

Hydrograph: G−21
Management Area: North of Basin
Layer 3
RMSE = 15.7 ft
Average Residual = −15.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: G−22
Management Area: North of Basin
Layer 3
RMSE = 16.5 ft
Average Residual = −15.8 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

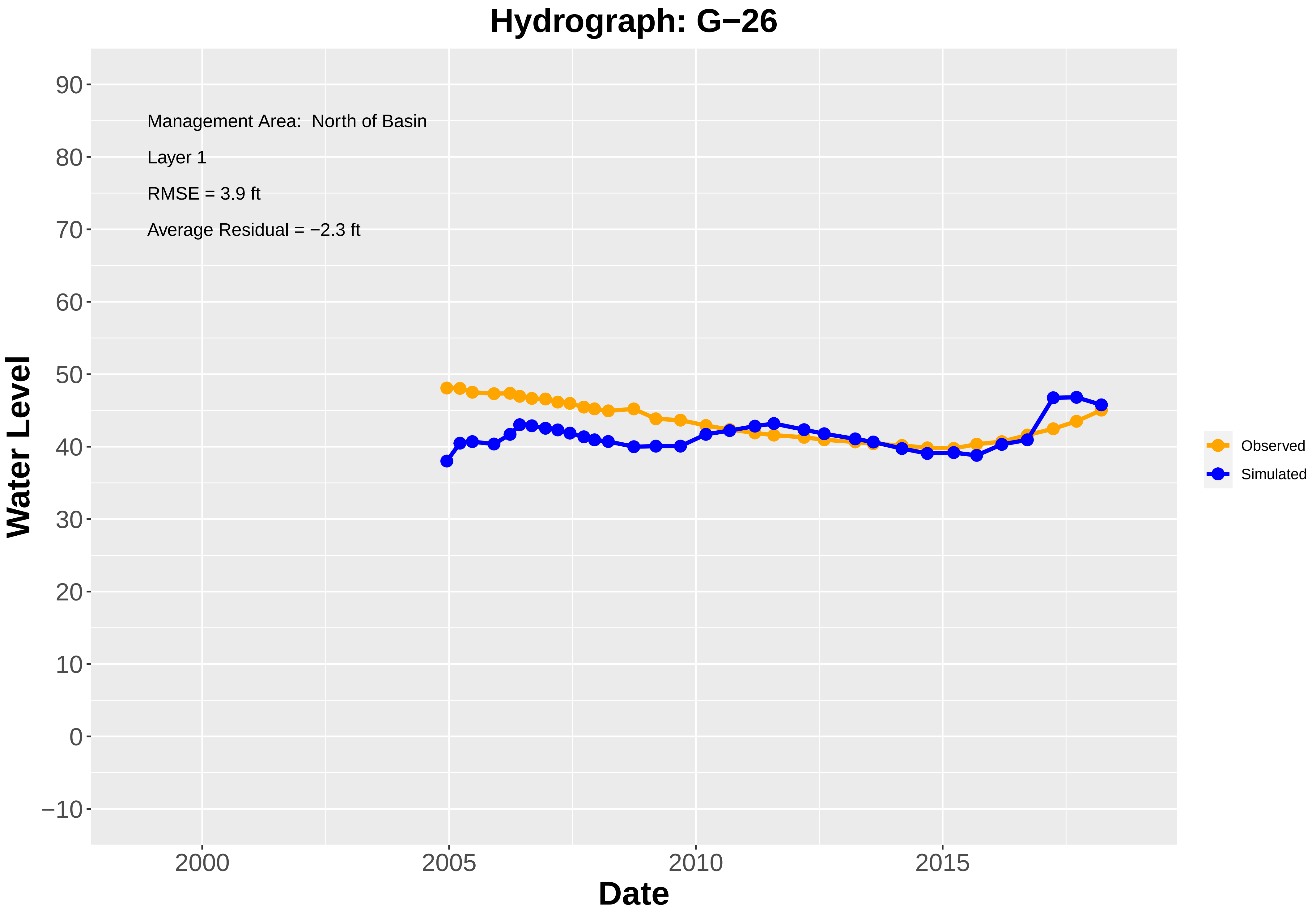


Hydrograph: G−23
Management Area: North of Basin
Layer 3
RMSE = 17.6 ft
Average Residual = −16.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

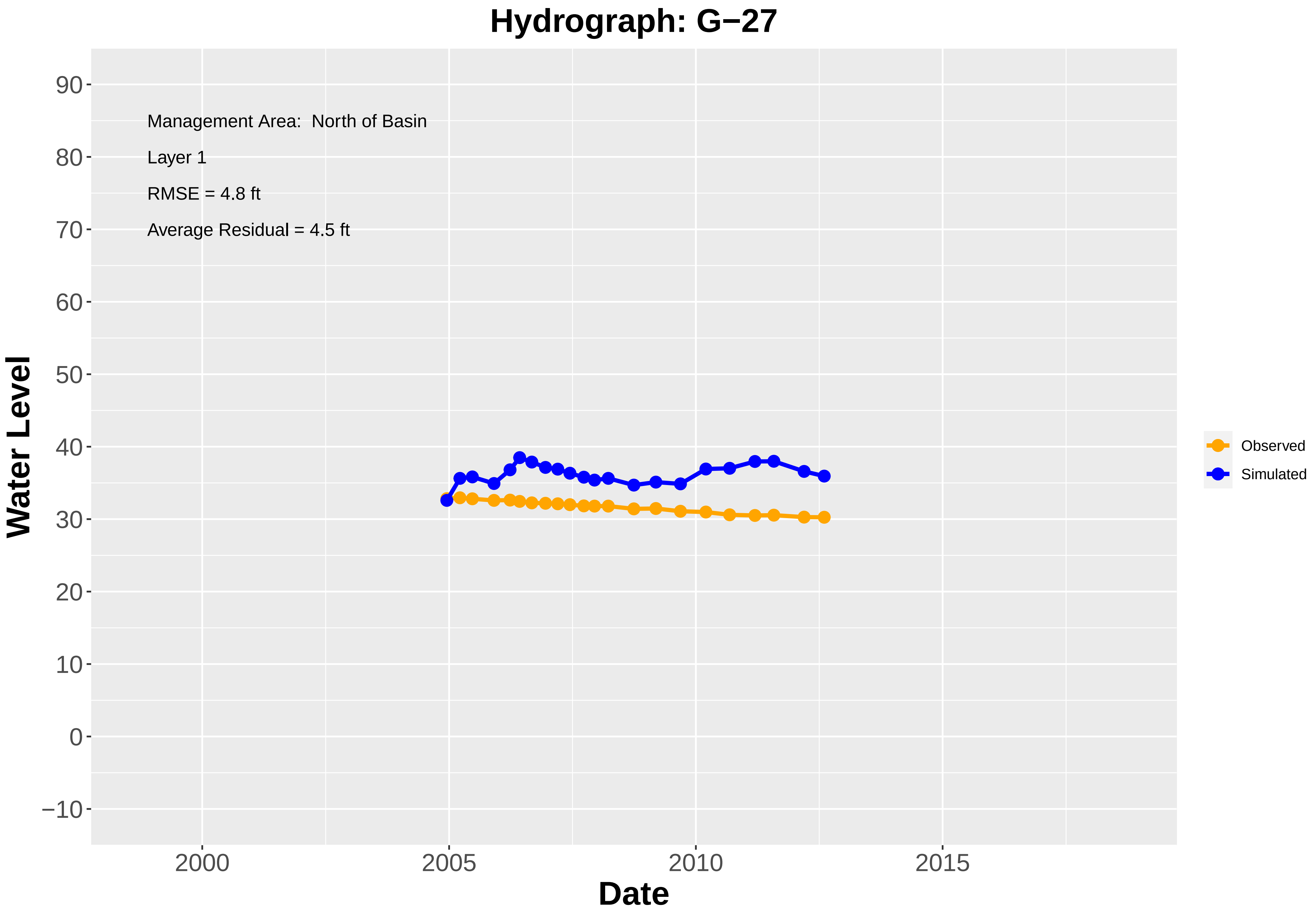

Hydrograph: G−24
Management Area: North of Basin
Layer 1
RMSE = 8.3 ft
Average Residual = 7.7 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



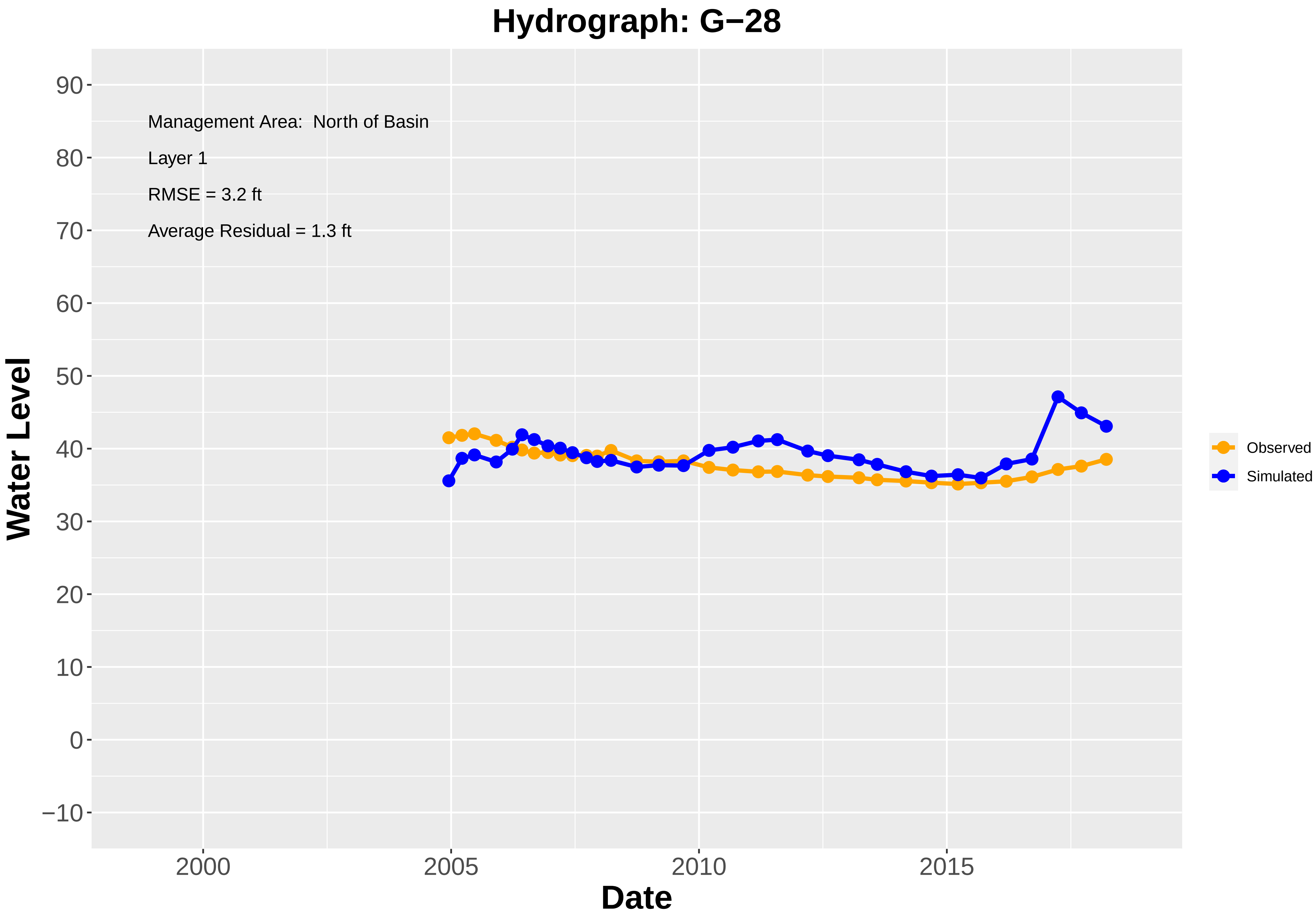
Hydrograph: G−25
Management Area: North of Basin
Layer 1
RMSE = 7.3 ft
Average Residual = 6.9 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated

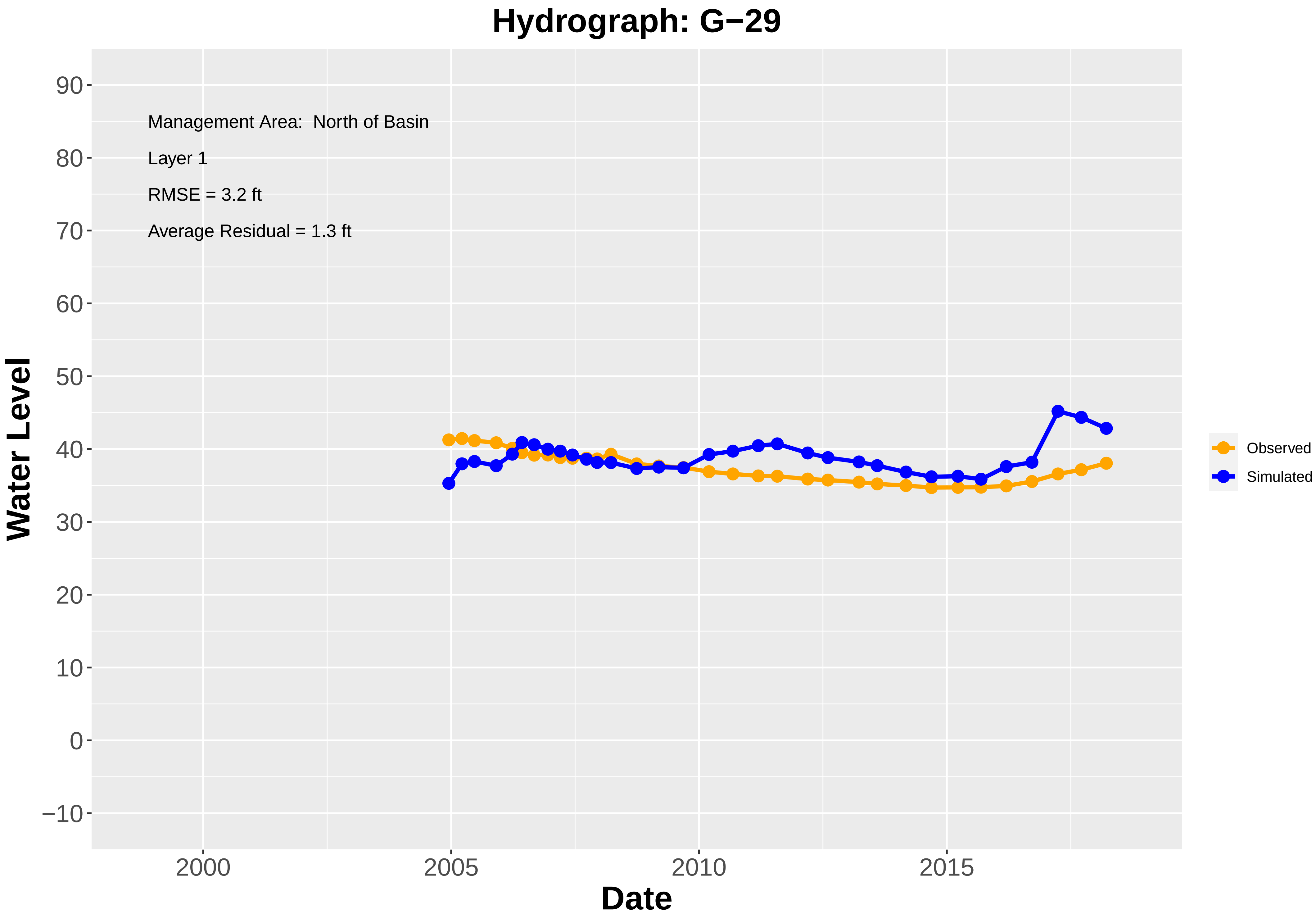


Hydrograph: G−26
Management Area: North of Basin
Layer 1
RMSE = 3.9 ft
Average Residual = −2.3 ft
Water Level
Date
Observed
Simulated
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015

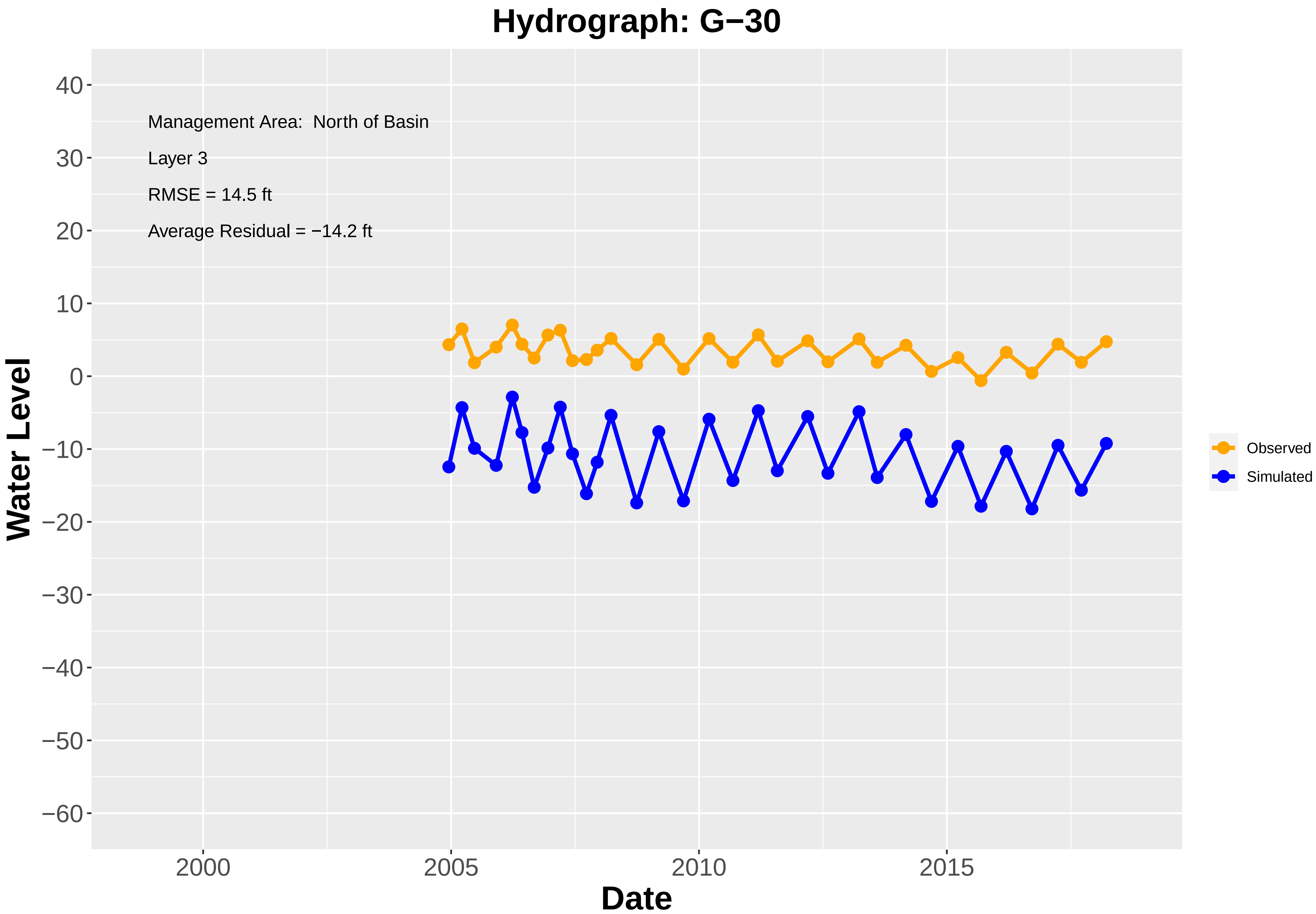


Hydrograph: G−27
Management Area: North of Basin
Layer 1
RMSE = 4.8 ft
Average Residual = 4.5 ft
Water Level
Date
Observed
Simulated
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015

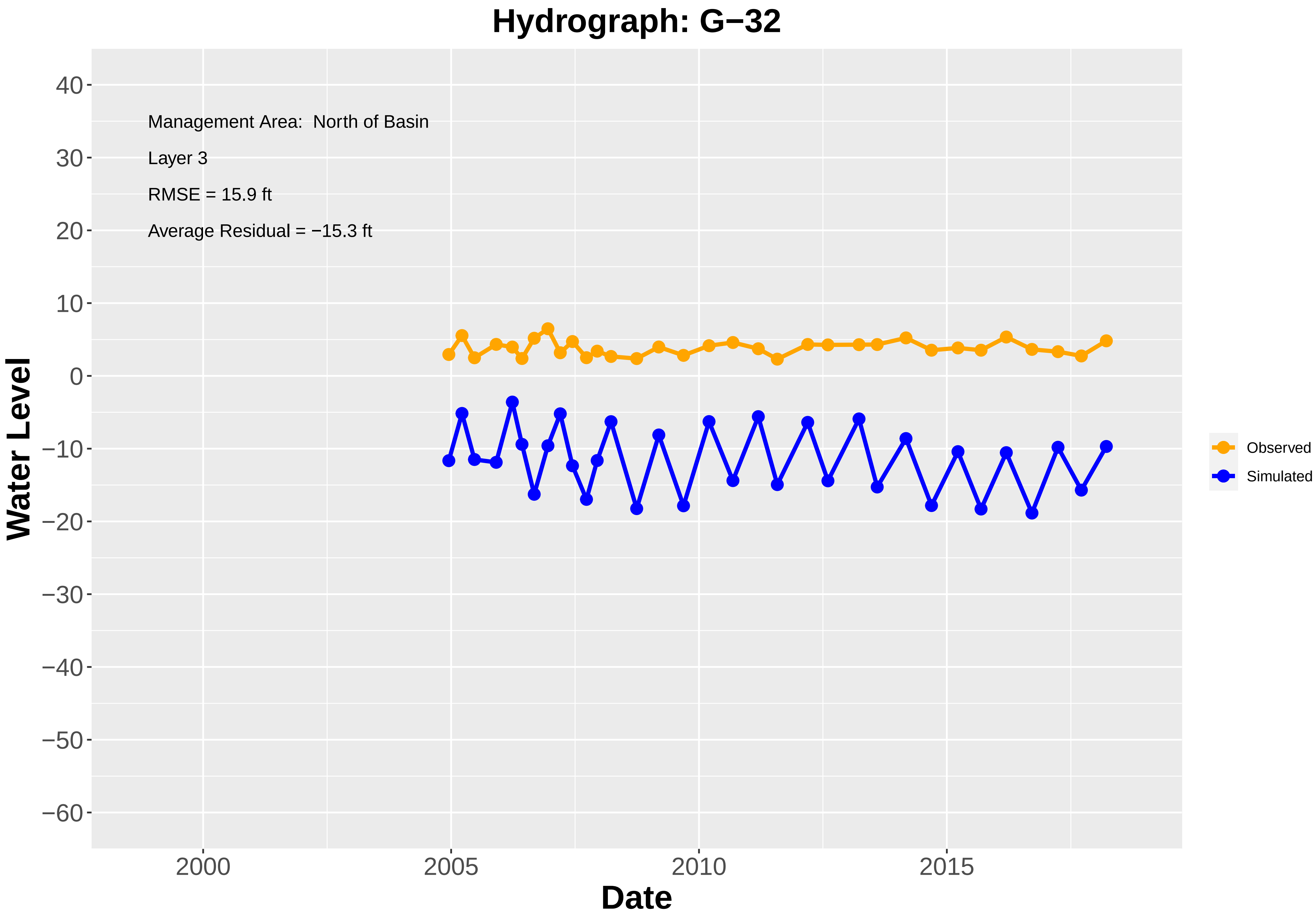

Hydrograph: G−28
Management Area: North of Basin
Layer 1
RMSE = 3.2 ft
Average Residual = 1.3 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated



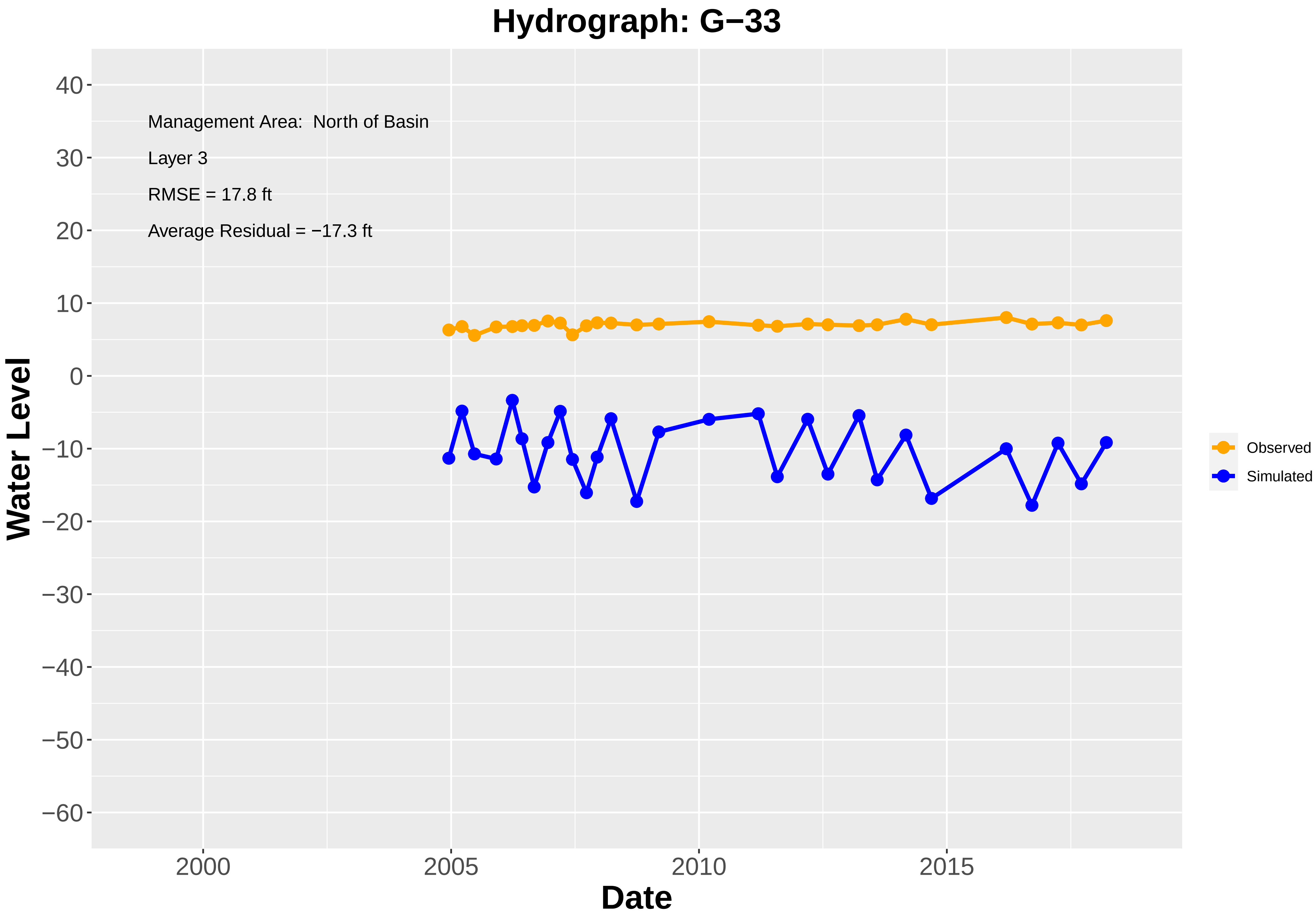
Hydrograph: G−29
Management Area: North of Basin
Layer 1
RMSE = 3.2 ft
Average Residual = 1.3 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated



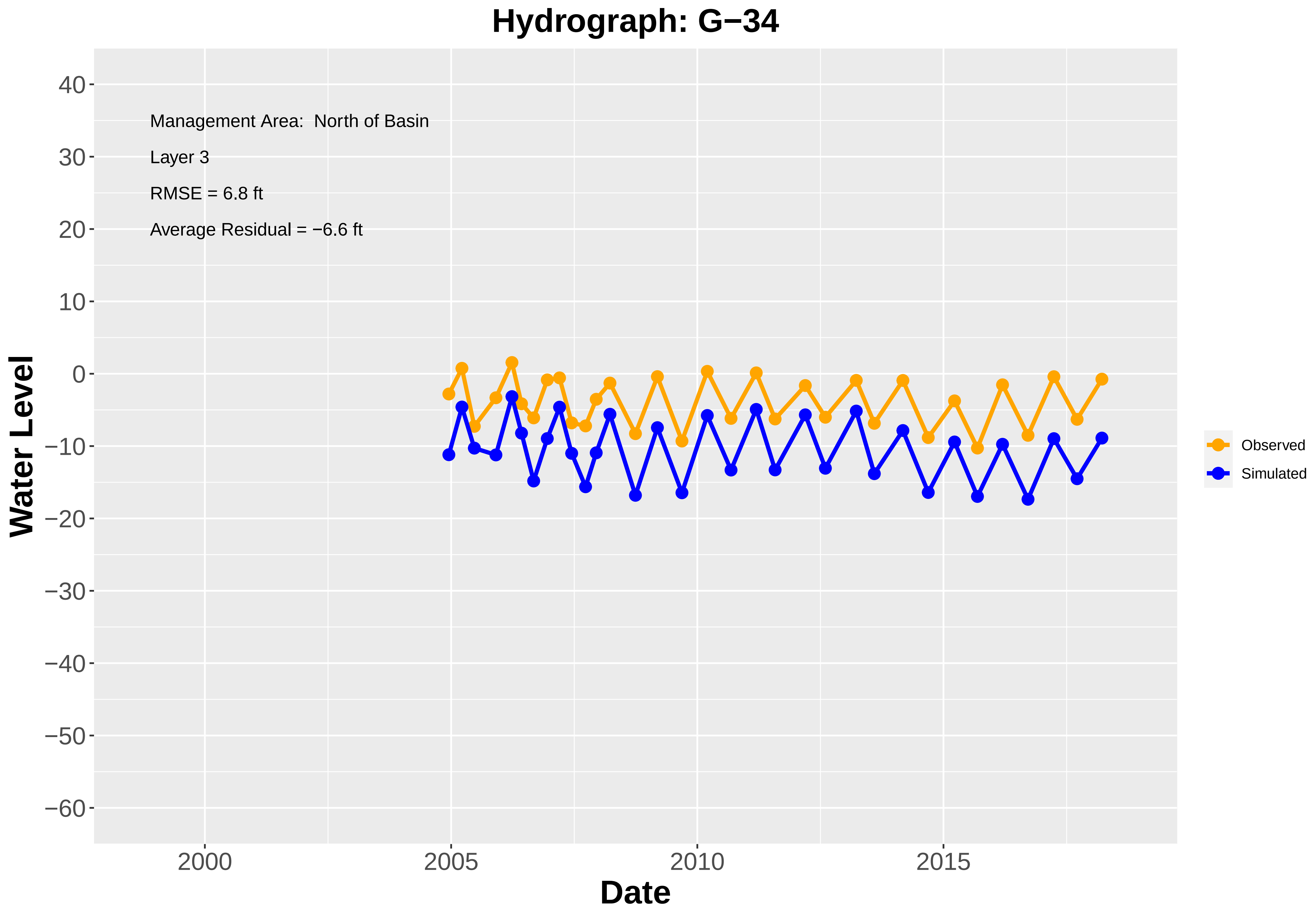
Hydrograph: G−30
Management Area: North of Basin
Layer 3
RMSE = 14.5 ft
Average Residual = −14.2 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

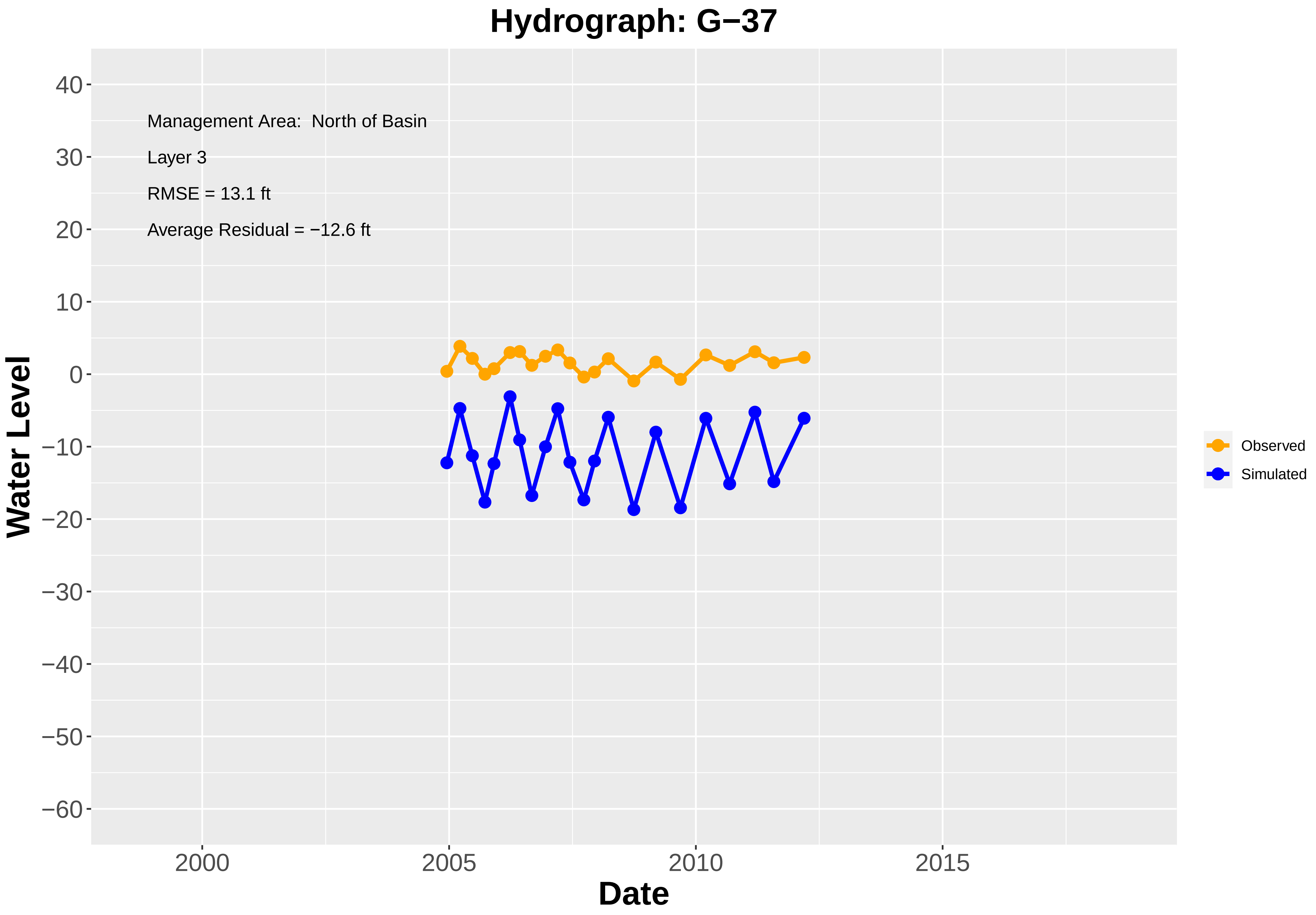


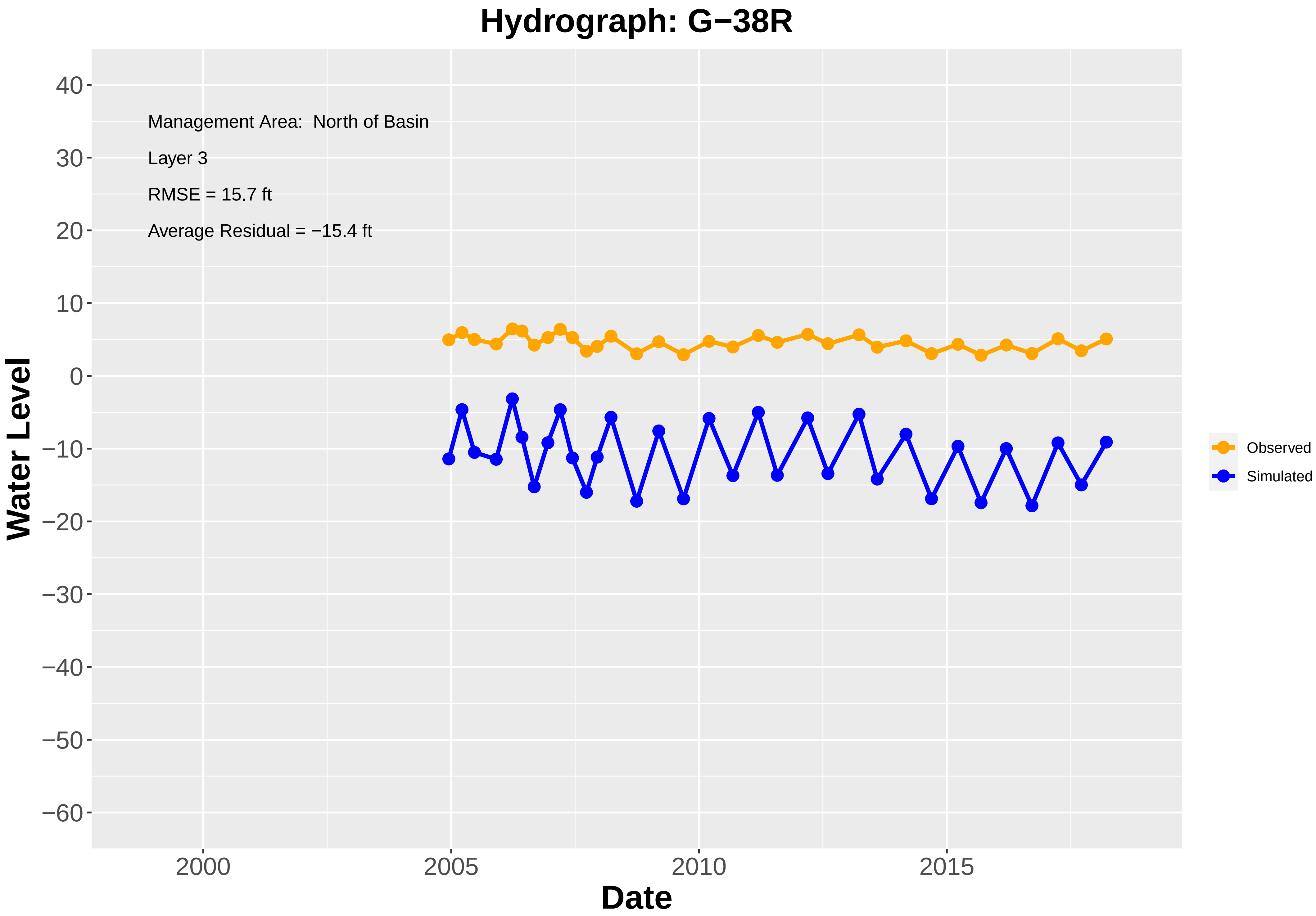
Hydrograph: G−32
Management Area: North of Basin
Layer 3
RMSE = 15.9 ft
Average Residual = −15.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

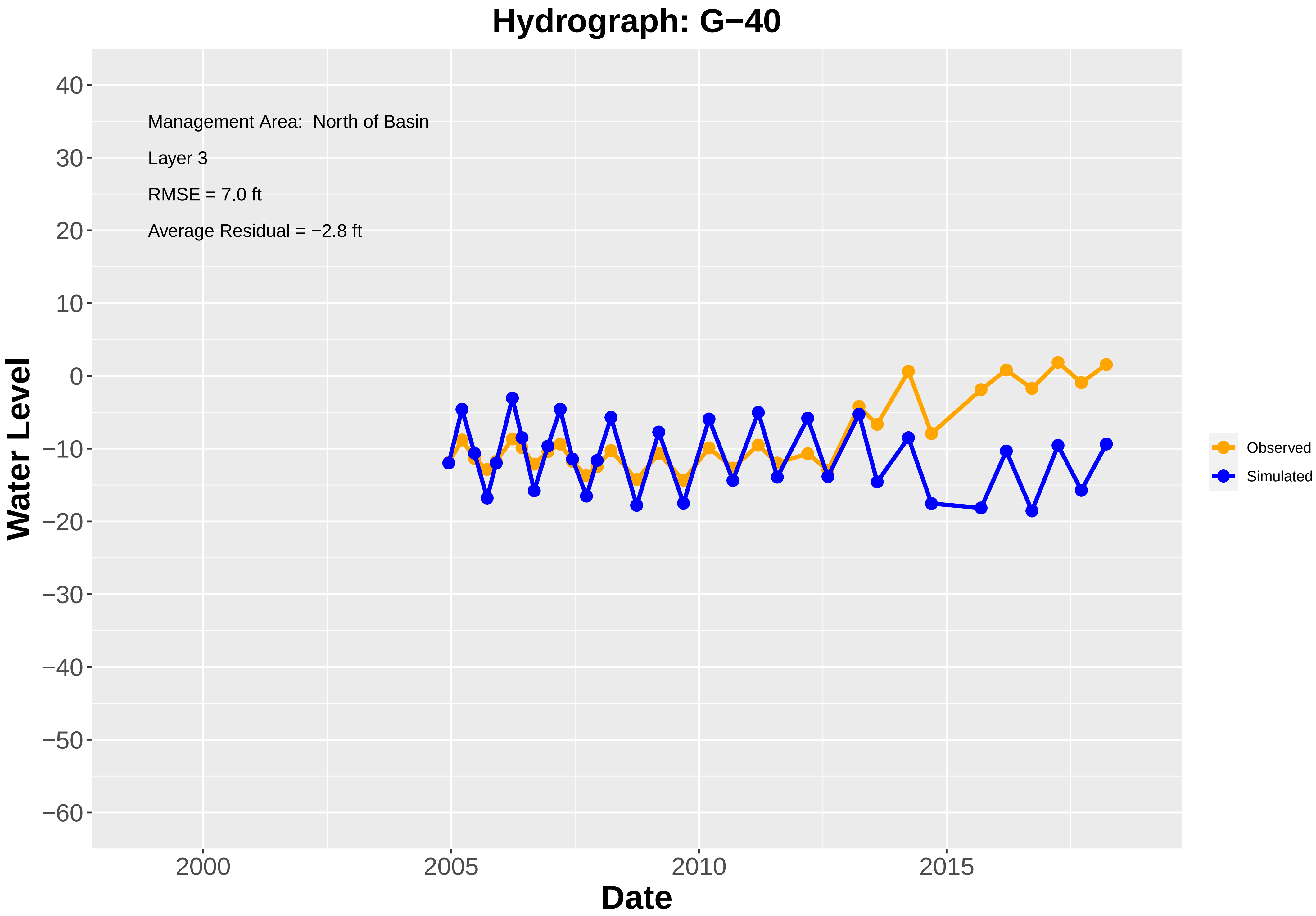


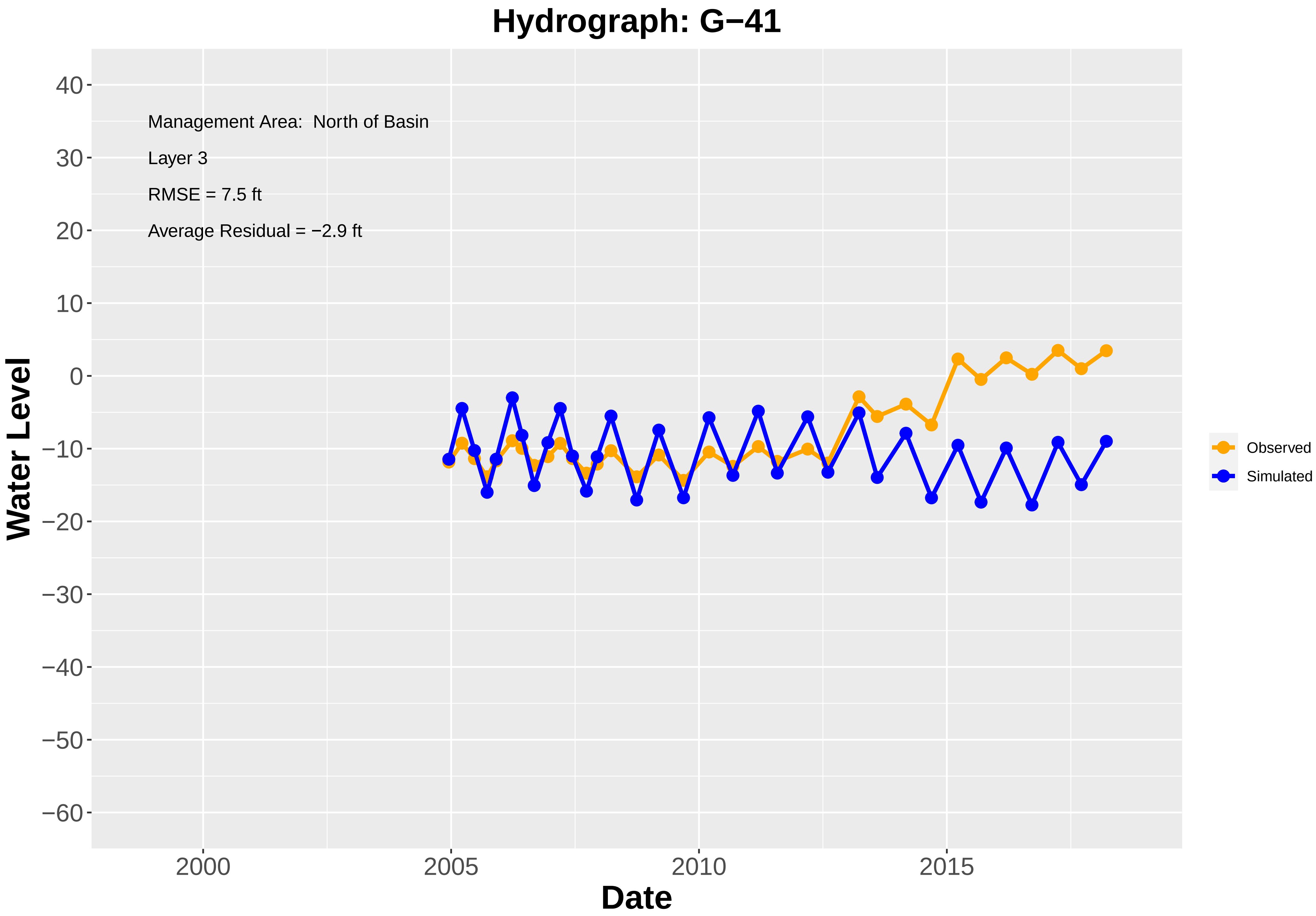
Hydrograph: G−33
Management Area: North of Basin
Layer 3
RMSE = 17.8 ft
Average Residual = −17.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

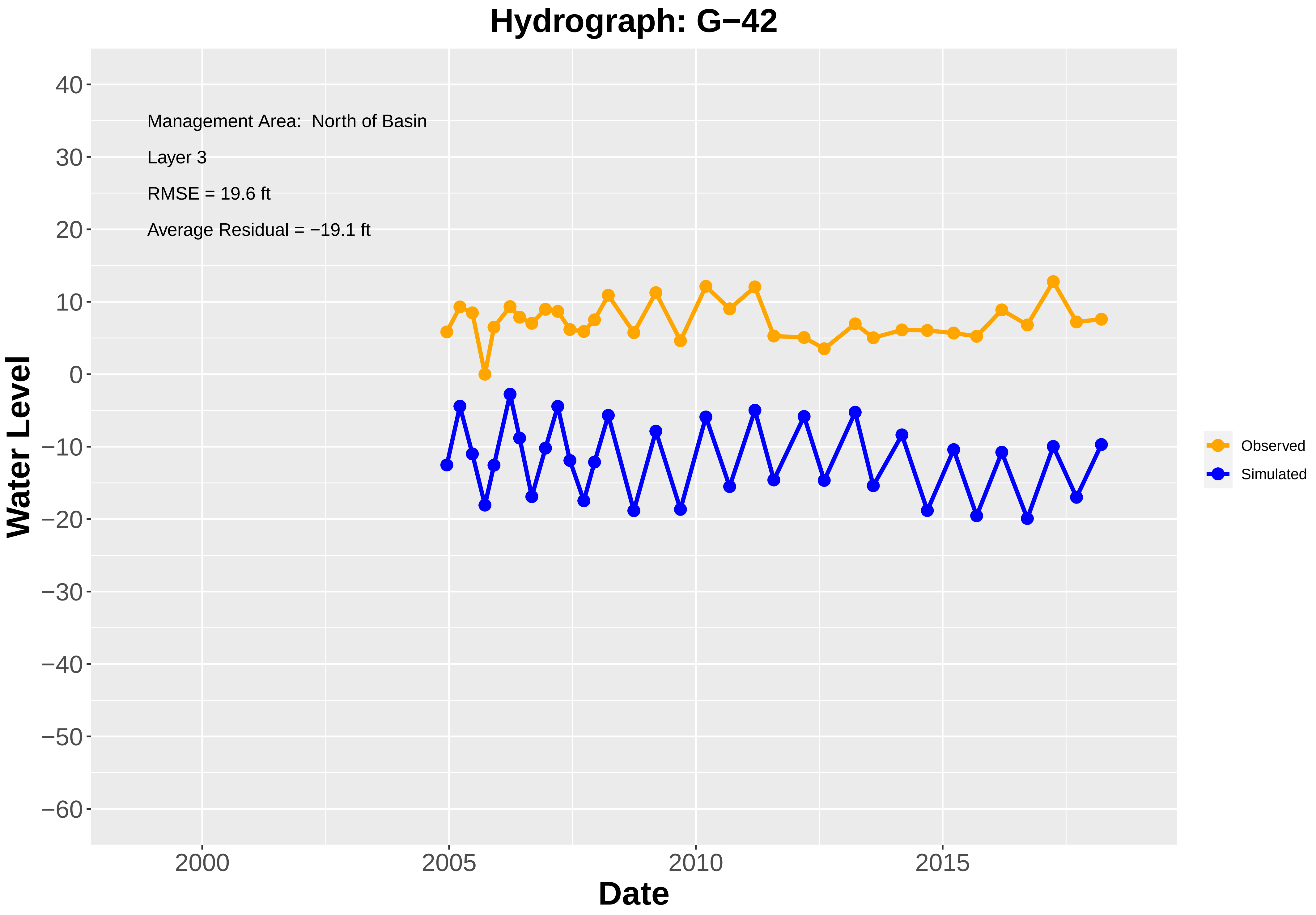

Hydrograph: G−34
Management Area: North of Basin
Layer 3
RMSE = 6.8 ft
Average Residual = −6.6 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: G−37
Management Area: North of Basin
Layer 3
RMSE = 13.1 ft
Average Residual = −12.6 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

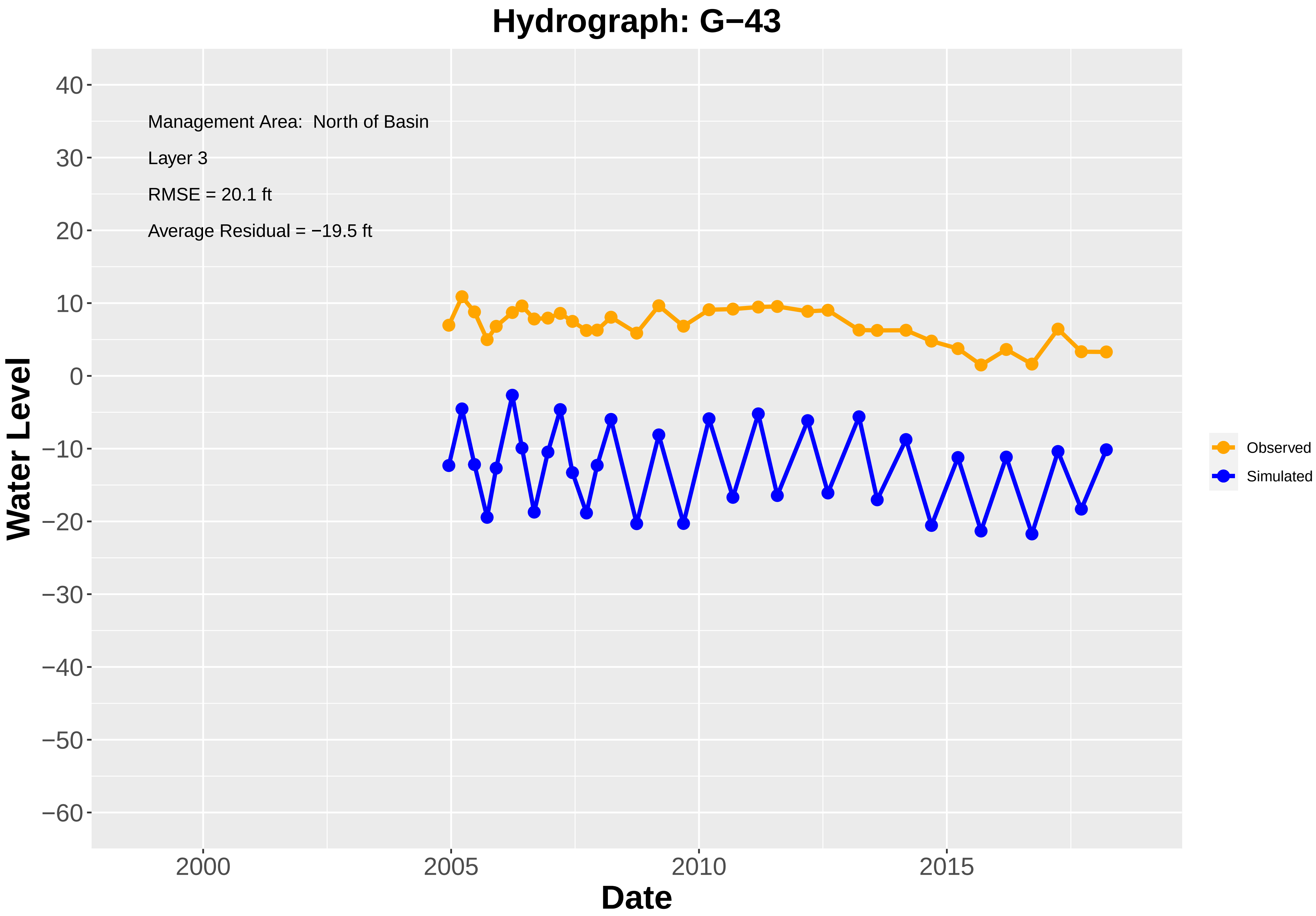

Hydrograph: G−38R
Management Area: North of Basin
Layer 3
RMSE = 15.7 ft
Average Residual = −15.4 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: G−40
Management Area: North of Basin
Layer 3
RMSE = 7.0 ft
Average Residual = −2.8 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

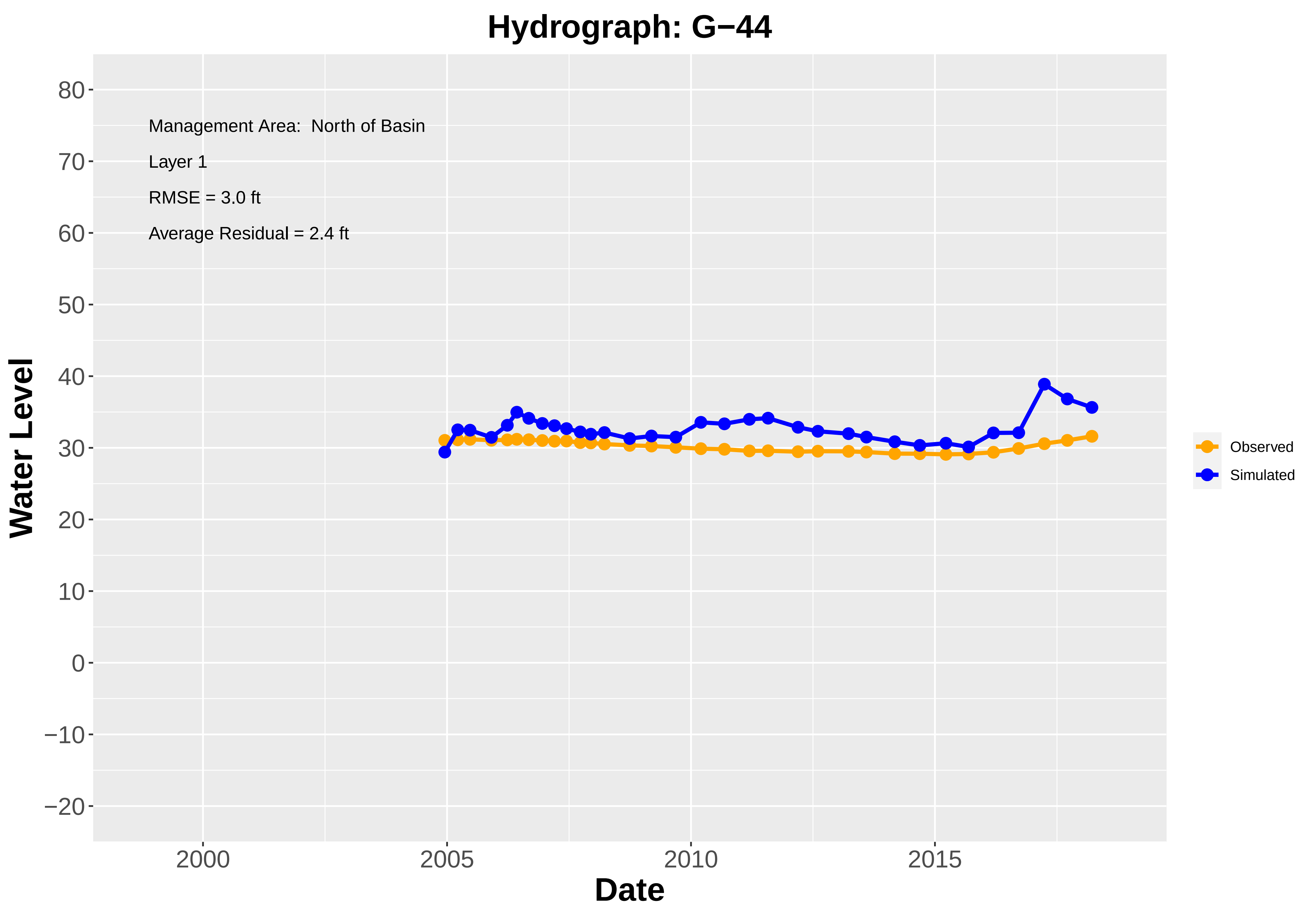

Hydrograph: G−41
Management Area: North of Basin
Layer 3
RMSE = 7.5 ft
Average Residual = −2.9 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated



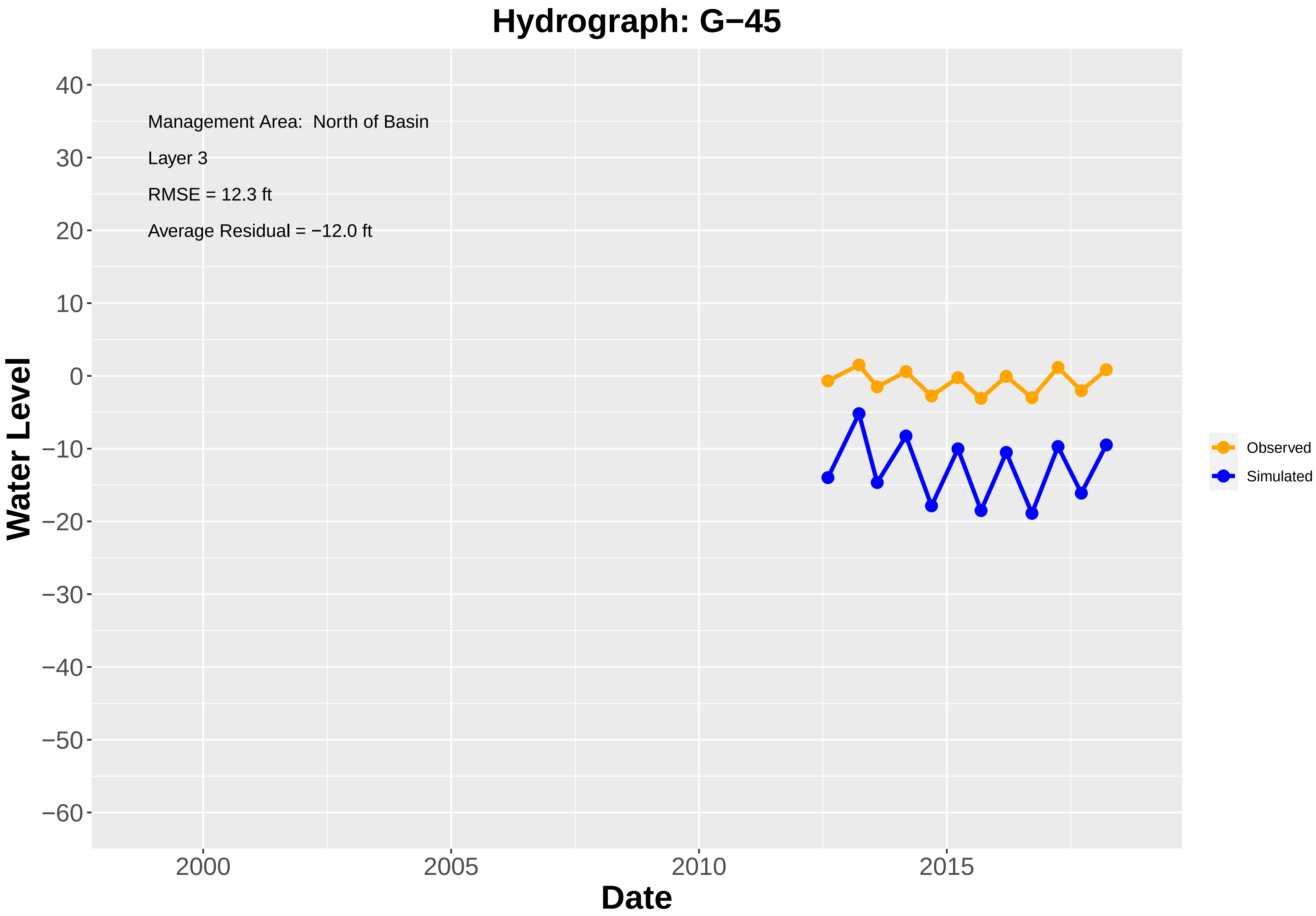
Hydrograph: G−42
Management Area: North of Basin
Layer 3
RMSE = 19.6 ft
Average Residual = −19.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

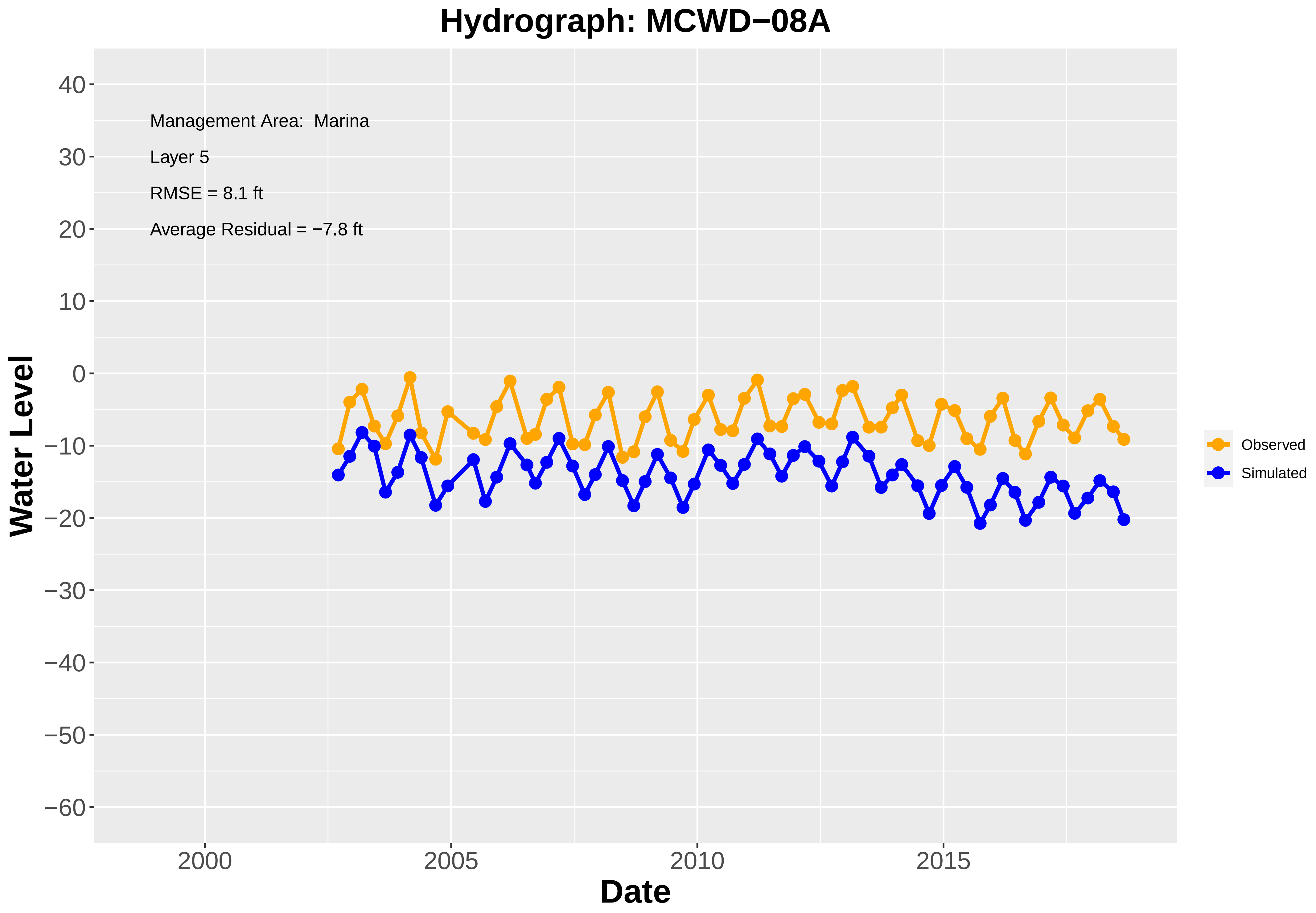


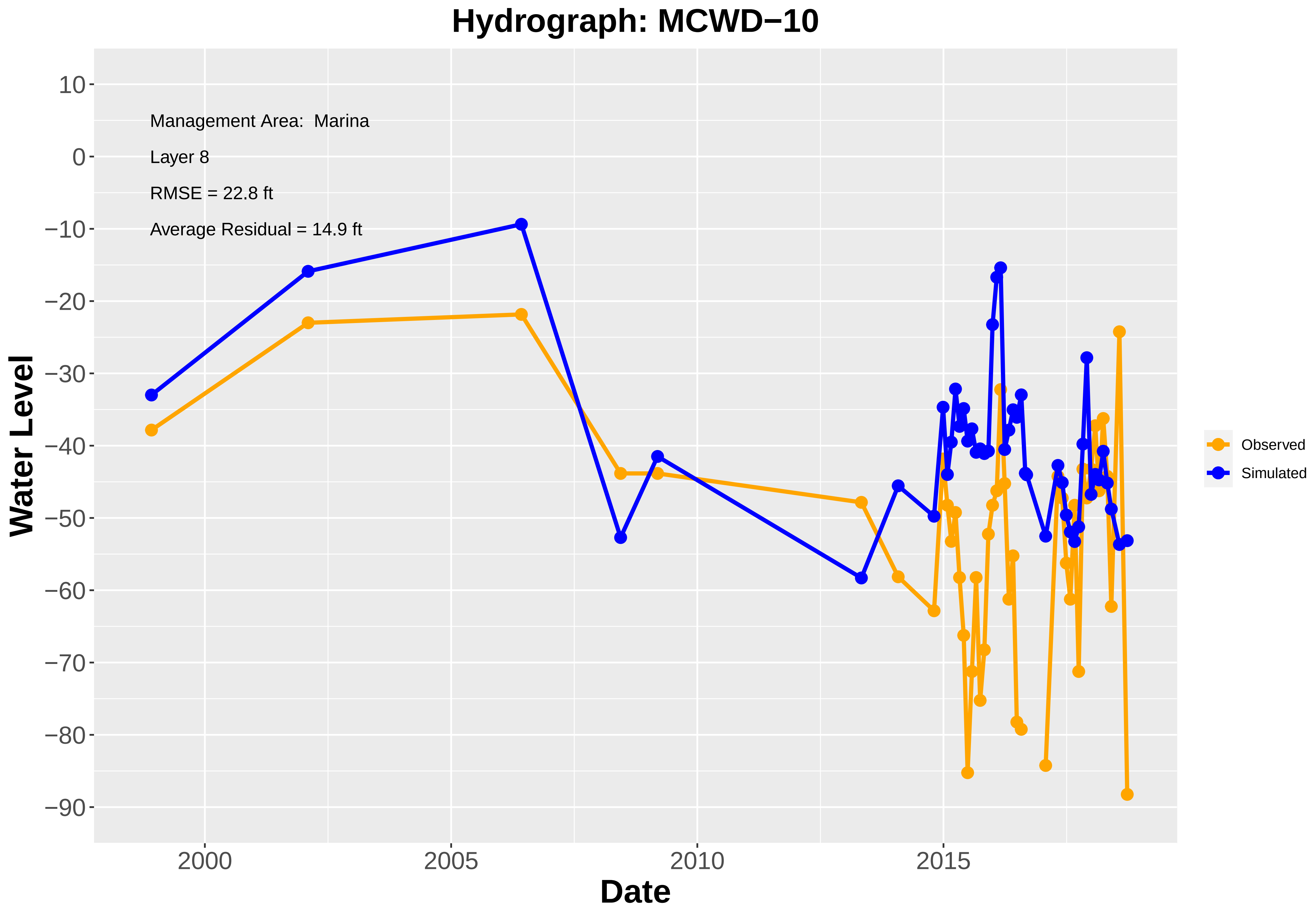
Hydrograph: G−43
Management Area: North of Basin
Layer 3
RMSE = 20.1 ft
Average Residual = −19.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



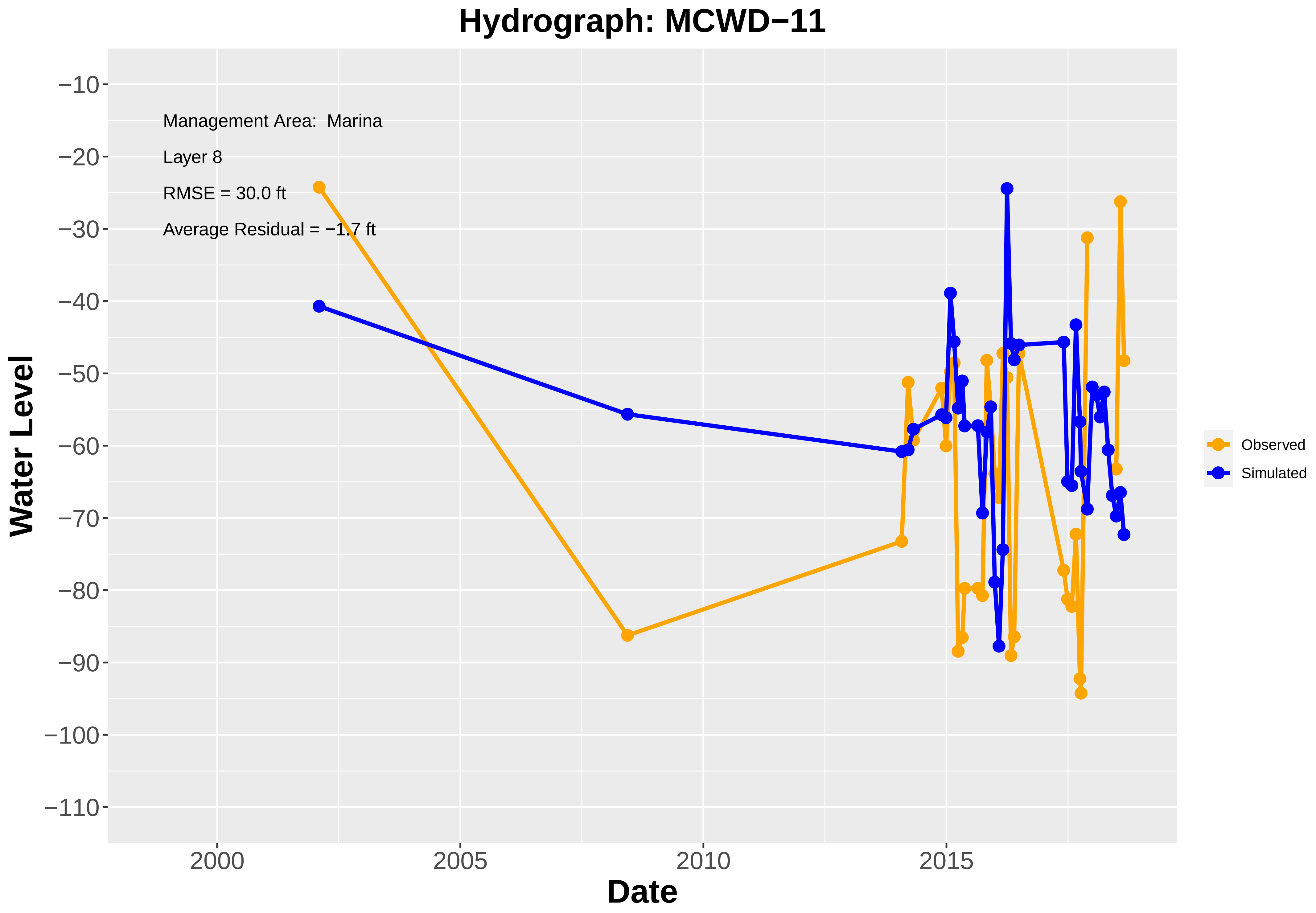
Hydrograph: G−44
Management Area: North of Basin
Layer 1
RMSE = 3.0 ft
Average Residual = 2.4 ft
Water Level
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: G−45
Management Area: North of Basin
Layer 3
RMSE = 12.3 ft
Average Residual = −12.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

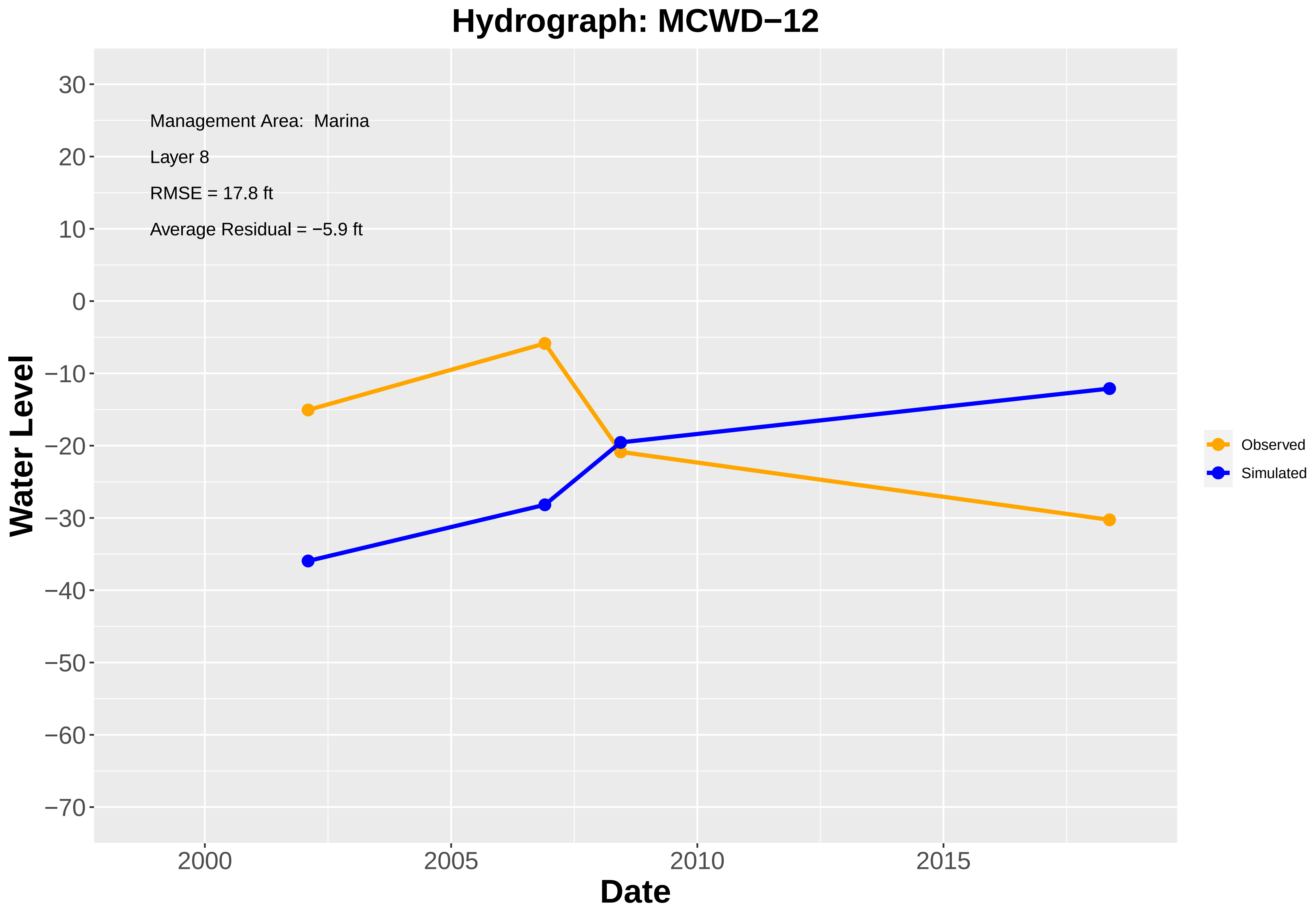

Hydrograph: MCWD−08A
Management Area: Marina
Layer 5
RMSE = 8.1 ft
Average Residual = −7.8 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



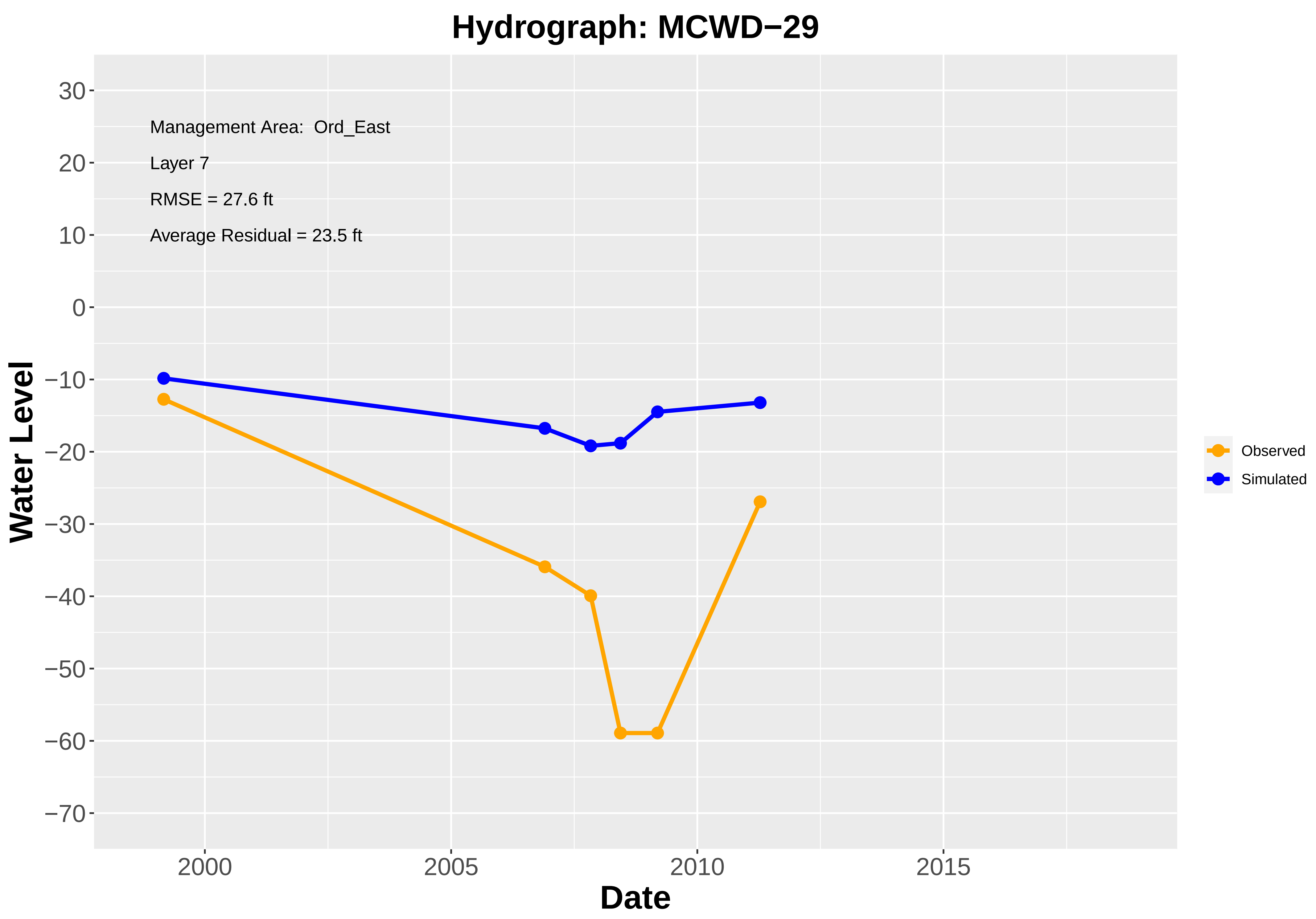
Hydrograph: MCWD−10
Management Area: Marina
Layer 8
RMSE = 22.8 ft
Average Residual = 14.9 ft
Water Level
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
2000
2005
2010
2015
Date
Observed
Simulated

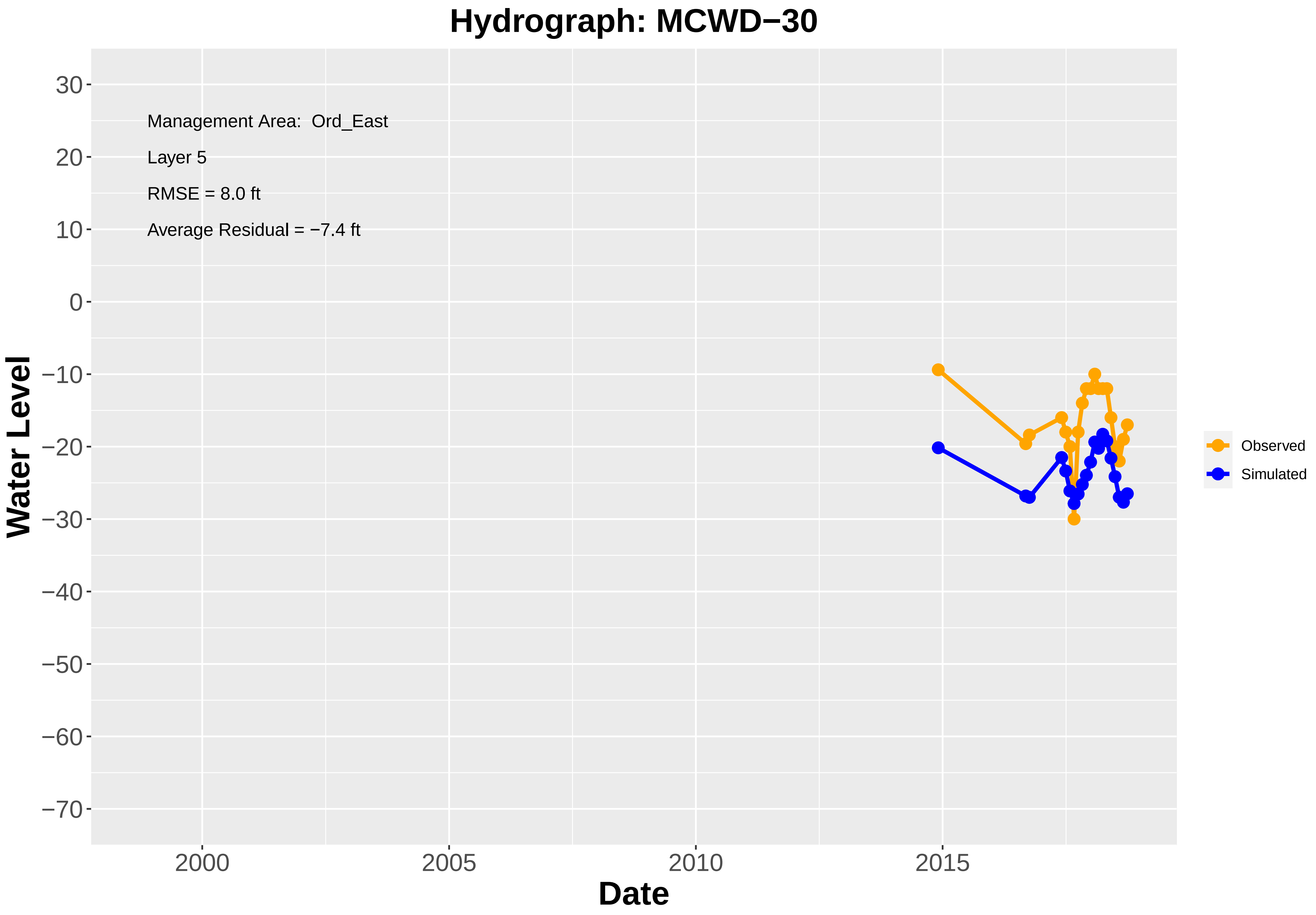


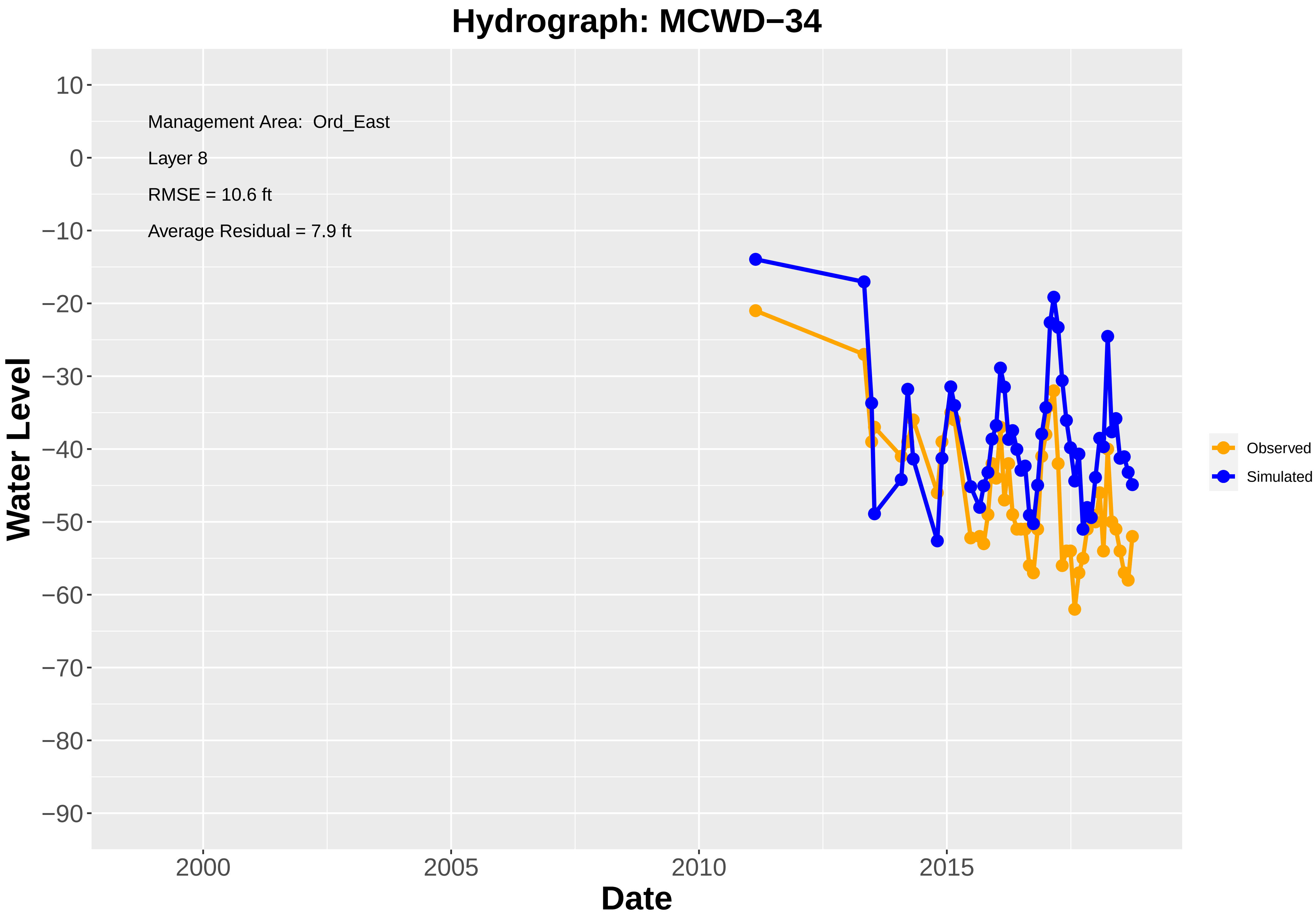
Hydrograph: MCWD−11
Management Area: Marina
Layer 8
RMSE = 30.0 ft
Average Residual = −1.7 ft
Water Level
Date
−10
−20
−30
−40
−50
−60
−70
−80
−90
−100
−110
2000
2005
2010
2015
Observed
Simulated

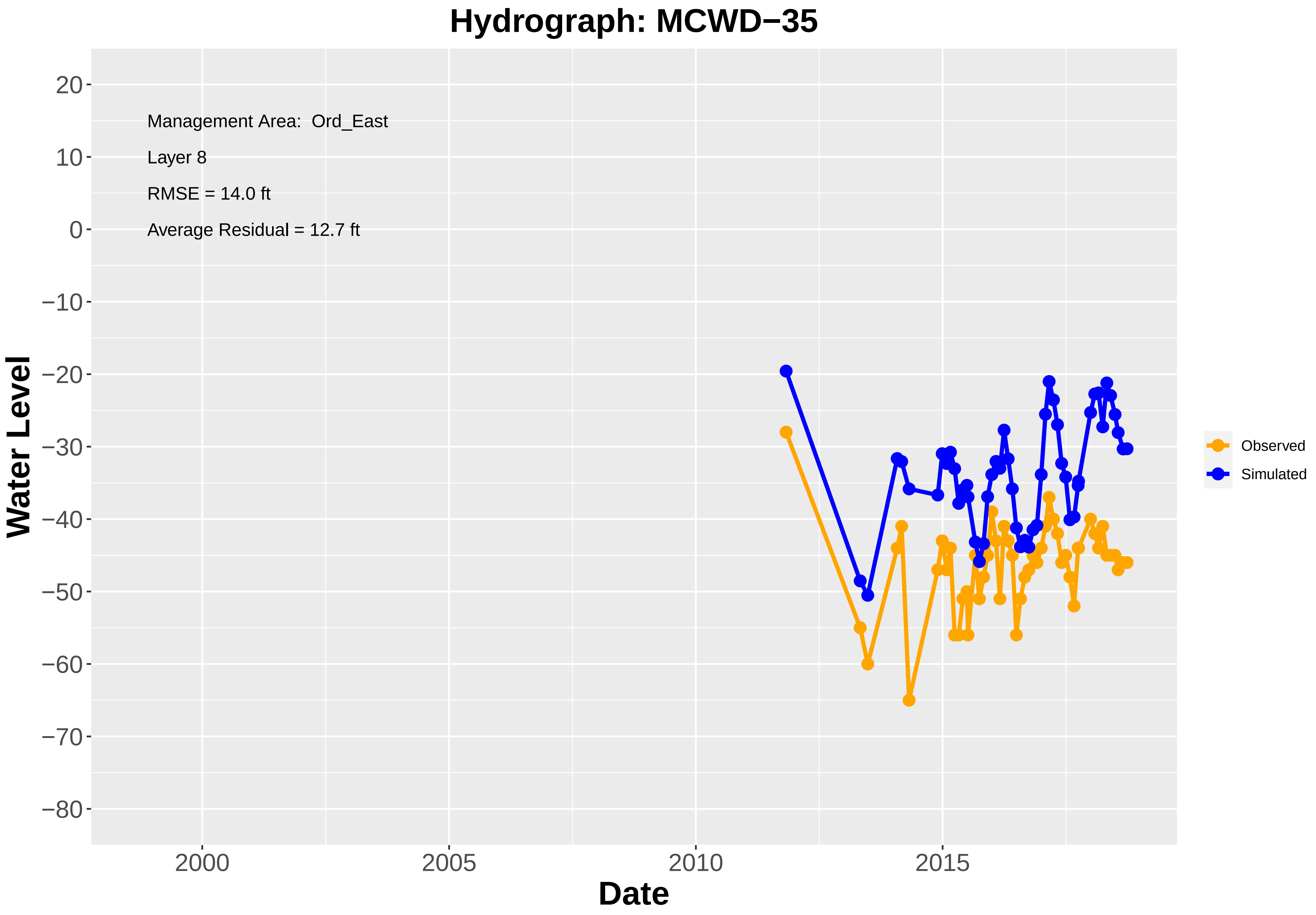


Hydrograph: MCWD−12
Management Area: Marina
Layer 8
RMSE = 17.8 ft
Average Residual = −5.9 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Date
2000
2005
2010
2015
Observed
Simulated

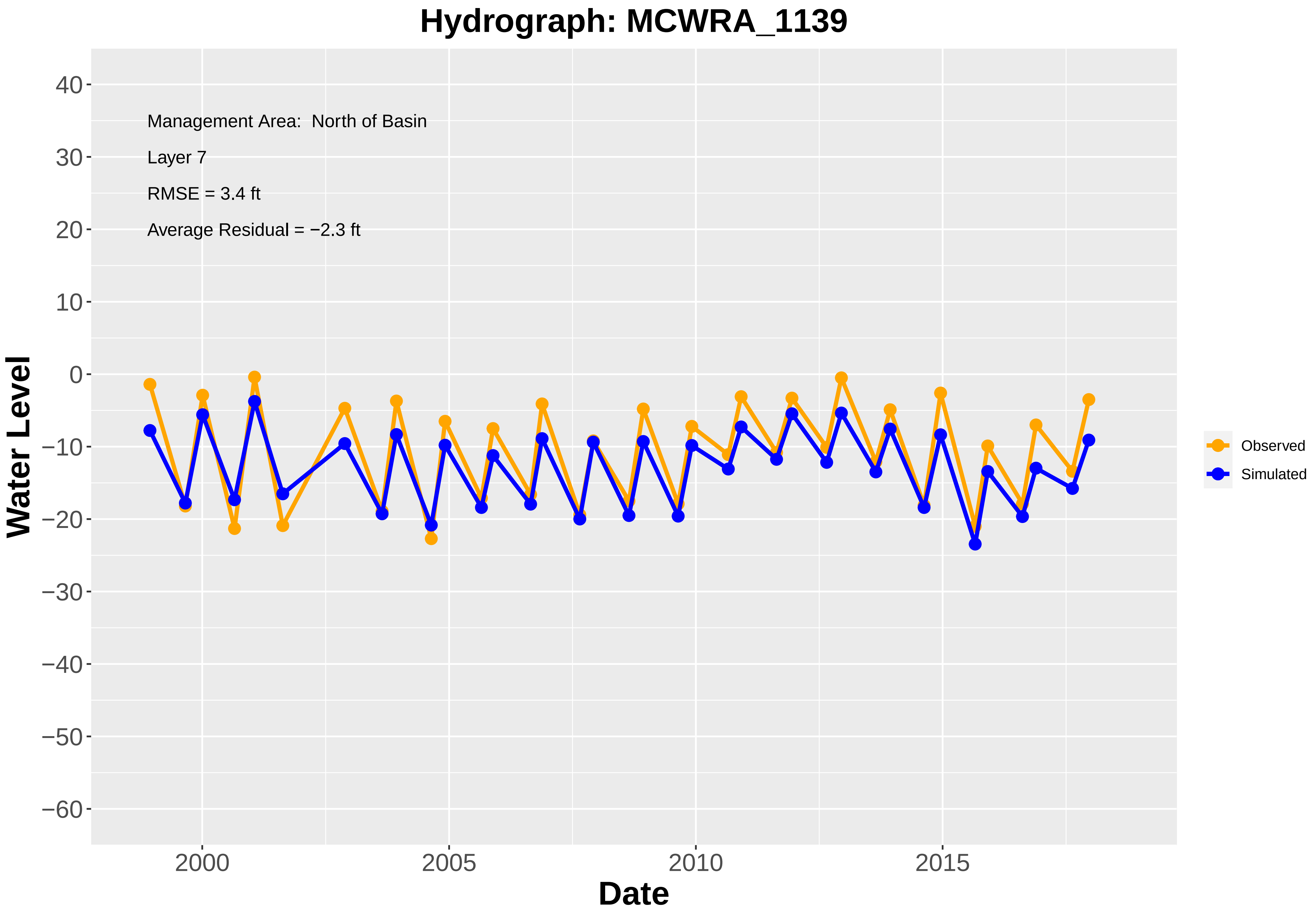

Hydrograph: MCWD−29
Management Area: Ord_East
Layer 7
RMSE = 27.6 ft
Average Residual = 23.5 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MCWD−30
Management Area: Ord_East
Layer 5
RMSE = 8.0 ft
Average Residual = −7.4 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

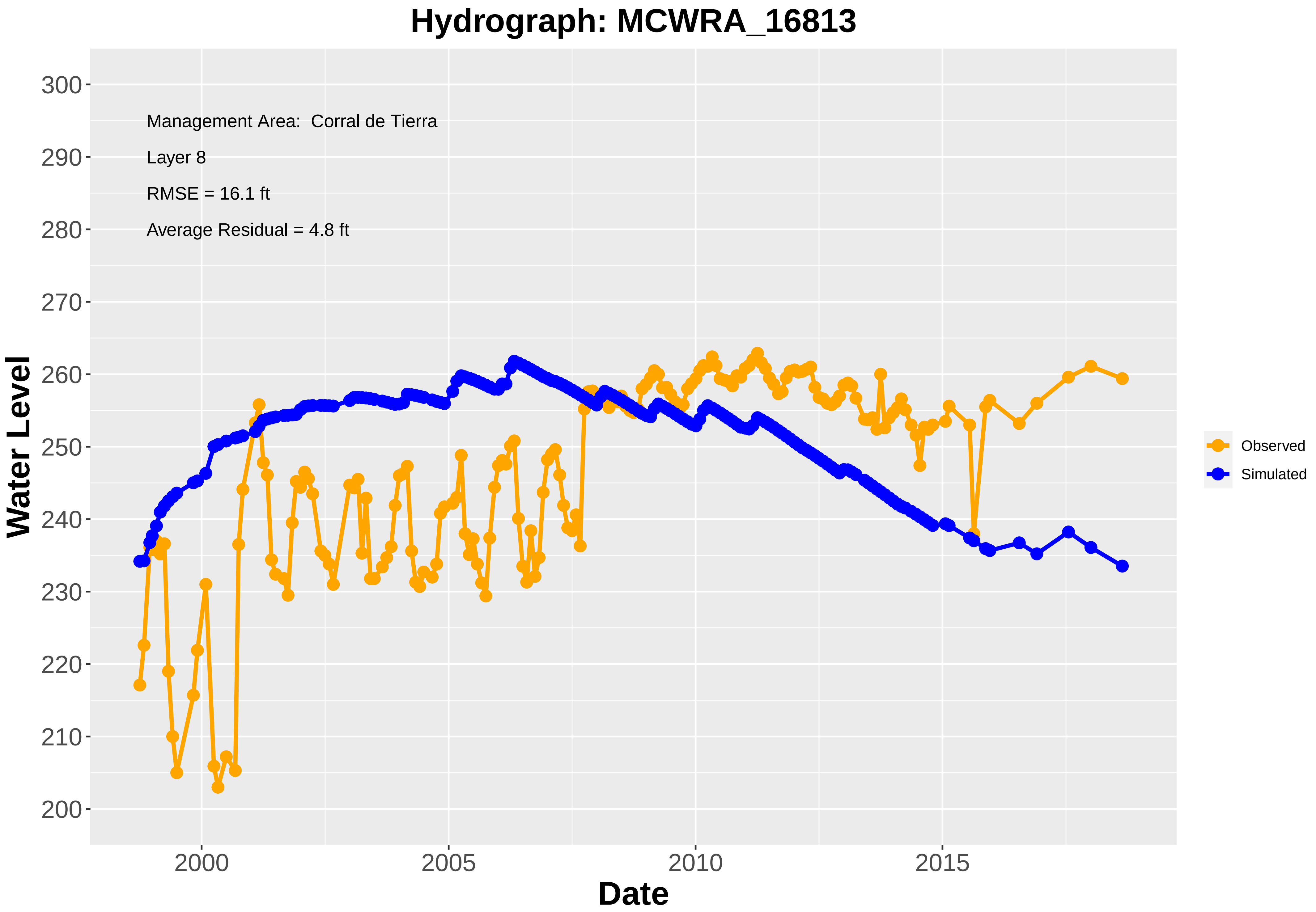

Hydrograph: MCWD−34
Management Area: Ord_East
Layer 8
RMSE = 10.6 ft
Average Residual = 7.9 ft
Water Level
Date
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
2000
2005
2010
2015
Observed
Simulated



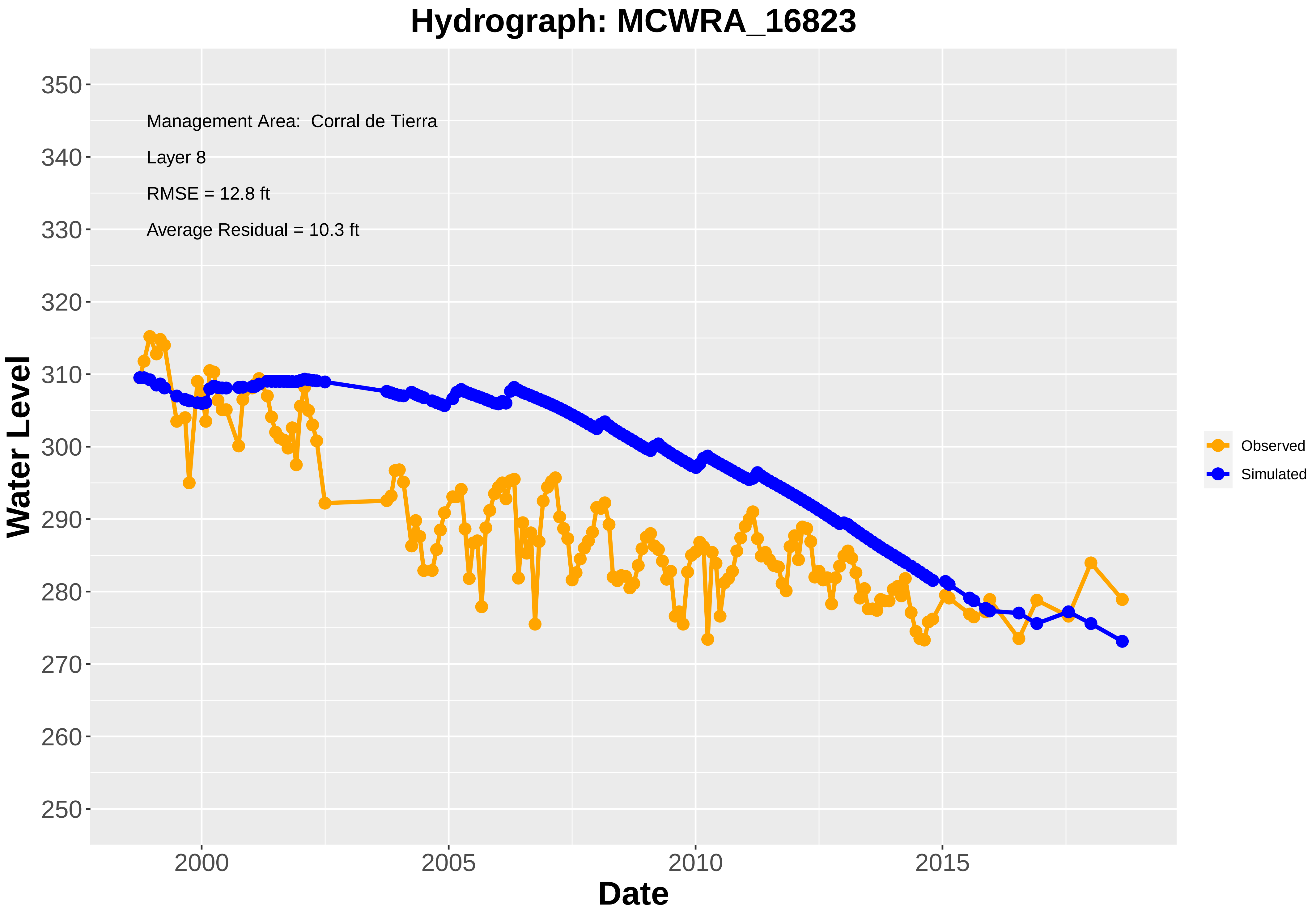
Hydrograph: MCWD−35
Management Area: Ord_East
Layer 8
RMSE = 14.0 ft
Average Residual = 12.7 ft
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80
Water Level
2000
2005
2010
2015
Date
Observed
Simulated



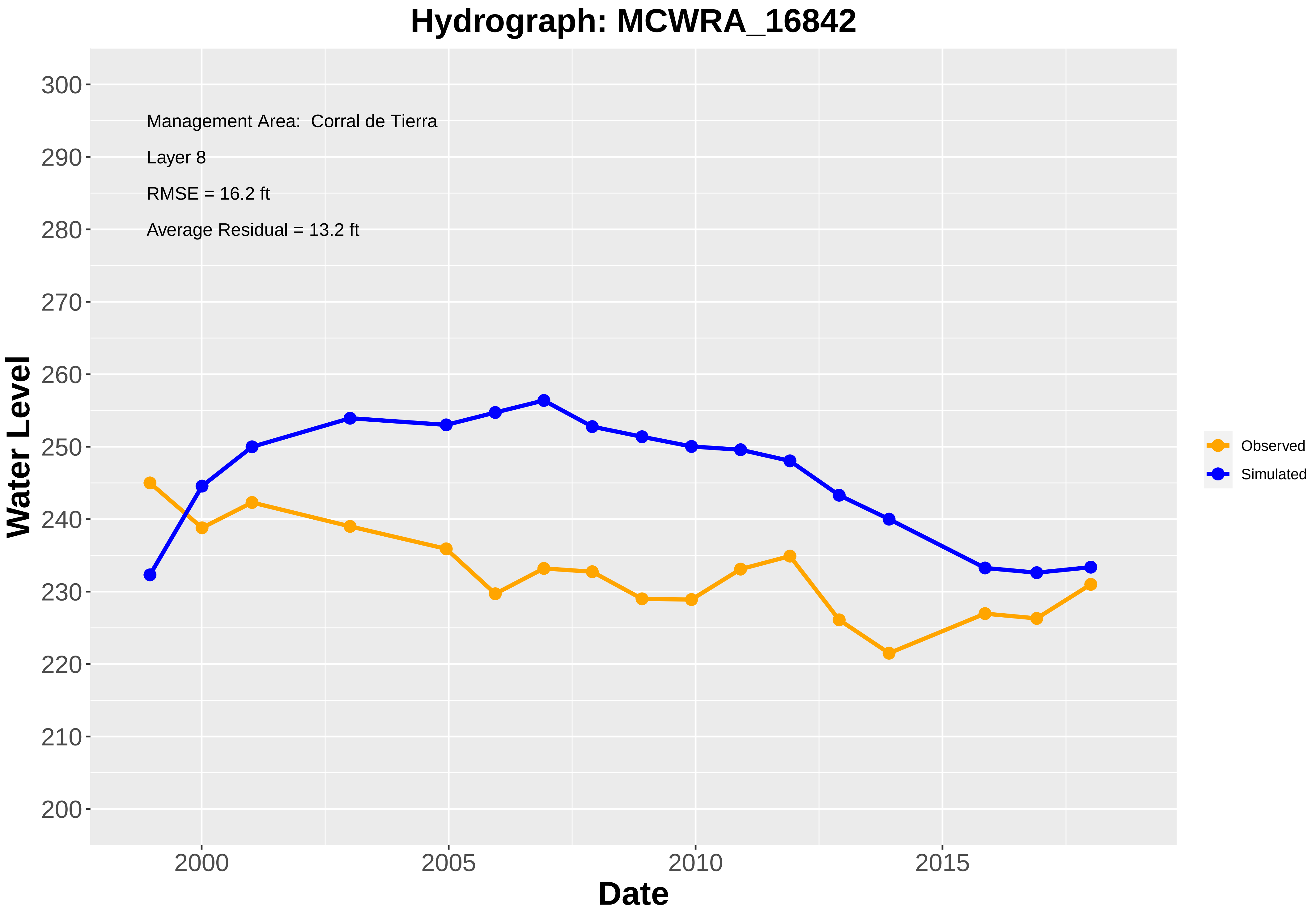
Hydrograph: MCWRA_1139
Management Area: North of Basin
Layer 7
RMSE = 3.4 ft
Average Residual = −2.3 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

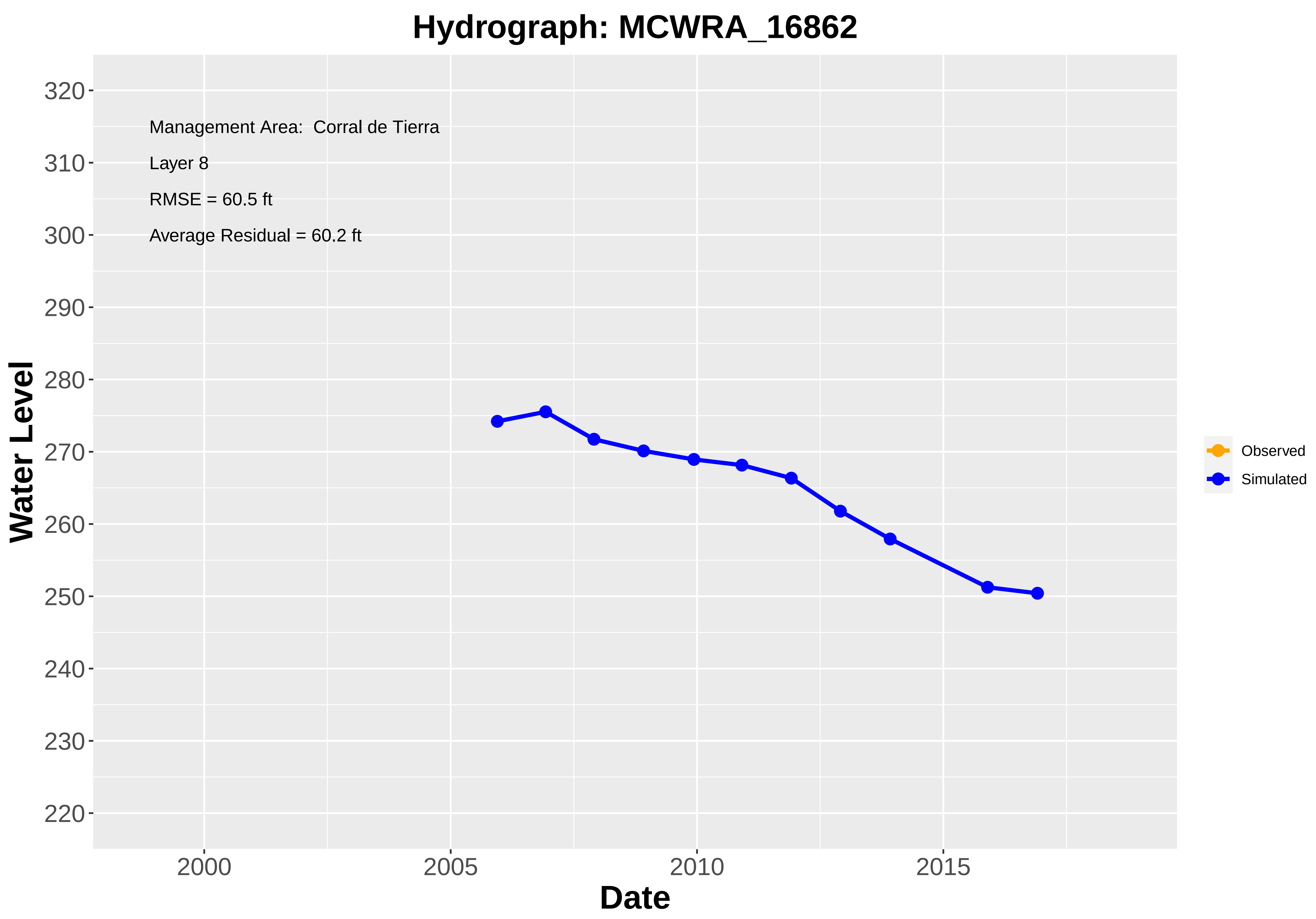


Hydrograph: MCWRA_16813
Management Area: Corral de Tierra
Layer 8
RMSE = 16.1 ft
Average Residual = 4.8 ft
Water Level
Date
300
290
280
270
260
250
240
230
220
210
200
2000
2005
2010
2015
Observed
Simulated

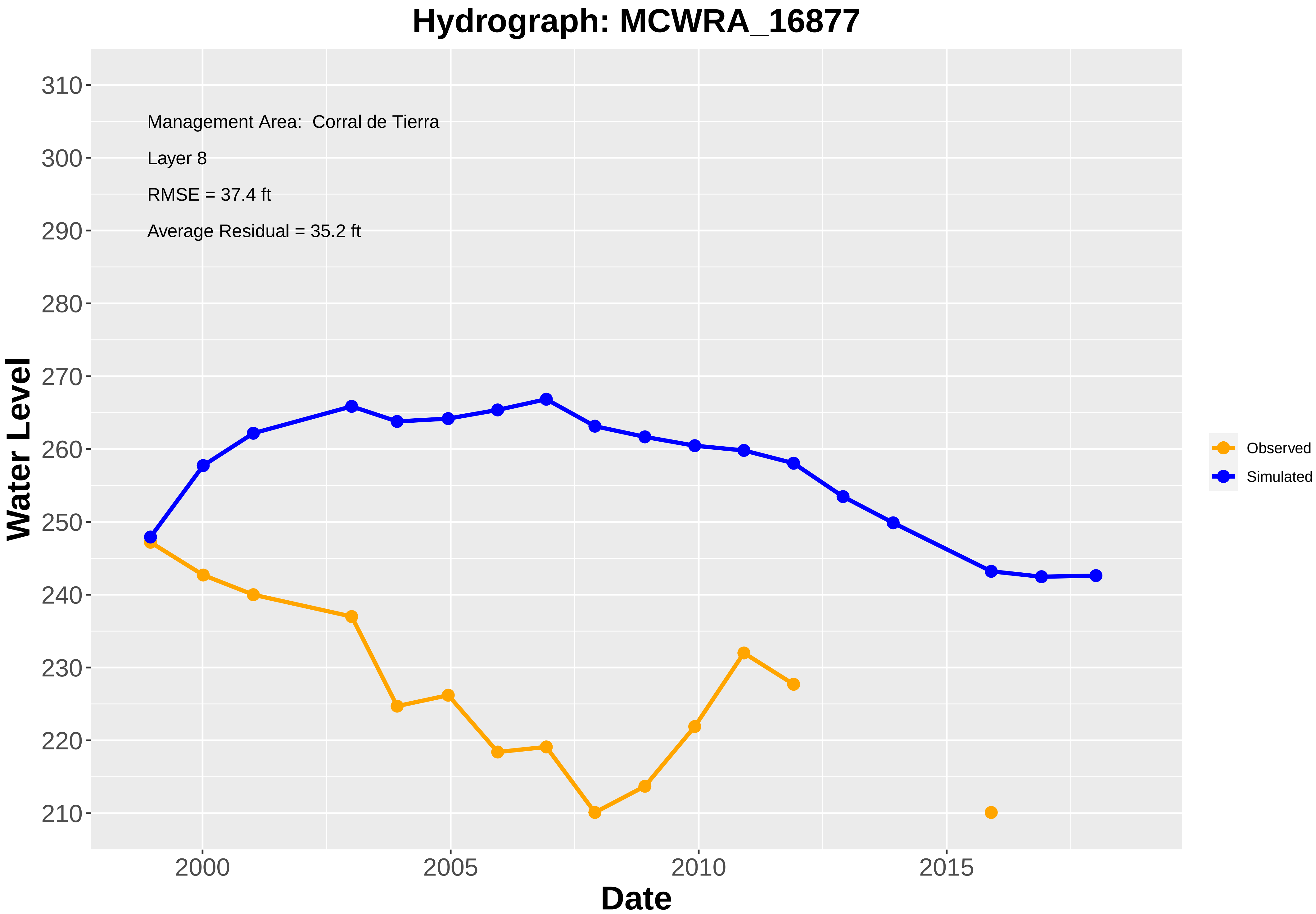


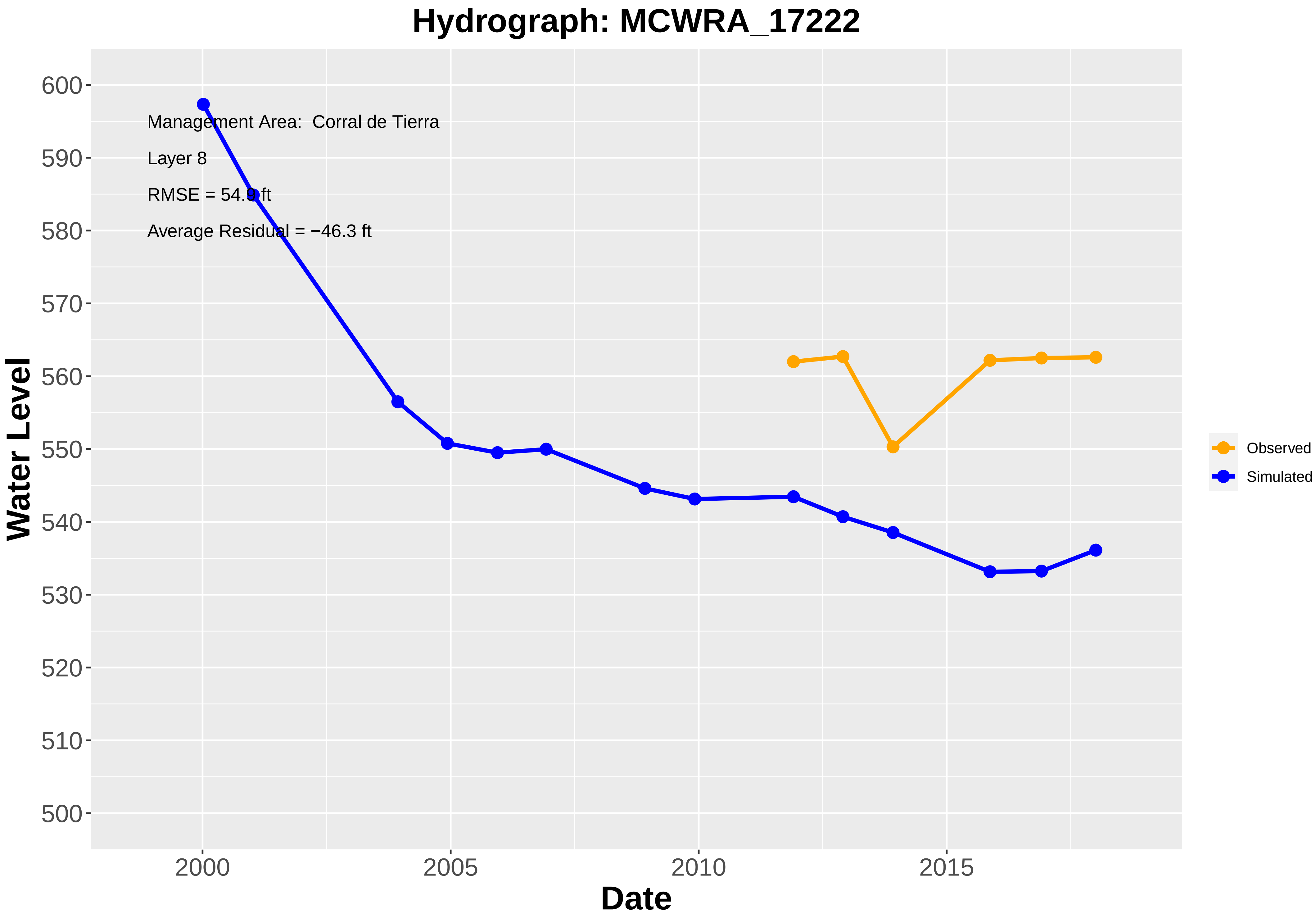
Hydrograph: MCWRA_16823
Management Area: Corral de Tierra
Layer 8
RMSE = 12.8 ft
Average Residual = 10.3 ft
Water Level
350
340
330
320
310
300
290
280
270
260
250
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MCWRA_16842
Management Area: Corral de Tierra
Layer 8
RMSE = 16.2 ft
Average Residual = 13.2 ft
Water Level
300
290
280
270
260
250
240
230
220
210
200
2000
2005
2010
2015
Date
Observed
Simulated

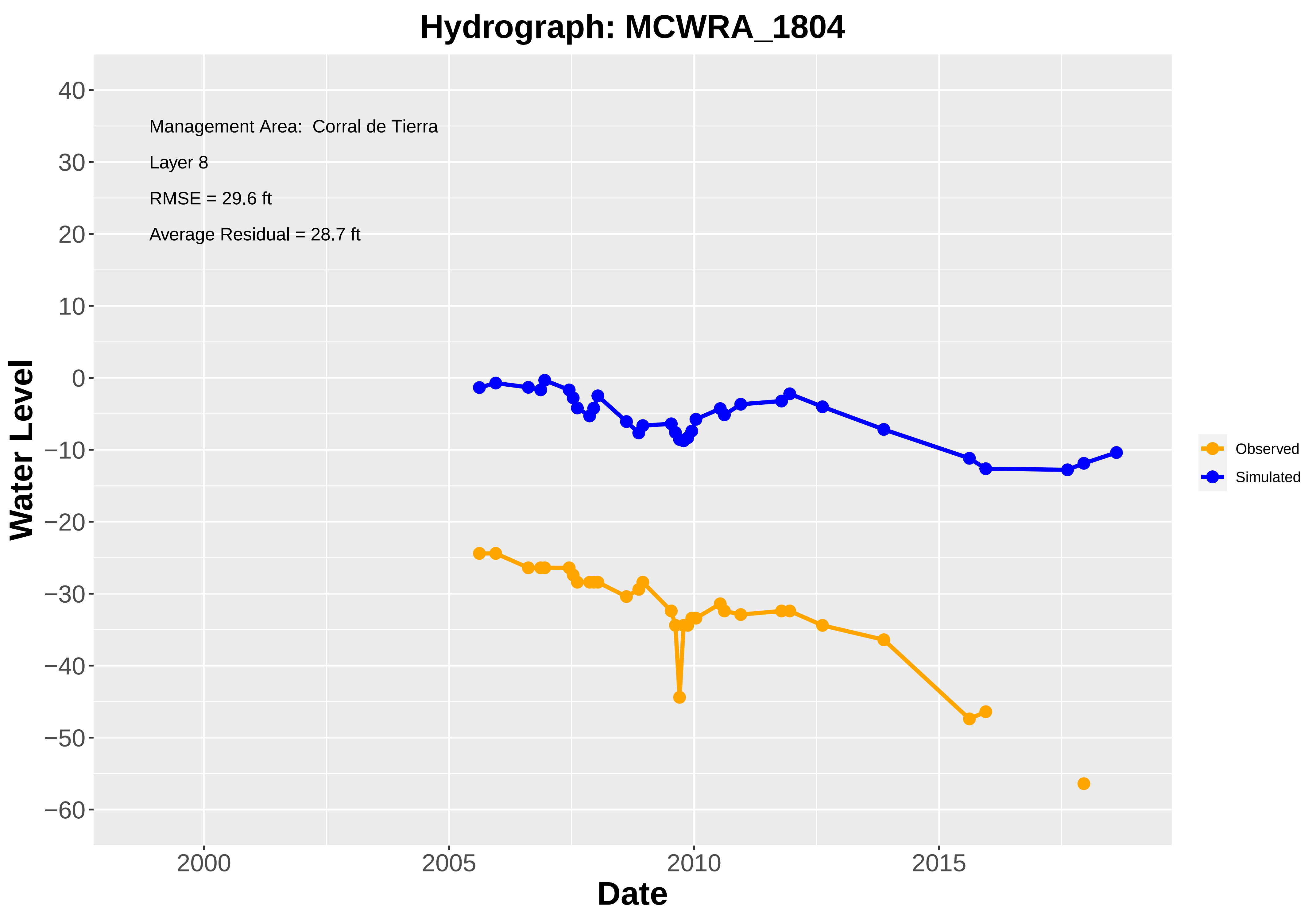


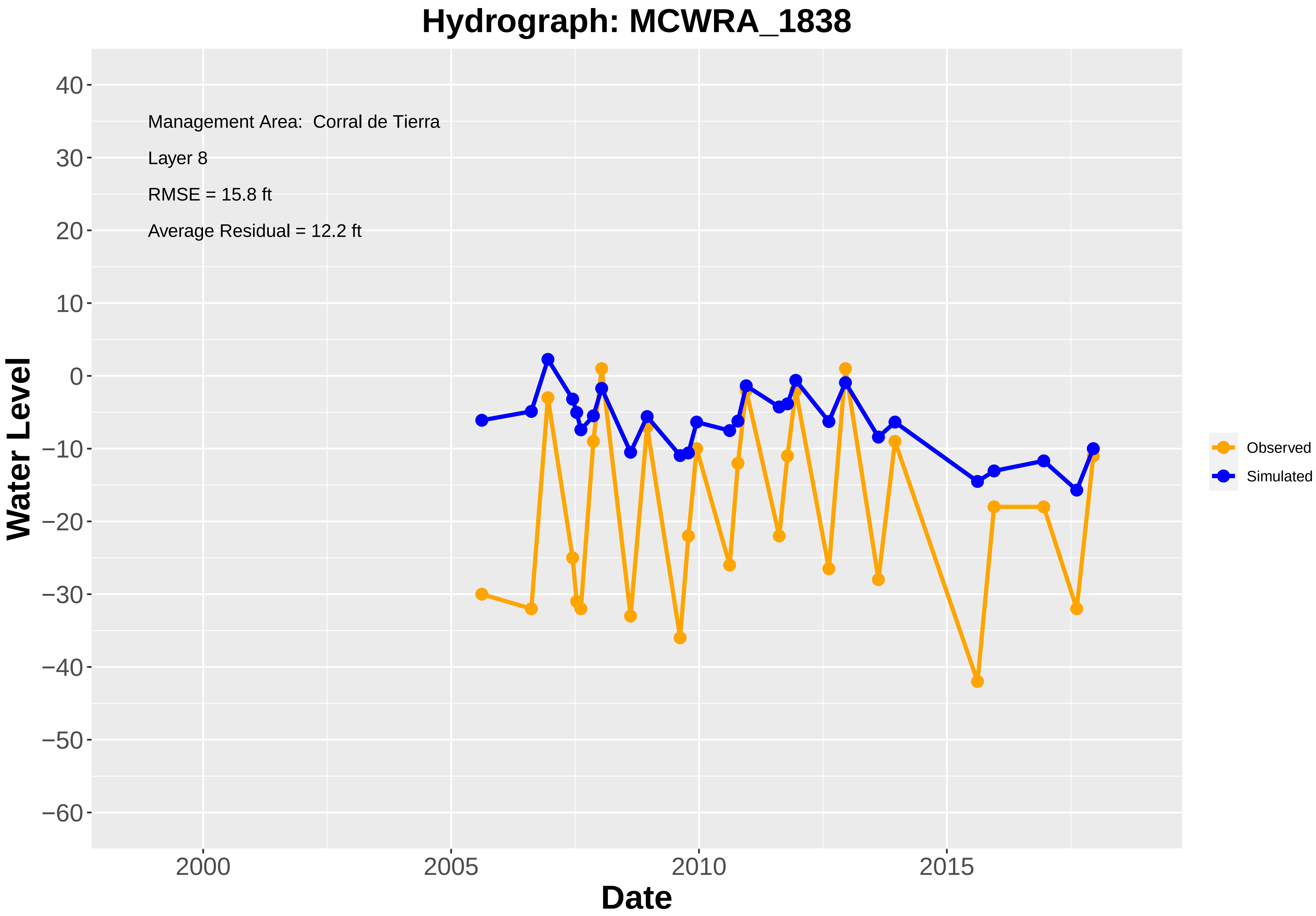
Hydrograph: MCWRA_16862
Management Area: Corral de Tierra
Layer 8
RMSE = 60.5 ft
Average Residual = 60.2 ft
Water Level
Date
320
310
300
290
280
270
260
250
240
230
220
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MCWRA_16877
Management Area: Corral de Tierra
Layer 8
RMSE = 37.4 ft
Average Residual = 35.2 ft
Water Level
Date
310
300
290
280
270
260
250
240
230
220
210
2000
2005
2010
2015
Observed
Simulated

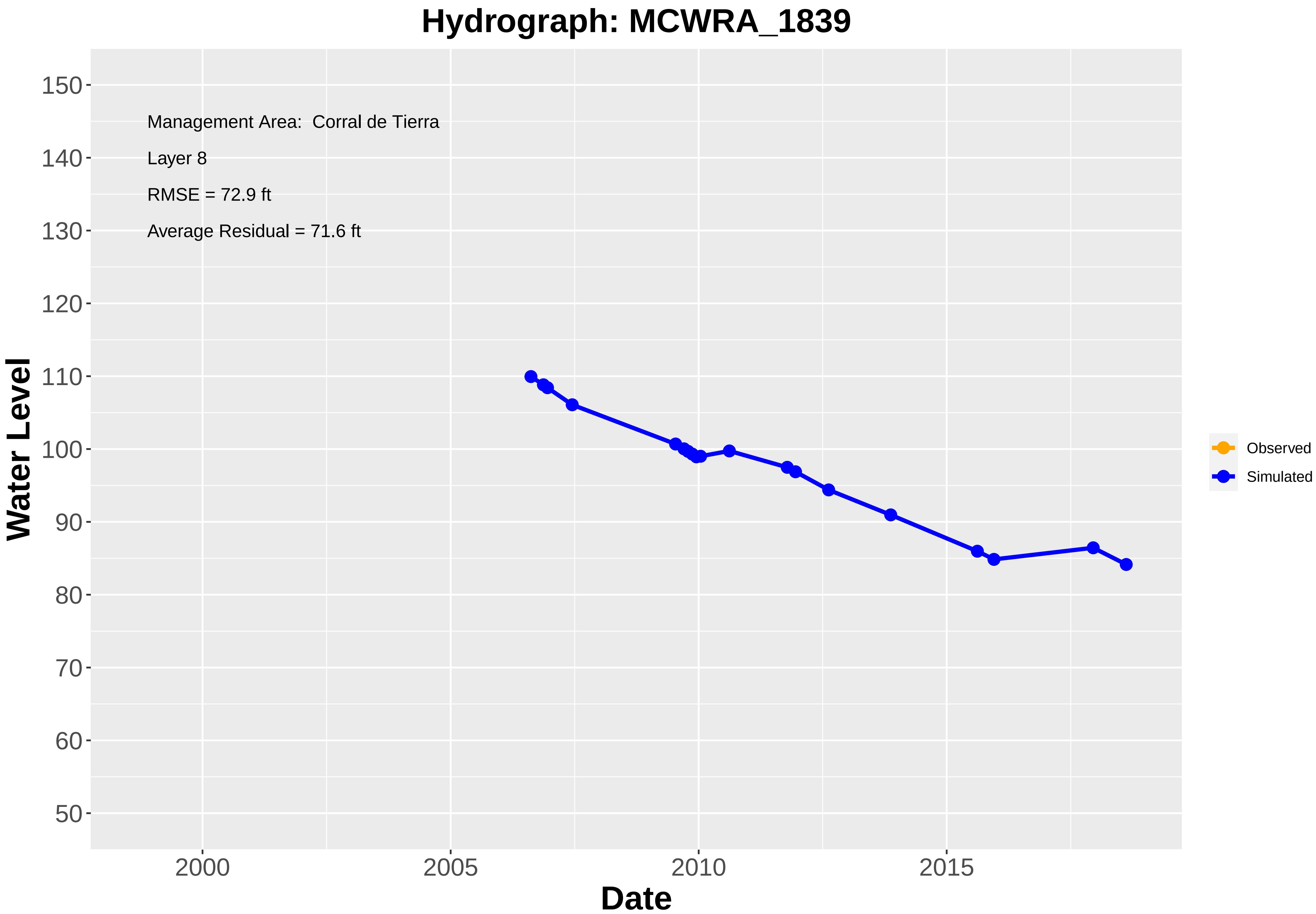


Hydrograph: MCWRA_17222
Management Area: Corral de Tierra
Layer 8
RMSE = 54.9 ft
Average Residual = −46.3 ft
Water Level
600
590
580
570
560
550
540
530
520
510
500
2000
2005
2010
2015
Date
Observed
Simulated

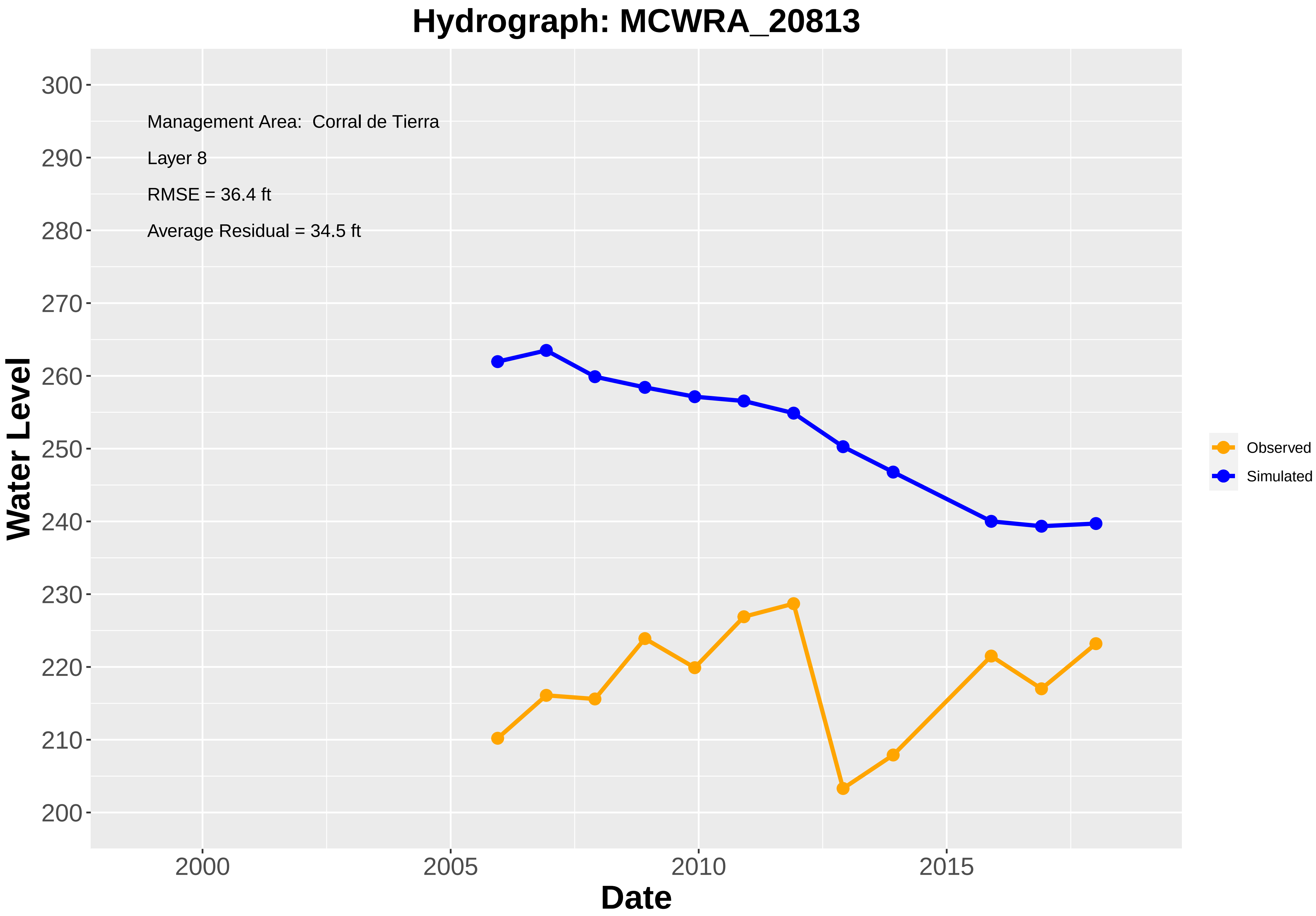

Hydrograph: MCWRA_1804
Management Area: Corral de Tierra
Layer 8
RMSE = 29.6 ft
Average Residual = 28.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

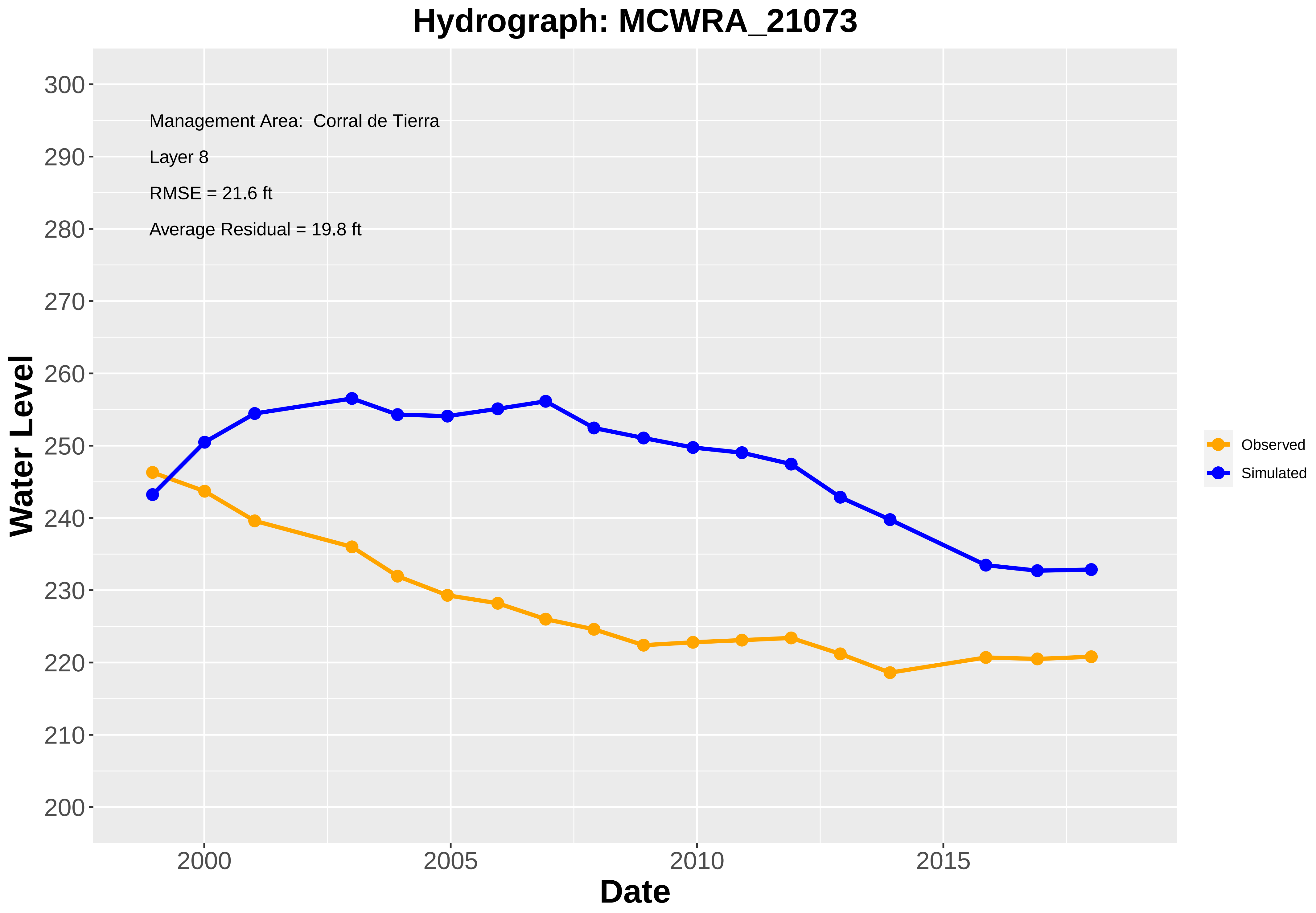


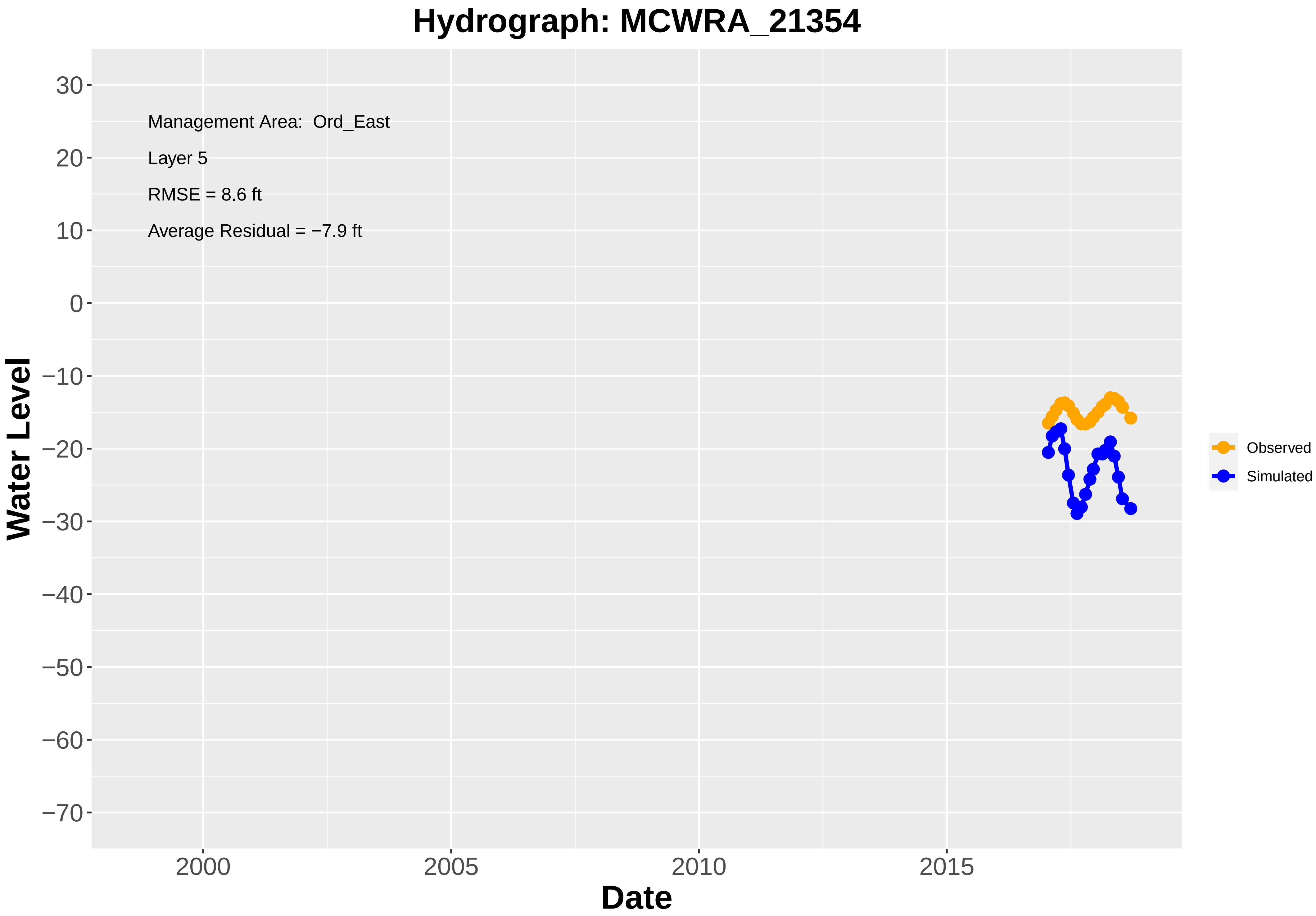
Hydrograph: MCWRA_1838
Management Area: Corral de Tierra
Layer 8
RMSE = 15.8 ft
Average Residual = 12.2 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



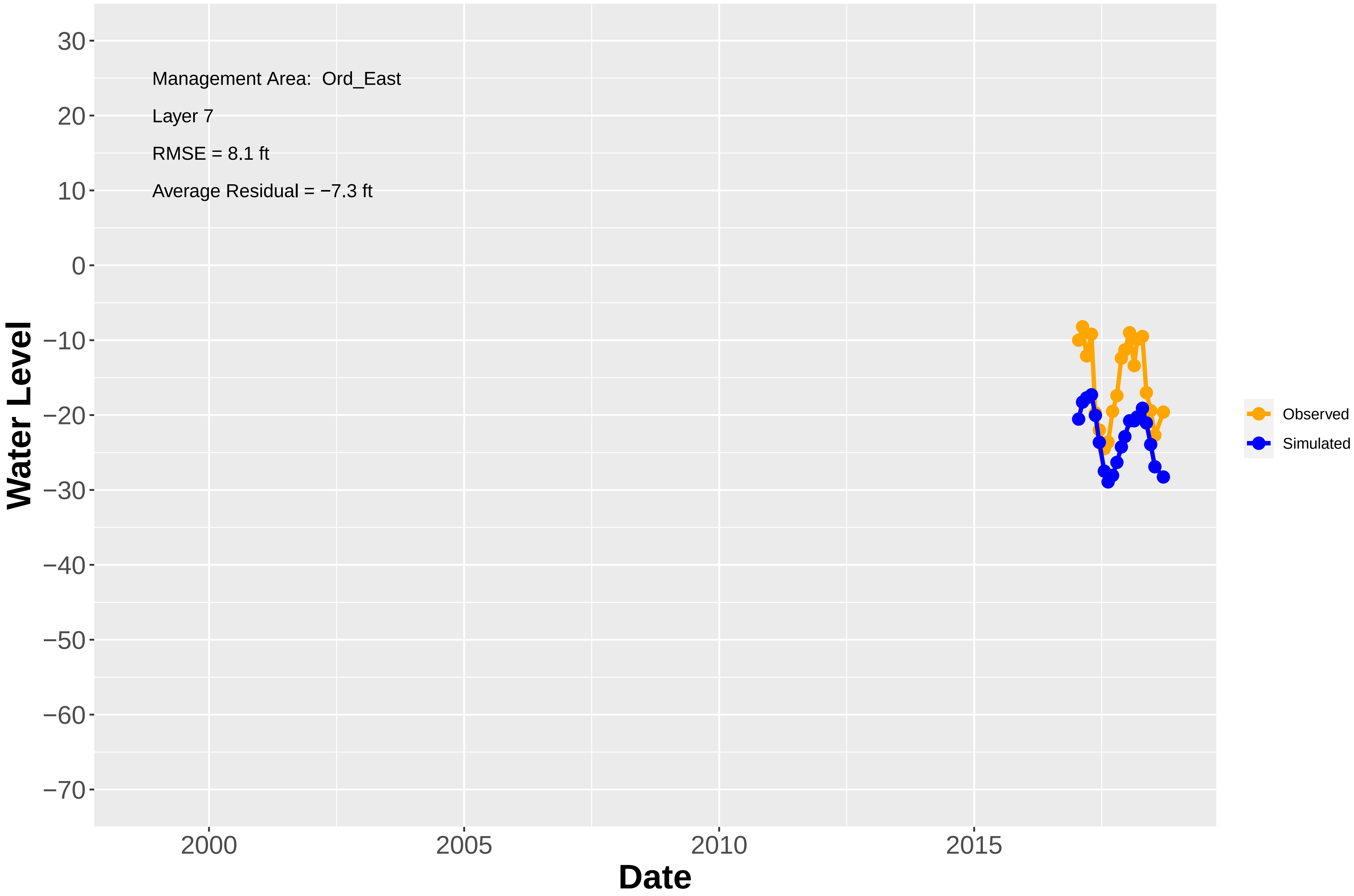
Hydrograph: MCWRA_1839
Management Area: Corral de Tierra
Layer 8
RMSE = 72.9 ft
Average Residual = 71.6 ft
Water Level
150
140
130
120
110
100
90
80
70
60
50
2000
2005
2010
2015
Date
Observed
Simulated

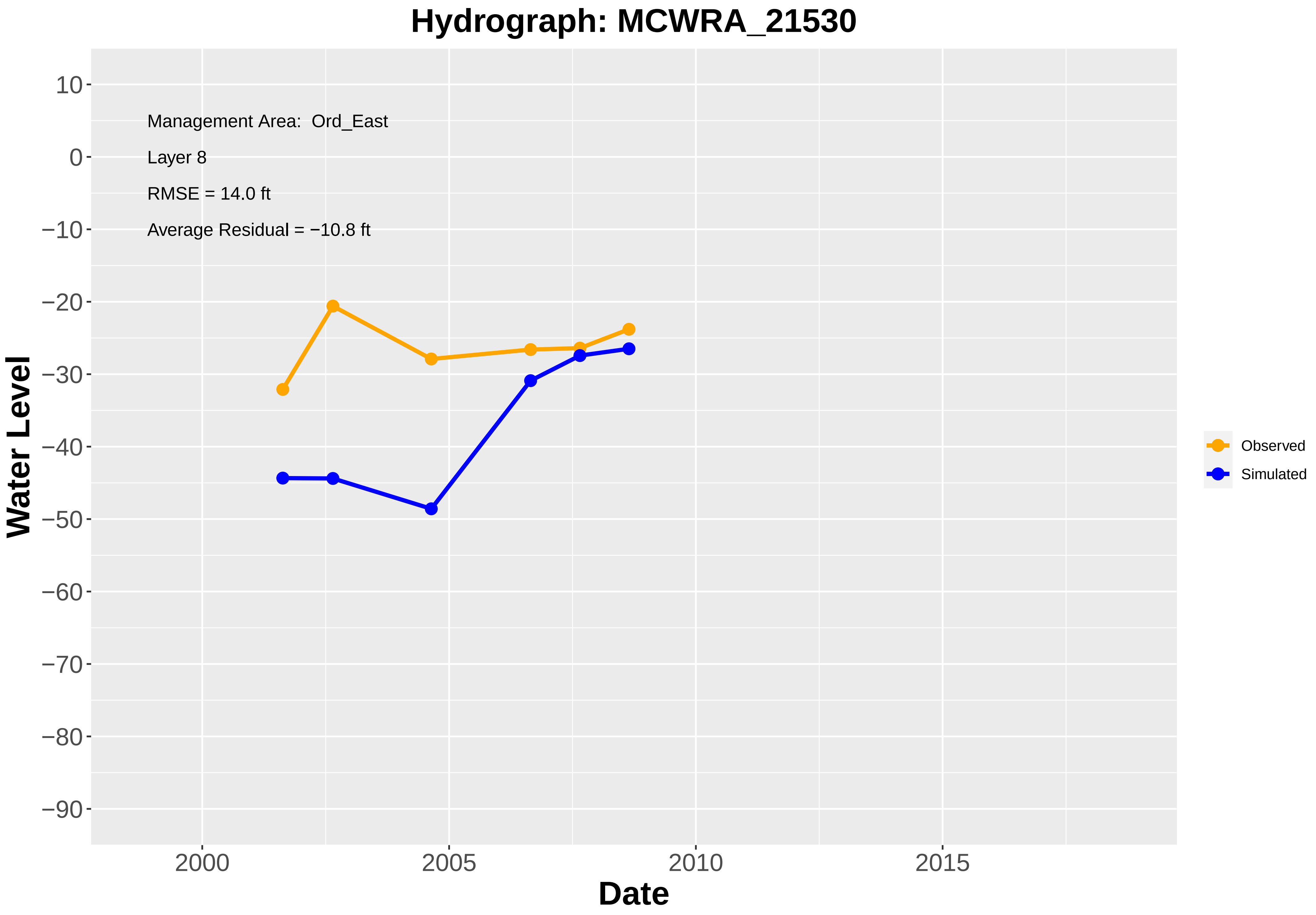

Hydrograph: MCWRA_20813
Management Area: Corral de Tierra
Layer 8
RMSE = 36.4 ft
Average Residual = 34.5 ft
Water Level
300
290
280
270
260
250
240
230
220
210
200
2000
2005
2010
2015
Date
Observed
Simulated

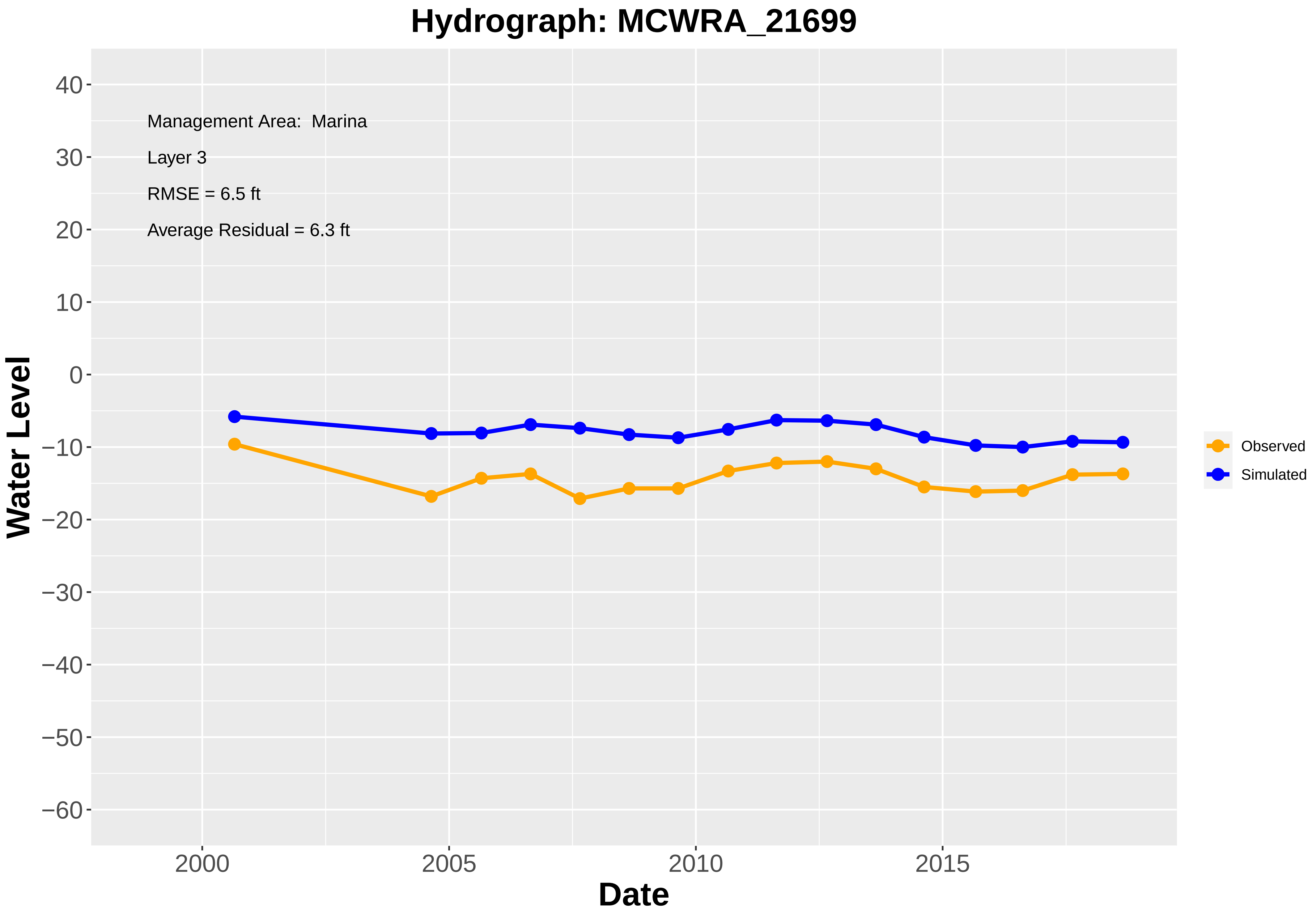

Hydrograph: MCWRA_21073
Management Area: Corral de Tierra
Layer 8
RMSE = 21.6 ft
Average Residual = 19.8 ft
Water Level
Date
300
290
280
270
260
250
240
230
220
210
200
2000
2005
2010
2015
Observed
Simulated

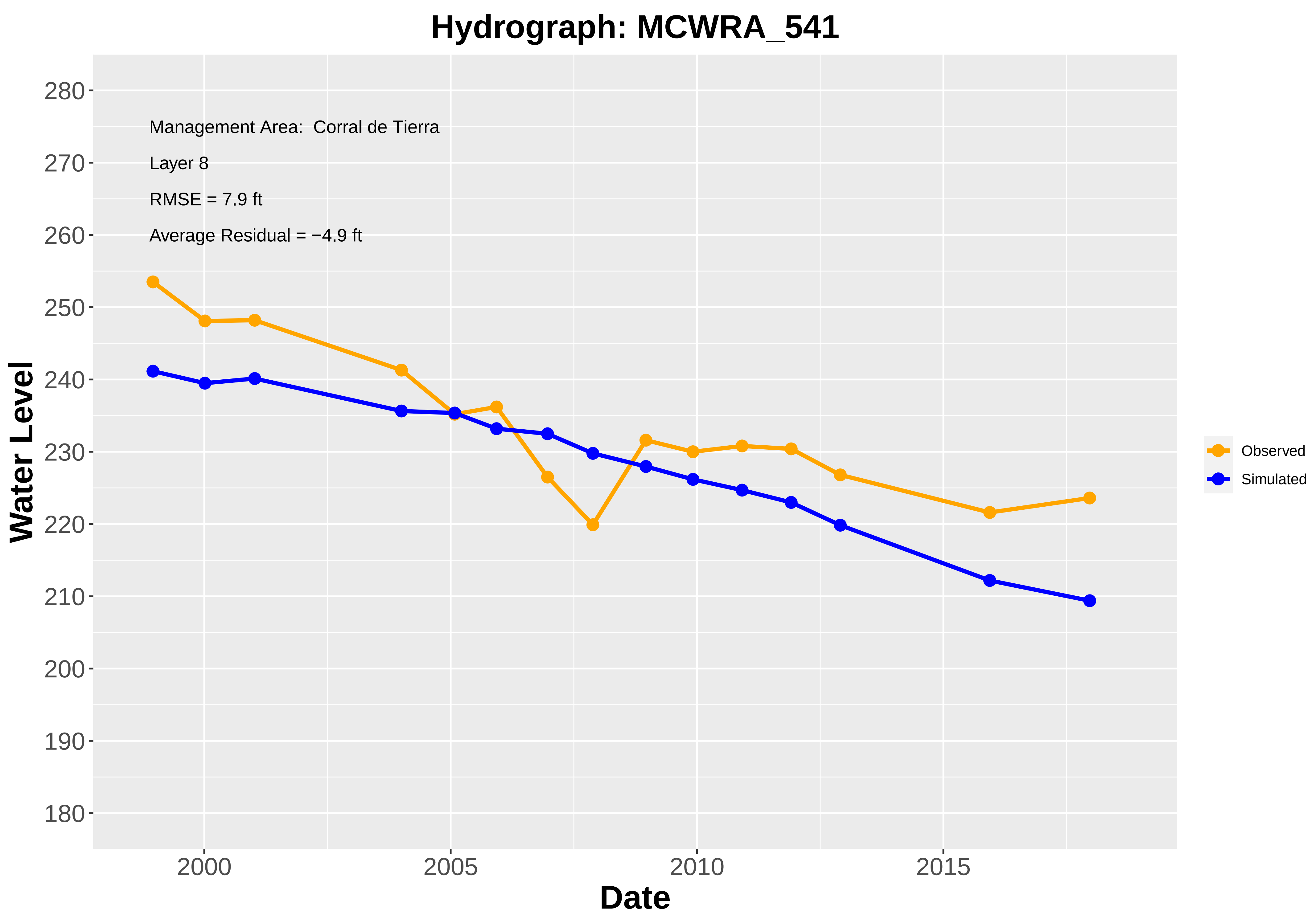

Hydrograph: MCWRA_21354
Management Area: Ord_East
Layer 5
RMSE = 8.6 ft
Average Residual = −7.9 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Date
2000
2005
2010
2015
Observed
Simulated

Hydrograph: MCWRA_21355

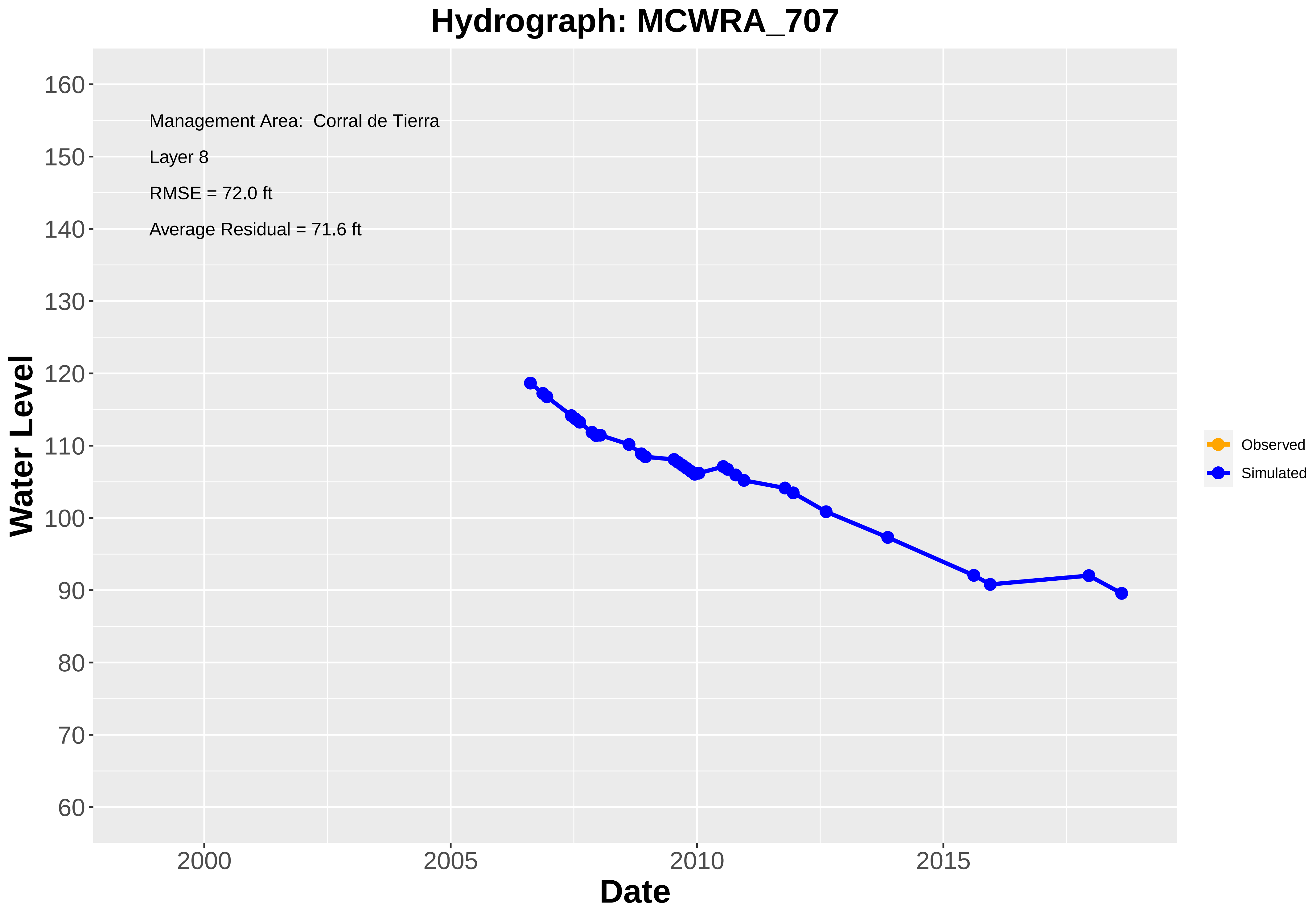


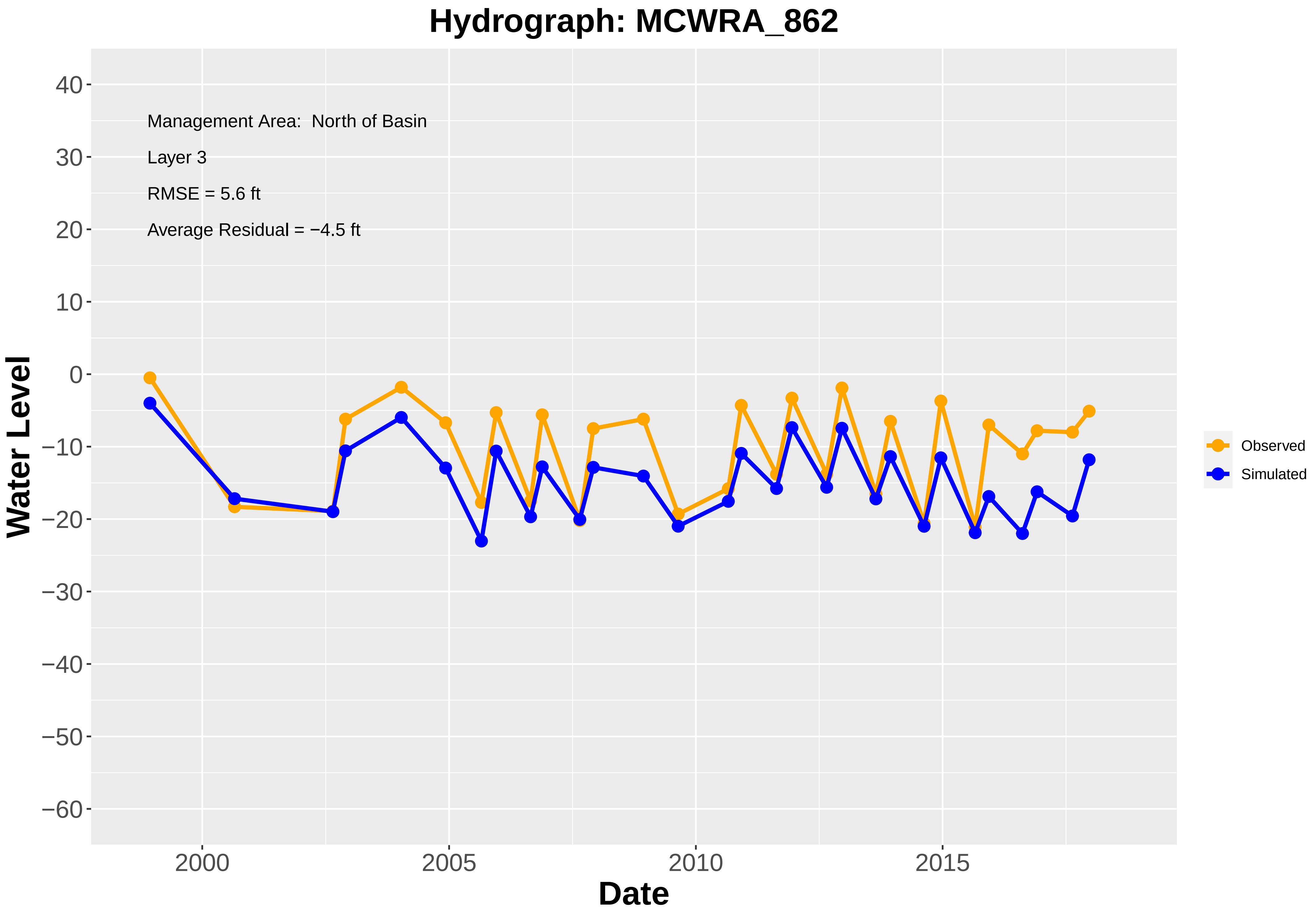

Hydrograph: MCWRA_21530
Management Area: Ord_East
Layer 8
RMSE = 14.0 ft
Average Residual = −10.8 ft
Water Level
10
0
−10
−20
−30
−40
−50
−60
−70
−80
−90
2000
2005
2010
2015
Date
Observed
Simulated

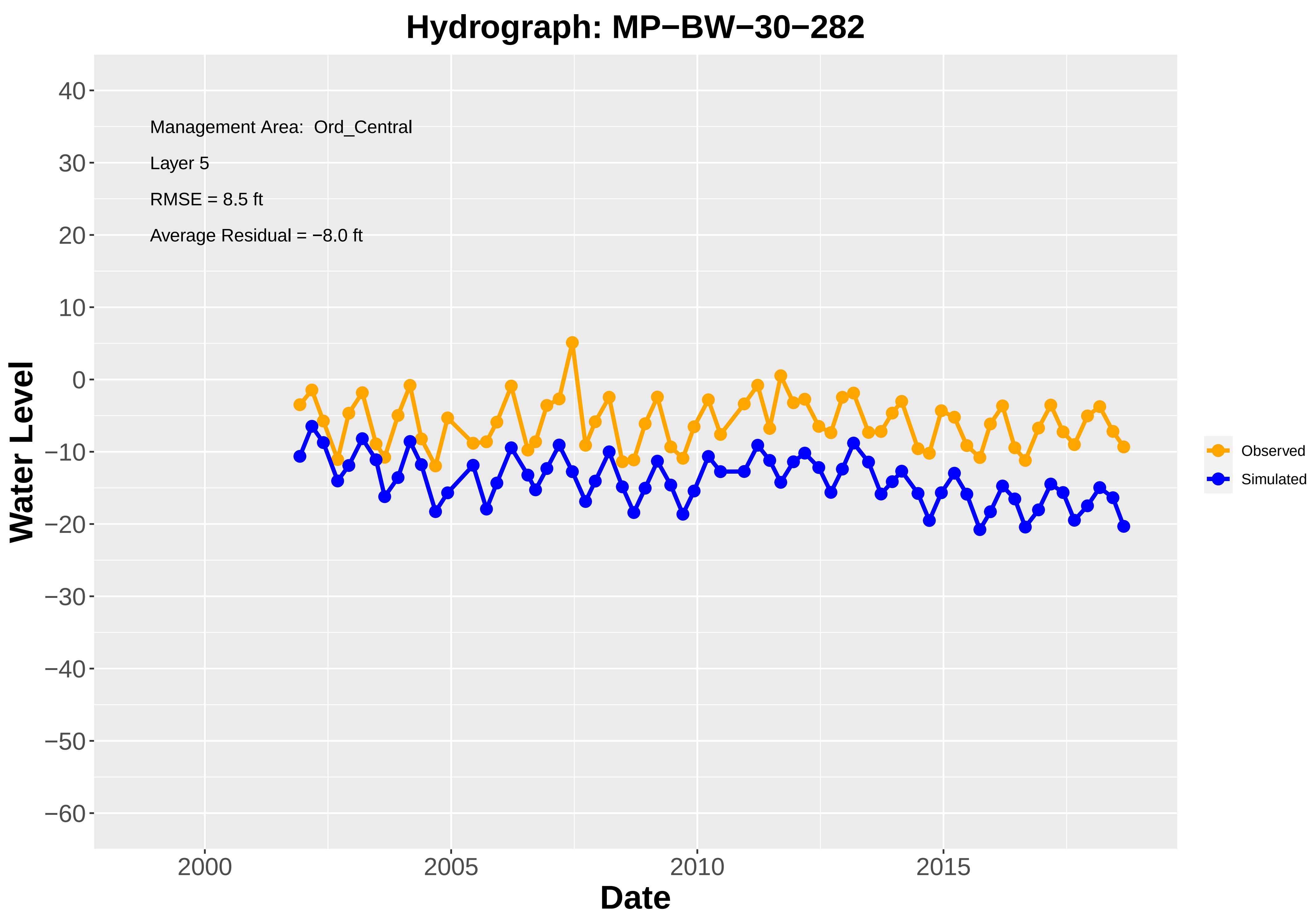

Hydrograph: MCWRA_21699
Management Area: Marina
Layer 3
RMSE = 6.5 ft
Average Residual = 6.3 ft
Water Level
Date
Observed
Simulated
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015

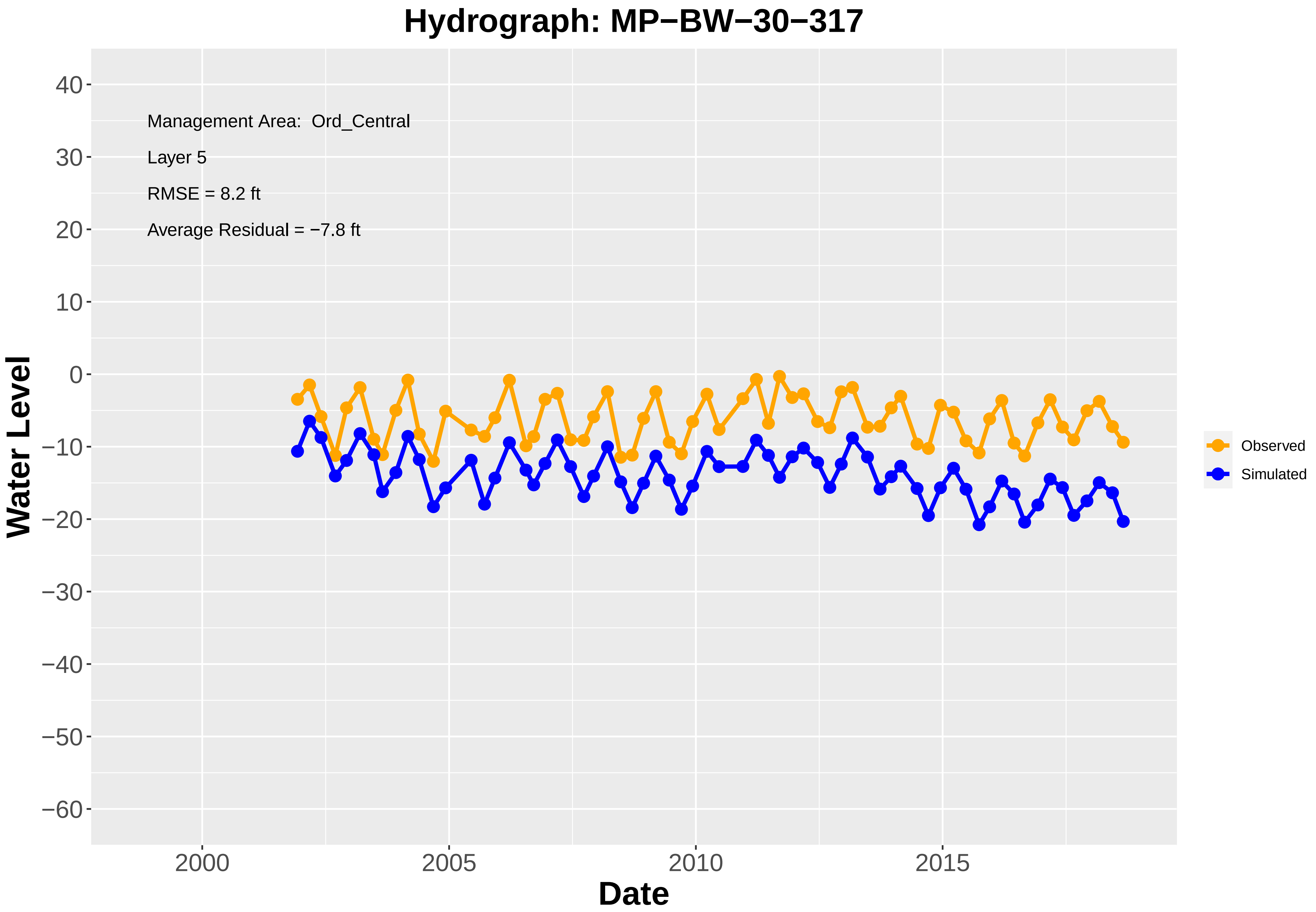


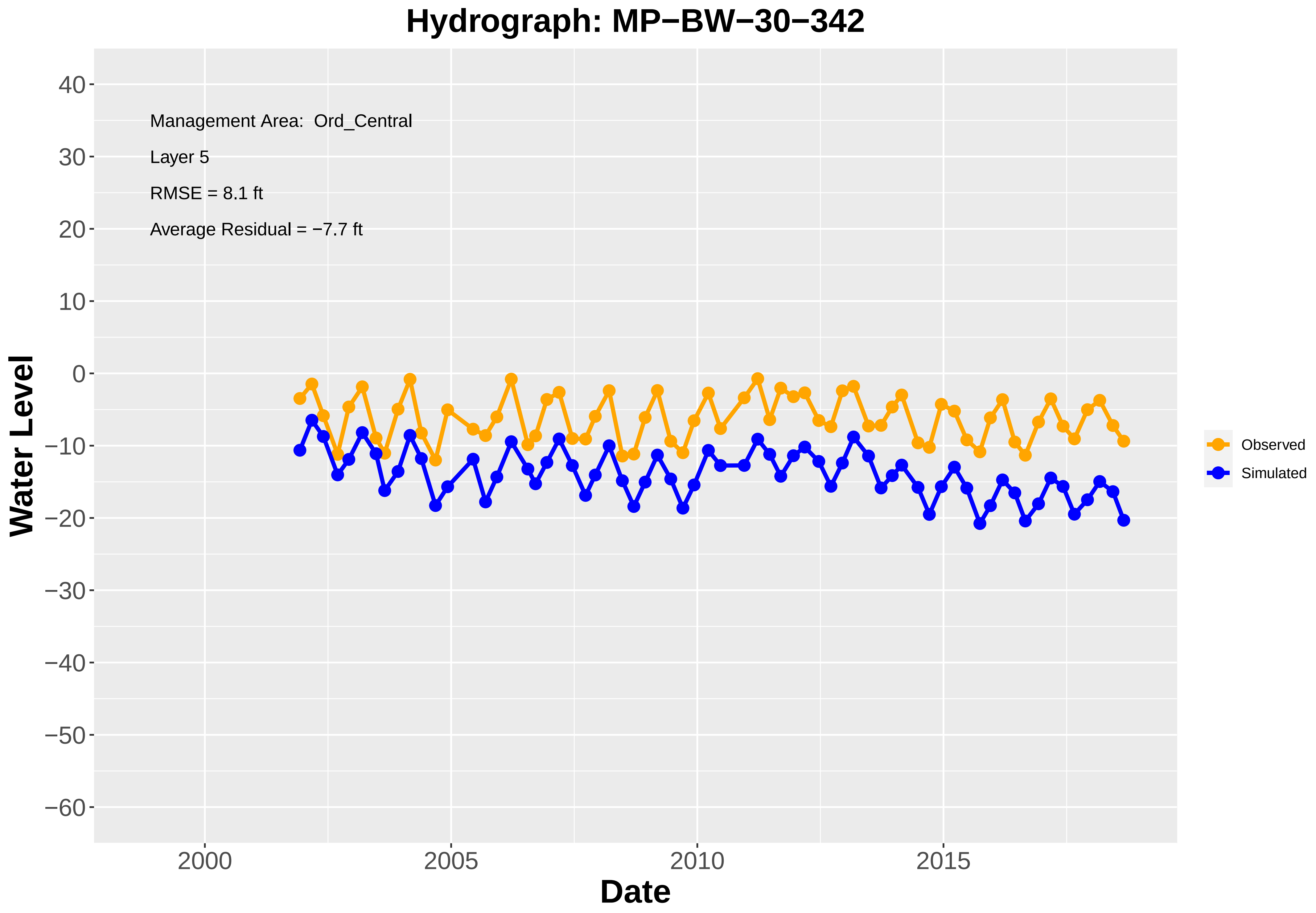
Hydrograph: MCWRA_541
Management Area: Corral de Tierra
Layer 8
RMSE = 7.9 ft
Average Residual = −4.9 ft
Water Level
Date
280
270
260
250
240
230
220
210
200
190
180
2000
2005
2010
2015
Observed
Simulated

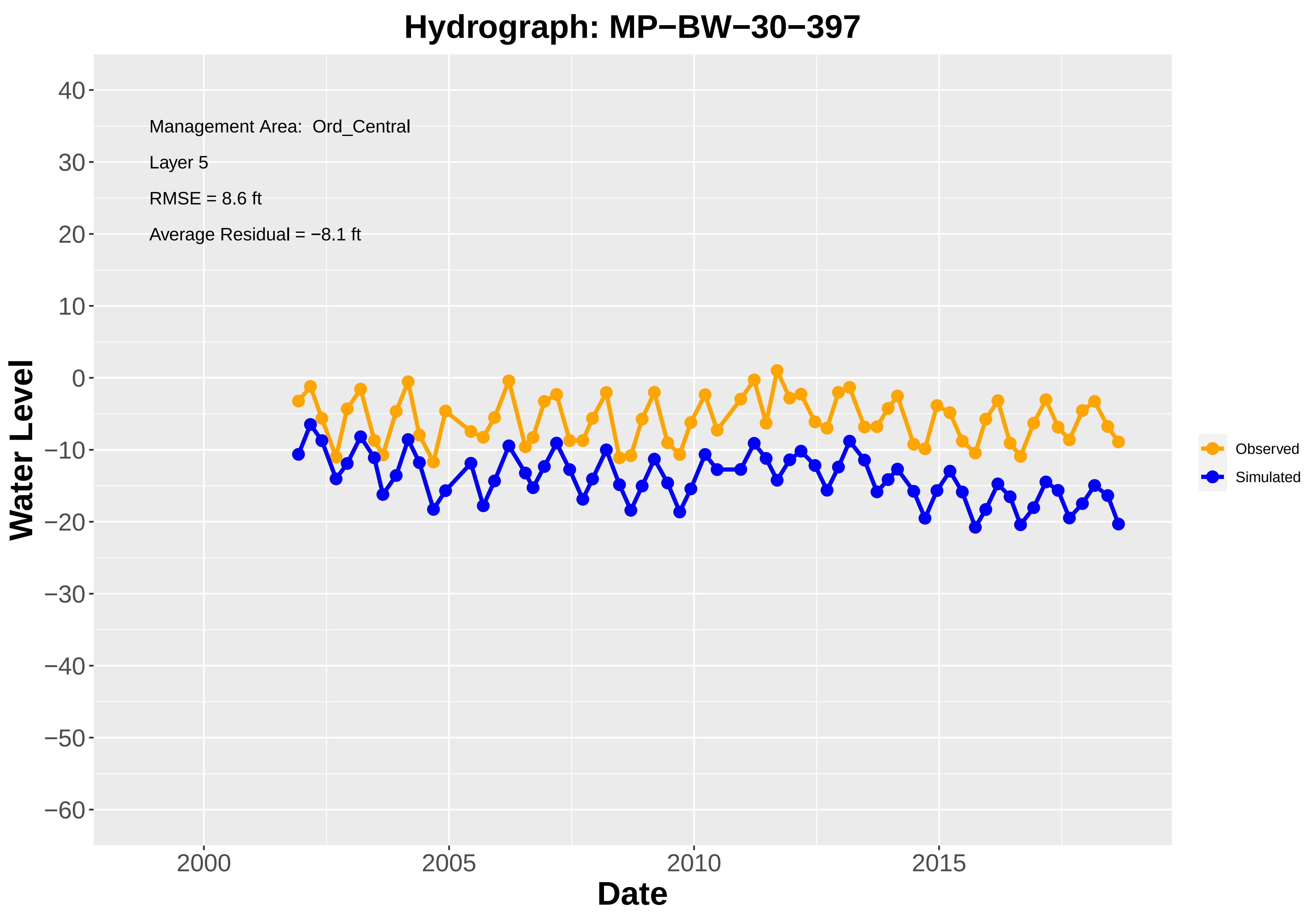

Hydrograph: MCWRA_707
Management Area: Corral de Tierra
Layer 8
RMSE = 72.0 ft
Average Residual = 71.6 ft
Water Level
160
150
140
130
120
110
100
90
80
70
60
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MCWRA_862
Management Area: North of Basin
Layer 3
RMSE = 5.6 ft
Average Residual = −4.5 ft
Water Level
Date
Observed
Simulated
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015

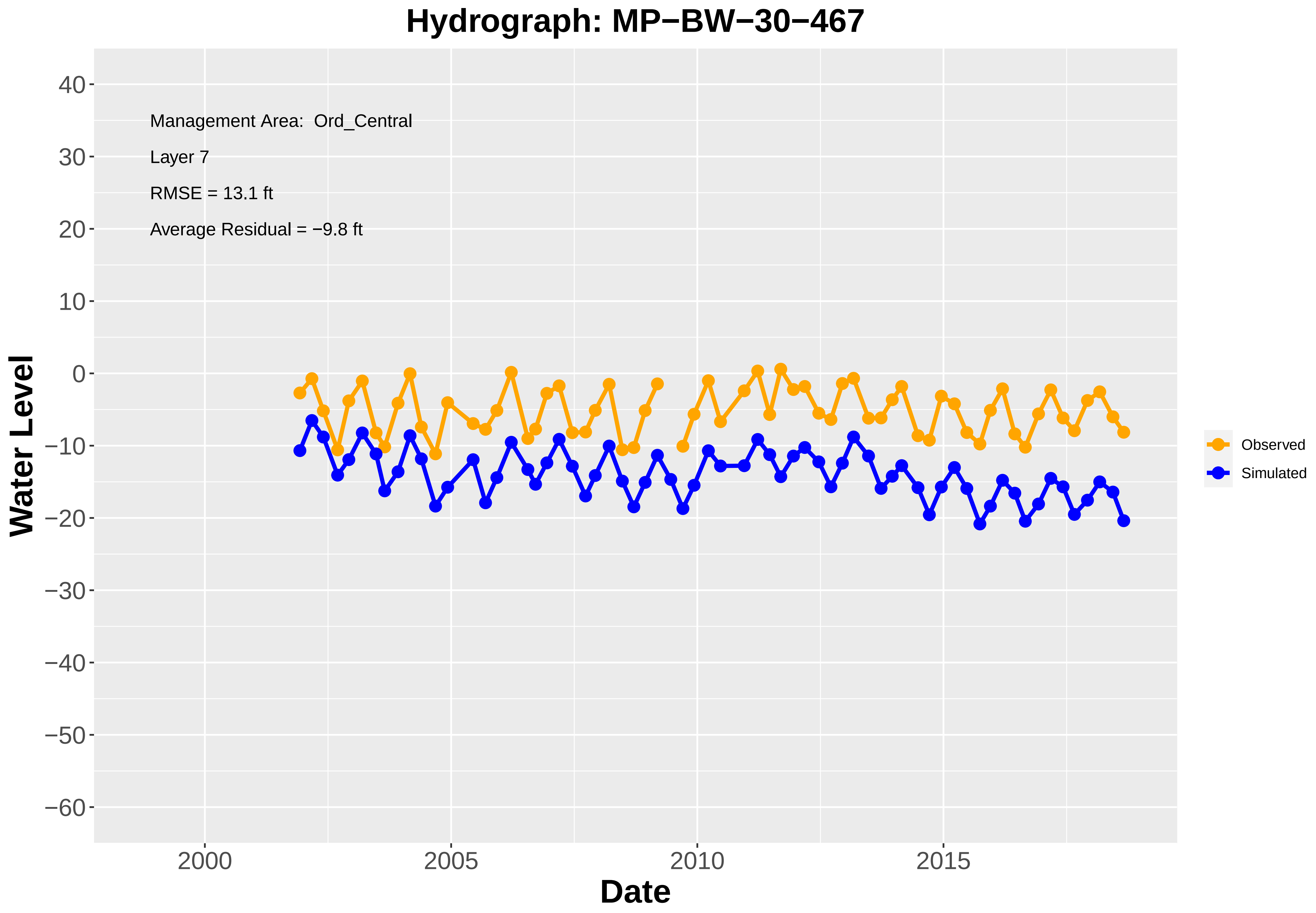

Hydrograph: MP−BW−30−282
Management Area: Ord_Central
Layer 5
RMSE = 8.5 ft
Average Residual = −8.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−30−317
Management Area: Ord_Central
Layer 5
RMSE = 8.2 ft
Average Residual = −7.8 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

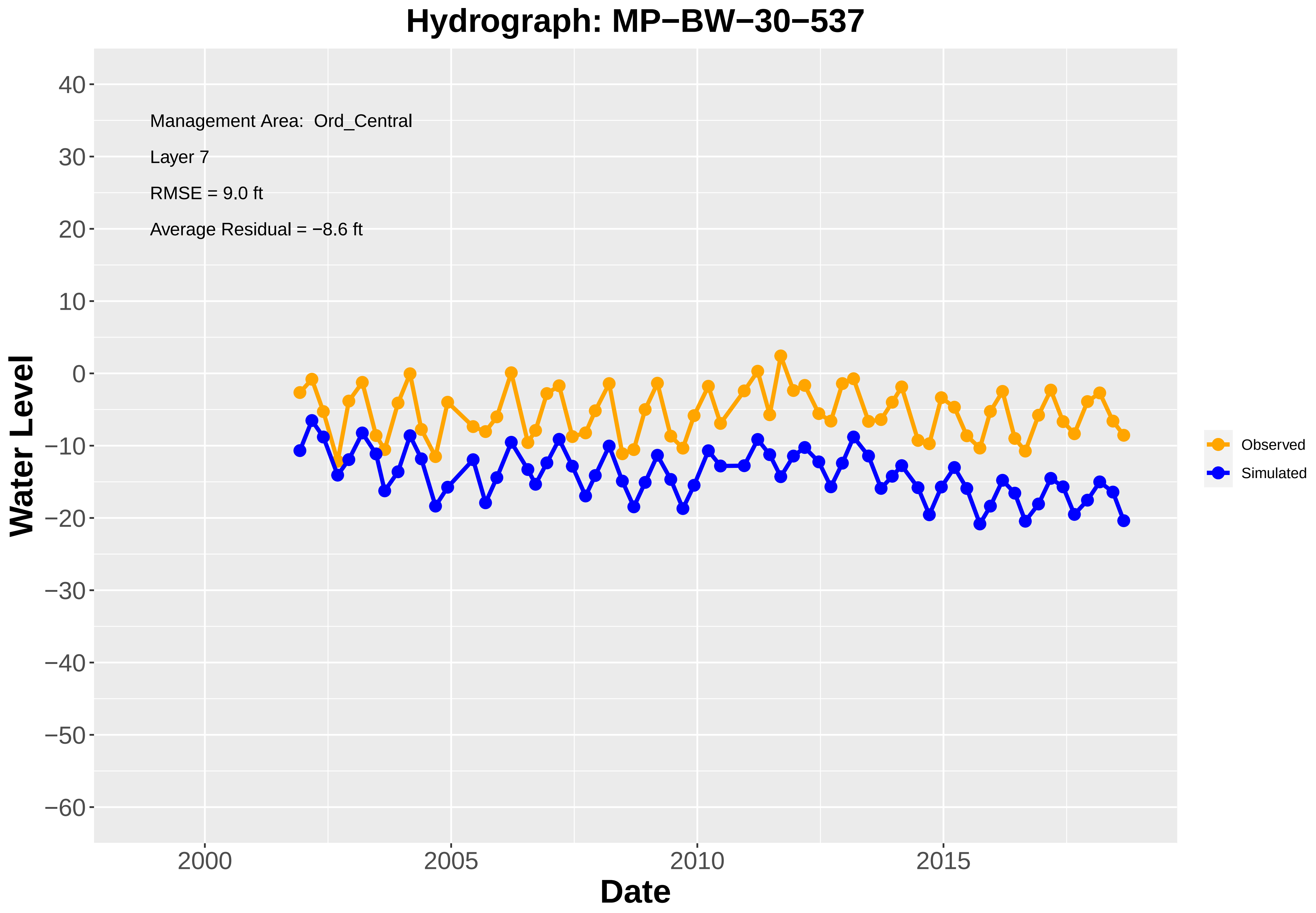

Hydrograph: MP−BW−30−342
Management Area: Ord_Central
Layer 5
RMSE = 8.1 ft
Average Residual = −7.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



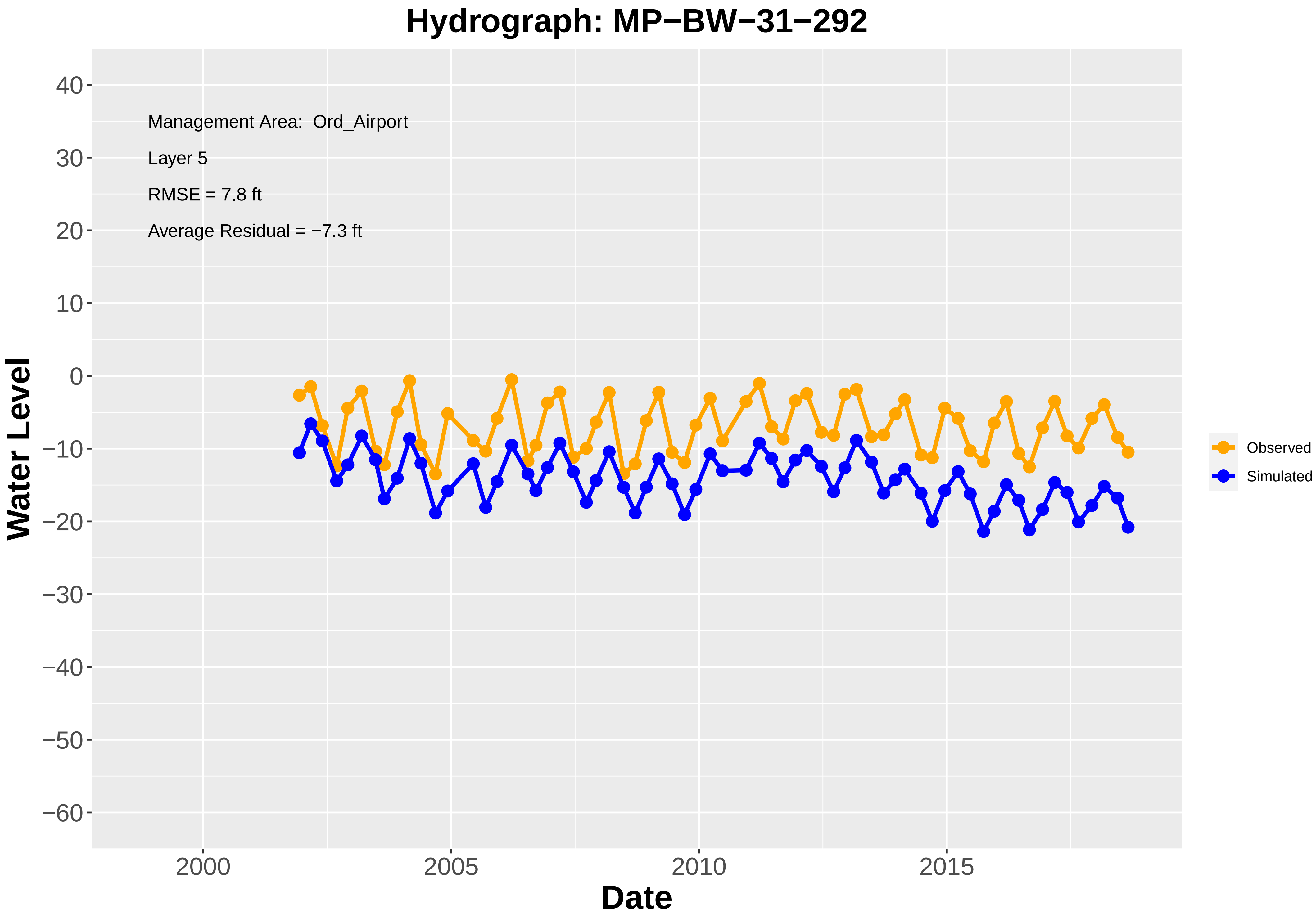
Hydrograph: MP−BW−30−397
Management Area: Ord_Central
Layer 5
RMSE = 8.6 ft
Average Residual = −8.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

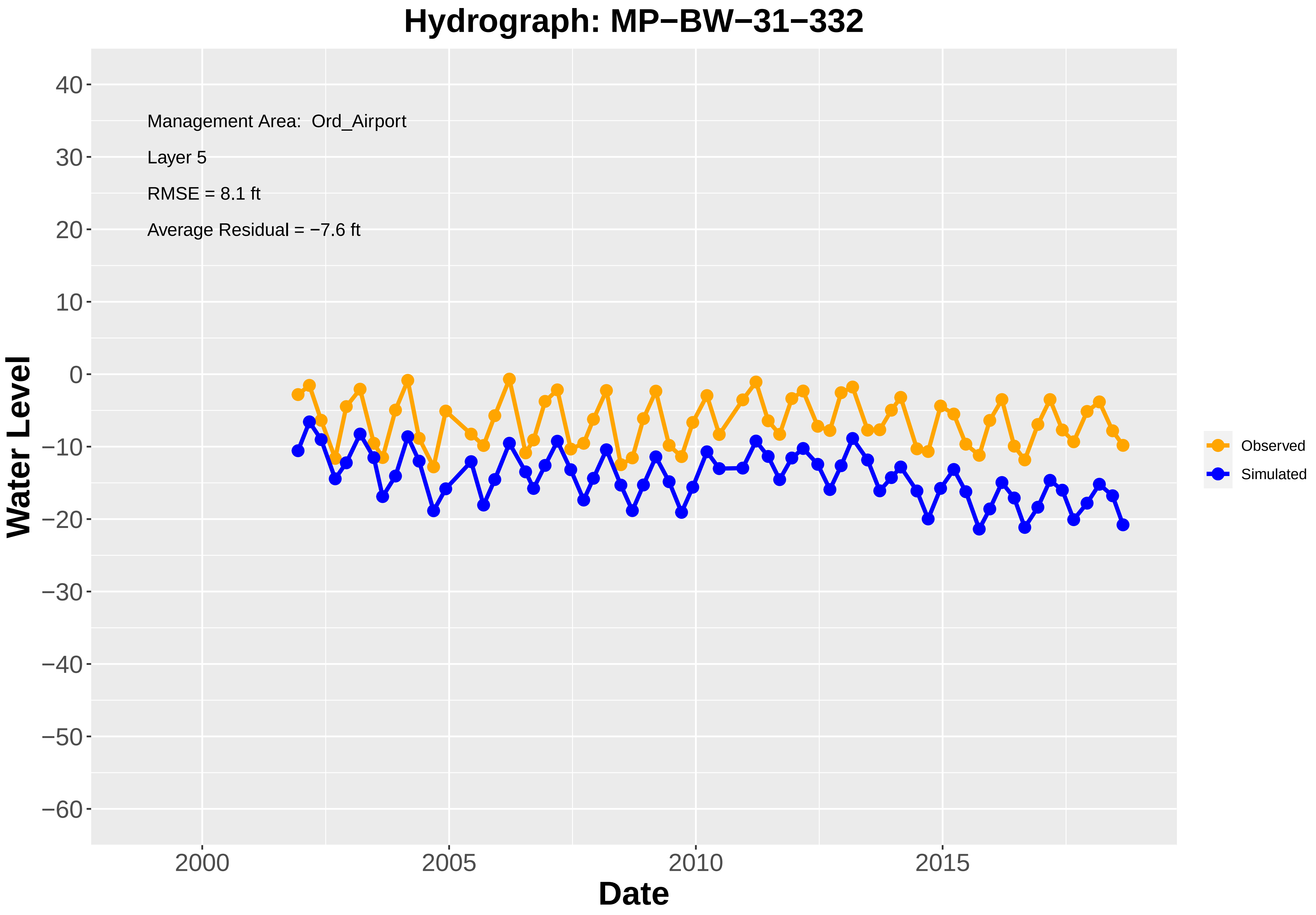


Hydrograph: MP−BW−30−467
Management Area: Ord_Central
Layer 7
RMSE = 13.1 ft
Average Residual = −9.8 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

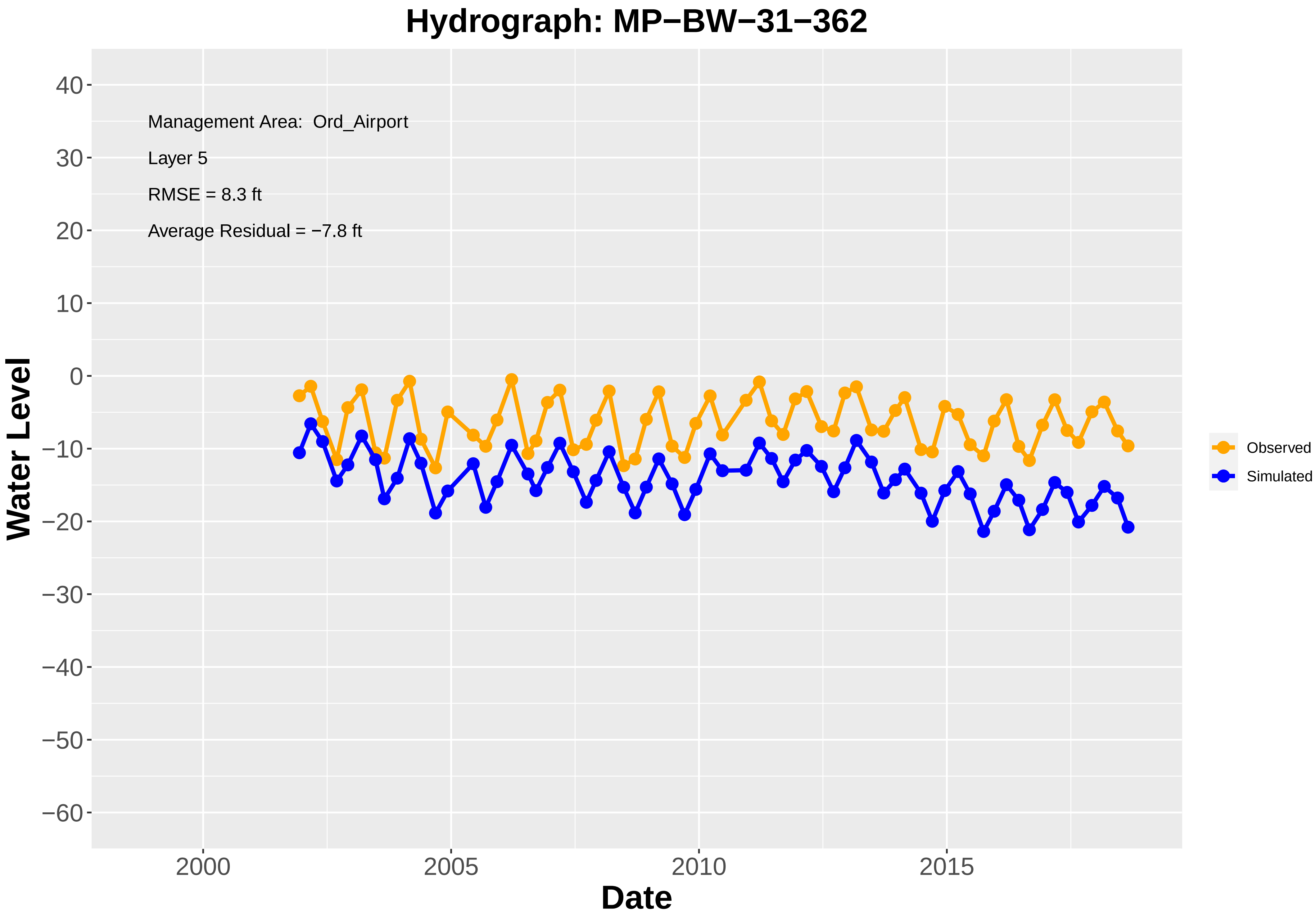


Hydrograph: MP−BW−30−537
Management Area: Ord_Central
Layer 7
RMSE = 9.0 ft
Average Residual = −8.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

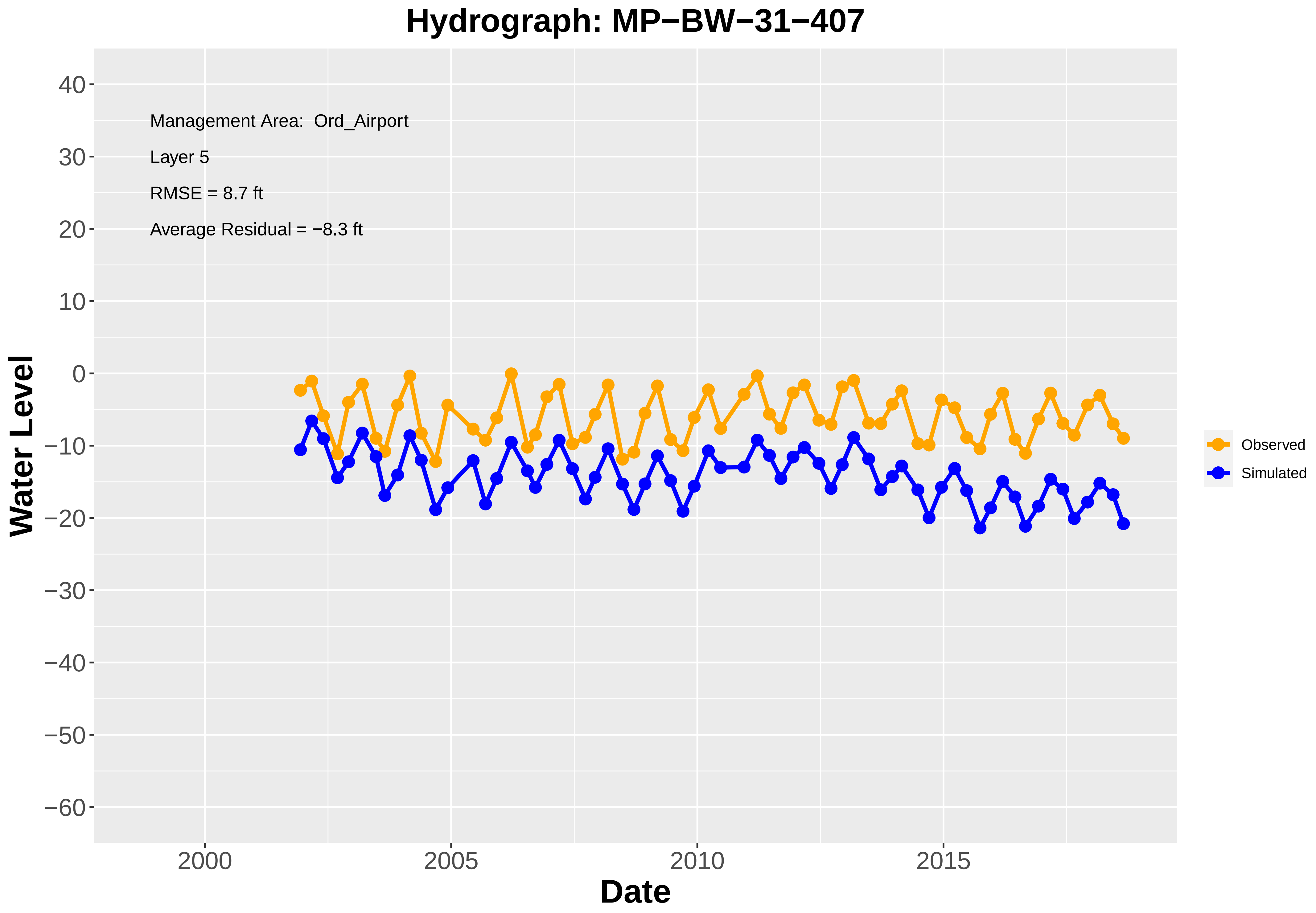

Hydrograph: MP−BW−31−292
Management Area: Ord_Airport
Layer 5
RMSE = 7.8 ft
Average Residual = −7.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



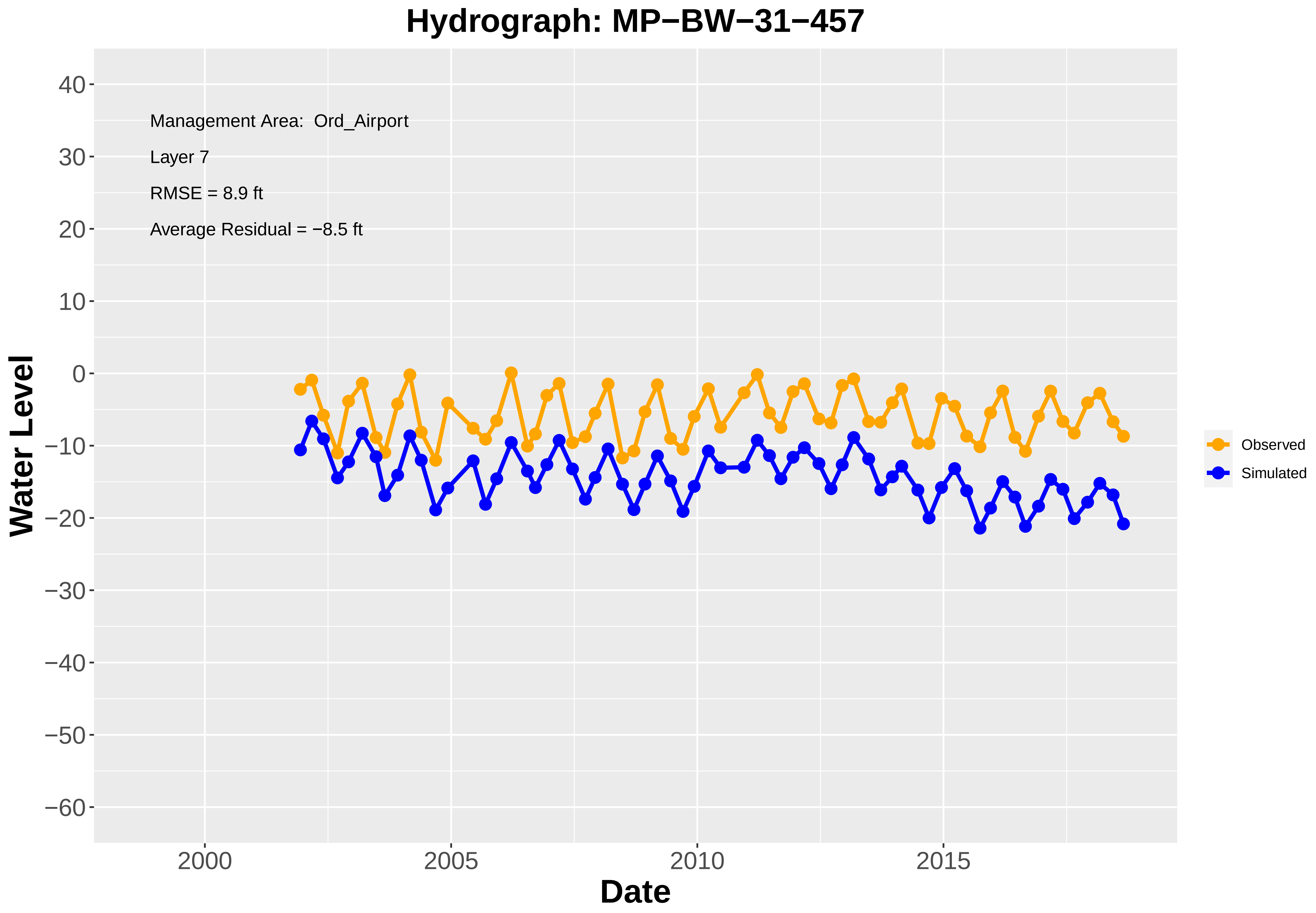
Hydrograph: MP−BW−31−332
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



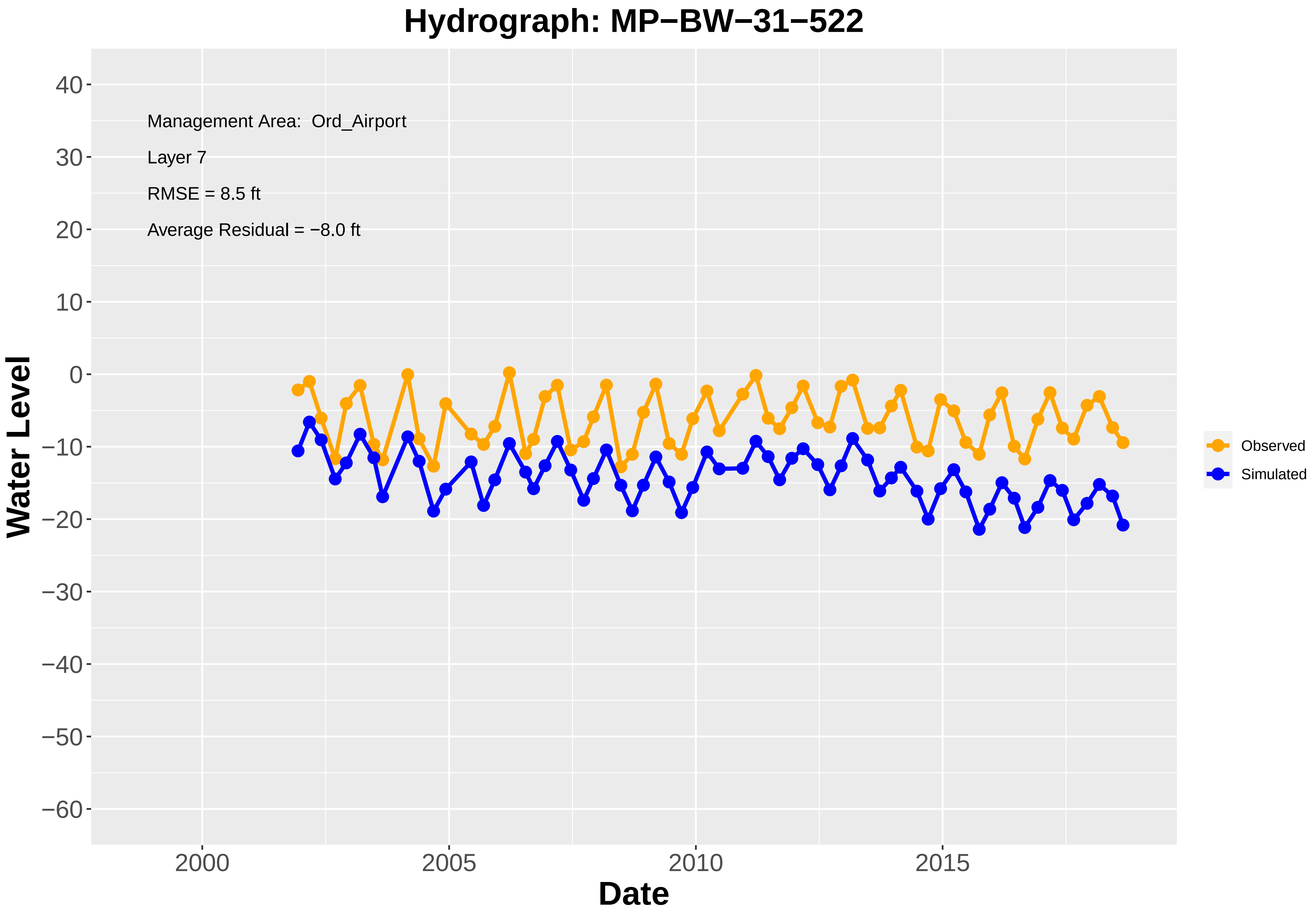
Hydrograph: MP−BW−31−362
Management Area: Ord_Airport
Layer 5
RMSE = 8.3 ft
Average Residual = −7.8 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



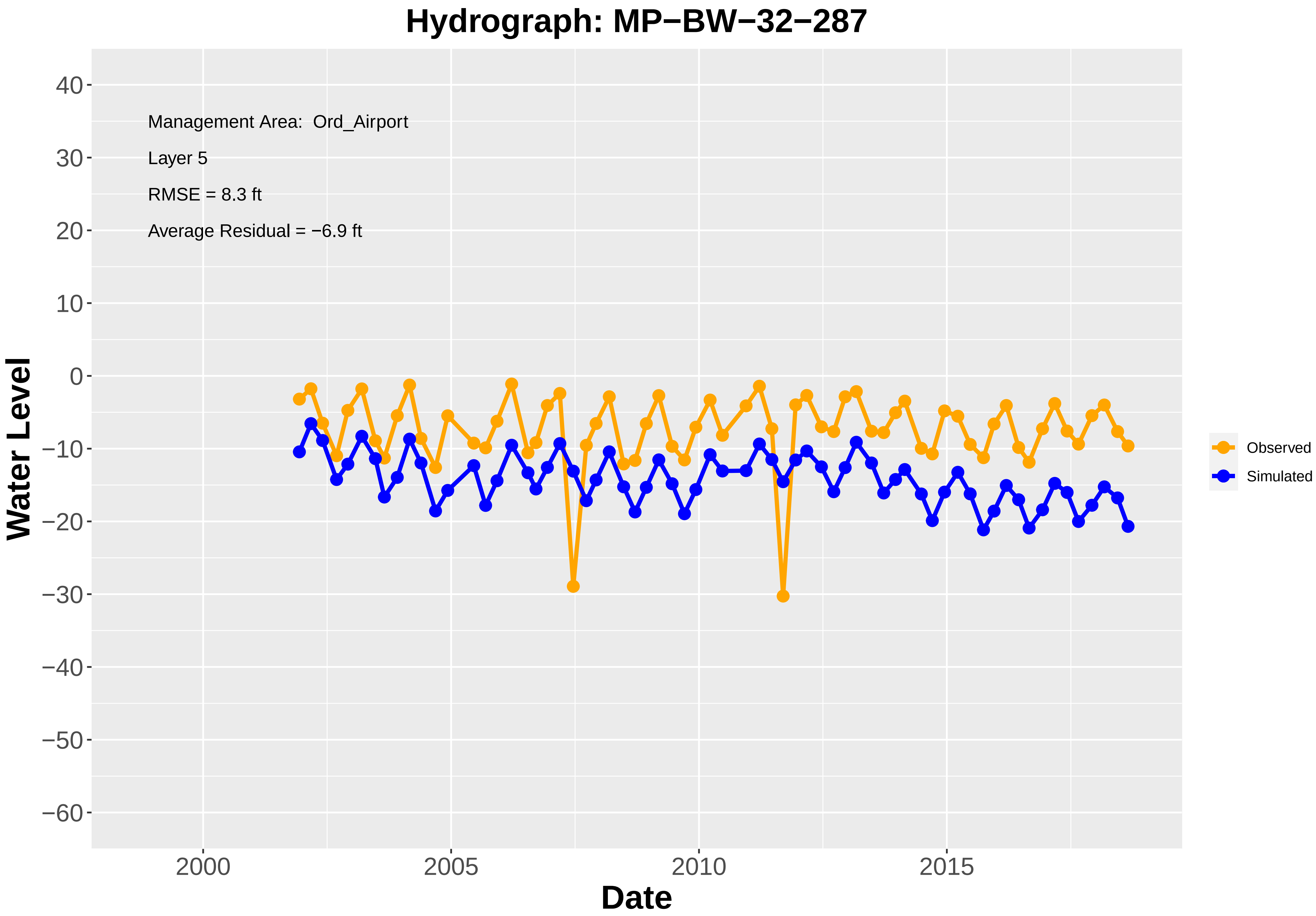
Hydrograph: MP−BW−31−407
Management Area: Ord_Airport
Layer 5
RMSE = 8.7 ft
Average Residual = −8.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

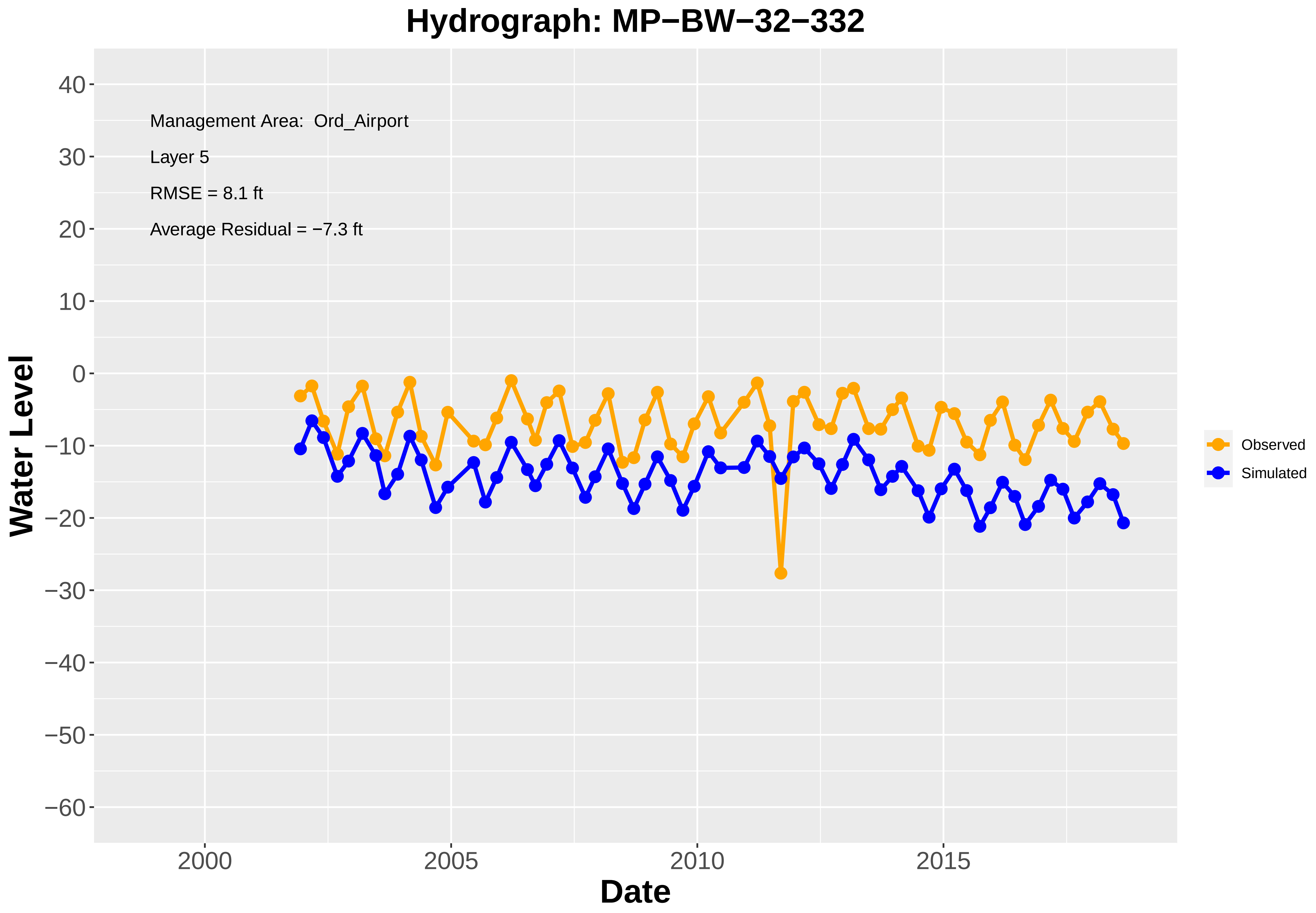


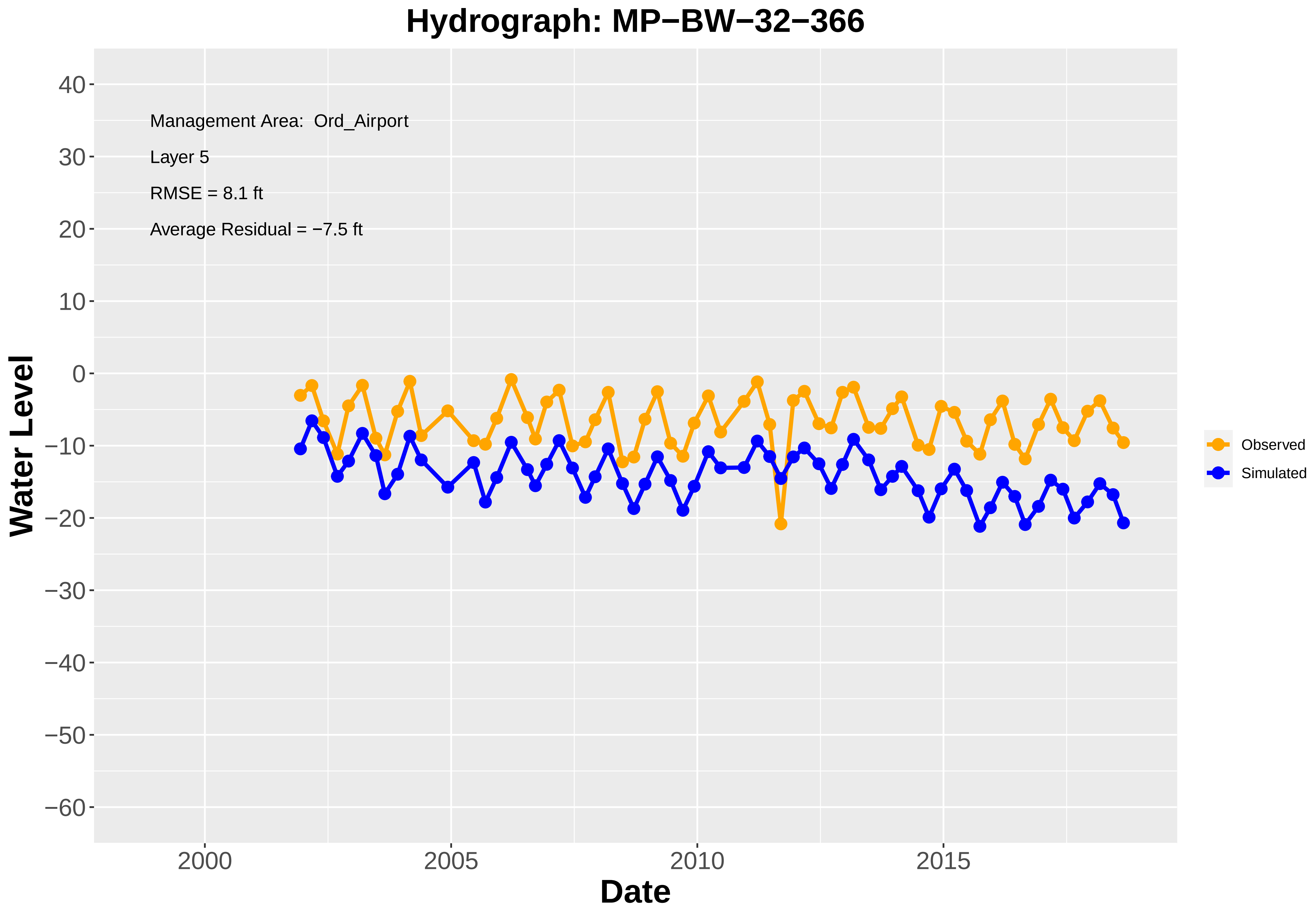
Hydrograph: MP−BW−31−457
Management Area: Ord_Airport
Layer 7
RMSE = 8.9 ft
Average Residual = −8.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

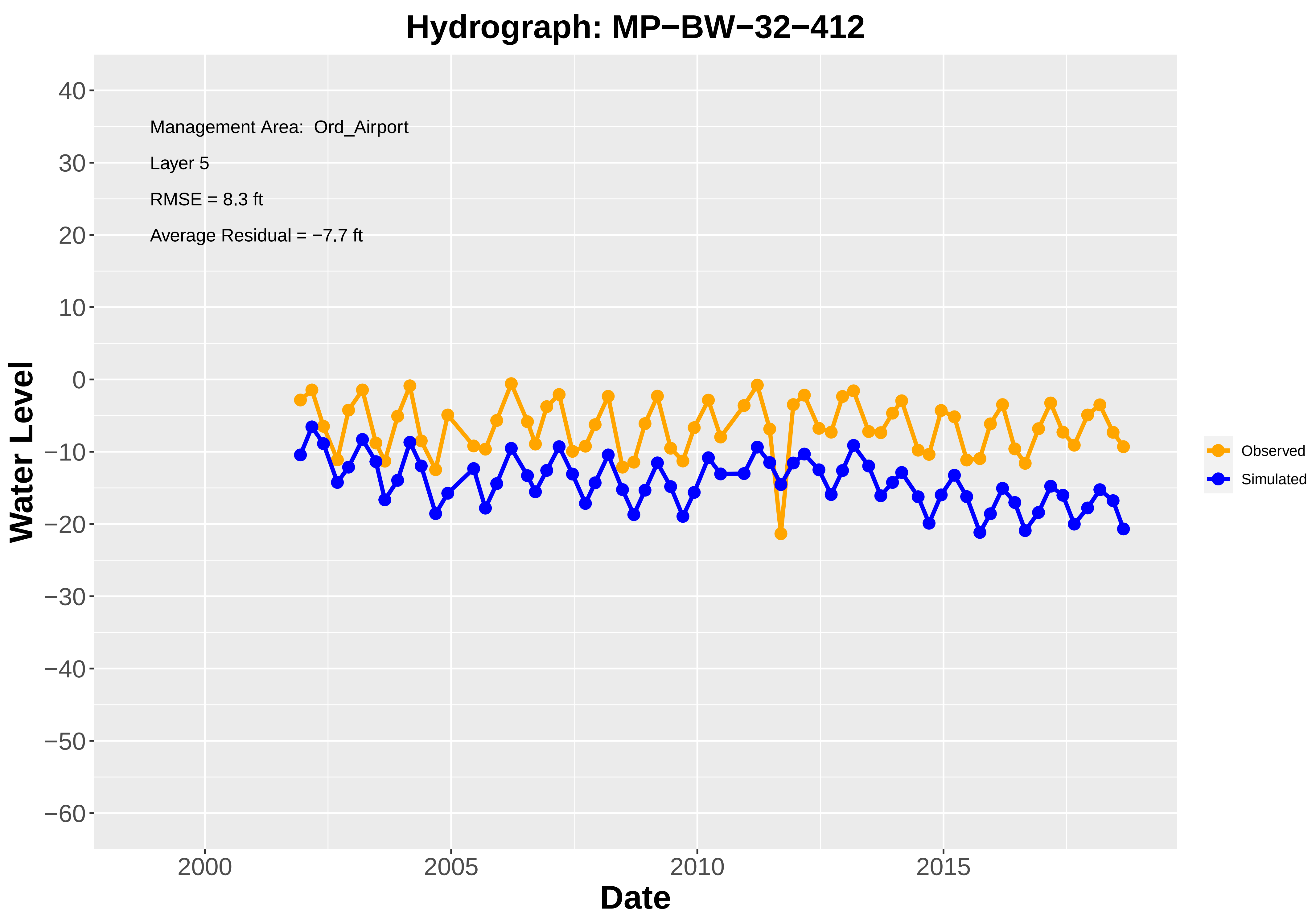


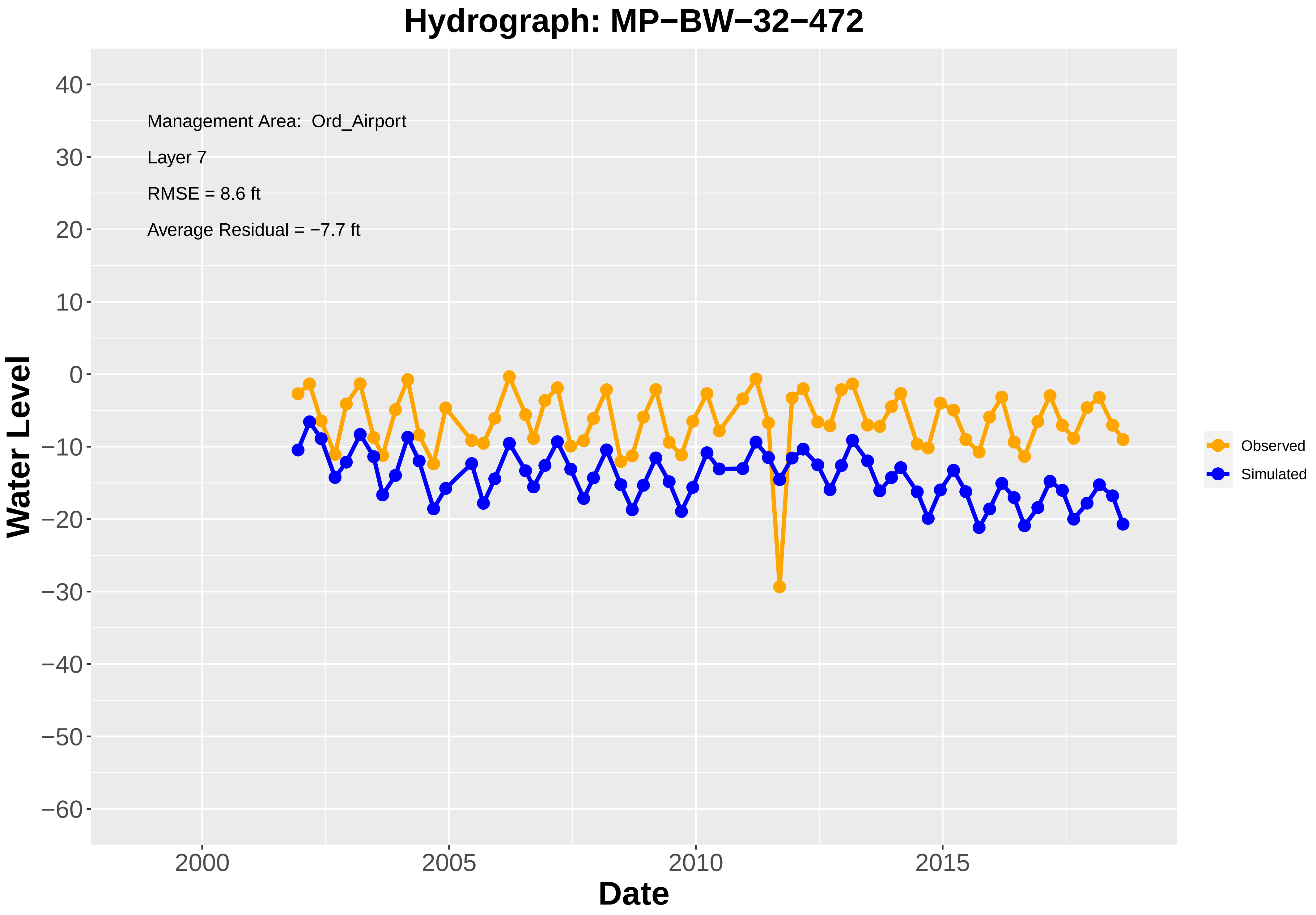
Hydrograph: MP−BW−31−522
Management Area: Ord_Airport
Layer 7
RMSE = 8.5 ft
Average Residual = −8.0 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−32−287
Management Area: Ord_Airport
Layer 5
RMSE = 8.3 ft
Average Residual = −6.9 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

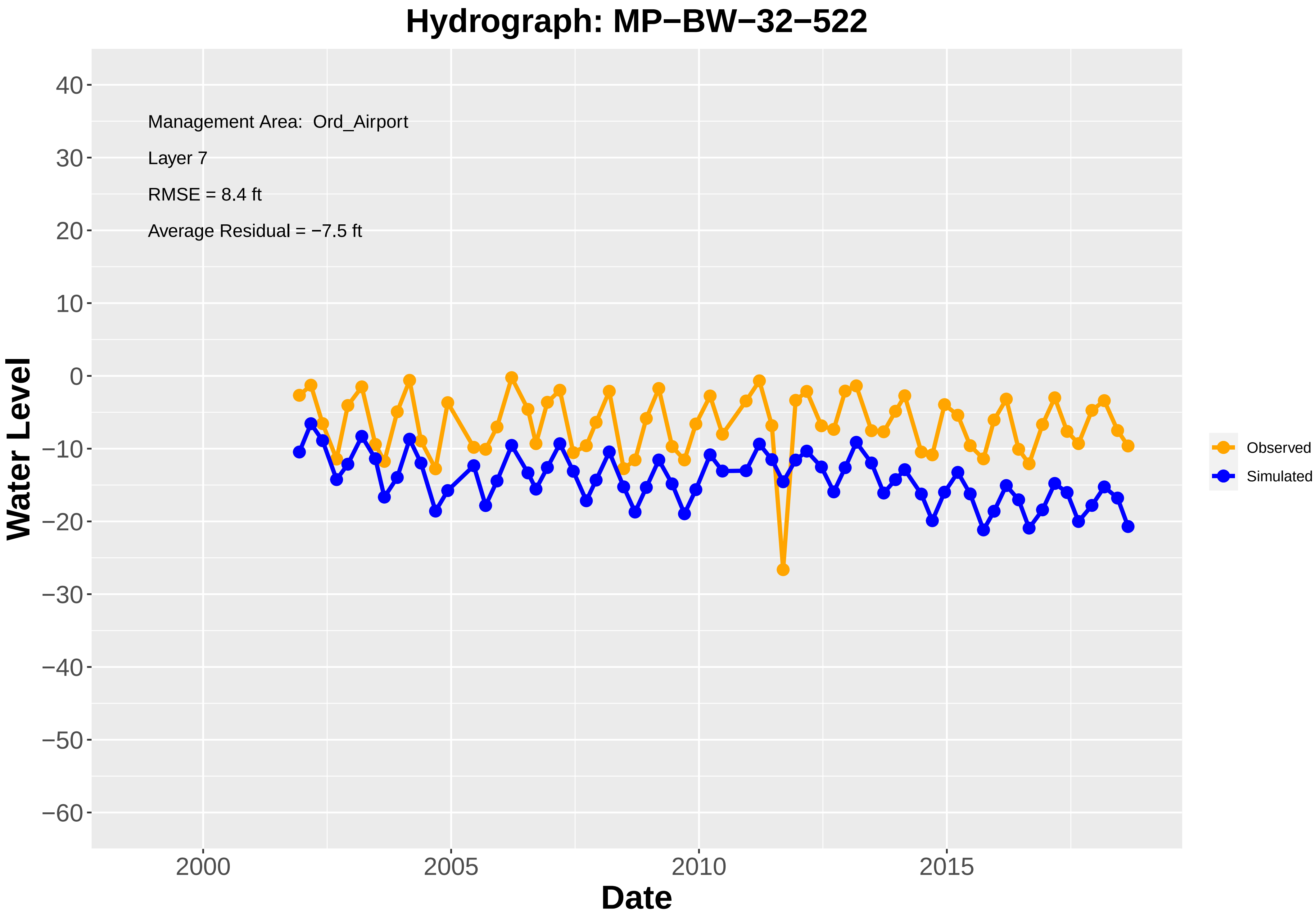

Hydrograph: MP−BW−32−332
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

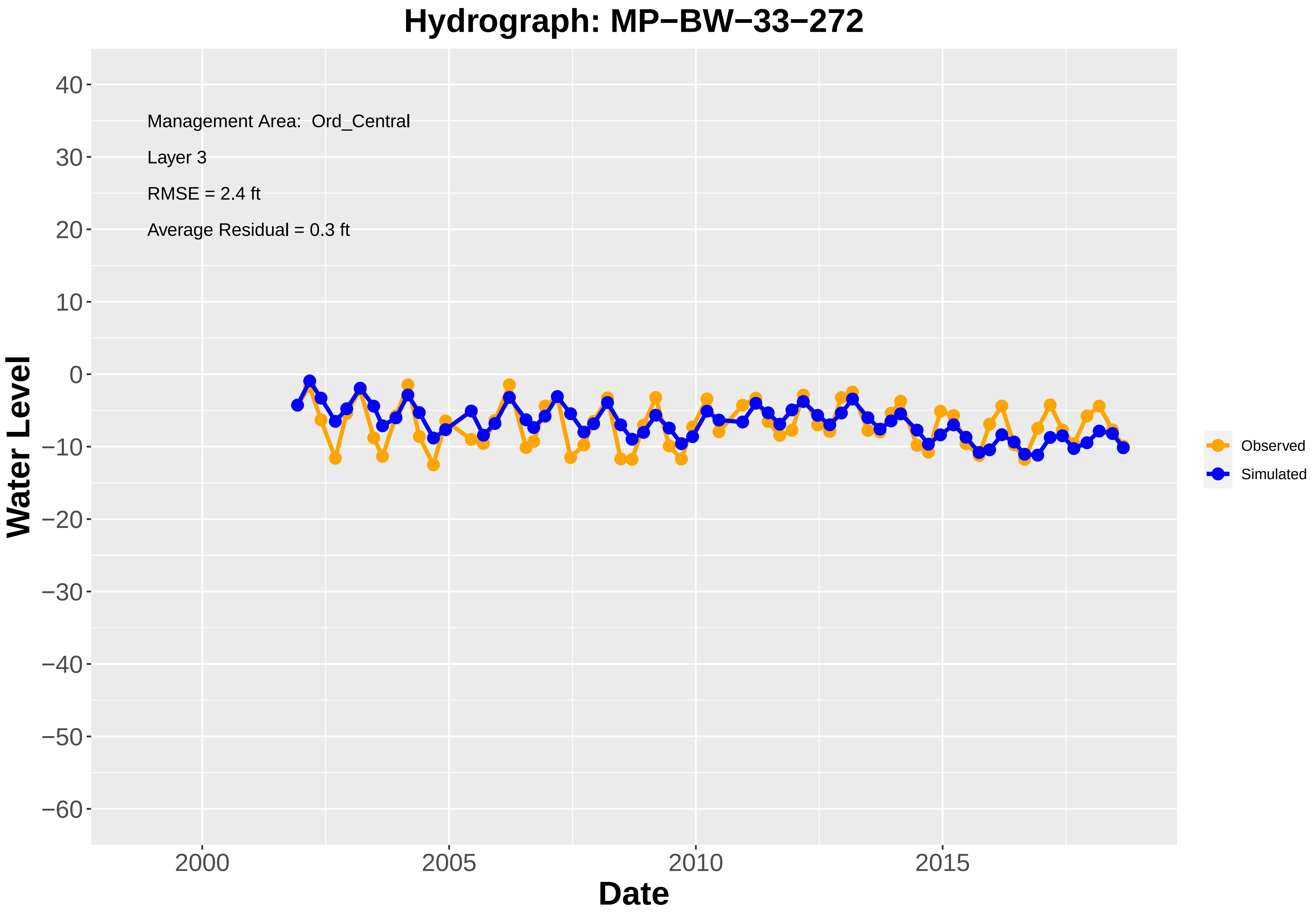

Hydrograph: MP−BW−32−366
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−32−412
Management Area: Ord_Airport
Layer 5
RMSE = 8.3 ft
Average Residual = −7.7 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

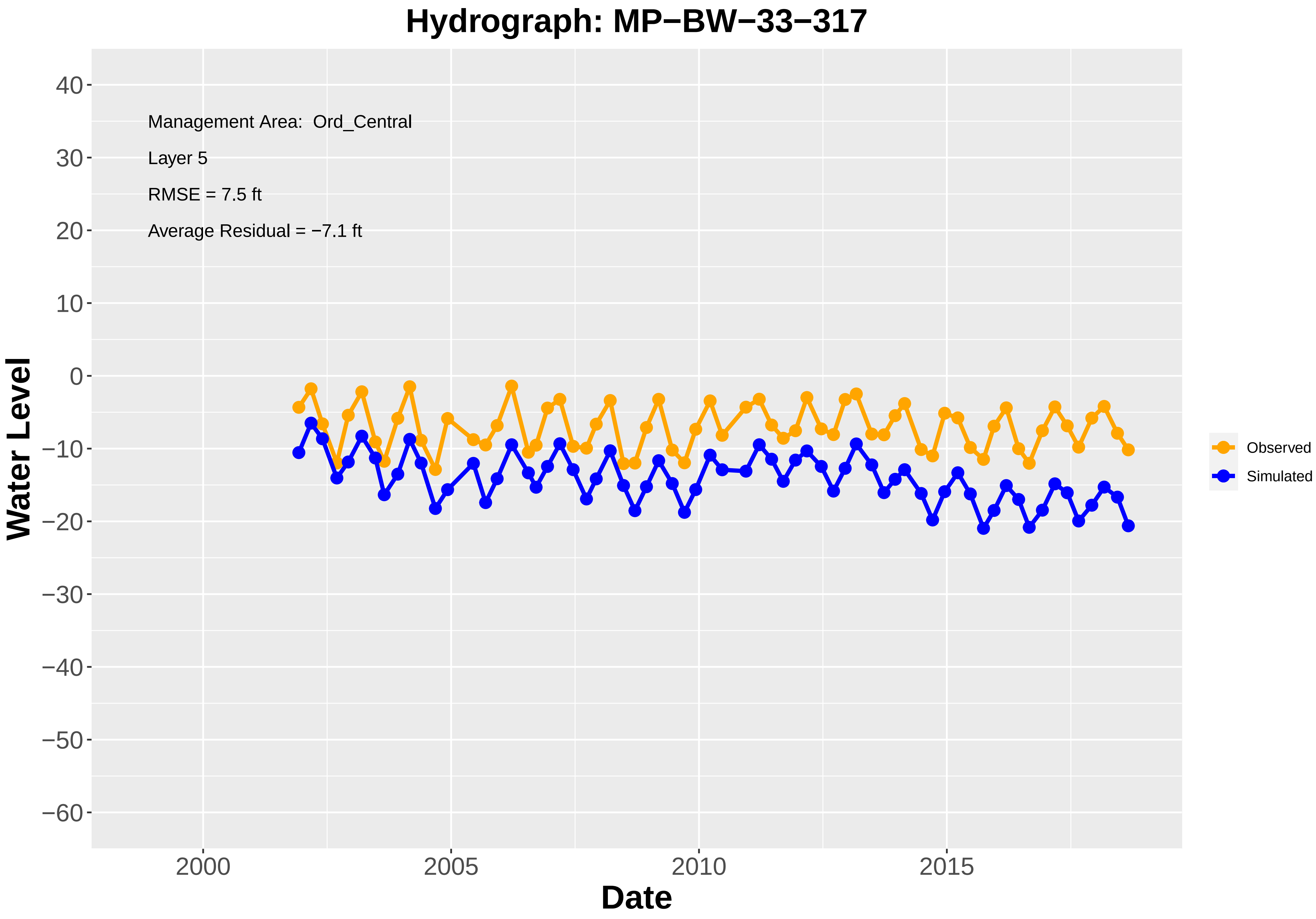


Hydrograph: MP−BW−32−472
Management Area: Ord_Airport
Layer 7
RMSE = 8.6 ft
Average Residual = −7.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

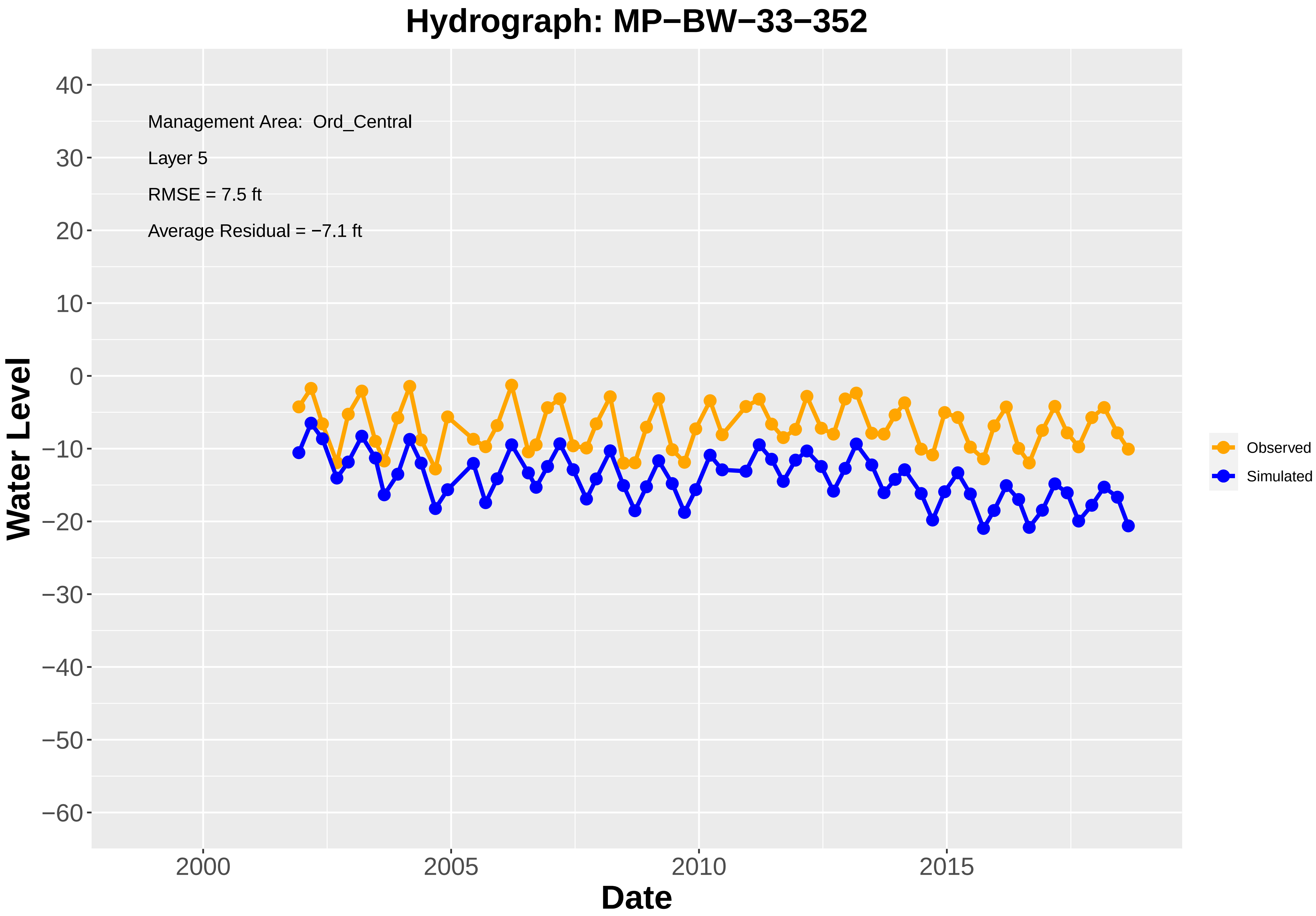

Hydrograph: MP−BW−32−522
Management Area: Ord_Airport
Layer 7
RMSE = 8.4 ft
Average Residual = −7.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



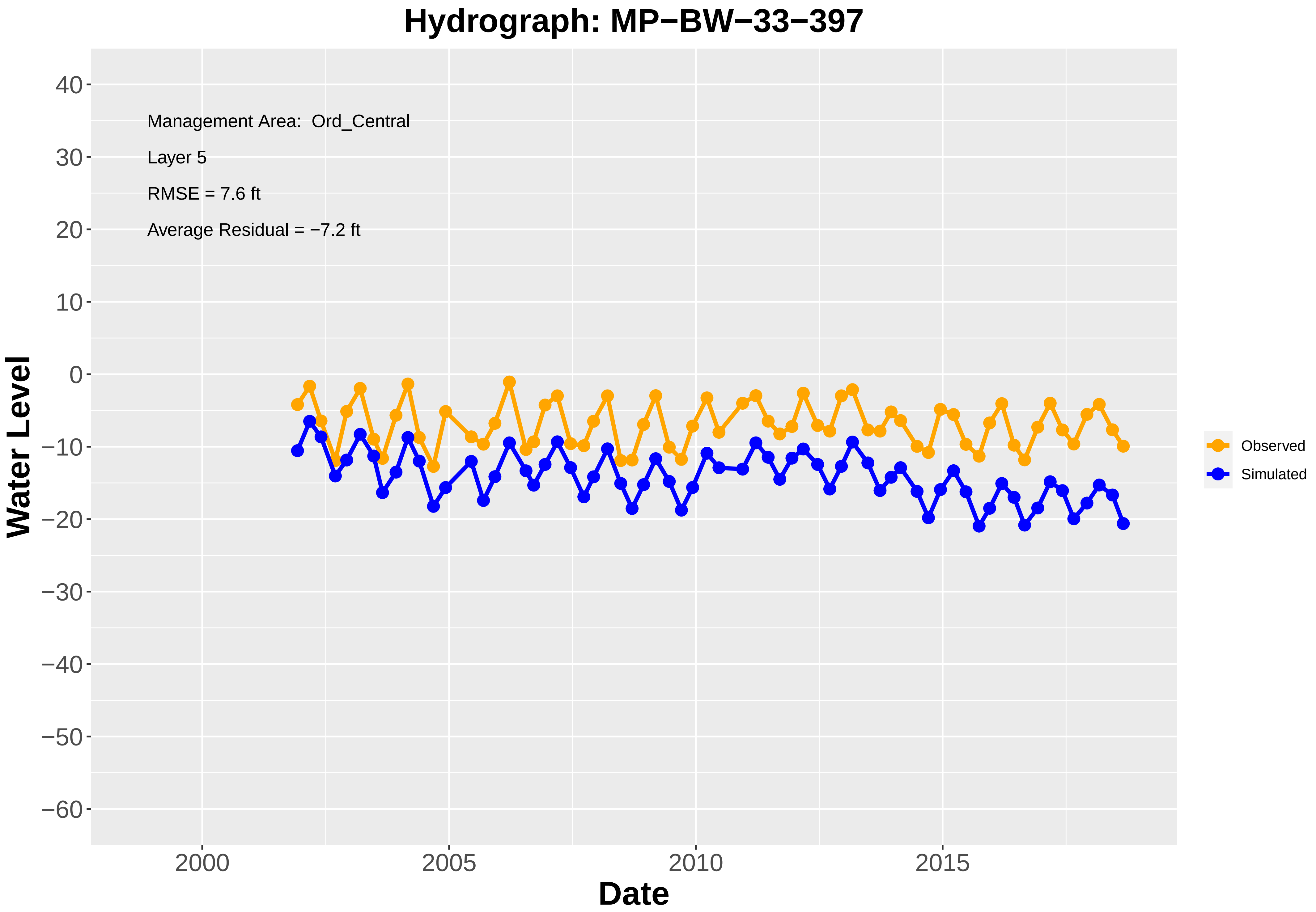
Hydrograph: MP−BW−33−272
Management Area: Ord_Central
Layer 3
RMSE = 2.4 ft
Average Residual = 0.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

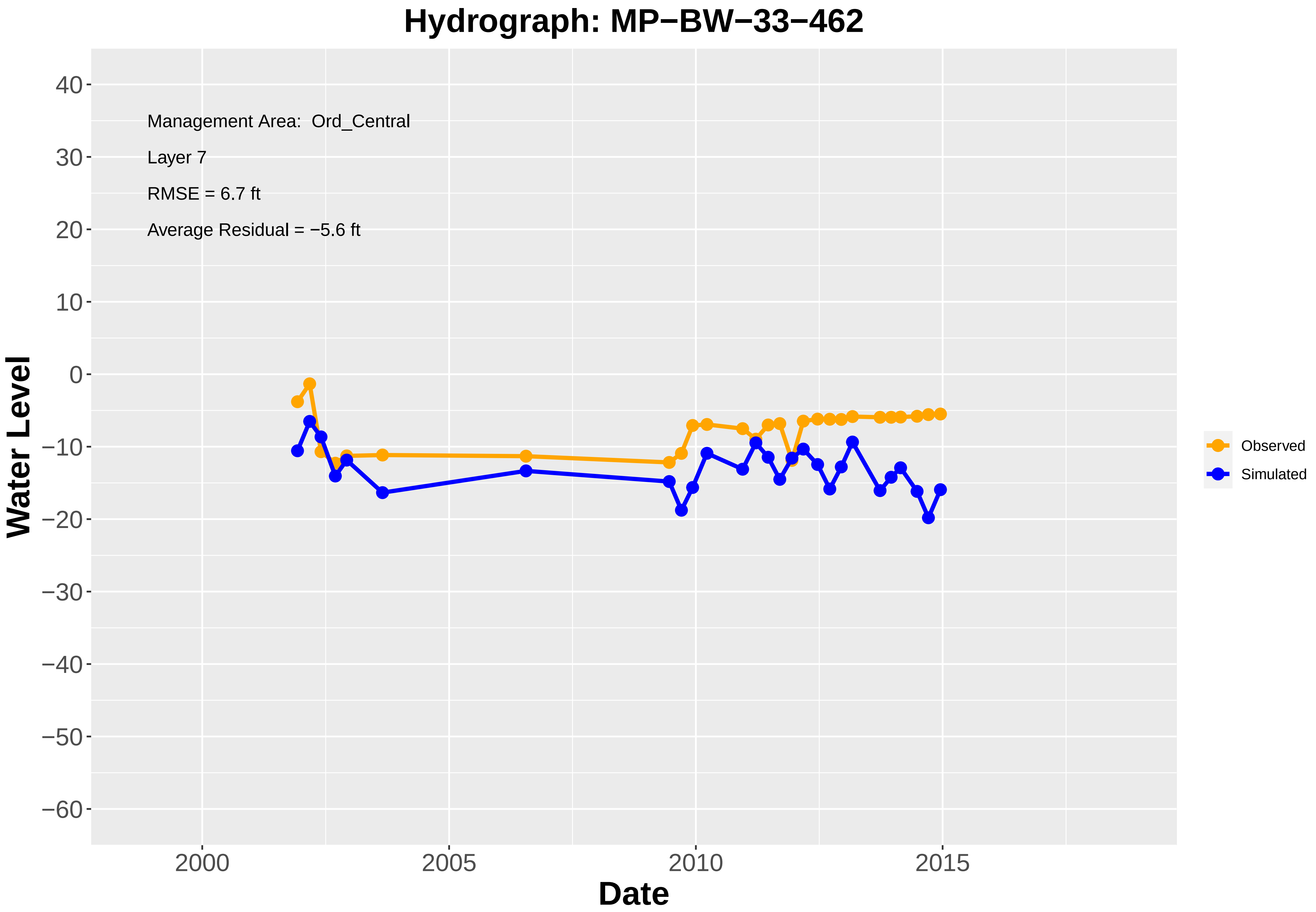


Hydrograph: MP−BW−33−317
Management Area: Ord_Central
Layer 5
RMSE = 7.5 ft
Average Residual = −7.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

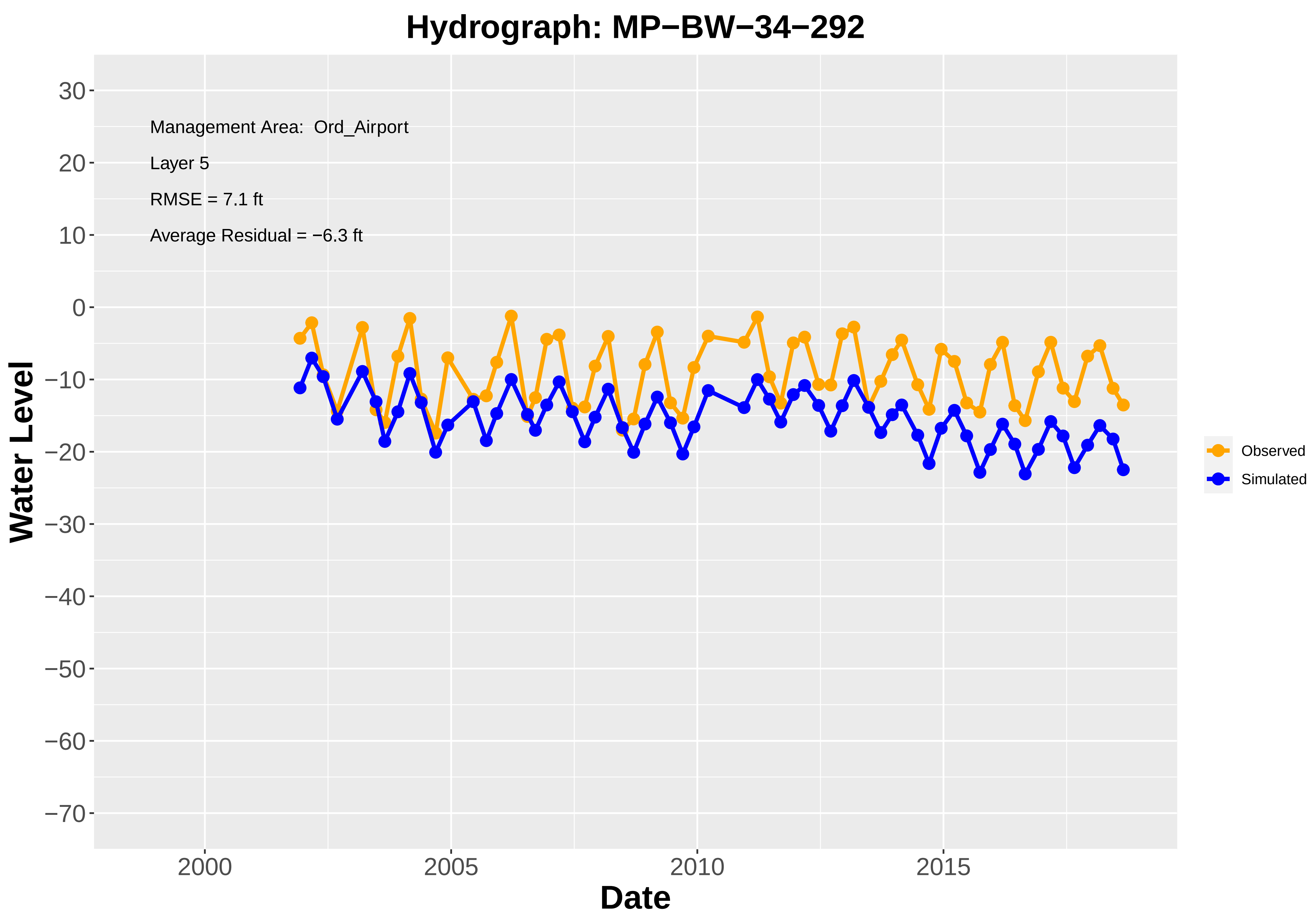


Hydrograph: MP−BW−33−352
Management Area: Ord_Central
Layer 5
RMSE = 7.5 ft
Average Residual = −7.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

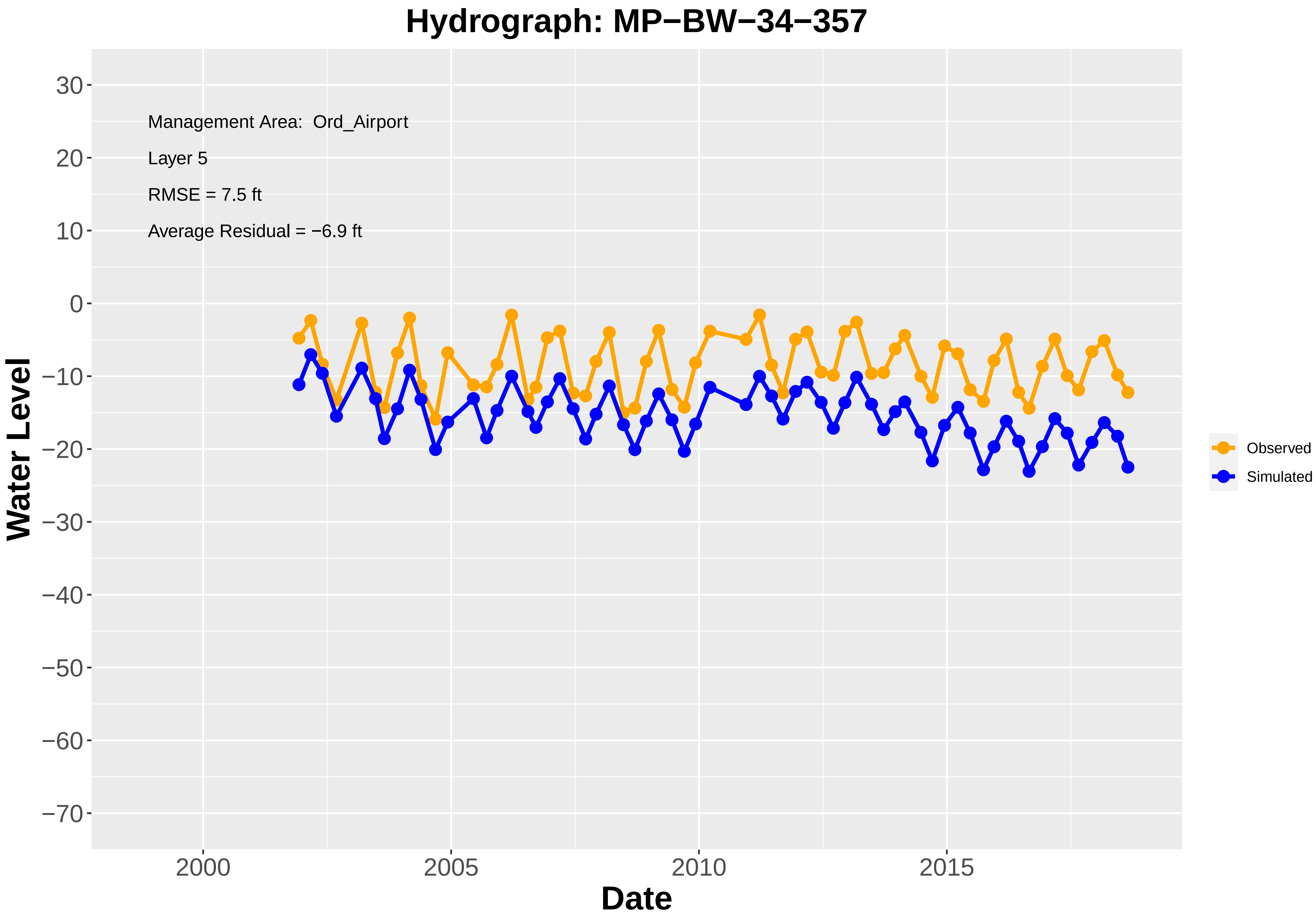

Hydrograph: MP−BW−33−397
Management Area: Ord_Central
Layer 5
RMSE = 7.6 ft
Average Residual = −7.2 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



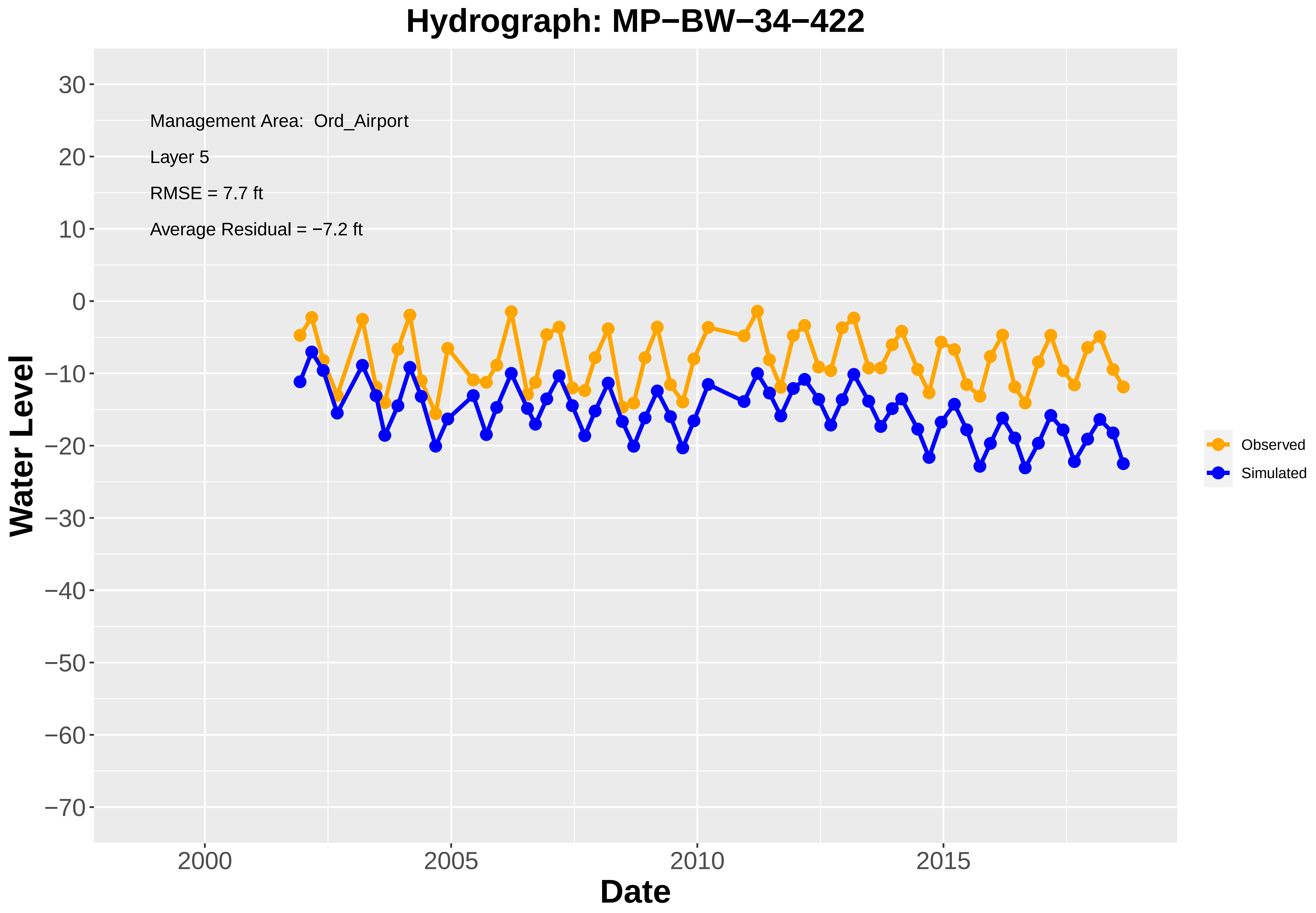
Hydrograph: MP−BW−33−462
Management Area: Ord_Central
Layer 7
RMSE = 6.7 ft
Average Residual = −5.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



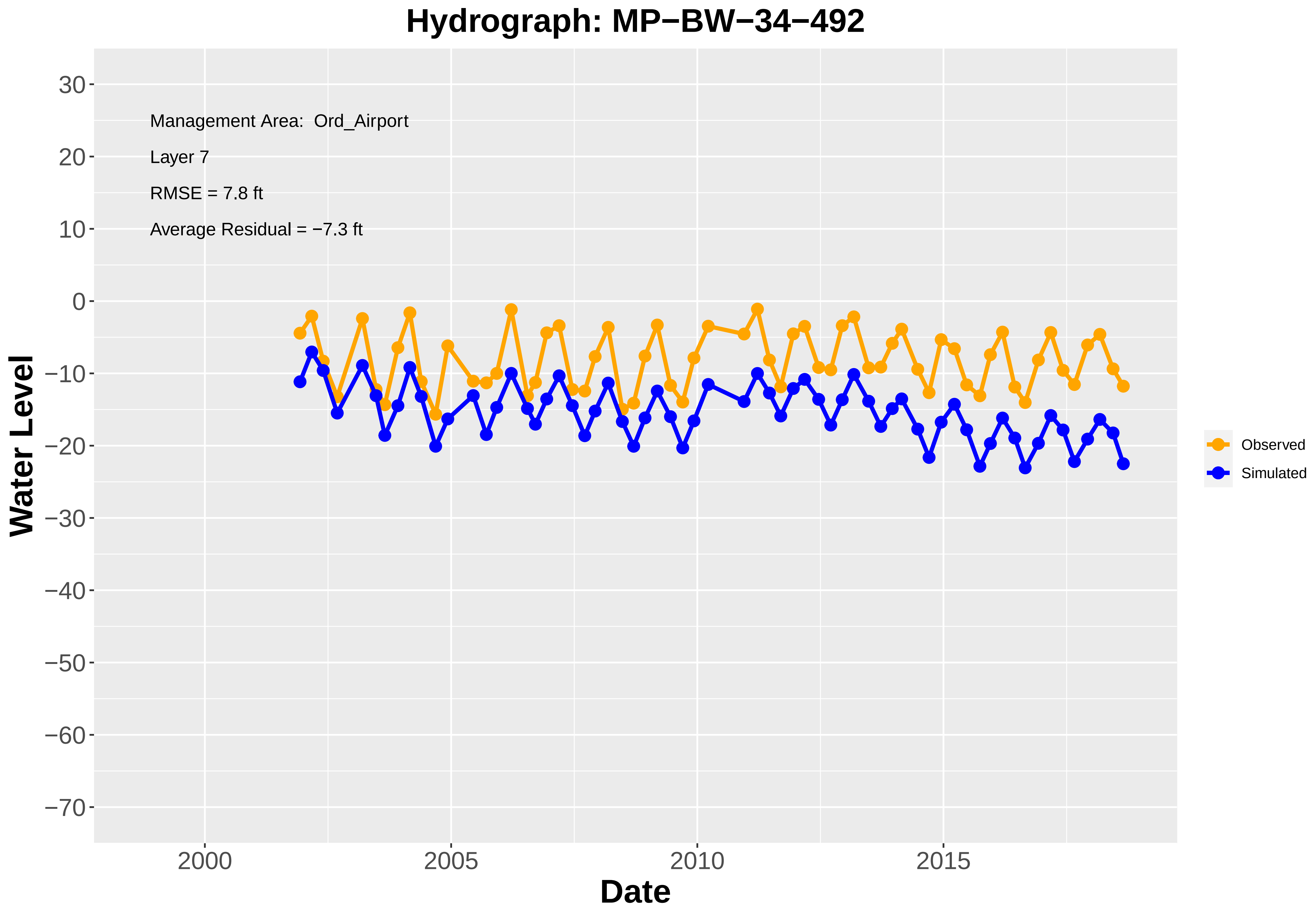
Hydrograph: MP−BW−34−292
Management Area: Ord_Airport
Layer 5
RMSE = 7.1 ft
Average Residual = −6.3 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated



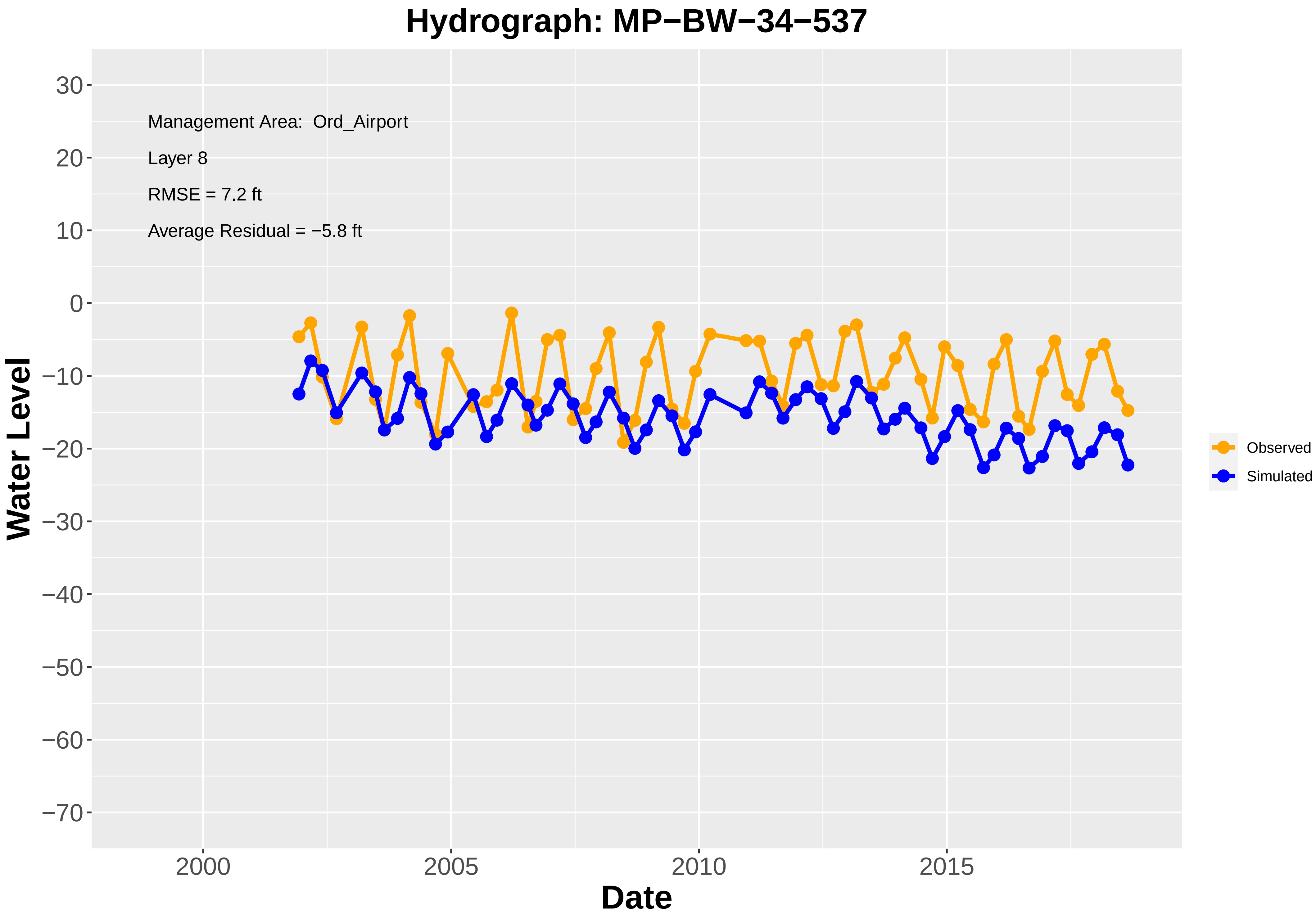
Hydrograph: MP−BW−34−357
Management Area: Ord_Airport
Layer 5
RMSE = 7.5 ft
Average Residual = −6.9 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



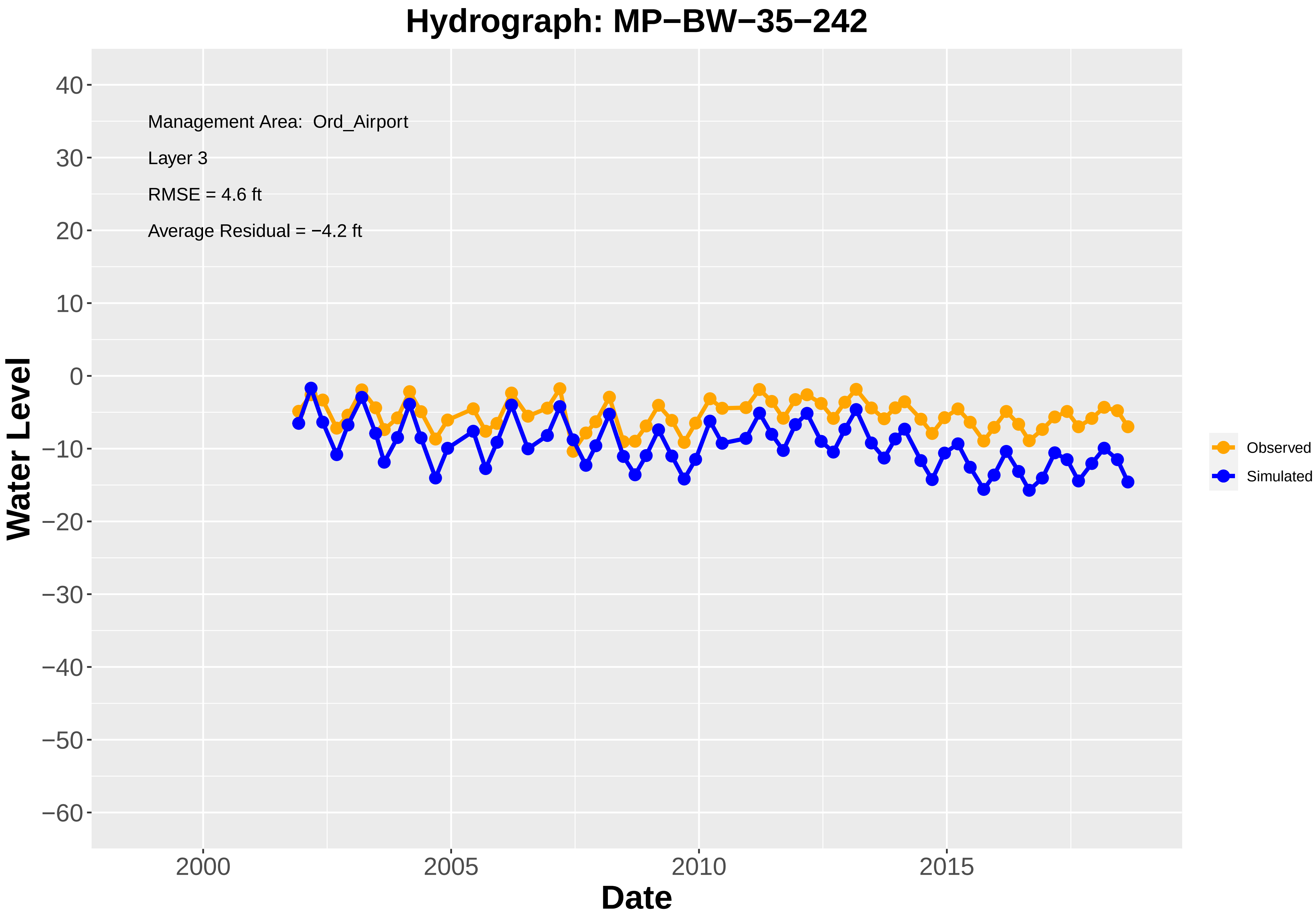
Hydrograph: MP−BW−34−422
Management Area: Ord_Airport
Layer 5
RMSE = 7.7 ft
Average Residual = −7.2 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



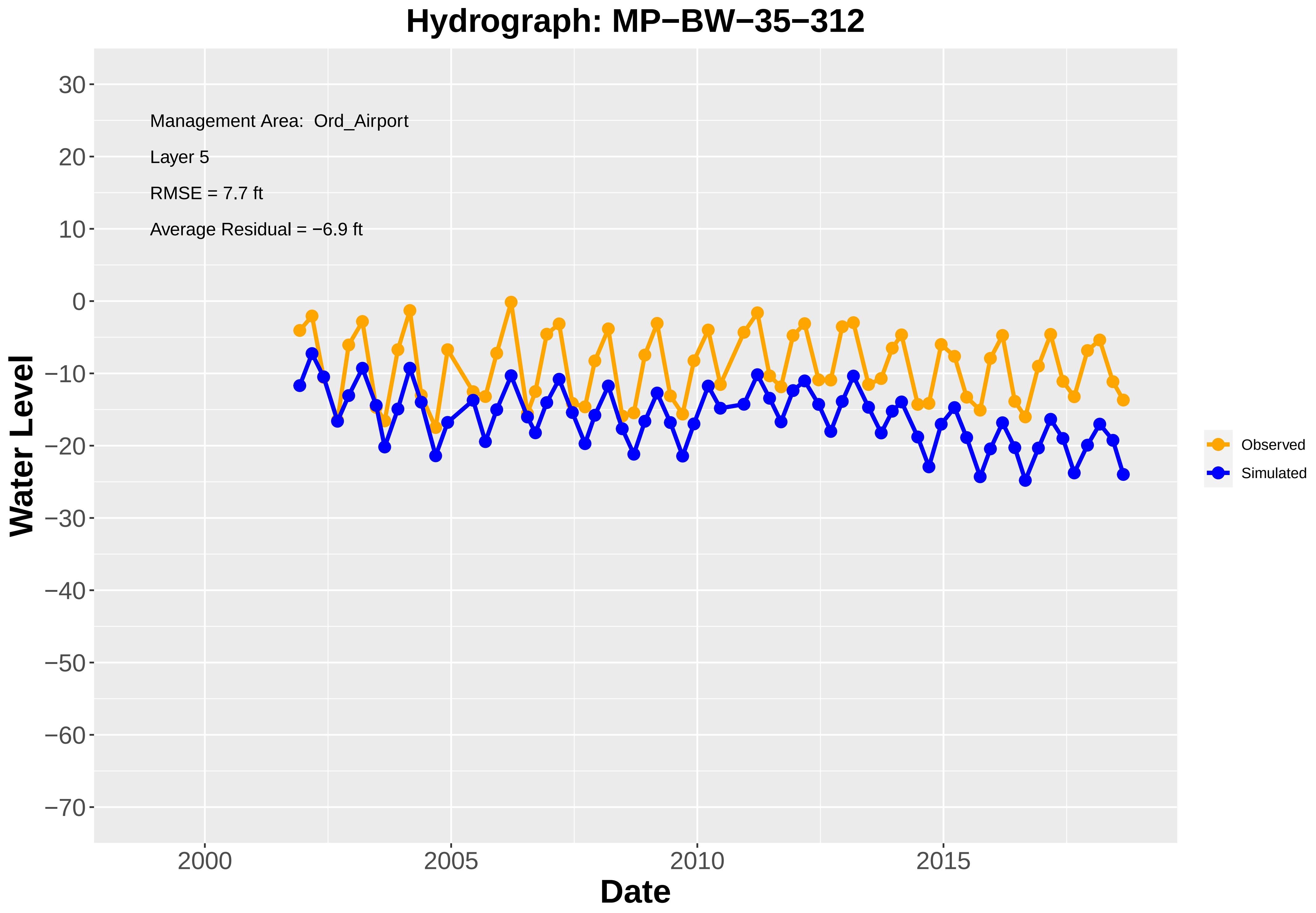
Hydrograph: MP−BW−34−492
Management Area: Ord_Airport
Layer 7
RMSE = 7.8 ft
Average Residual = −7.3 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

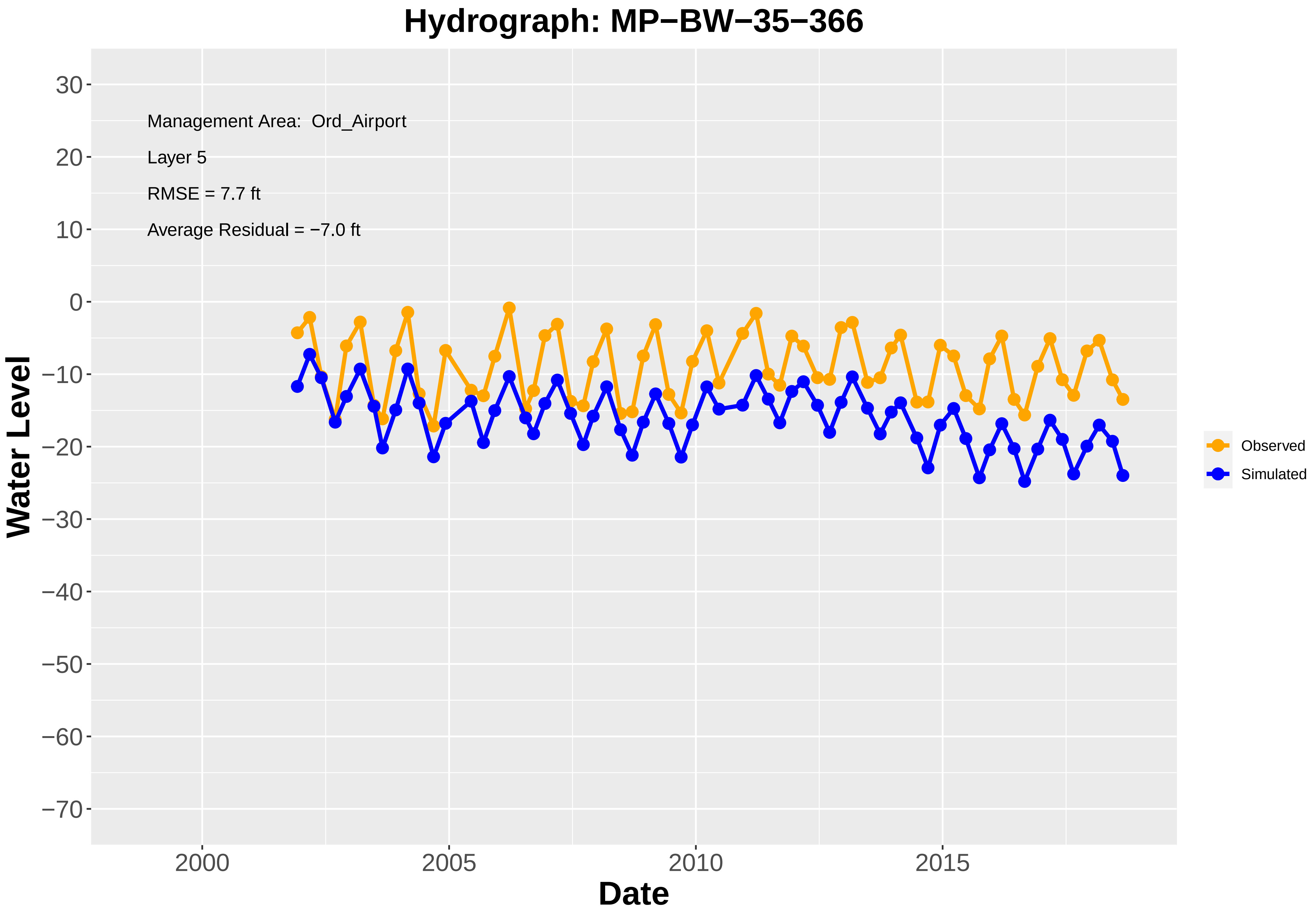


Hydrograph: MP−BW−34−537
Management Area: Ord_Airport
Layer 8
RMSE = 7.2 ft
Average Residual = −5.8 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

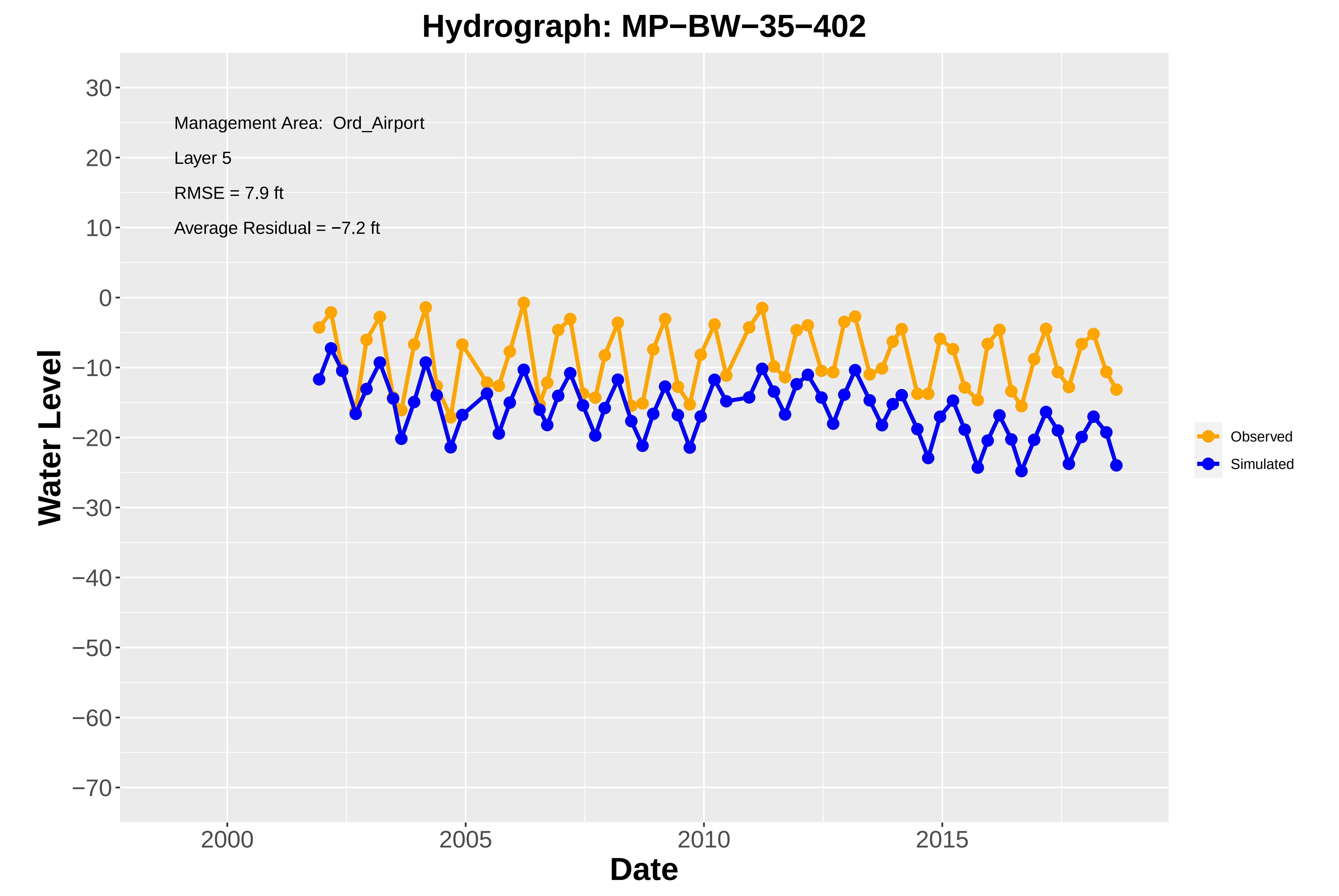


Hydrograph: MP−BW−35−242
Management Area: Ord_Airport
Layer 3
RMSE = 4.6 ft
Average Residual = −4.2 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

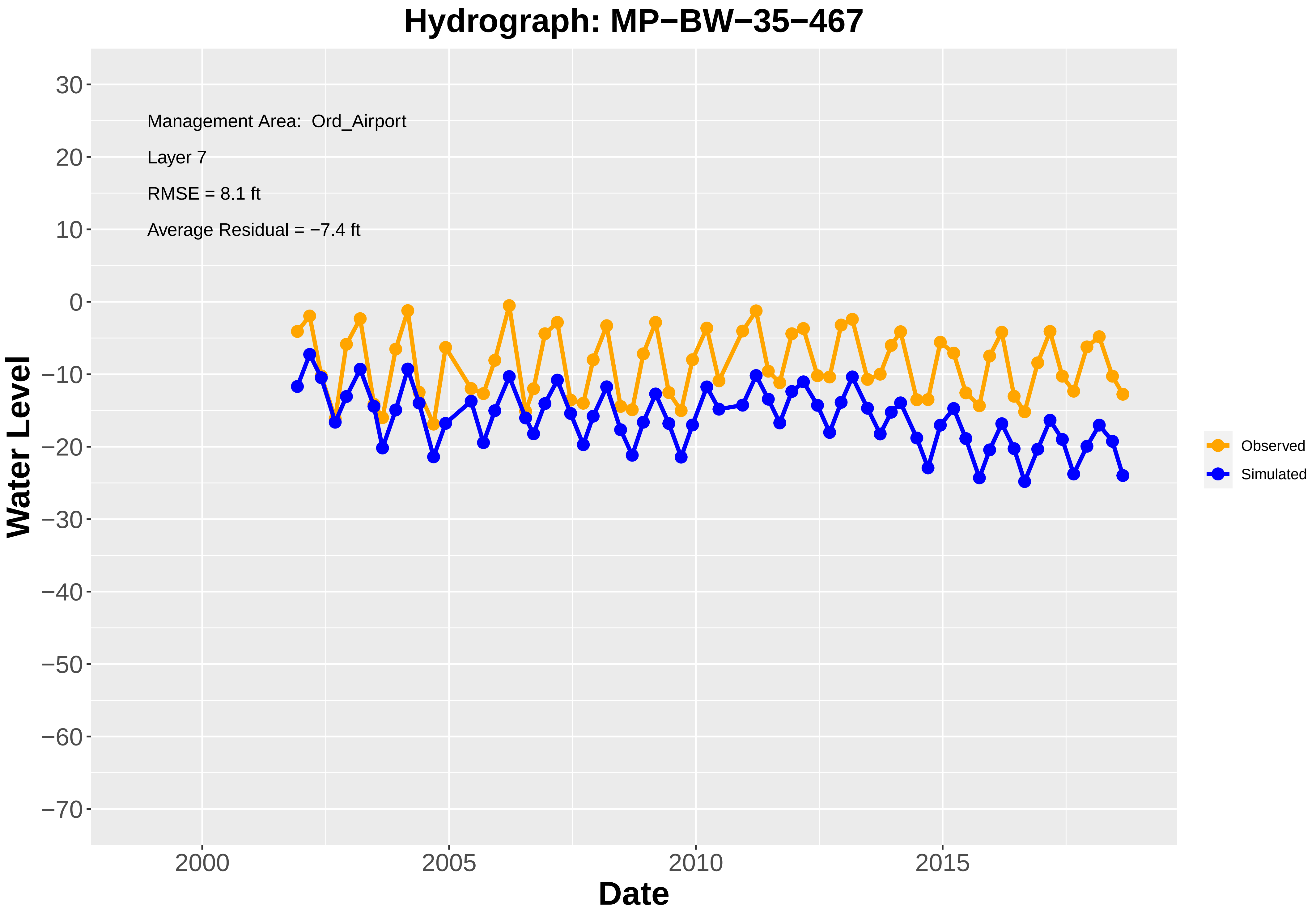

Hydrograph: MP−BW−35−312
Management Area: Ord_Airport
Layer 5
RMSE = 7.7 ft
Average Residual = −6.9 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated



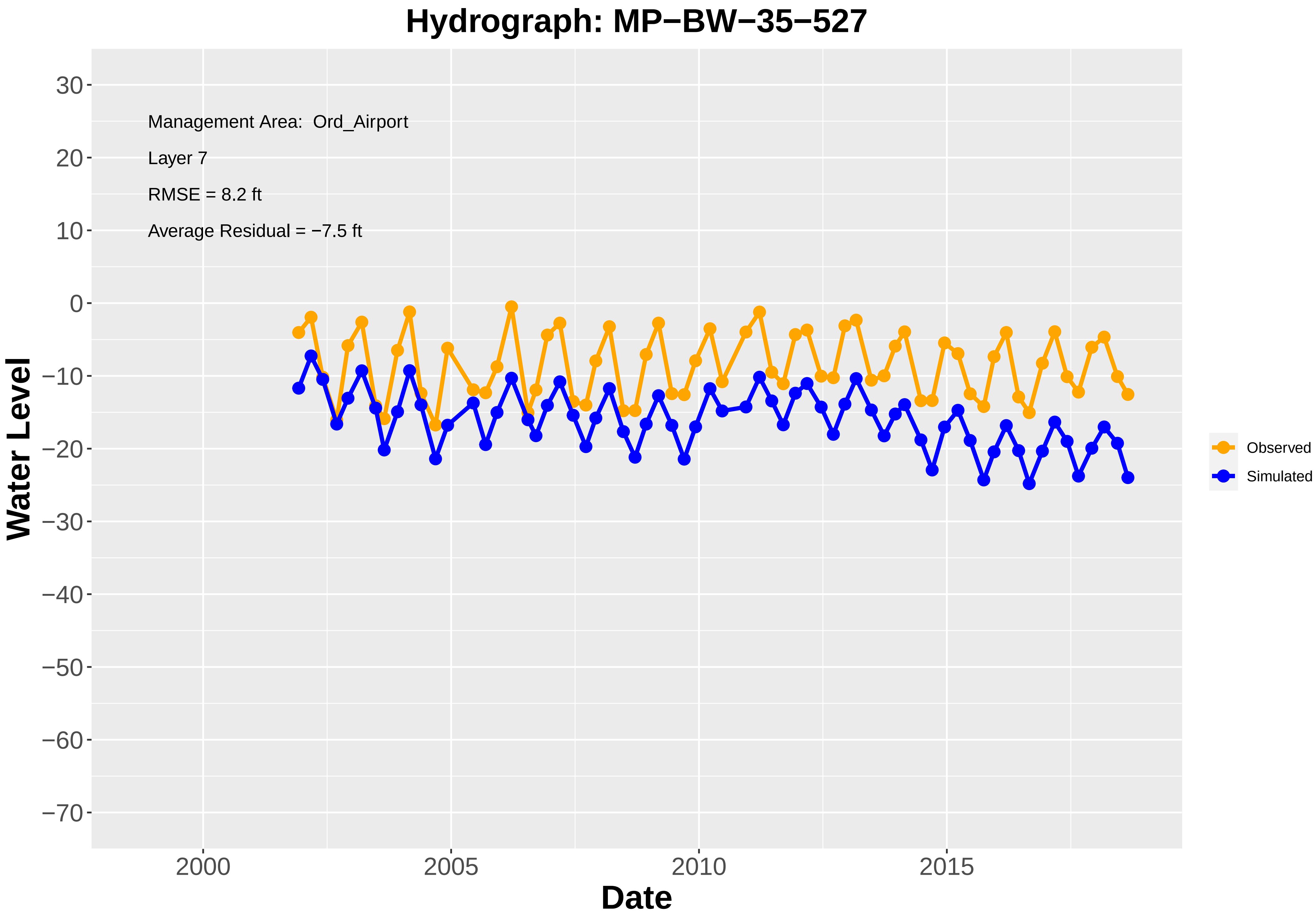
Hydrograph: MP−BW−35−366
Management Area: Ord_Airport
Layer 5
RMSE = 7.7 ft
Average Residual = −7.0 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



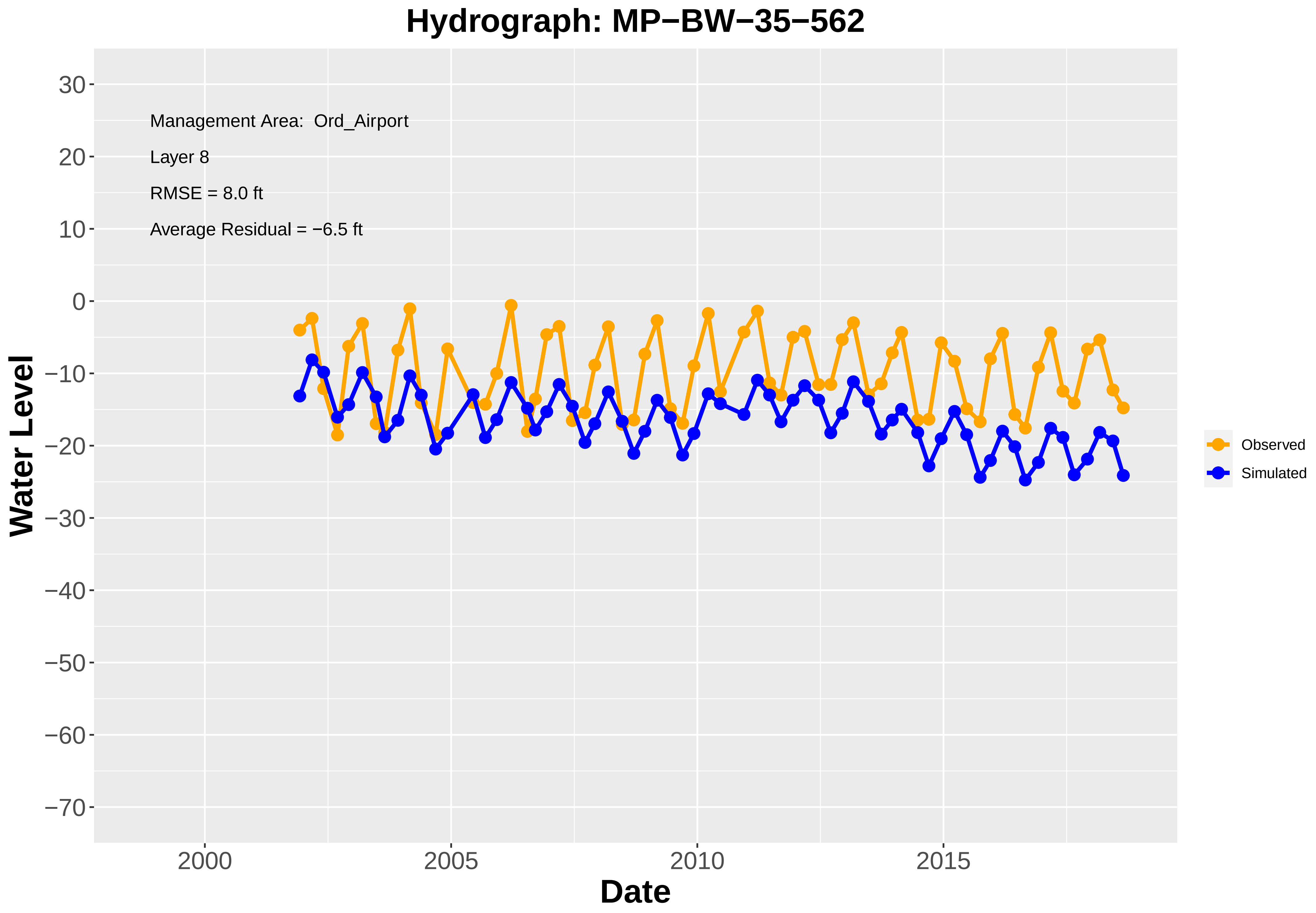
Hydrograph: MP−BW−35−402
Management Area: Ord_Airport
Layer 5
RMSE = 7.9 ft
Average Residual = −7.2 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



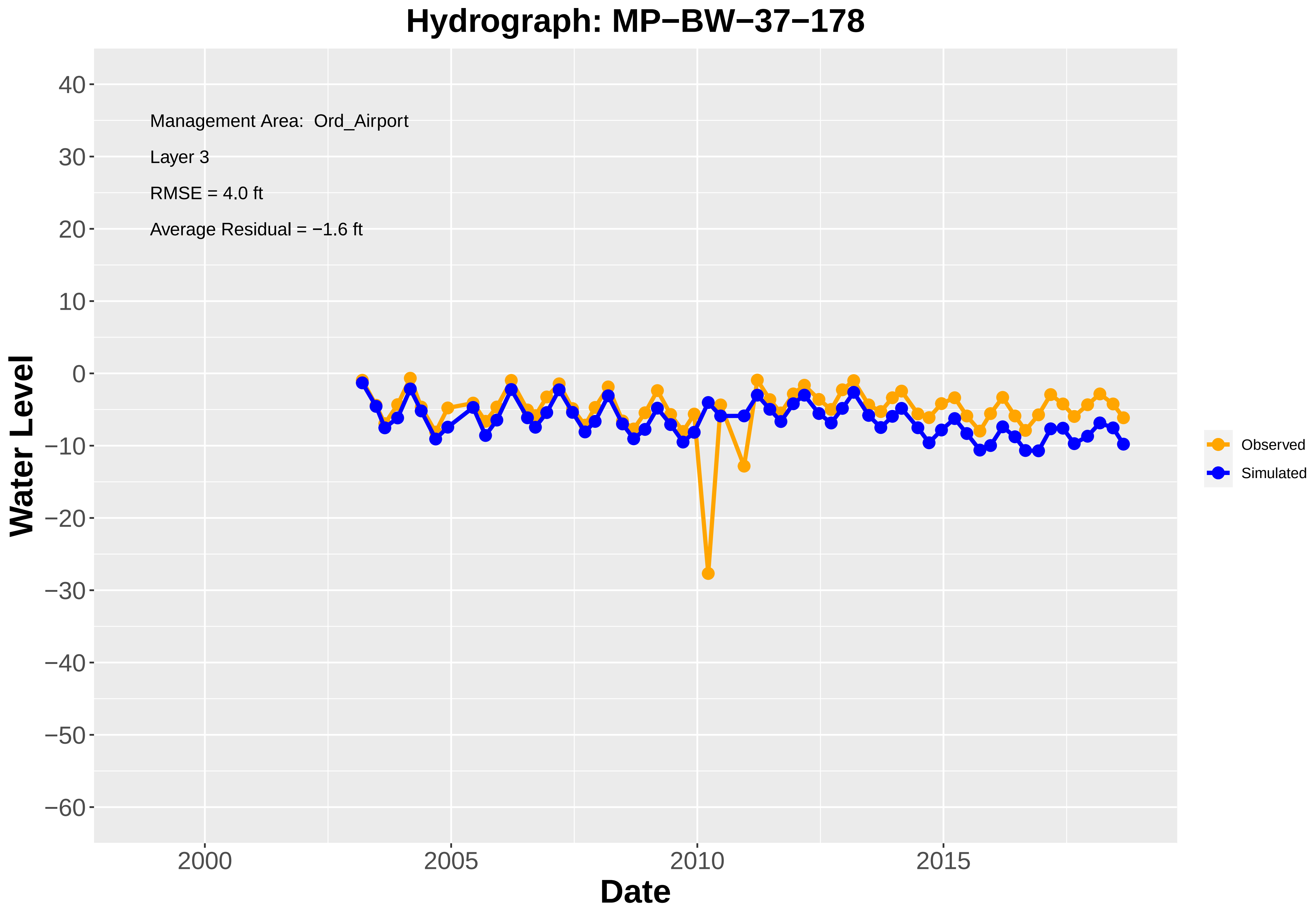
Hydrograph: MP−BW−35−467
Management Area: Ord_Airport
Layer 7
RMSE = 8.1 ft
Average Residual = −7.4 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

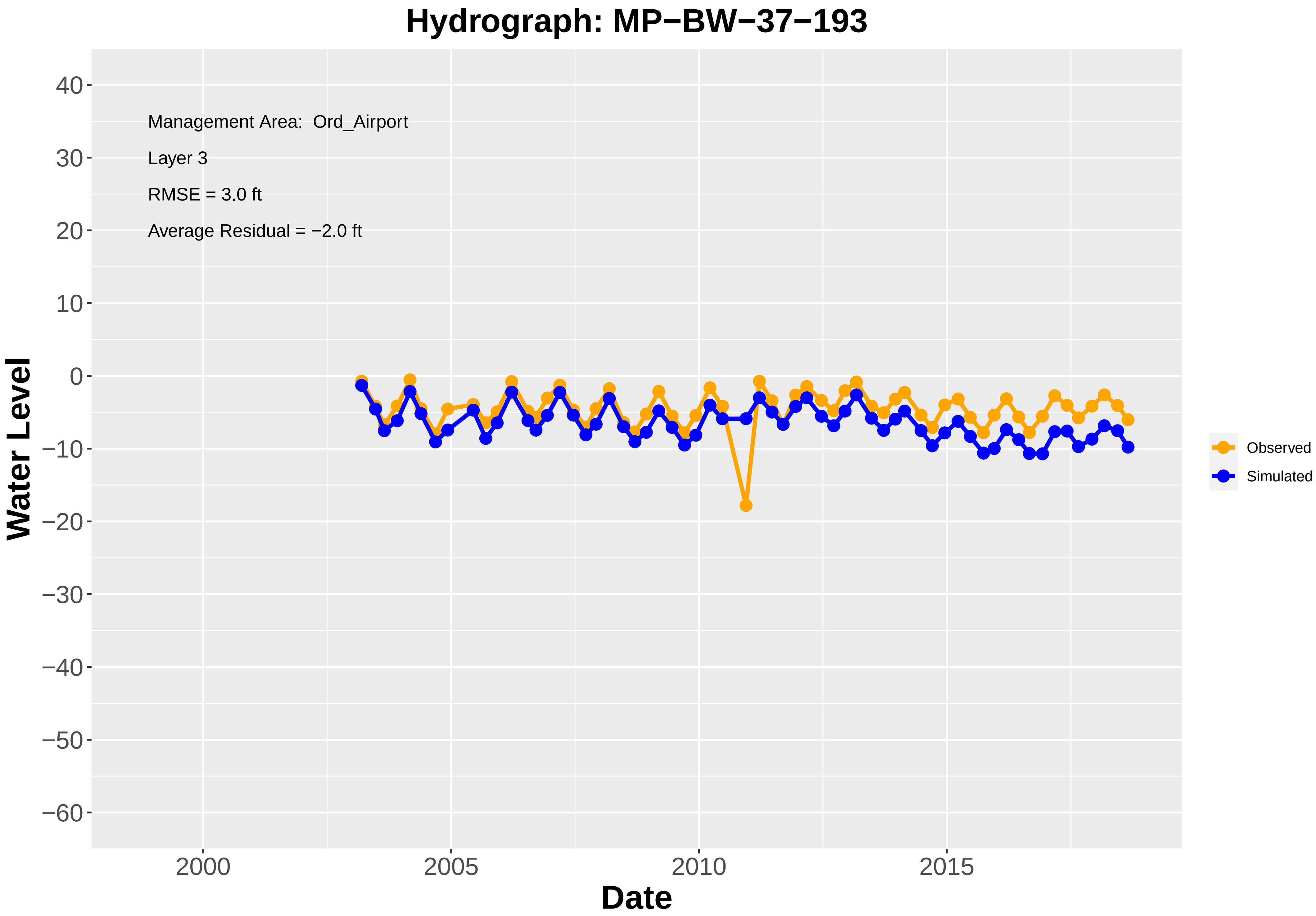


Hydrograph: MP−BW−35−527
Management Area: Ord_Airport
Layer 7
RMSE = 8.2 ft
Average Residual = −7.5 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

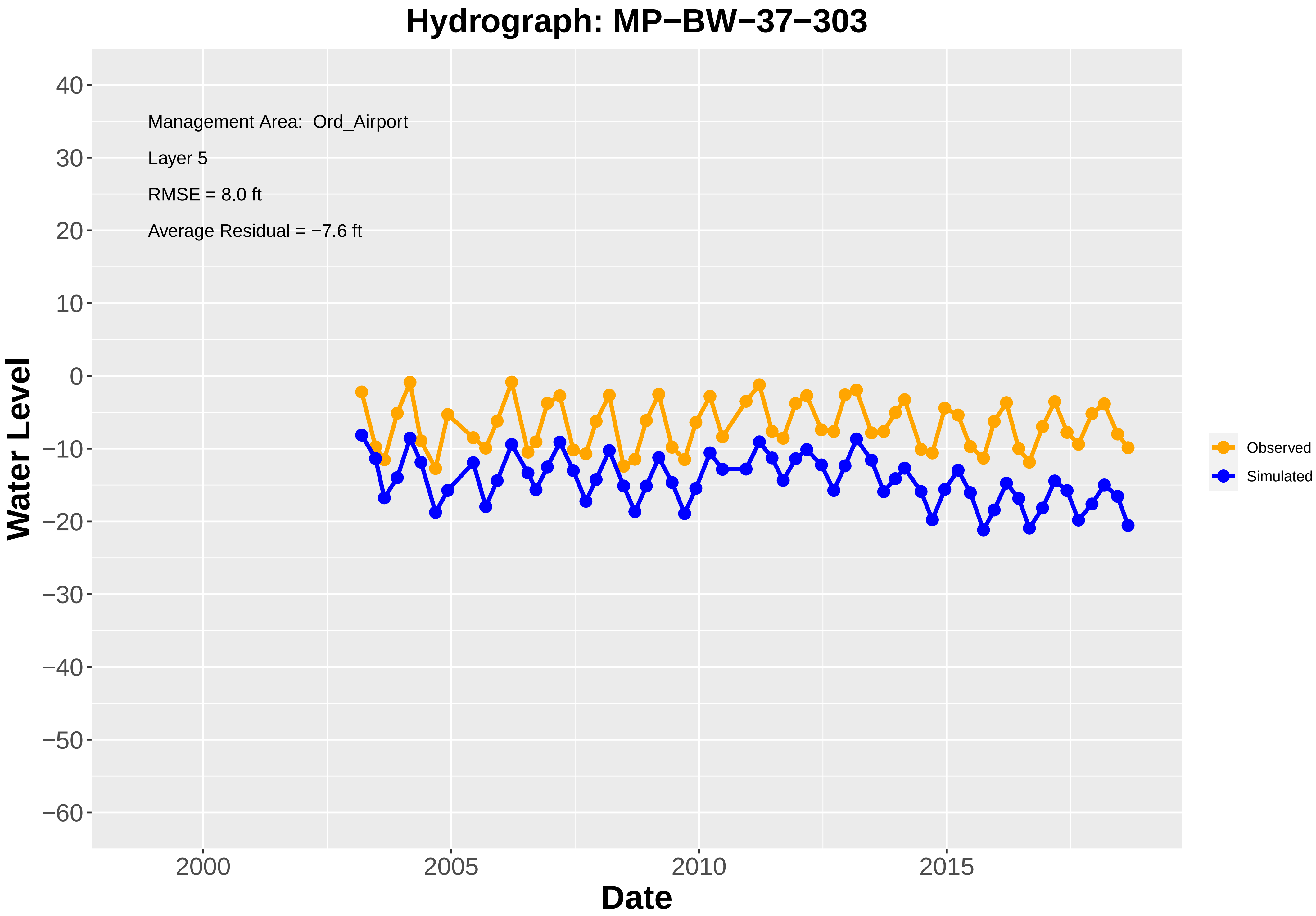


Hydrograph: MP−BW−35−562
Management Area: Ord_Airport
Layer 8
RMSE = 8.0 ft
Average Residual = −6.5 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

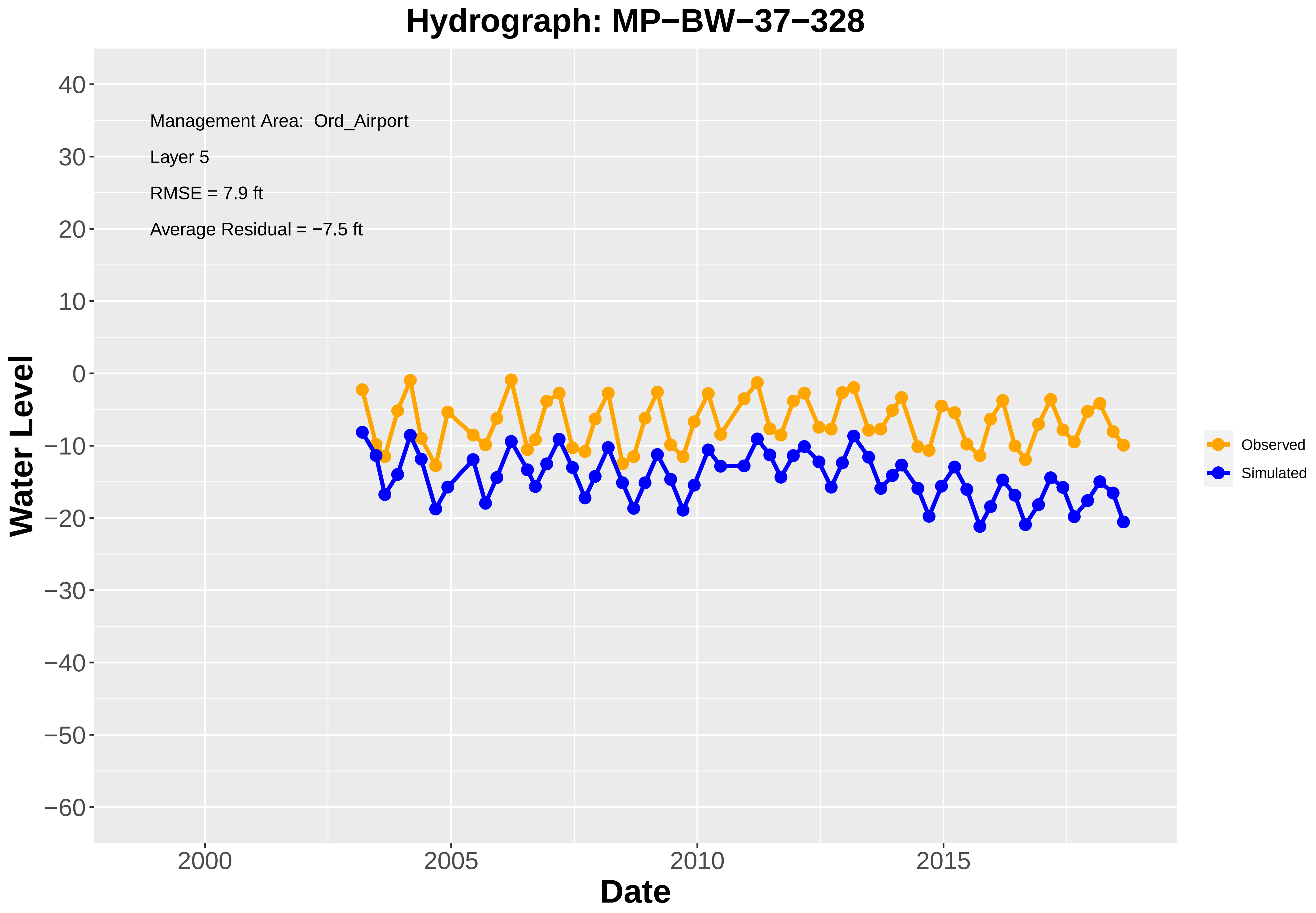

Hydrograph: MP−BW−37−178
Management Area: Ord_Airport
Layer 3
RMSE = 4.0 ft
Average Residual = −1.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

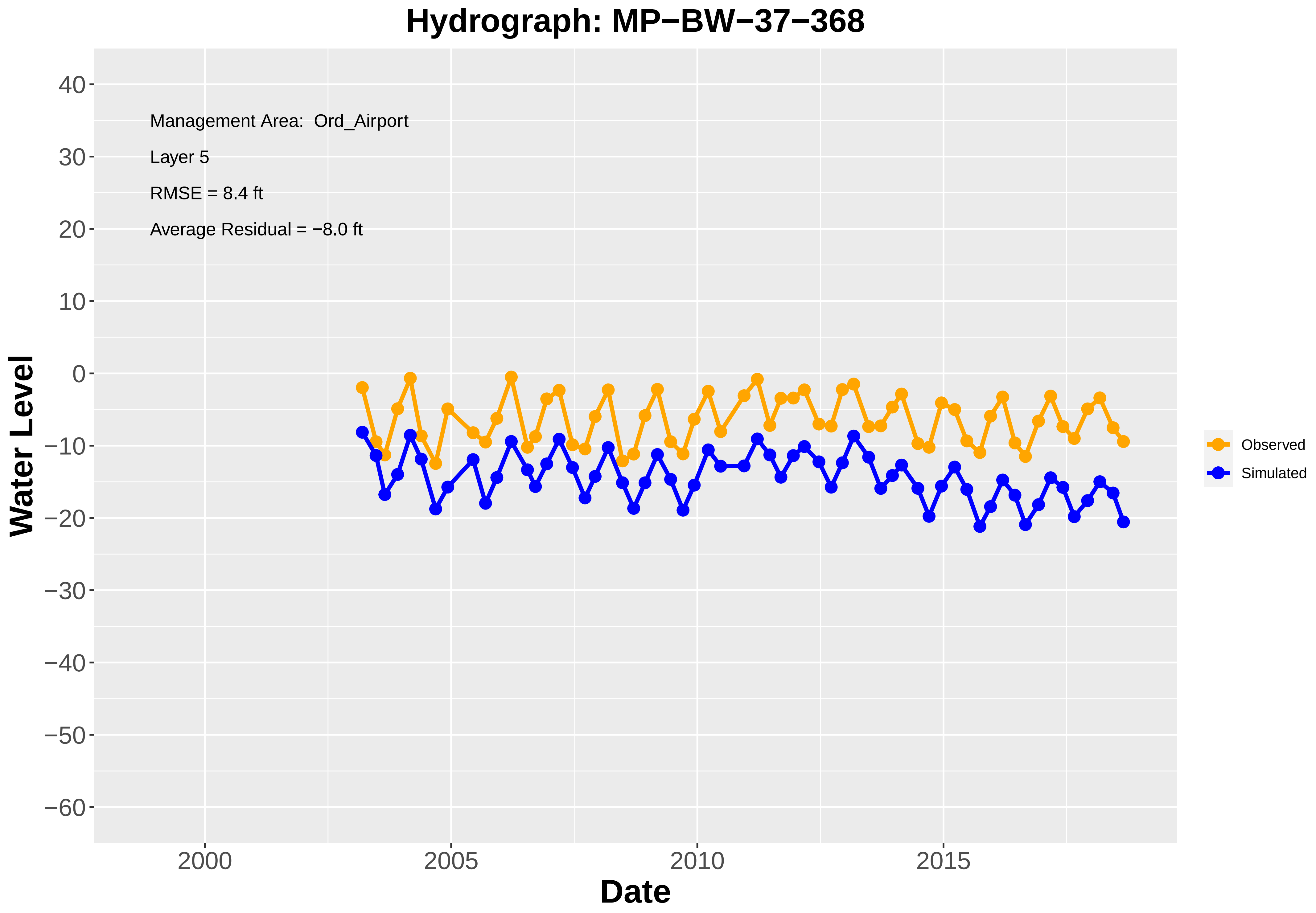


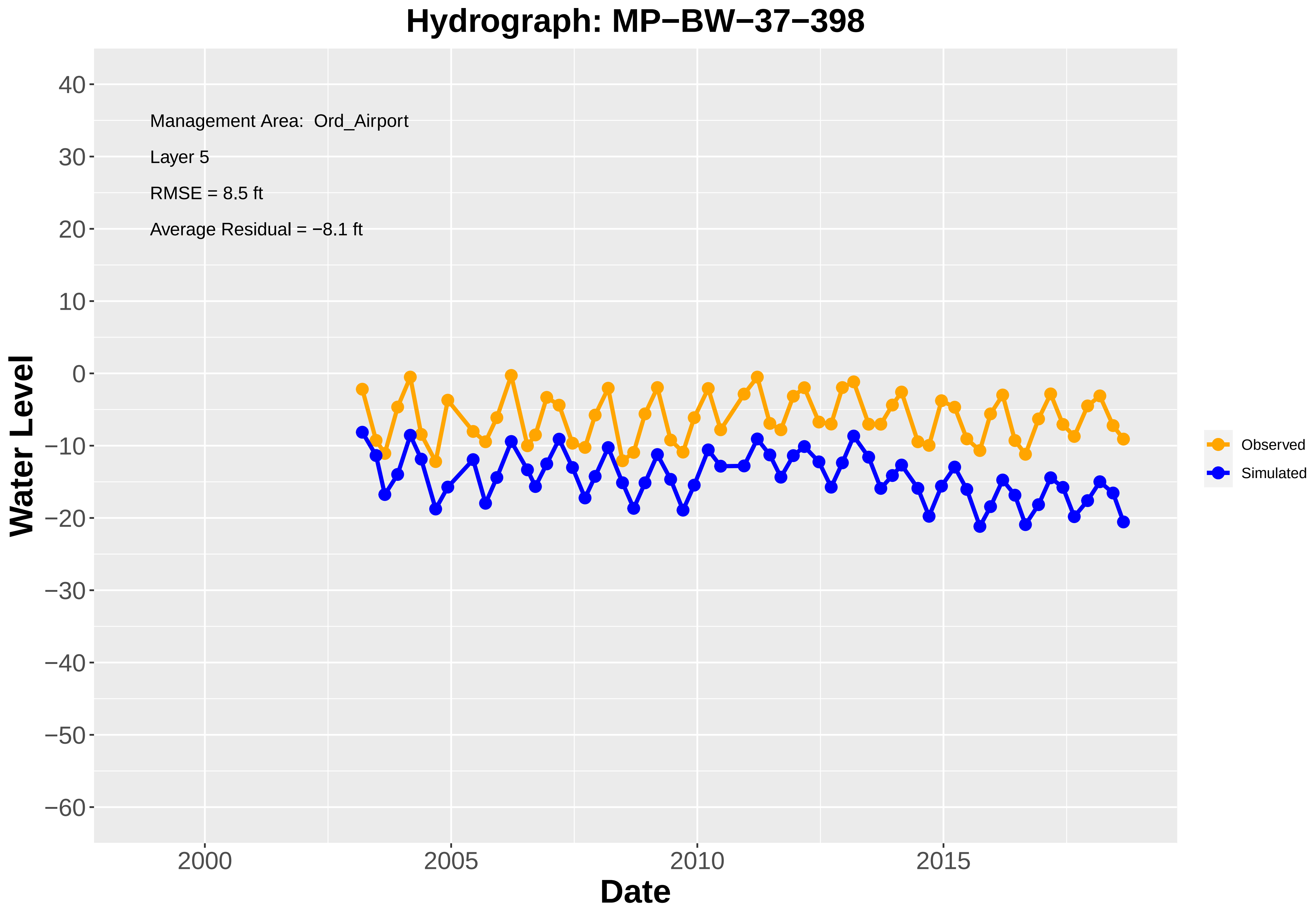
Hydrograph: MP−BW−37−193
Management Area: Ord_Airport
Layer 3
RMSE = 3.0 ft
Average Residual = −2.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

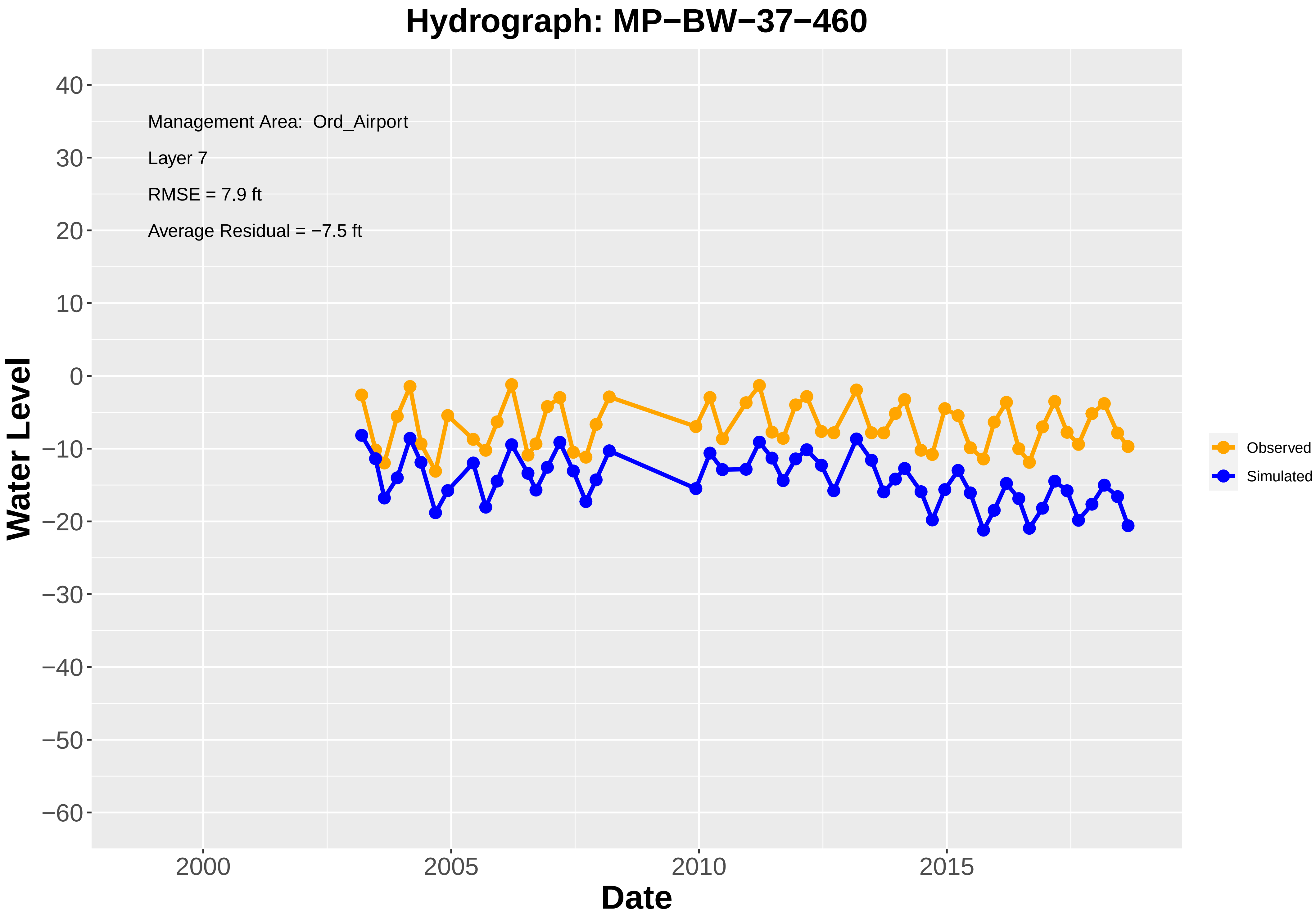


Hydrograph: MP−BW−37−303
Management Area: Ord_Airport
Layer 5
RMSE = 8.0 ft
Average Residual = −7.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

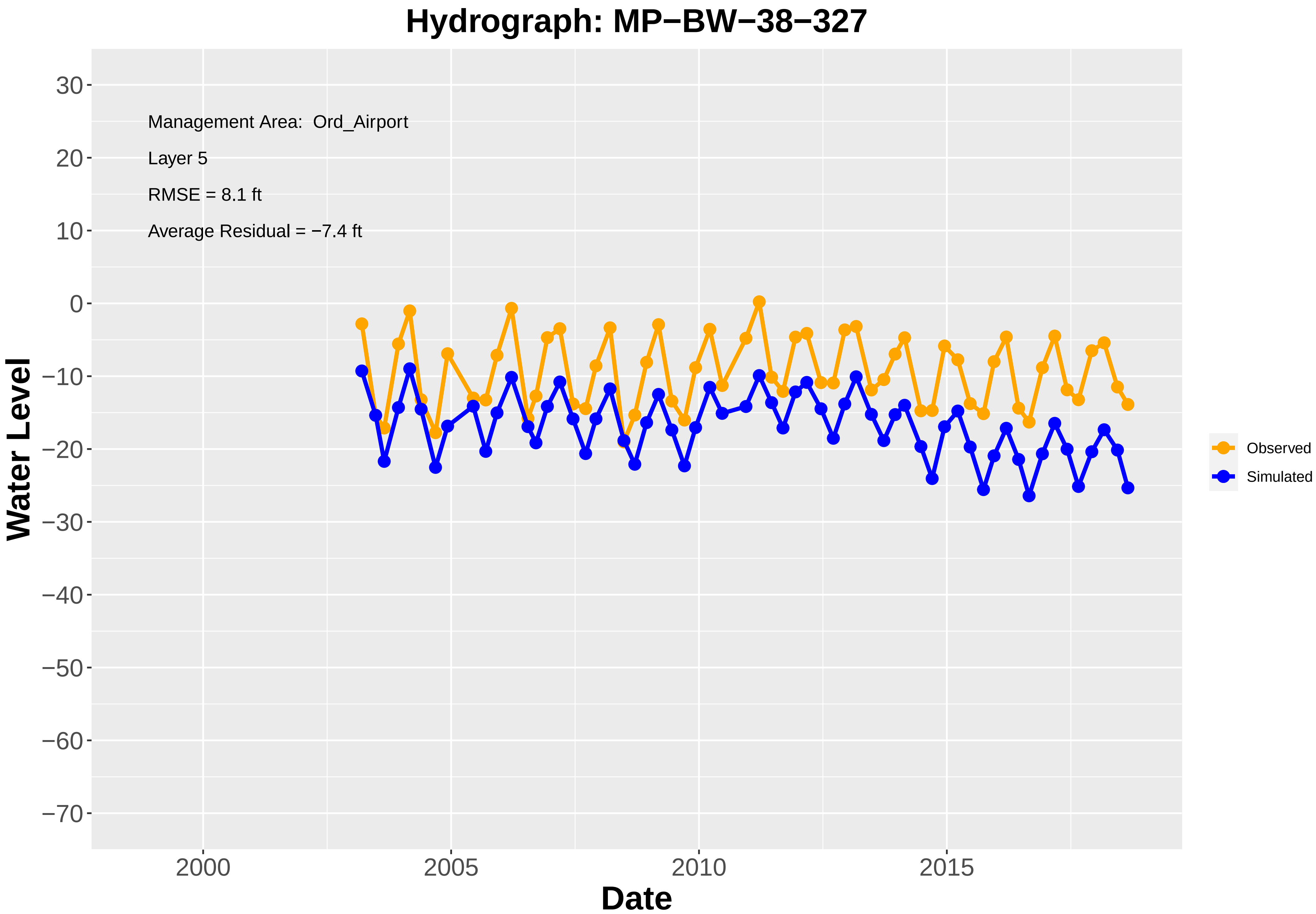

Hydrograph: MP−BW−37−328
Management Area: Ord_Airport
Layer 5
RMSE = 7.9 ft
Average Residual = −7.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MP−BW−37−368
Management Area: Ord_Airport
Layer 5
RMSE = 8.4 ft
Average Residual = −8.0 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

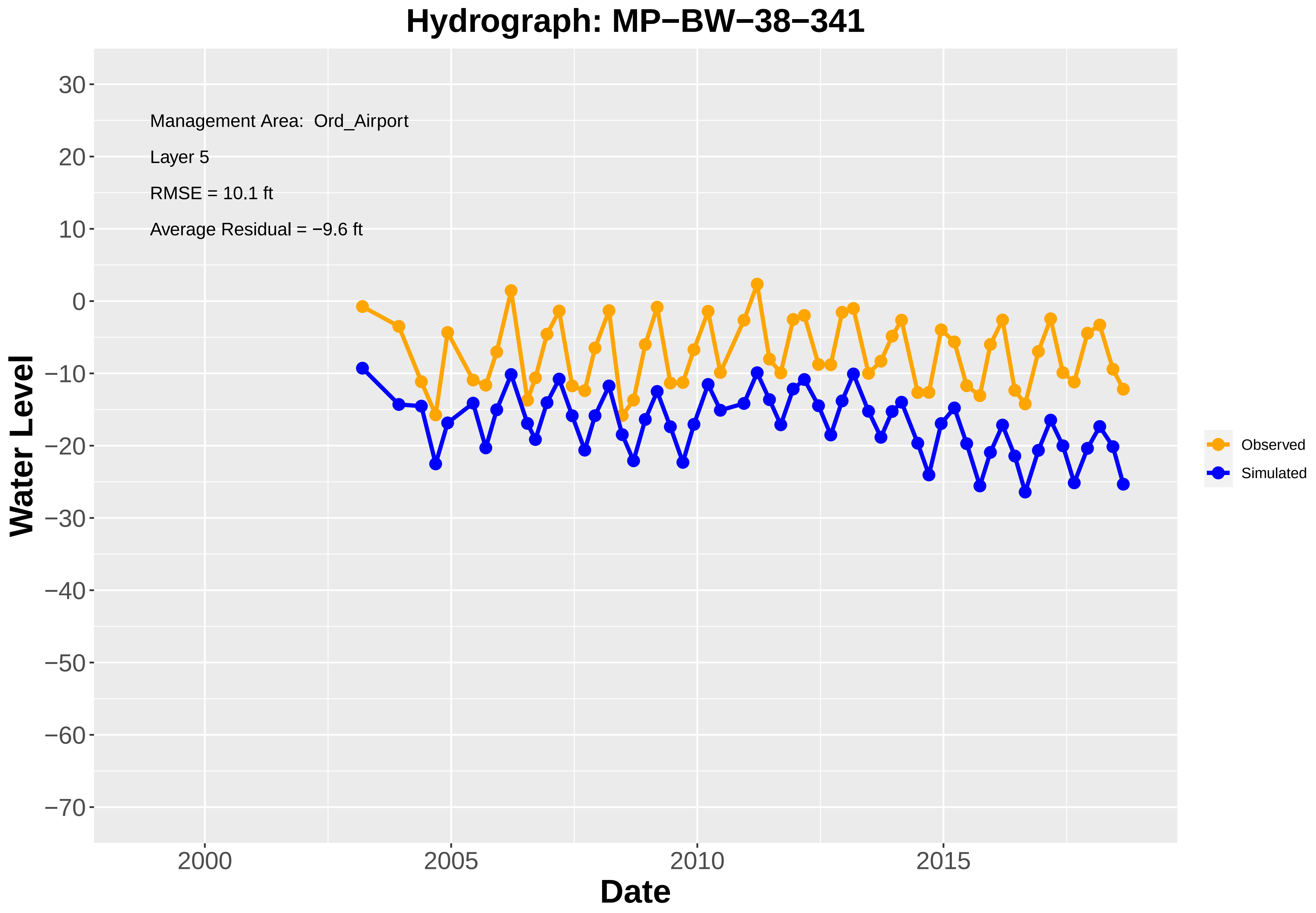

Hydrograph: MP−BW−37−398
Management Area: Ord_Airport
Layer 5
RMSE = 8.5 ft
Average Residual = −8.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

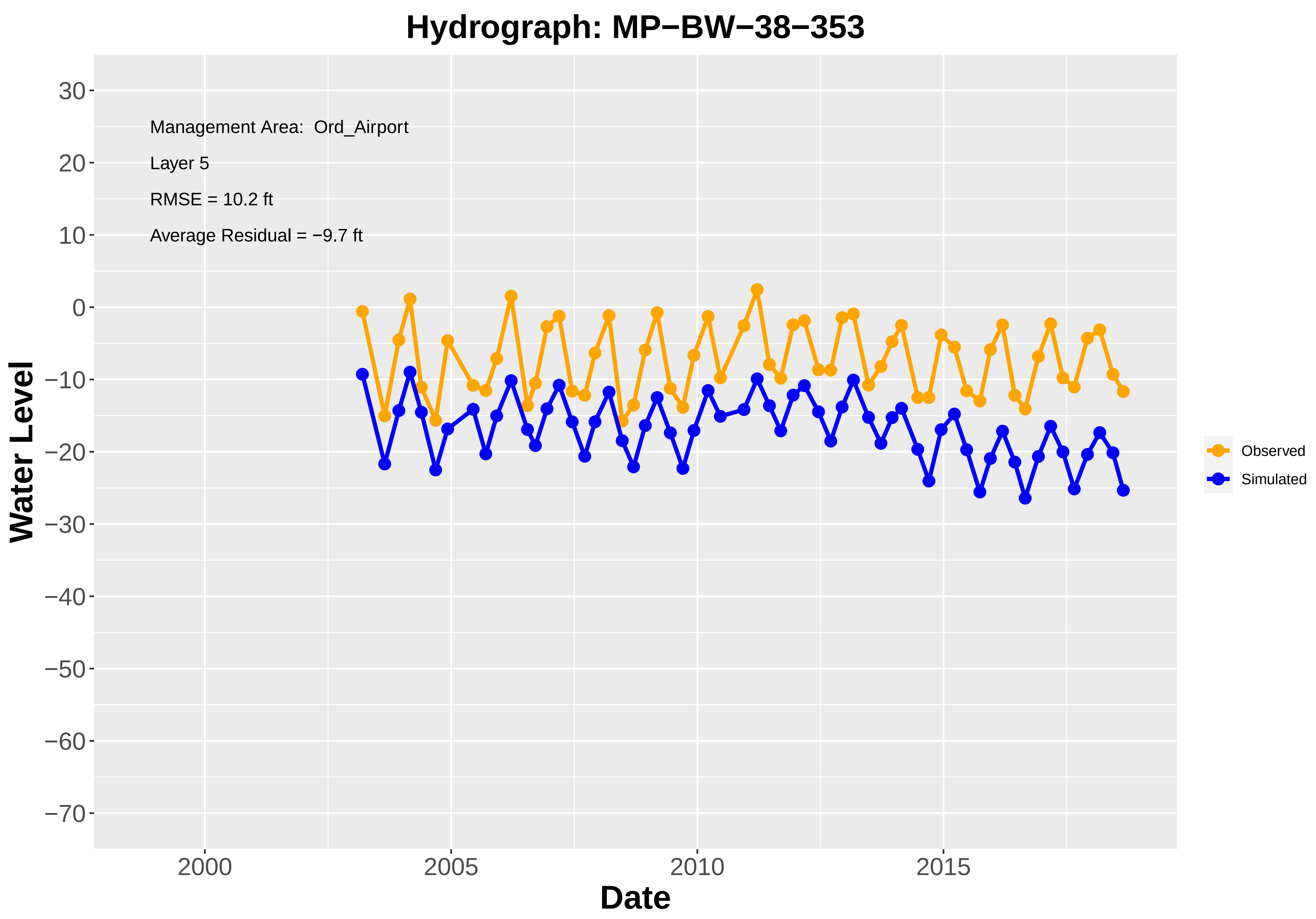


Hydrograph: MP−BW−37−460
Management Area: Ord_Airport
Layer 7
RMSE = 7.9 ft
Average Residual = −7.5 ft
Water Level
Date
Observed
Simulated
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015

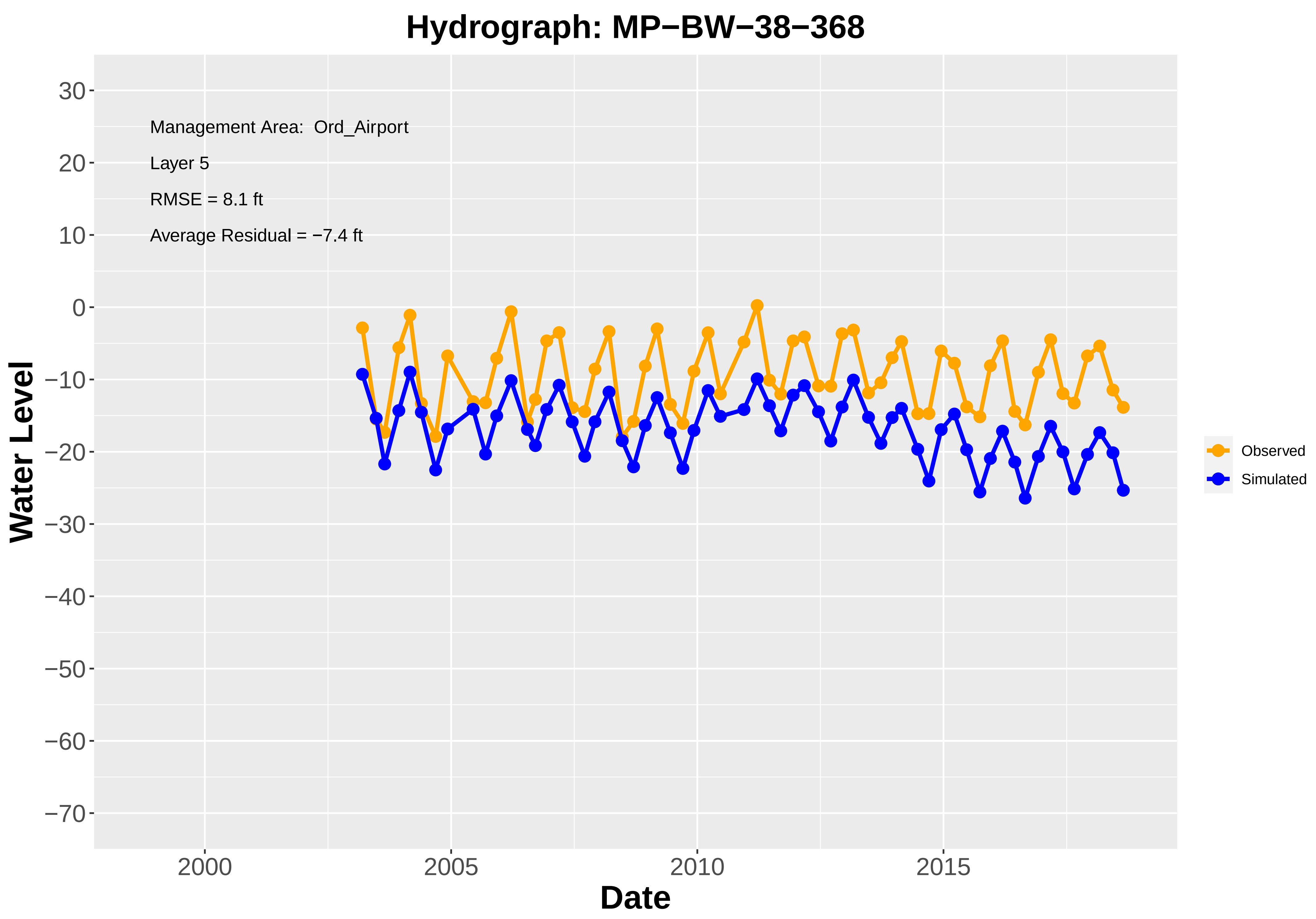


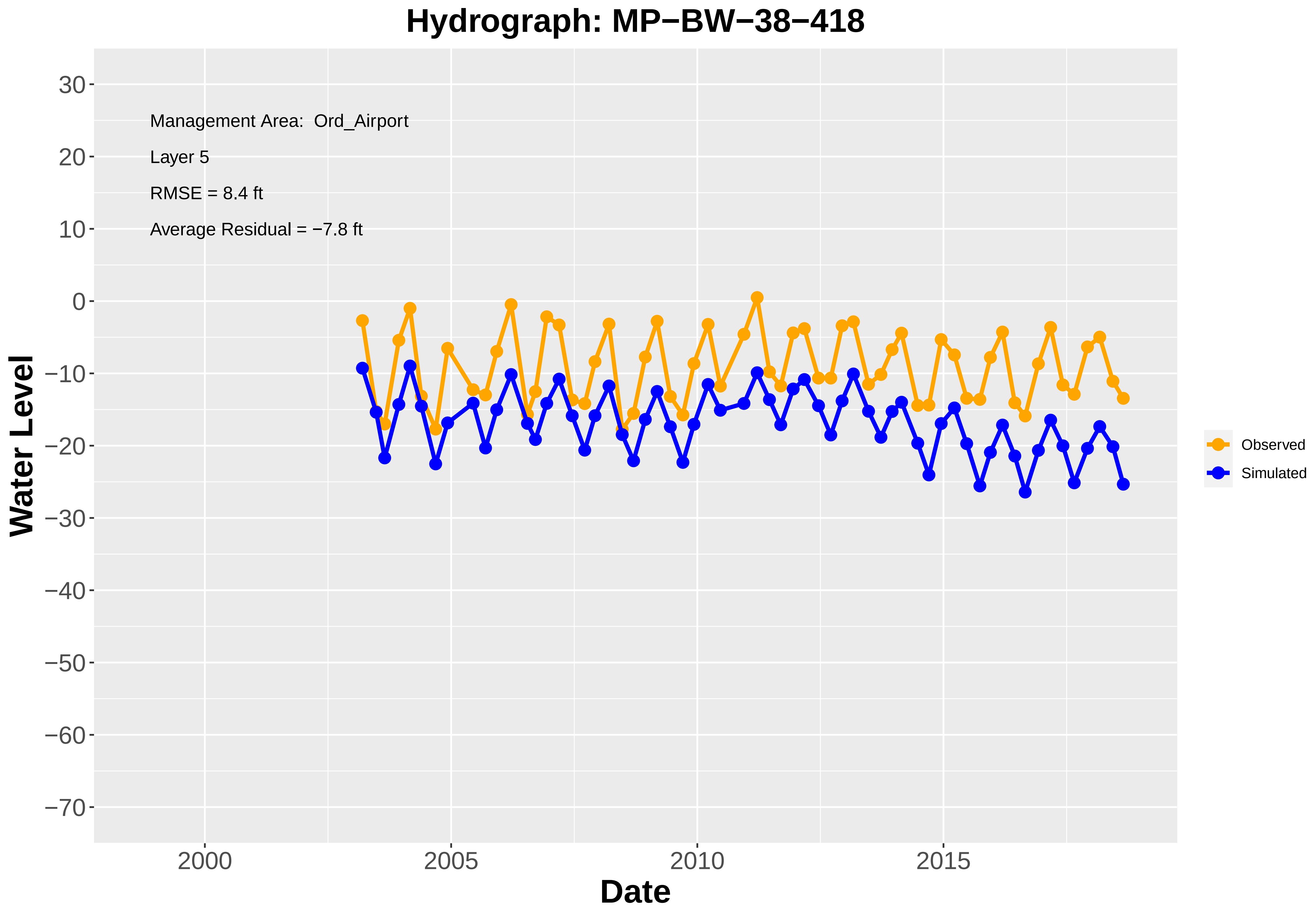
Hydrograph: MP−BW−38−327
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.4 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−38−341
Management Area: Ord_Airport
Layer 5
RMSE = 10.1 ft
Average Residual = −9.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

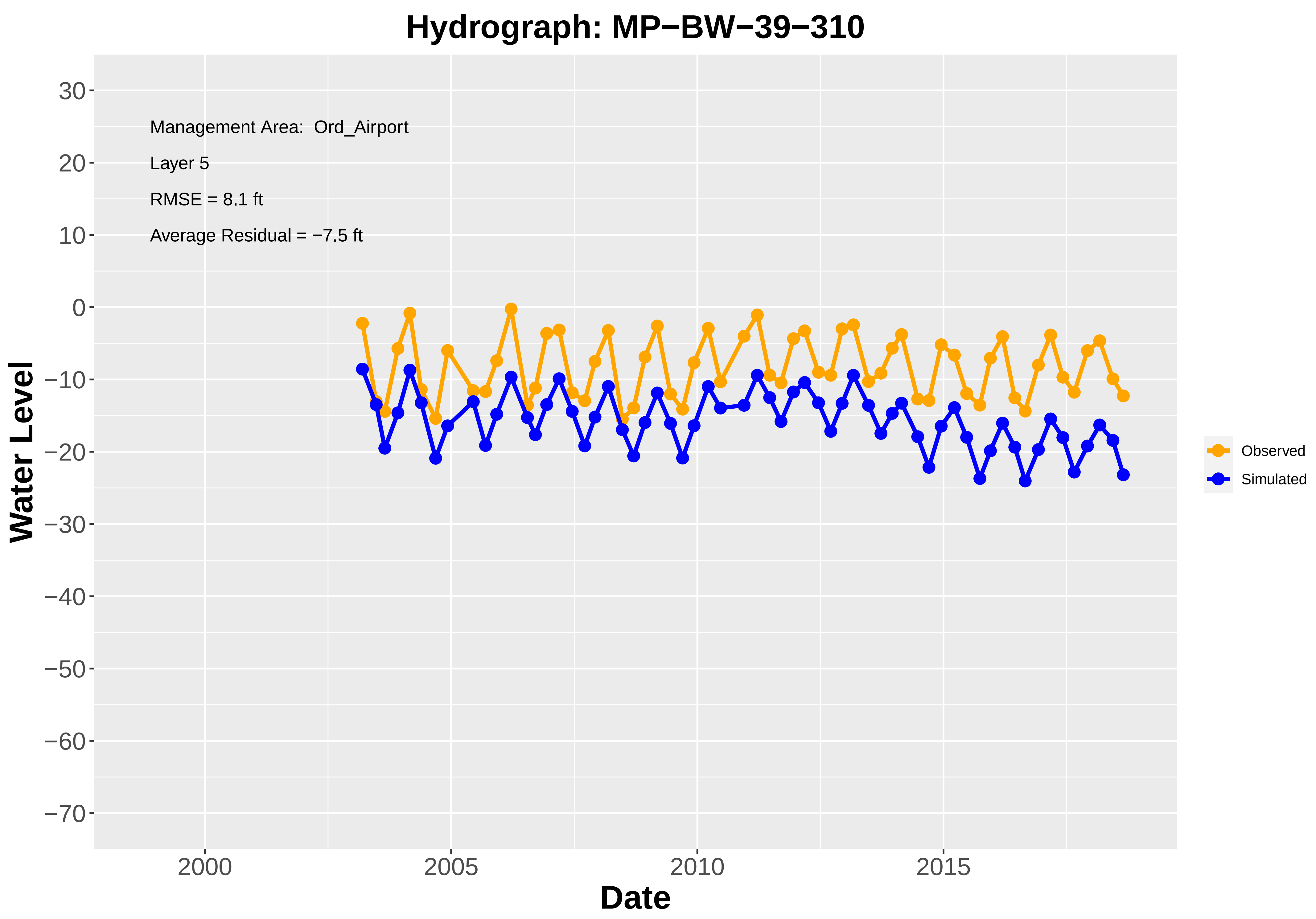


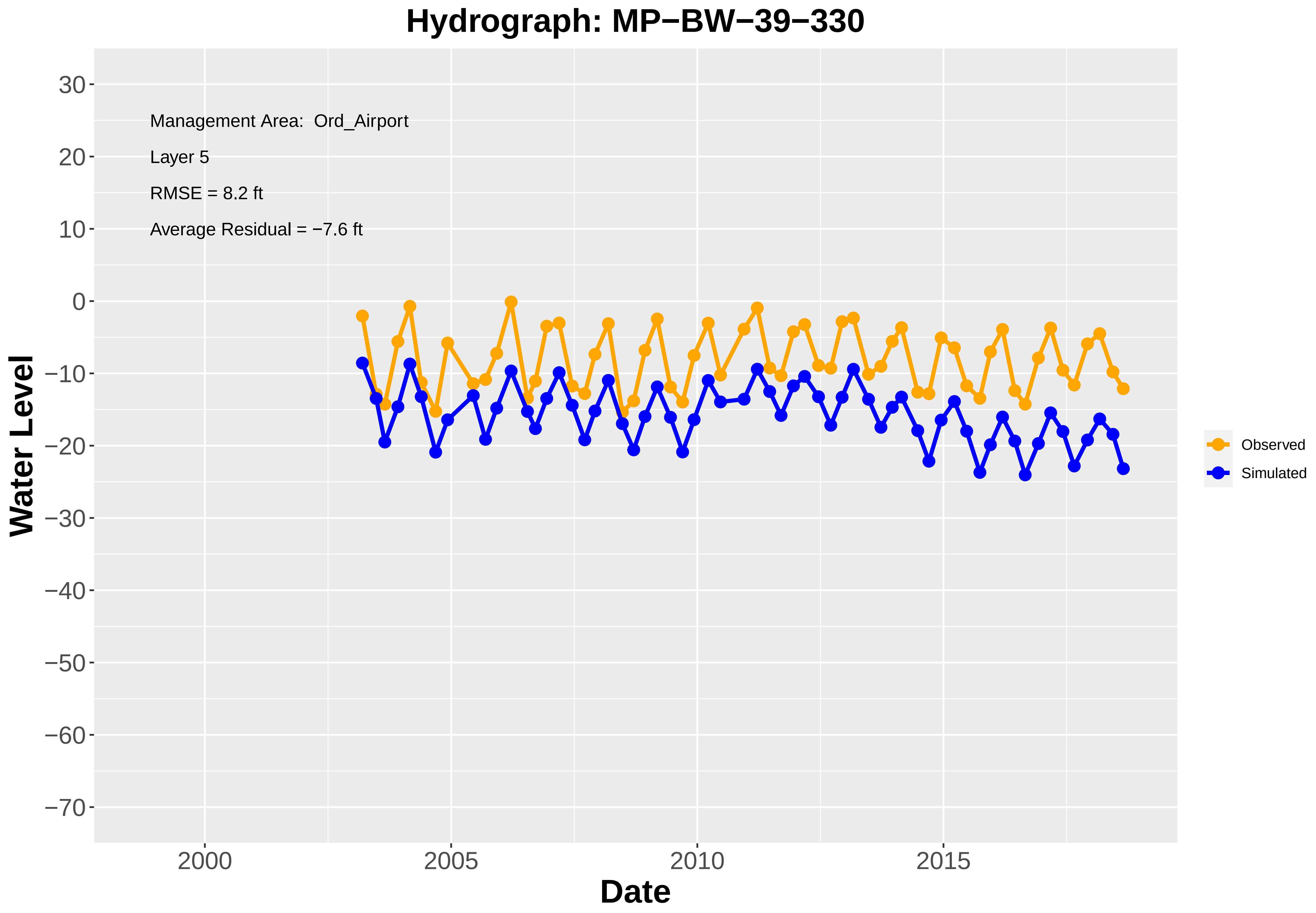
Hydrograph: MP−BW−38−353
Management Area: Ord_Airport
Layer 5
RMSE = 10.2 ft
Average Residual = −9.7 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MP−BW−38−368
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.4 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

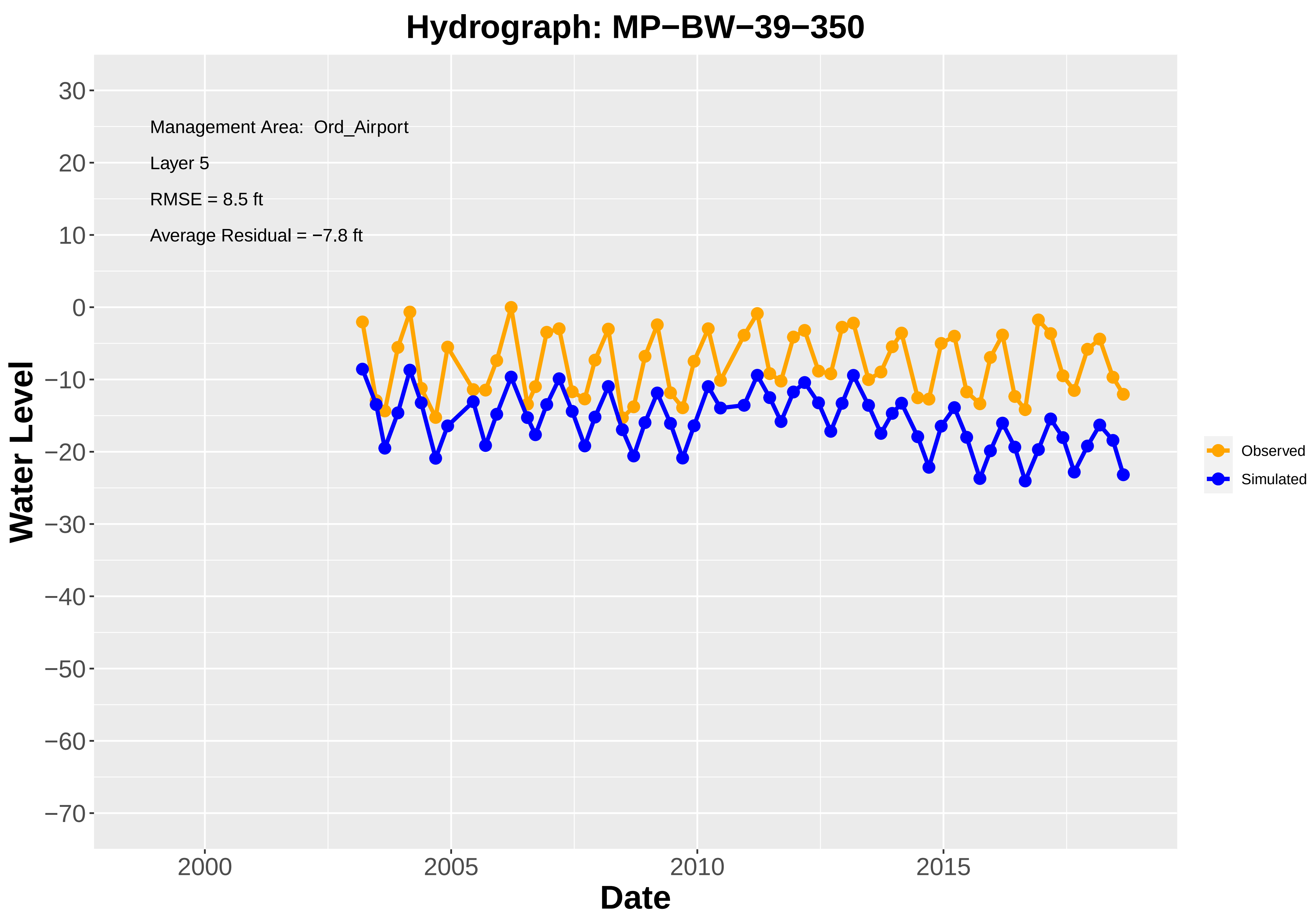


Hydrograph: MP−BW−38−418
Management Area: Ord_Airport
Layer 5
RMSE = 8.4 ft
Average Residual = −7.8 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

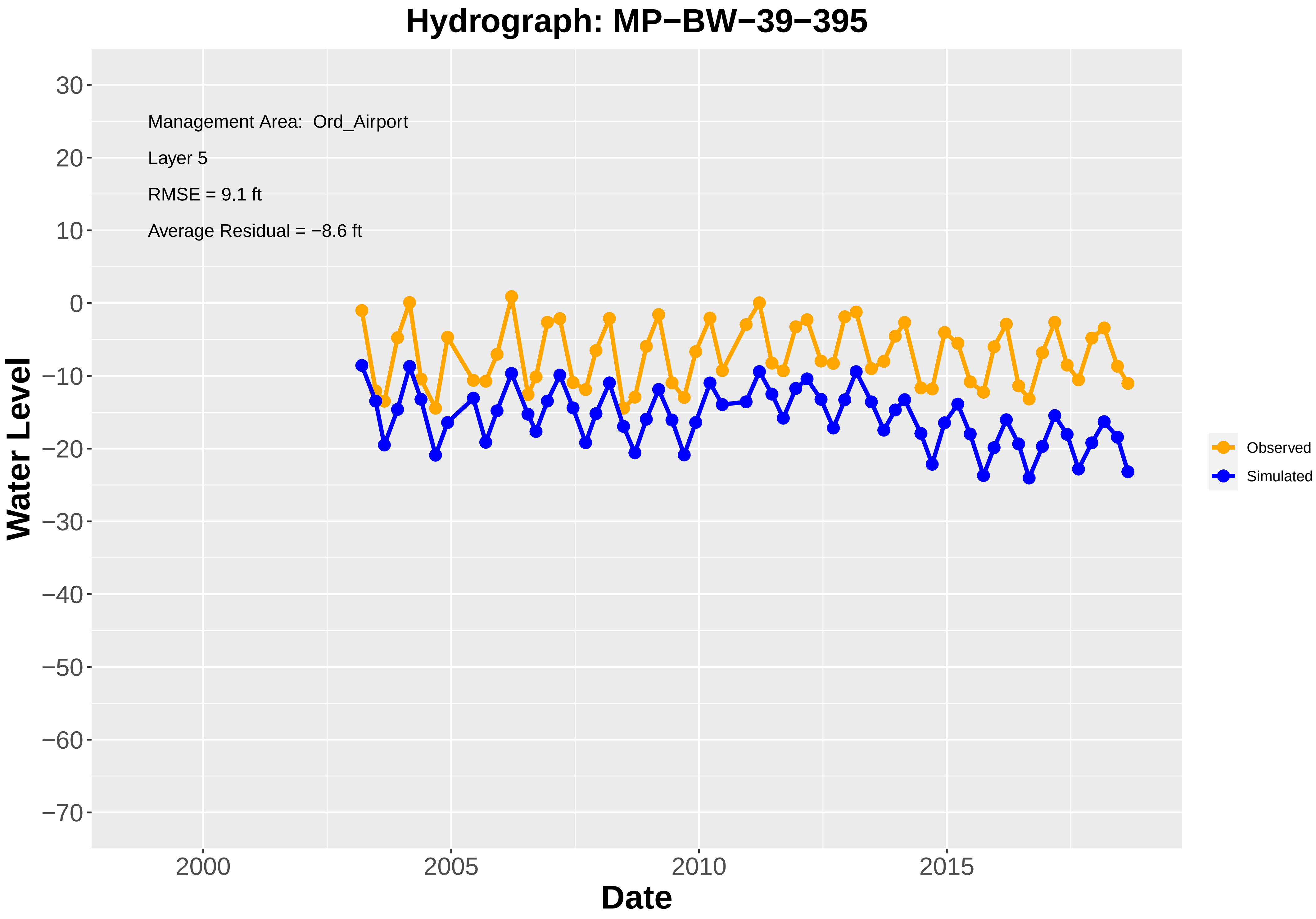

Hydrograph: MP−BW−39−310
Management Area: Ord_Airport
Layer 5
RMSE = 8.1 ft
Average Residual = −7.5 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

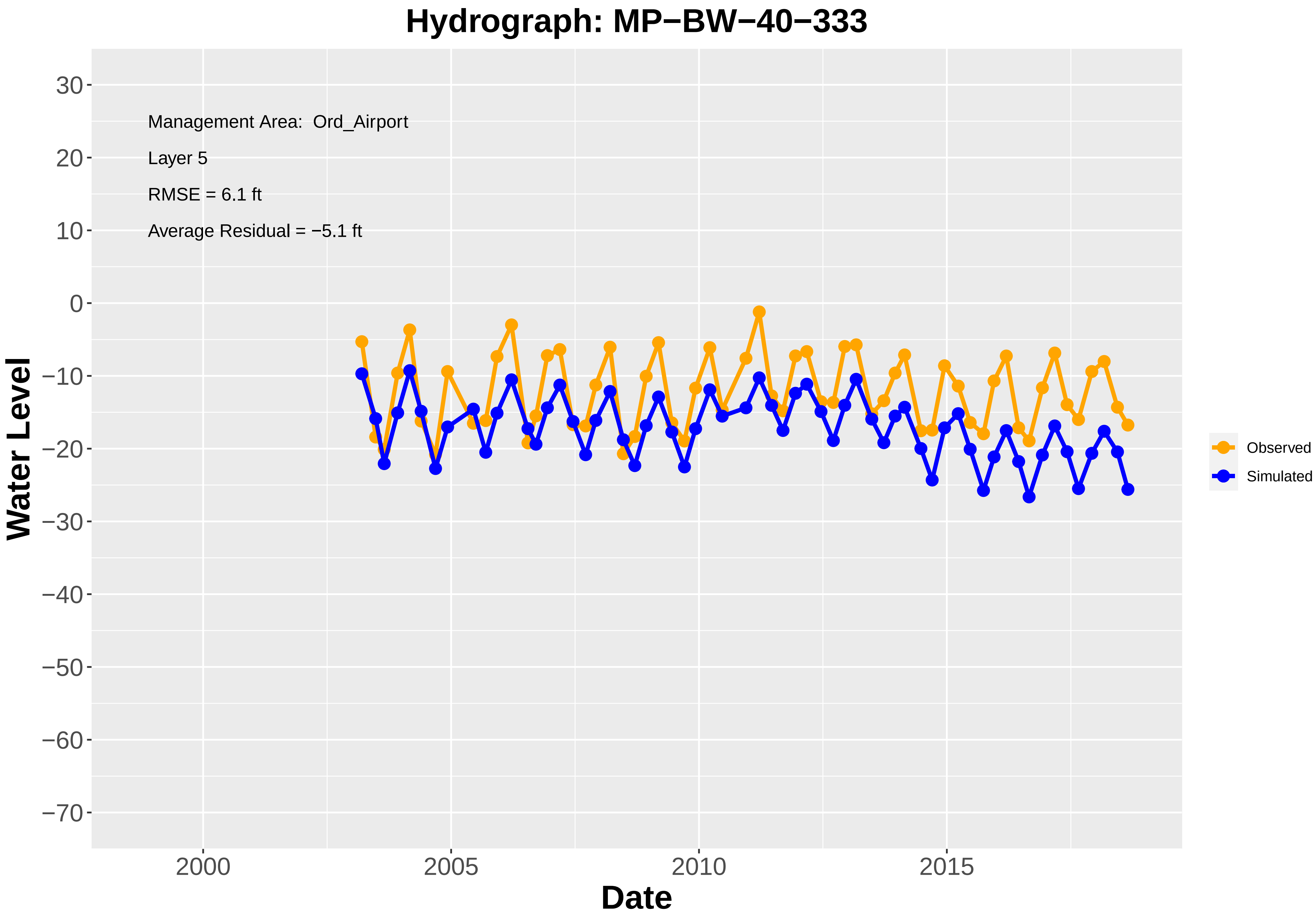


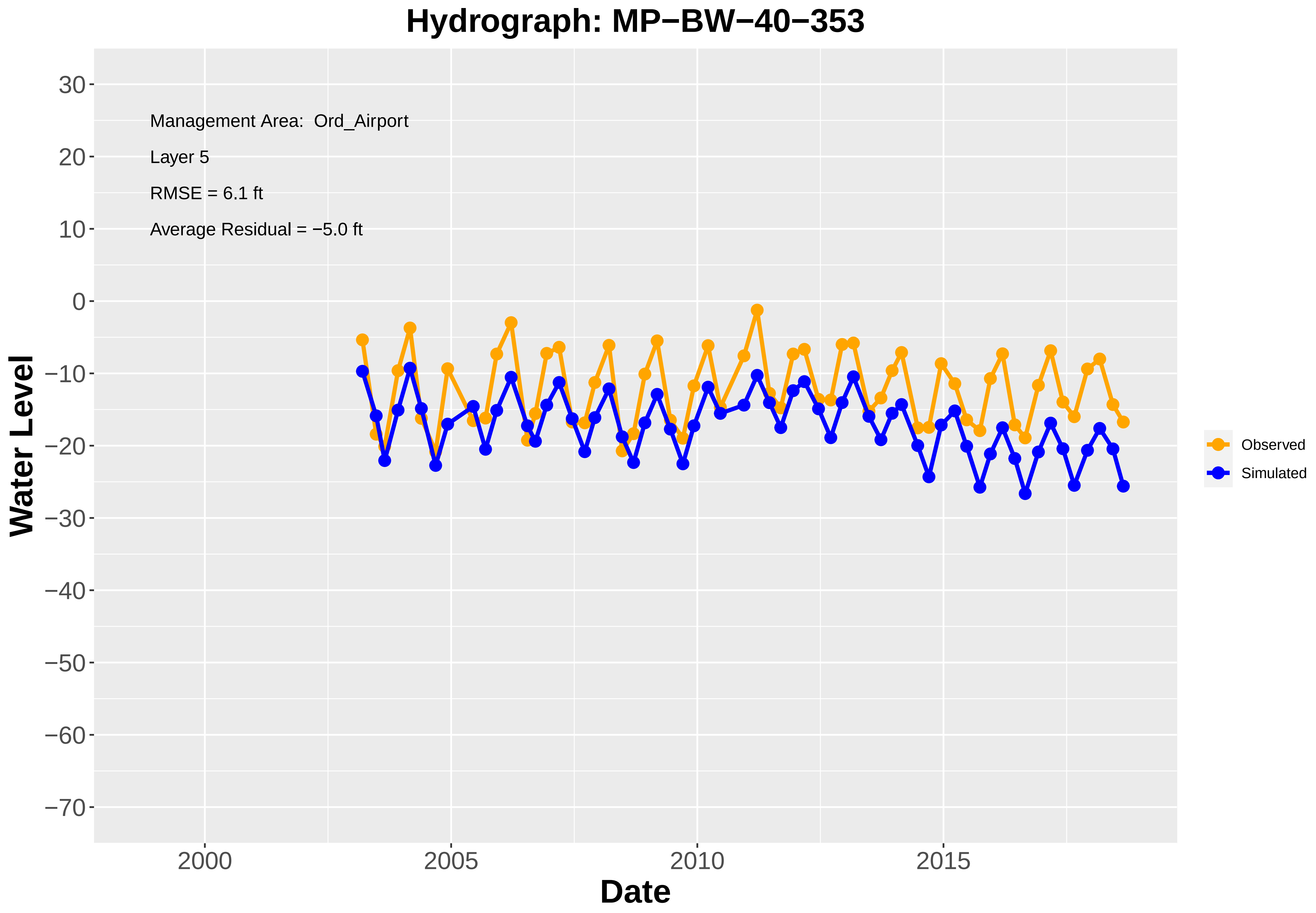
Hydrograph: MP−BW−39−330
Management Area: Ord_Airport
Layer 5
RMSE = 8.2 ft
Average Residual = −7.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



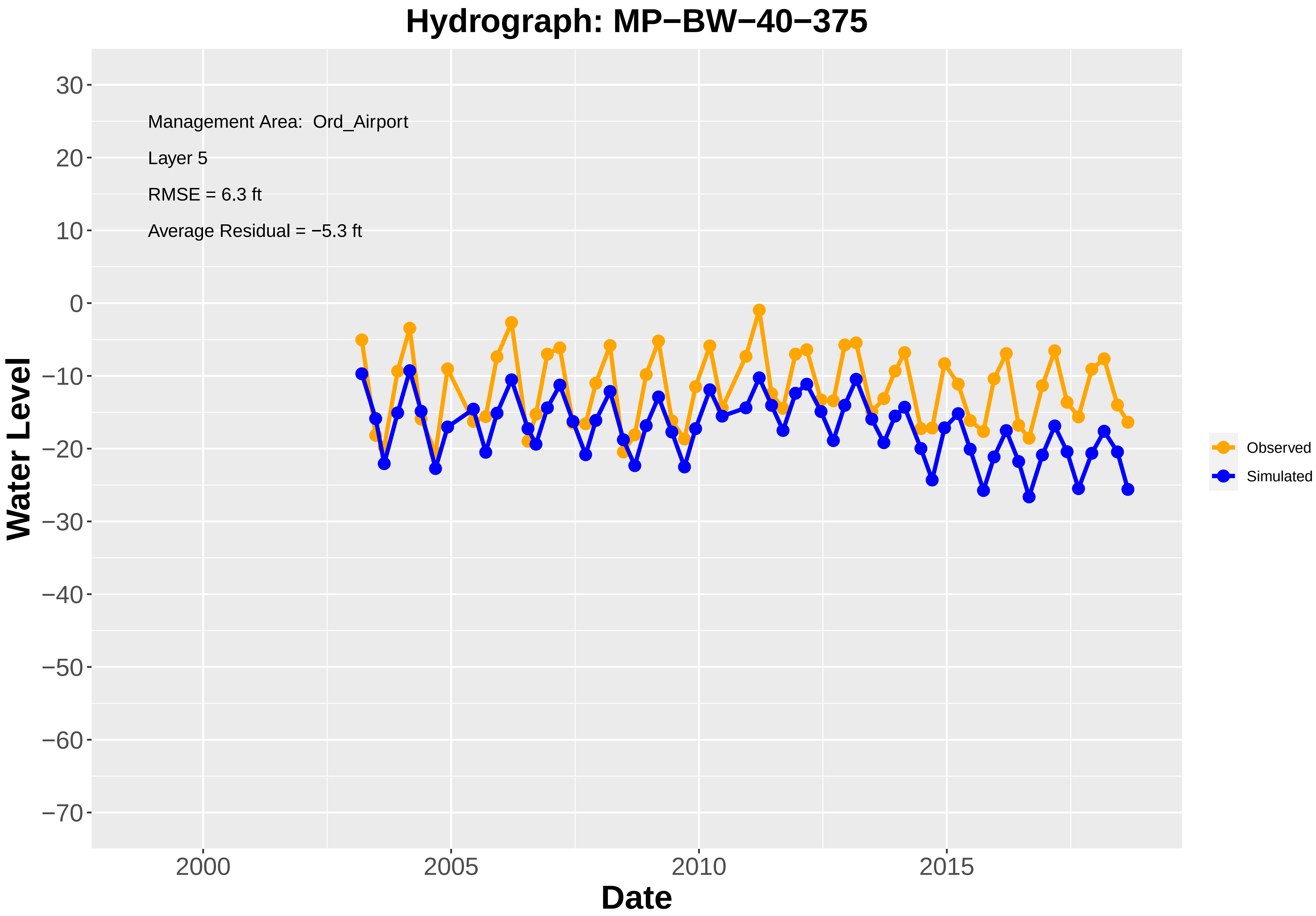
Hydrograph: MP−BW−39−350
Management Area: Ord_Airport
Layer 5
RMSE = 8.5 ft
Average Residual = −7.8 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−39−395
Management Area: Ord_Airport
Layer 5
RMSE = 9.1 ft
Average Residual = −8.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

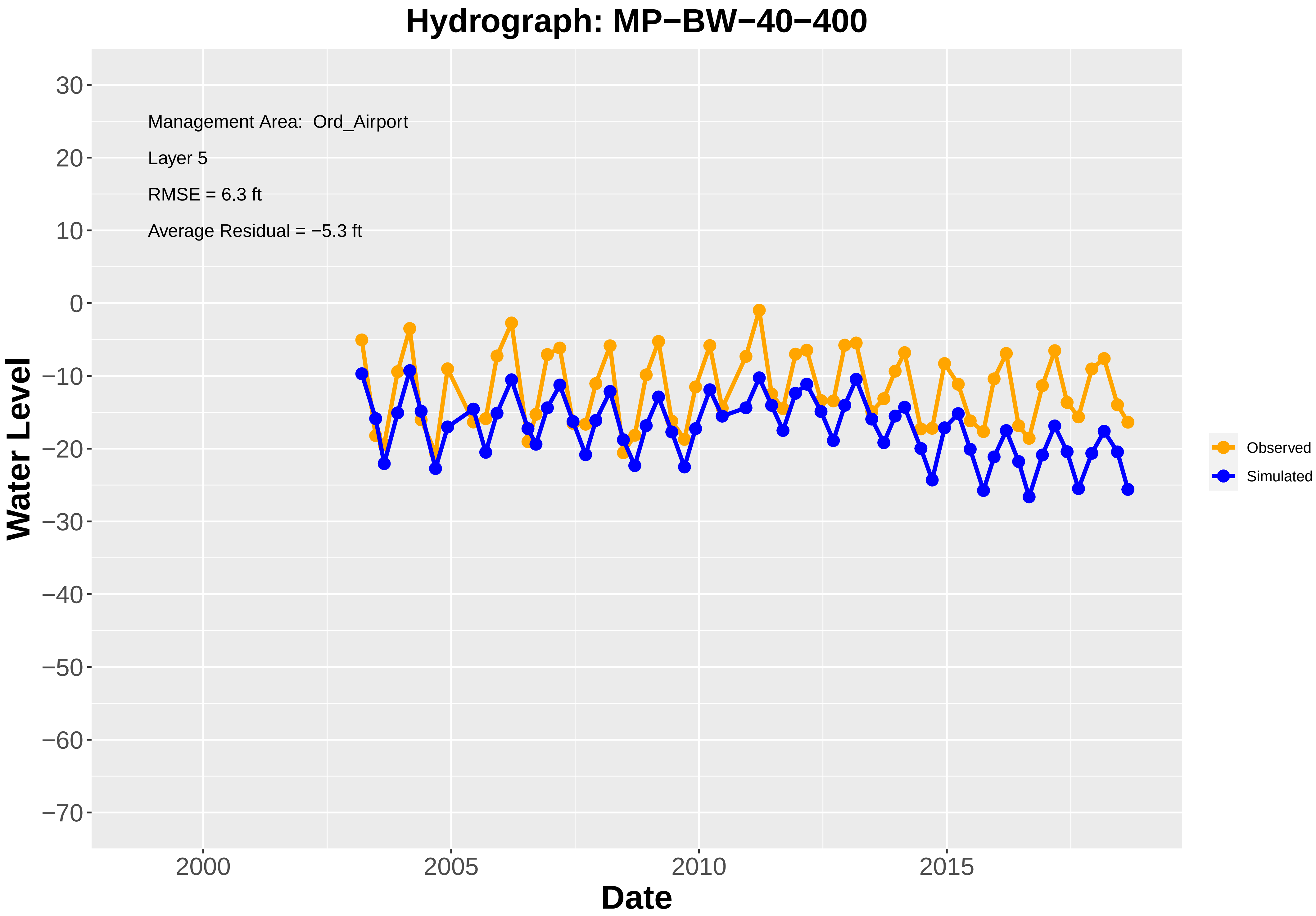

Hydrograph: MP−BW−40−333
Management Area: Ord_Airport
Layer 5
RMSE = 6.1 ft
Average Residual = −5.1 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated



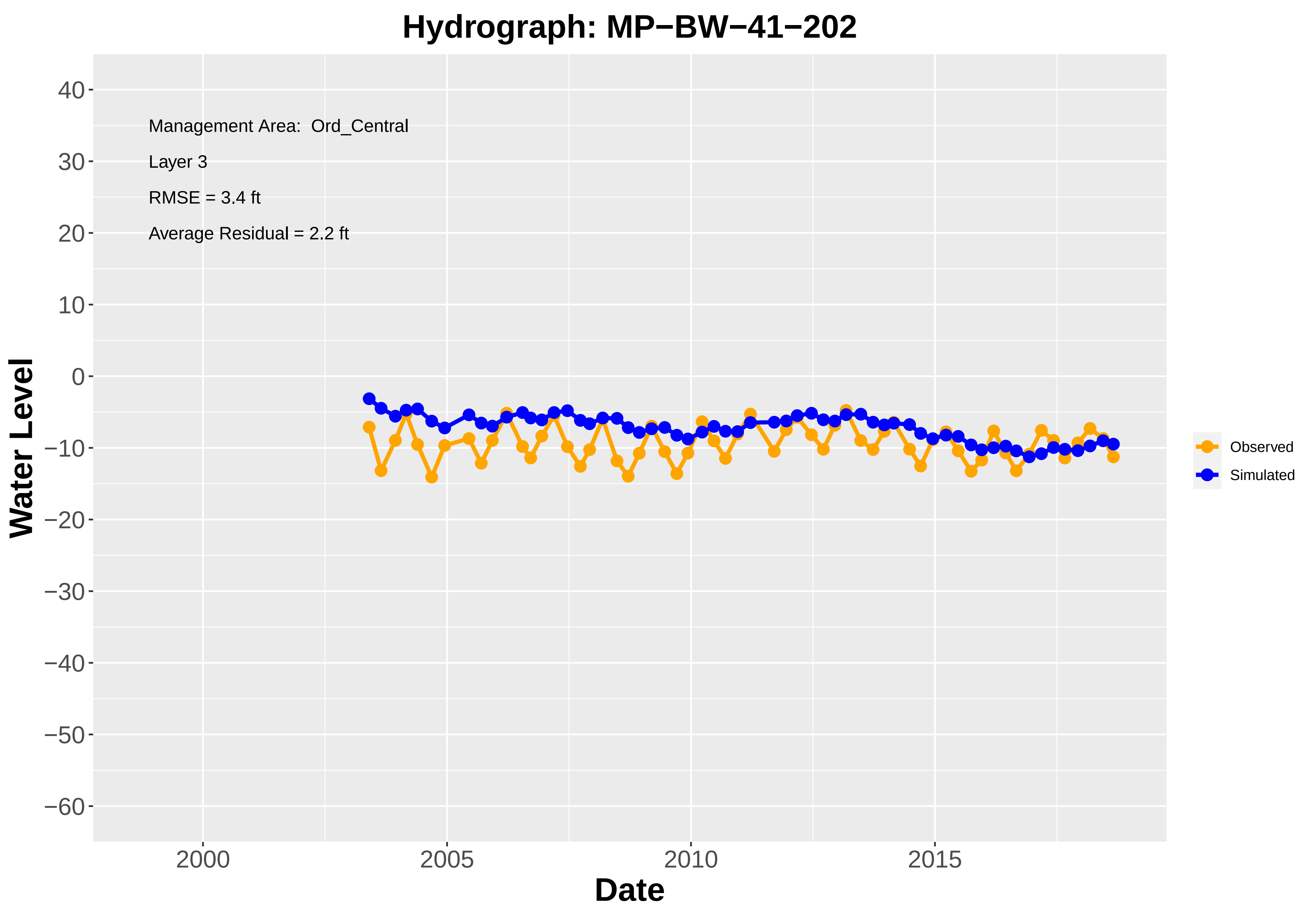
Hydrograph: MP−BW−40−353
Management Area: Ord_Airport
Layer 5
RMSE = 6.1 ft
Average Residual = −5.0 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



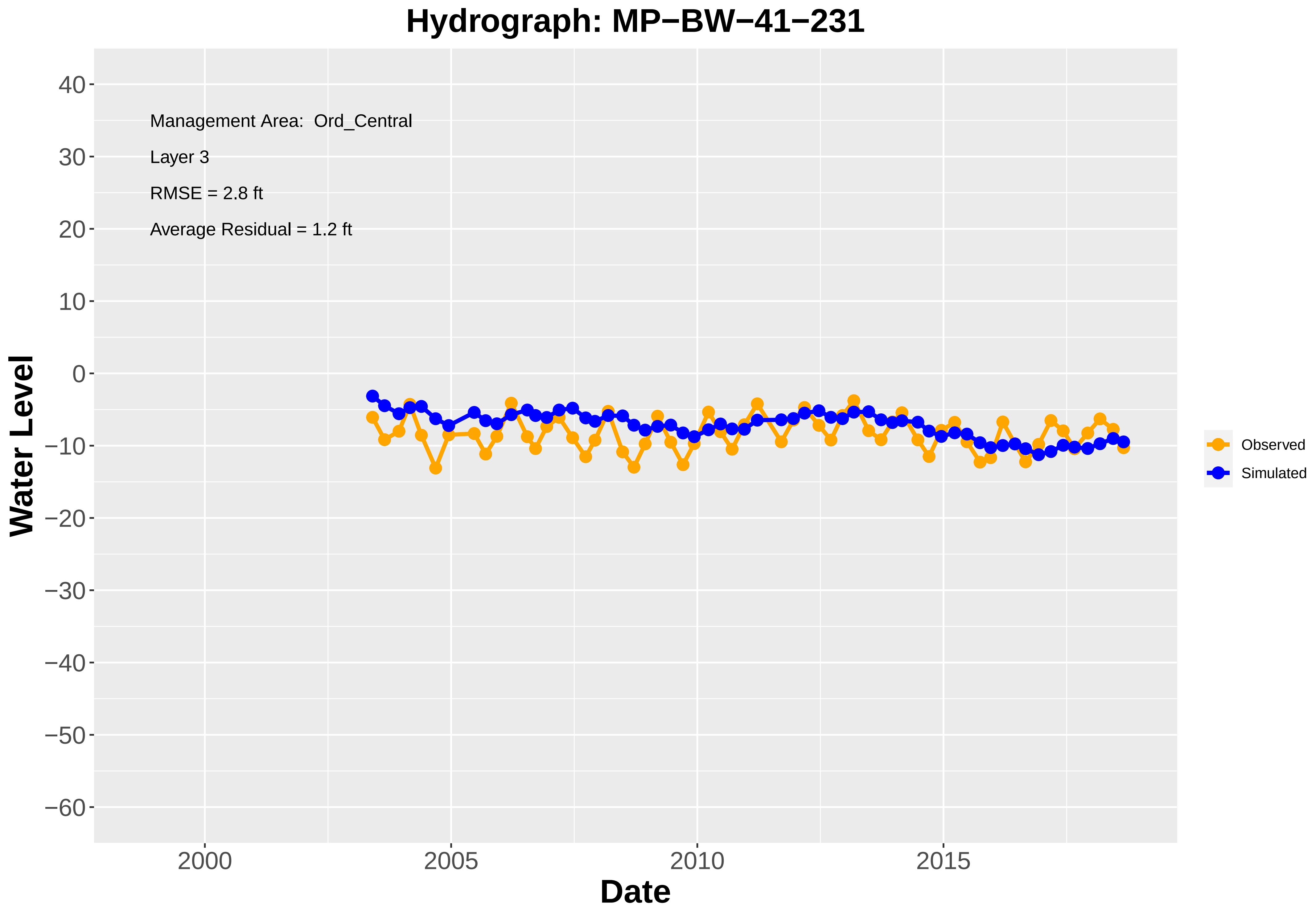
Hydrograph: MP−BW−40−375
Management Area: Ord_Airport
Layer 5
RMSE = 6.3 ft
Average Residual = −5.3 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Date
2000
2005
2010
2015
Observed
Simulated



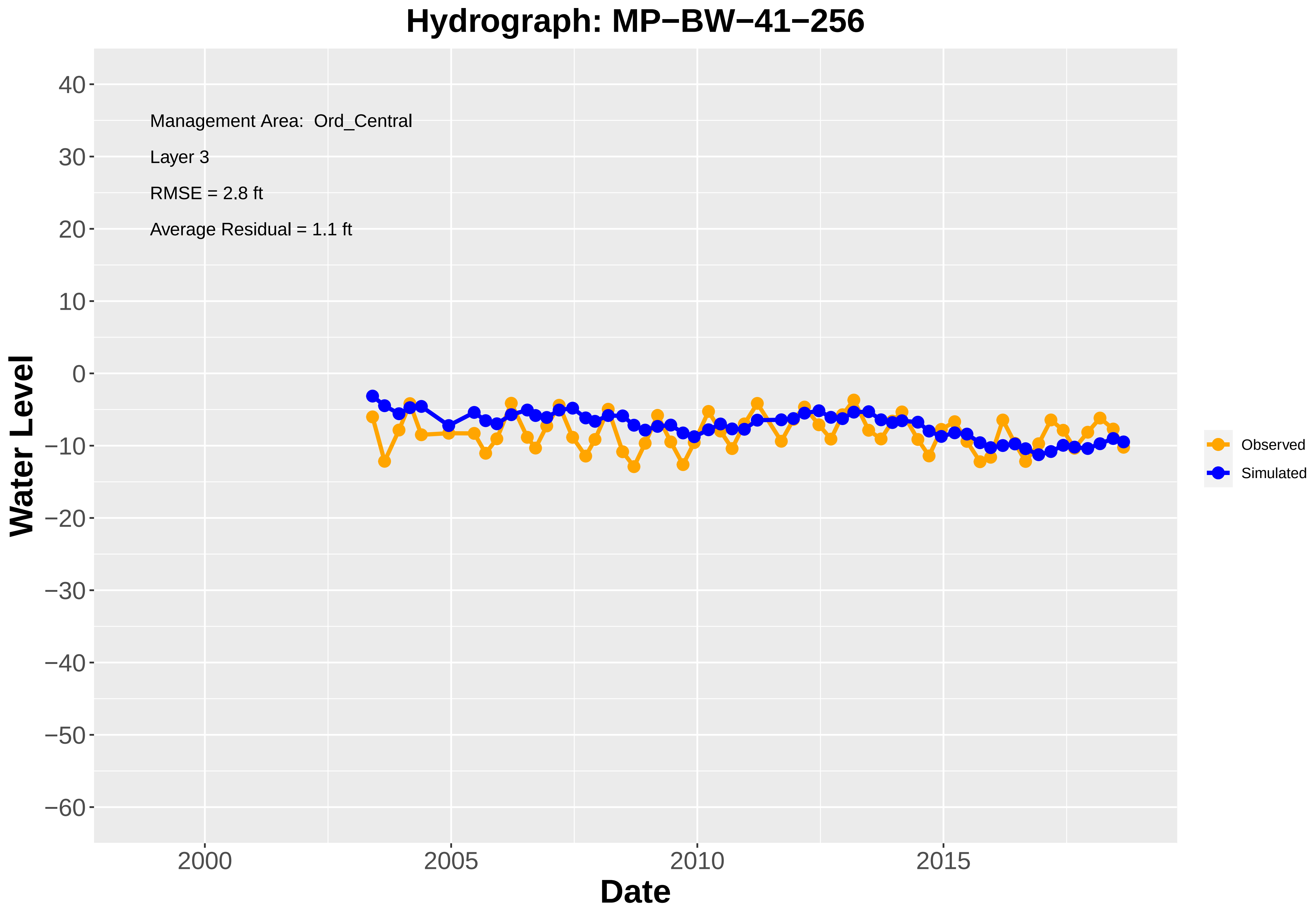
Hydrograph: MP−BW−40−400
Management Area: Ord_Airport
Layer 5
RMSE = 6.3 ft
Average Residual = −5.3 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



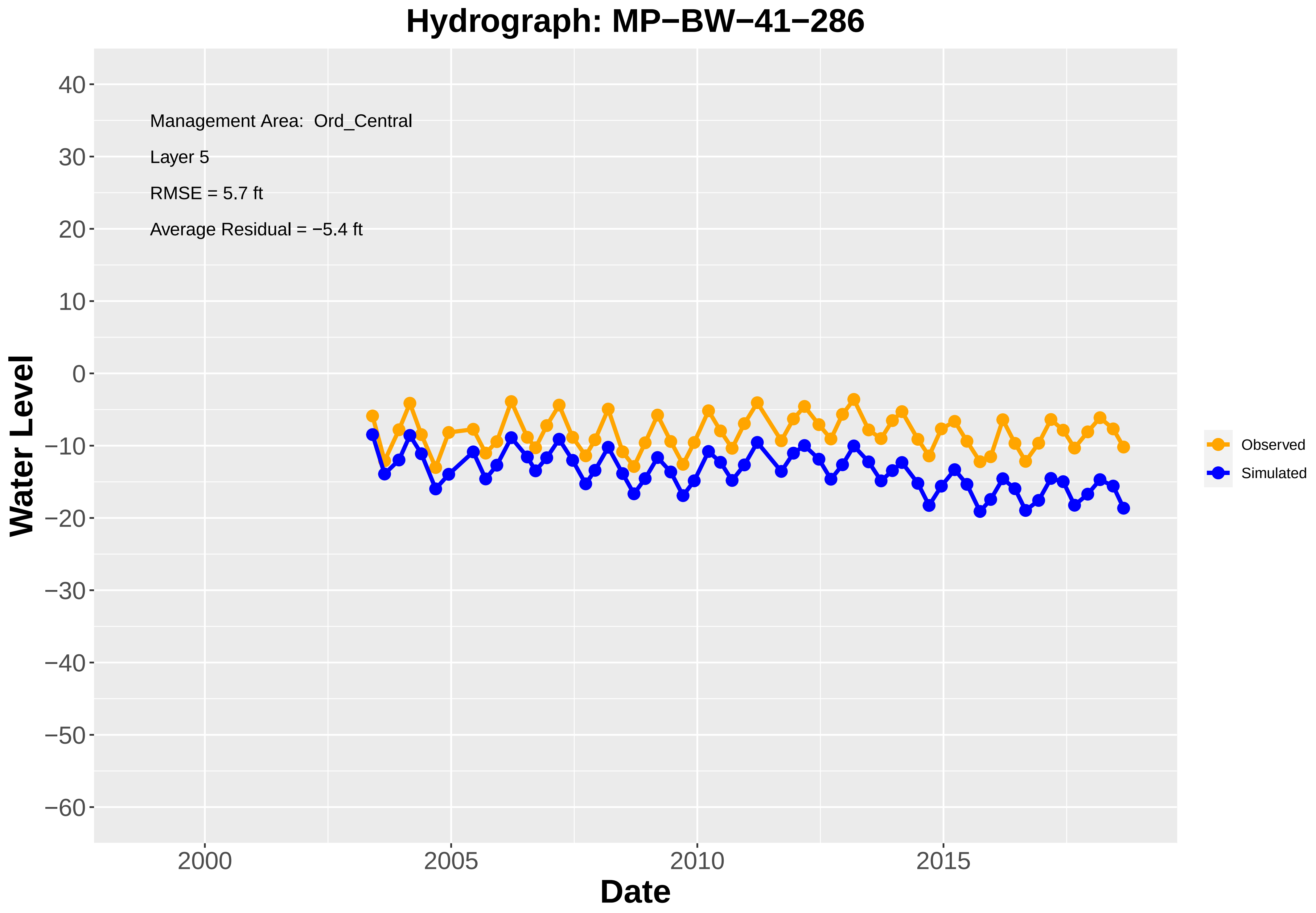
Hydrograph: MP−BW−41−202
Management Area: Ord_Central
Layer 3
RMSE = 3.4 ft
Average Residual = 2.2 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

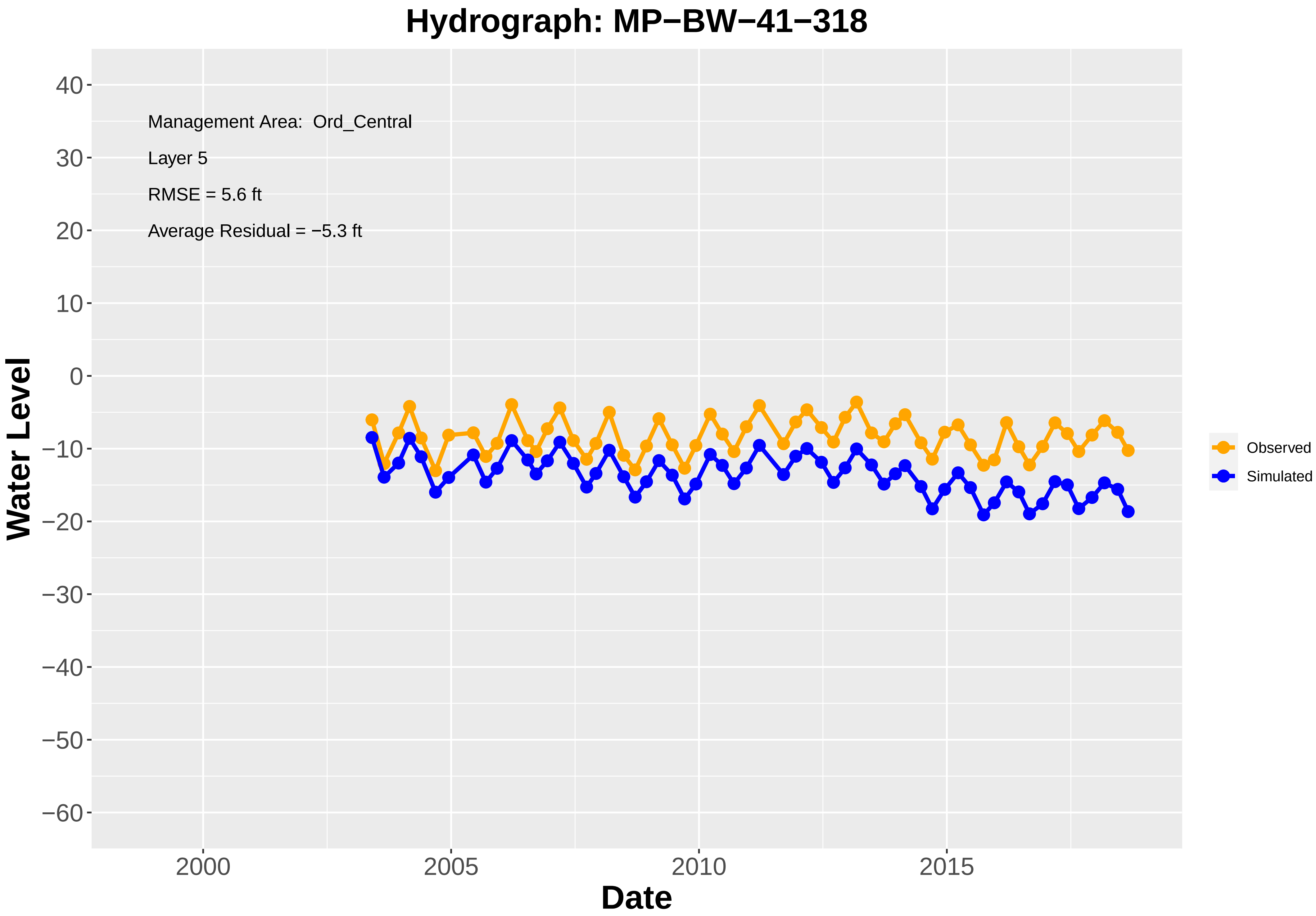


Hydrograph: MP−BW−41−231
Management Area: Ord_Central
Layer 3
RMSE = 2.8 ft
Average Residual = 1.2 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

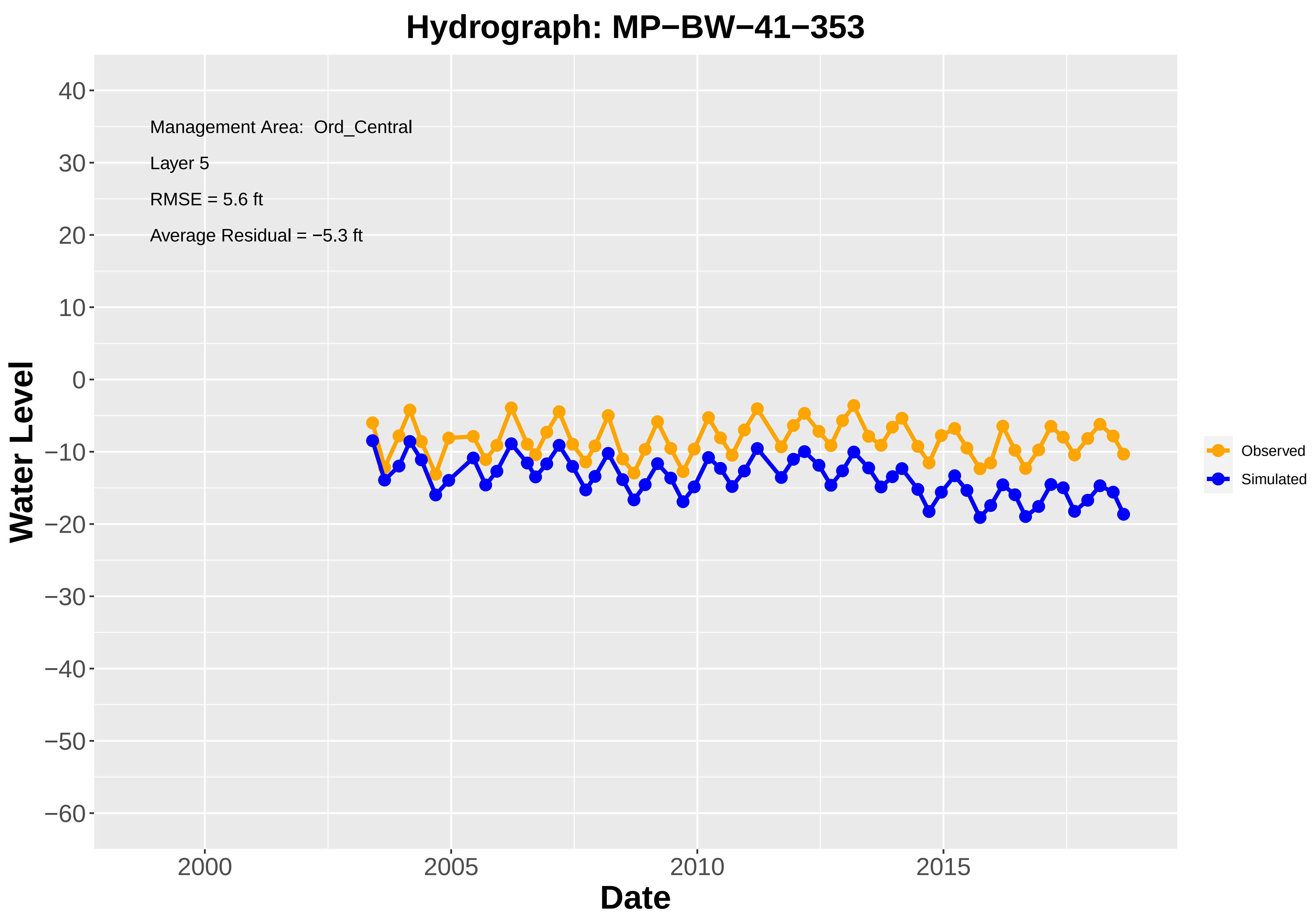


Hydrograph: MP−BW−41−256
Management Area: Ord_Central
Layer 3
RMSE = 2.8 ft
Average Residual = 1.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

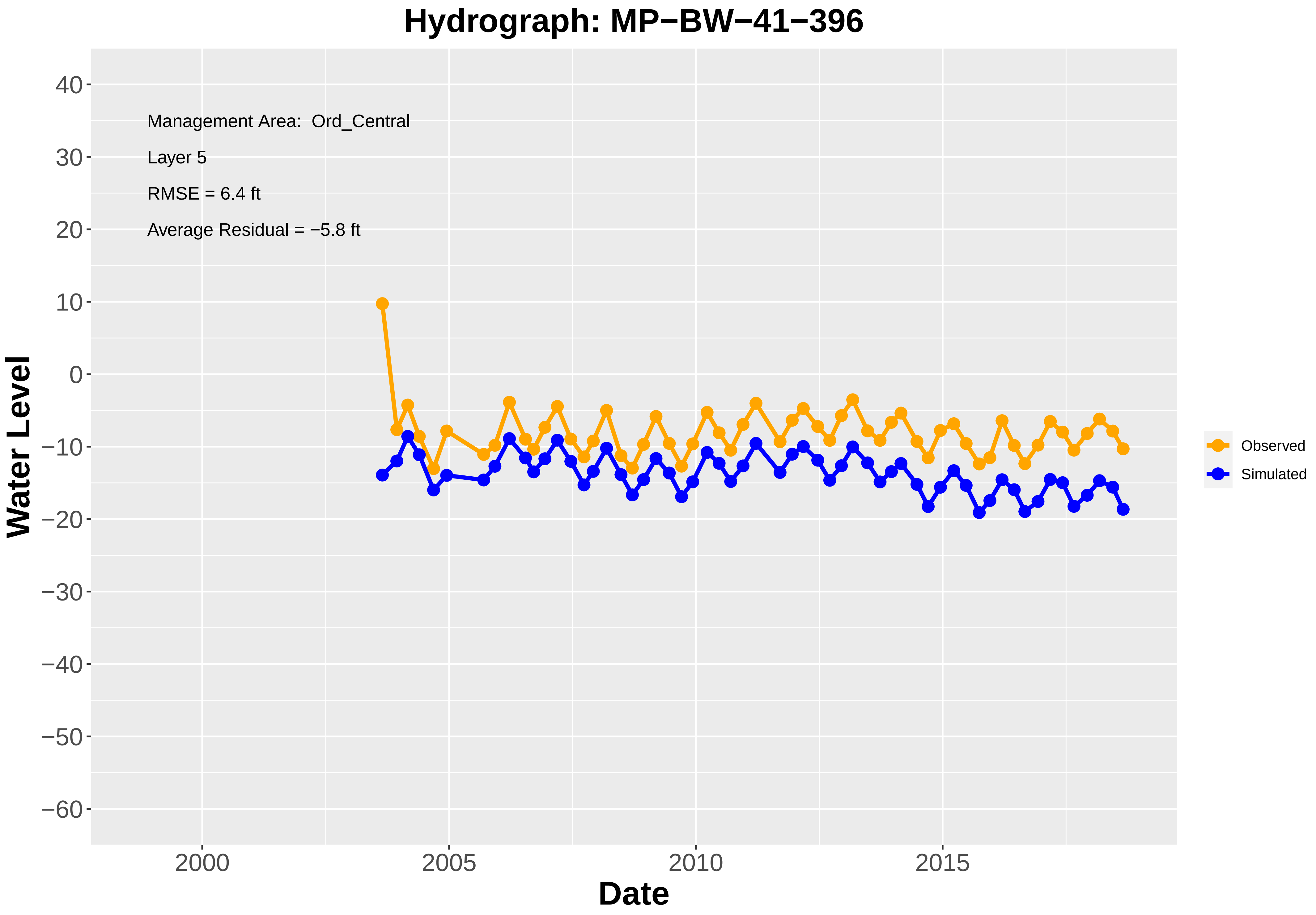

Hydrograph: MP−BW−41−286
Management Area: Ord_Central
Layer 5
RMSE = 5.7 ft
Average Residual = −5.4 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

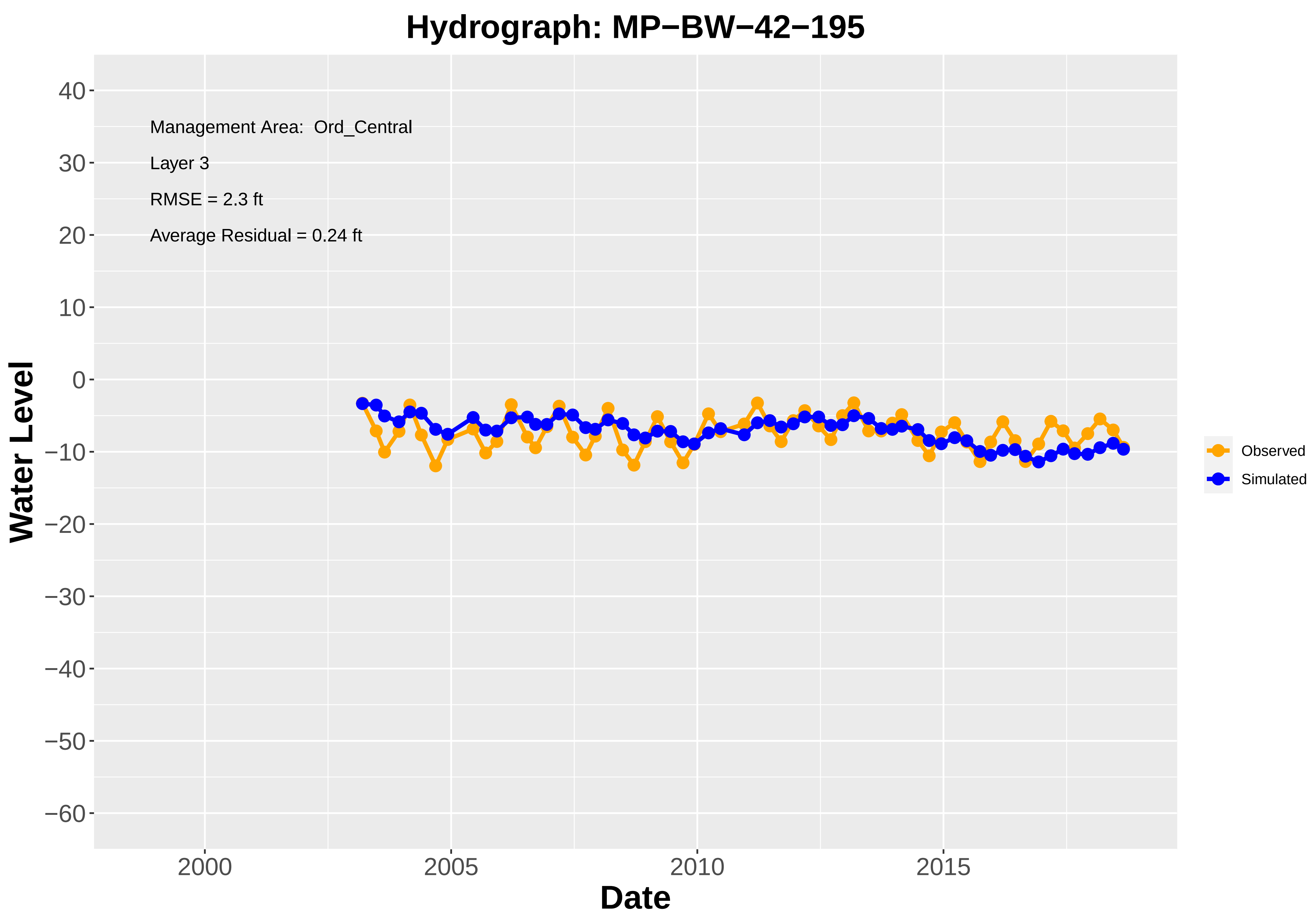


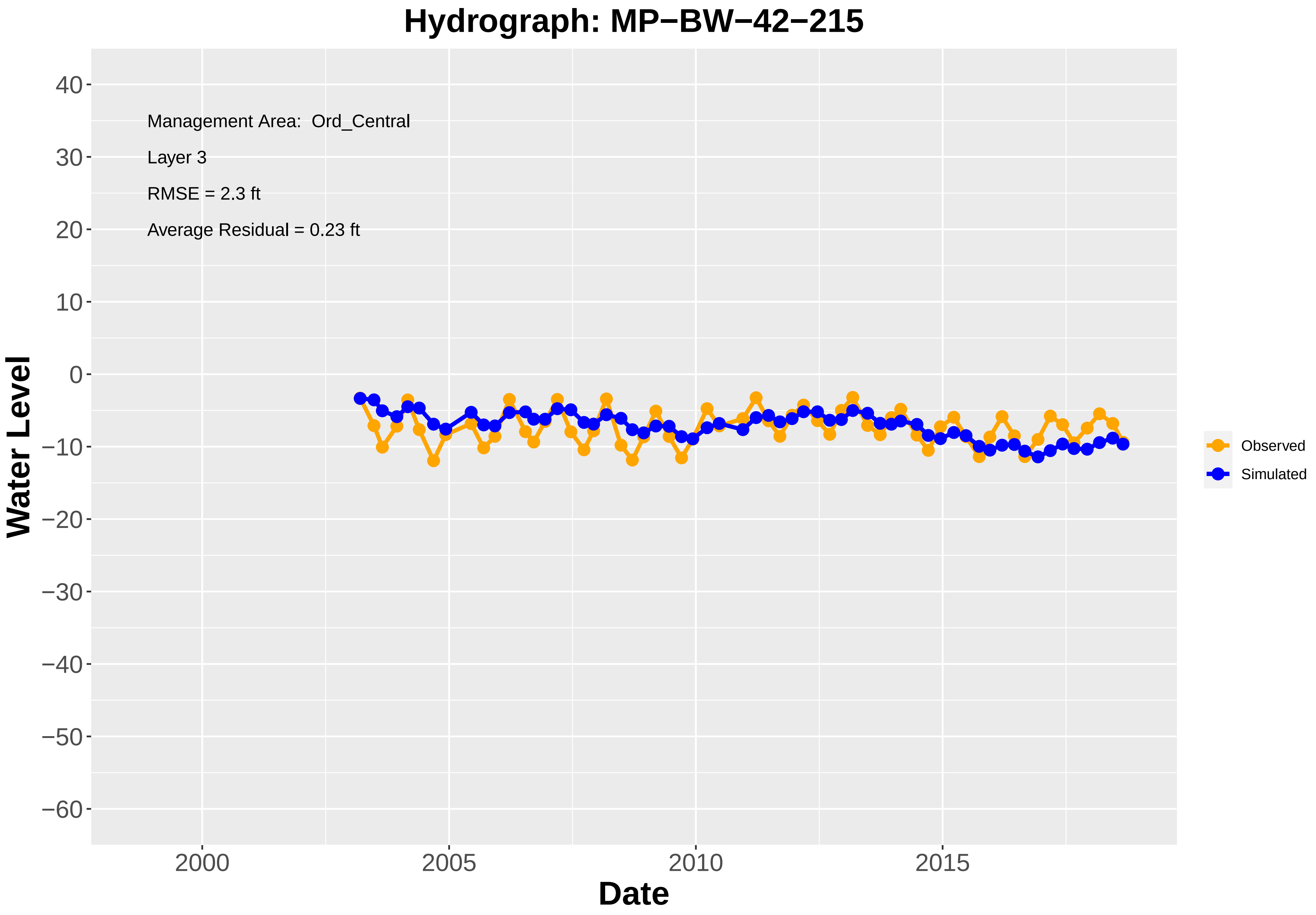
Hydrograph: MP−BW−41−318
Management Area: Ord_Central
Layer 5
RMSE = 5.6 ft
Average Residual = −5.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated



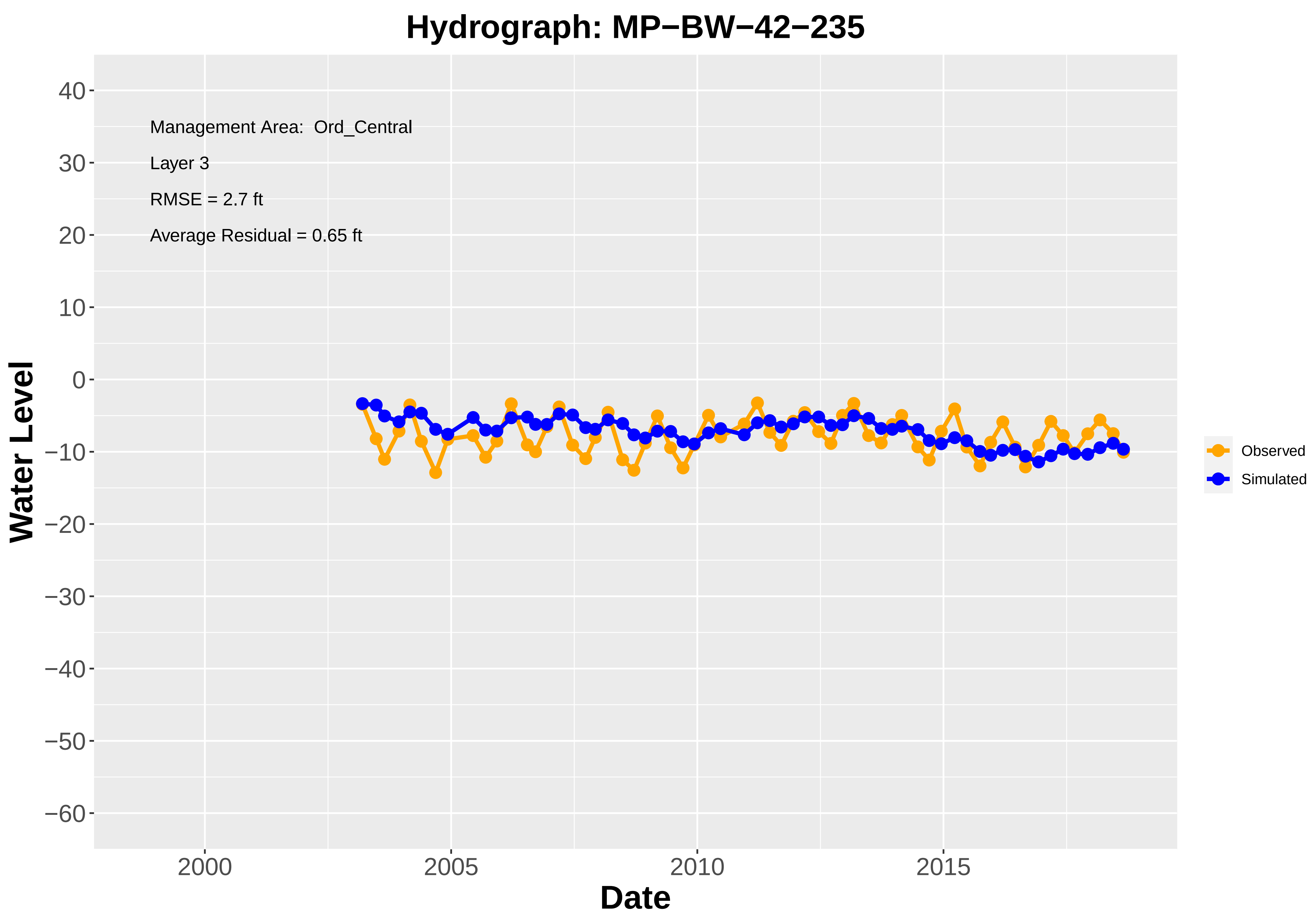
Hydrograph: MP−BW−41−353
Management Area: Ord_Central
Layer 5
RMSE = 5.6 ft
Average Residual = −5.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MP−BW−41−396
Management Area: Ord_Central
Layer 5
RMSE = 6.4 ft
Average Residual = −5.8 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

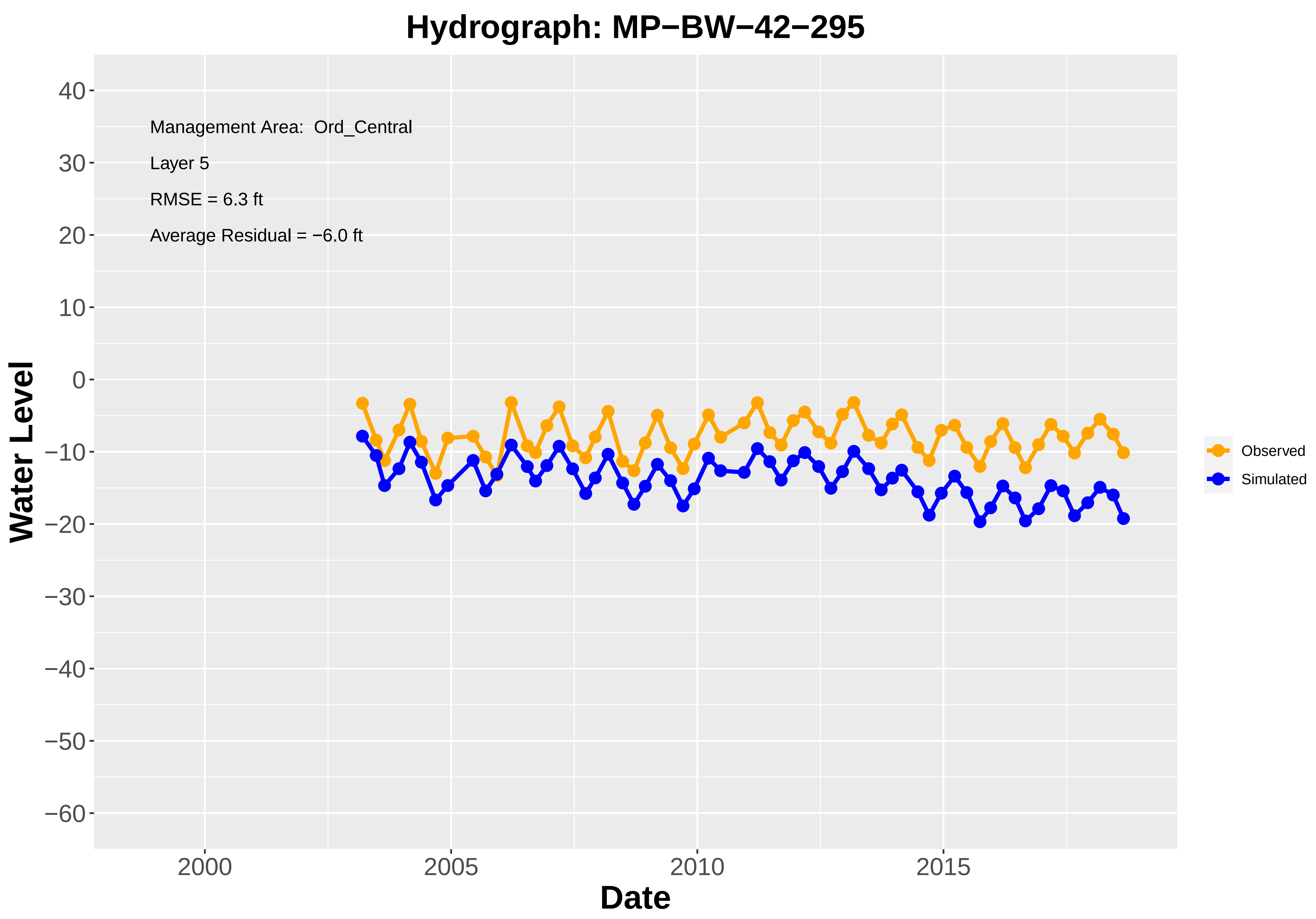

Hydrograph: MP−BW−42−195
Management Area: Ord_Central
Layer 3
RMSE = 2.3 ft
Average Residual = 0.24 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

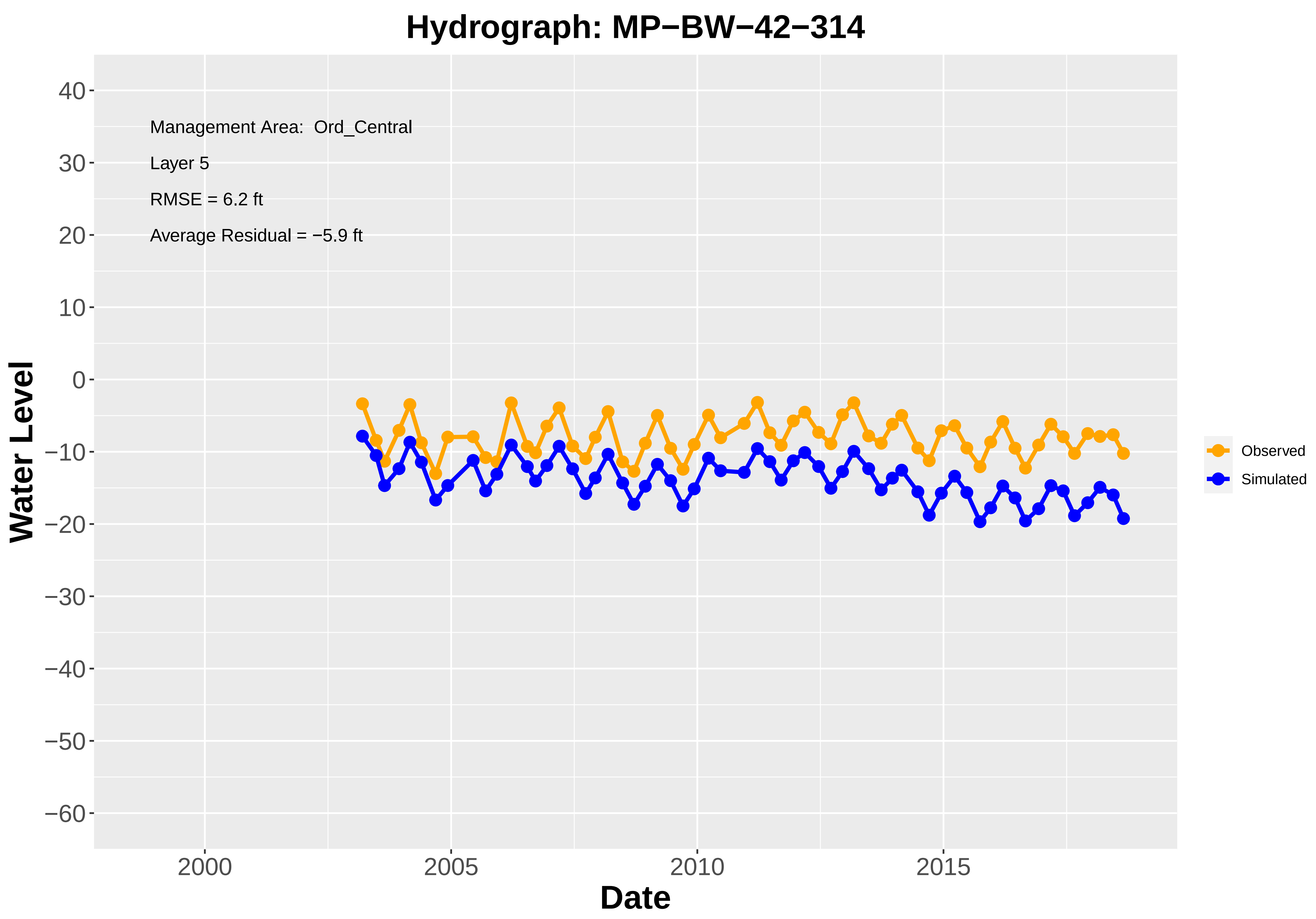


Hydrograph: MP−BW−42−215
Management Area: Ord_Central
Layer 3
RMSE = 2.3 ft
Average Residual = 0.23 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

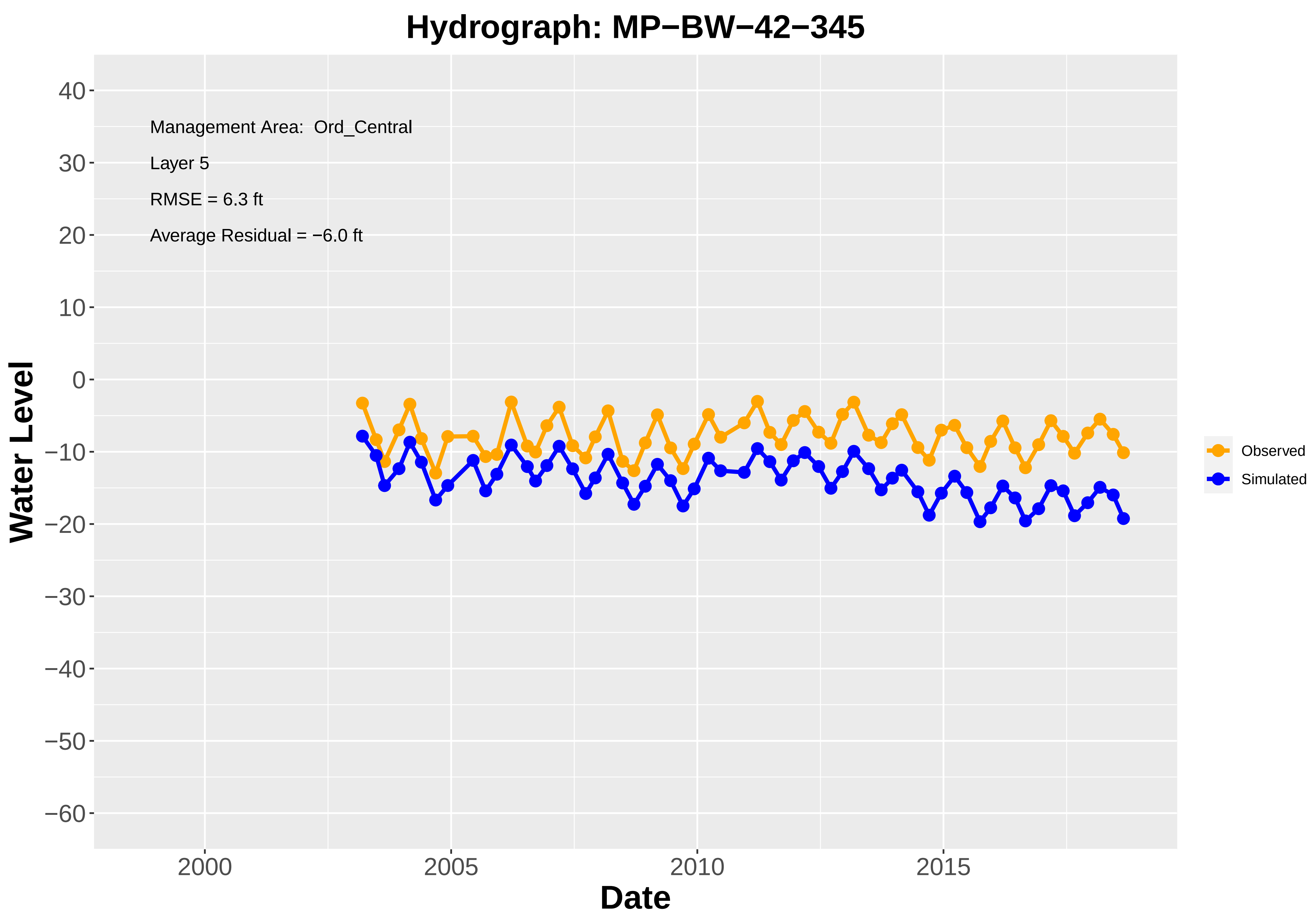


Hydrograph: MP−BW−42−235
Management Area: Ord_Central
Layer 3
RMSE = 2.7 ft
Average Residual = 0.65 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

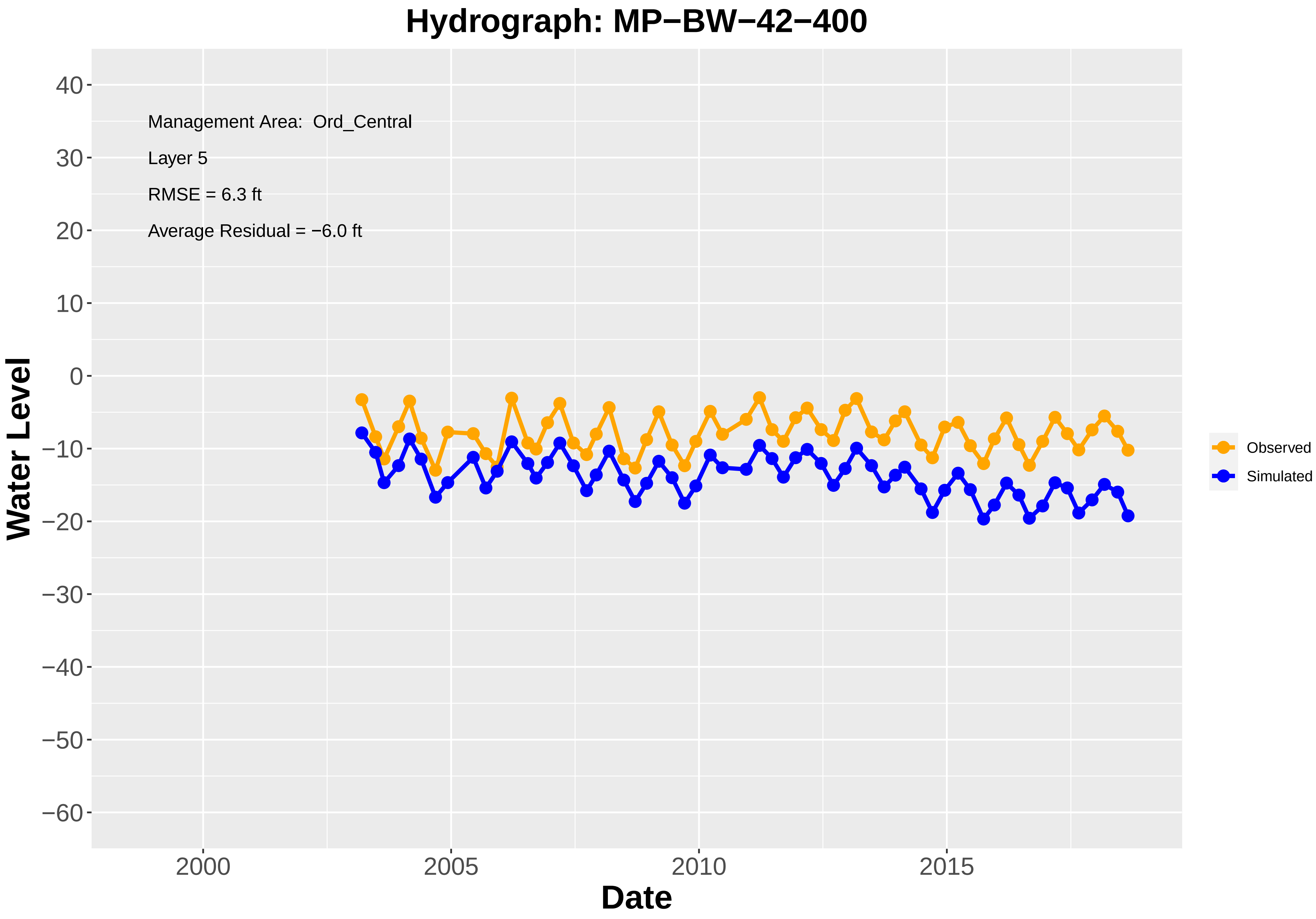

Hydrograph: MP−BW−42−295
Management Area: Ord_Central
Layer 5
RMSE = 6.3 ft
Average Residual = −6.0 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated



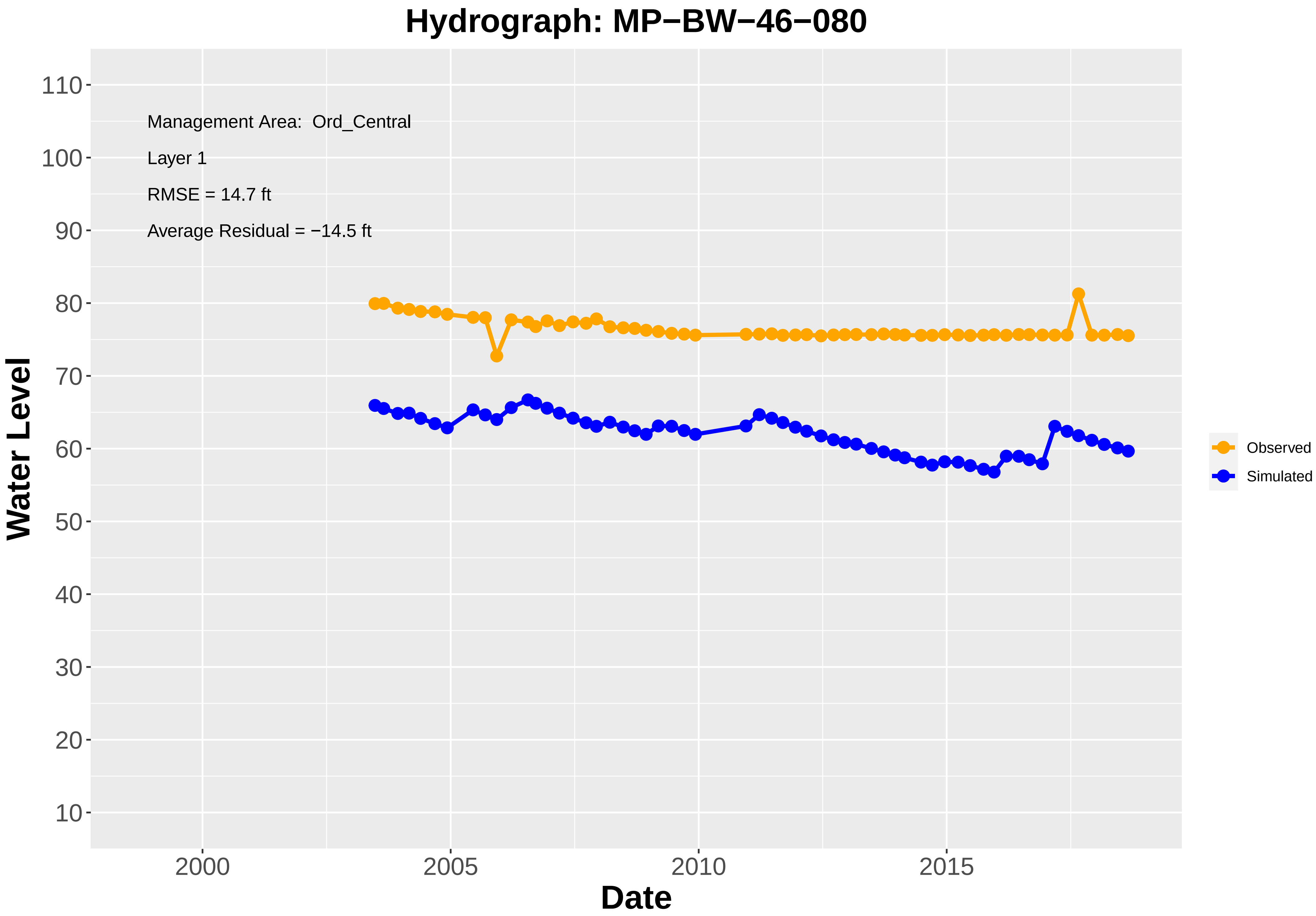
Hydrograph: MP−BW−42−314
Management Area: Ord_Central
Layer 5
RMSE = 6.2 ft
Average Residual = −5.9 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

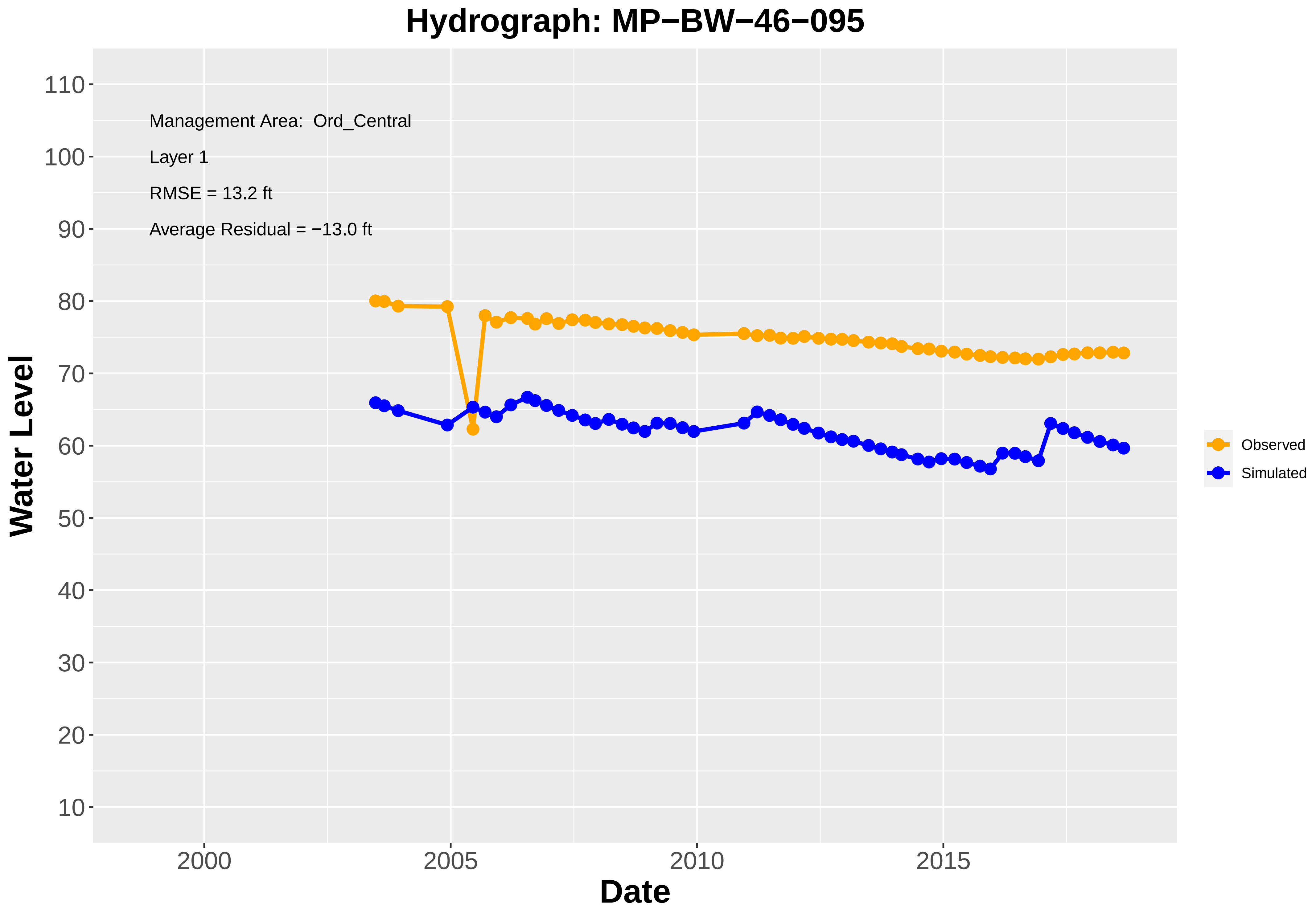


Hydrograph: MP−BW−42−345
Management Area: Ord_Central
Layer 5
RMSE = 6.3 ft
Average Residual = −6.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

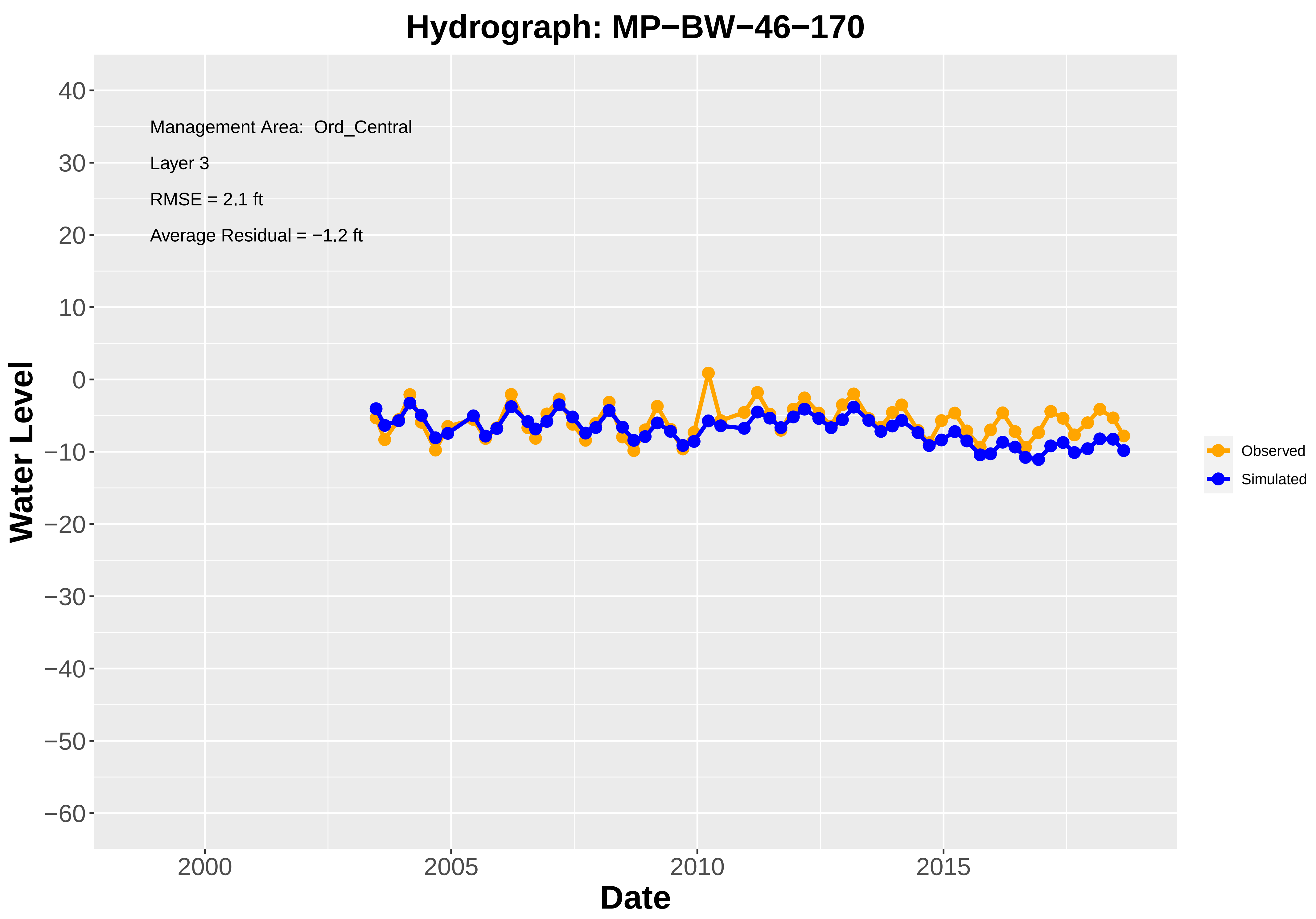


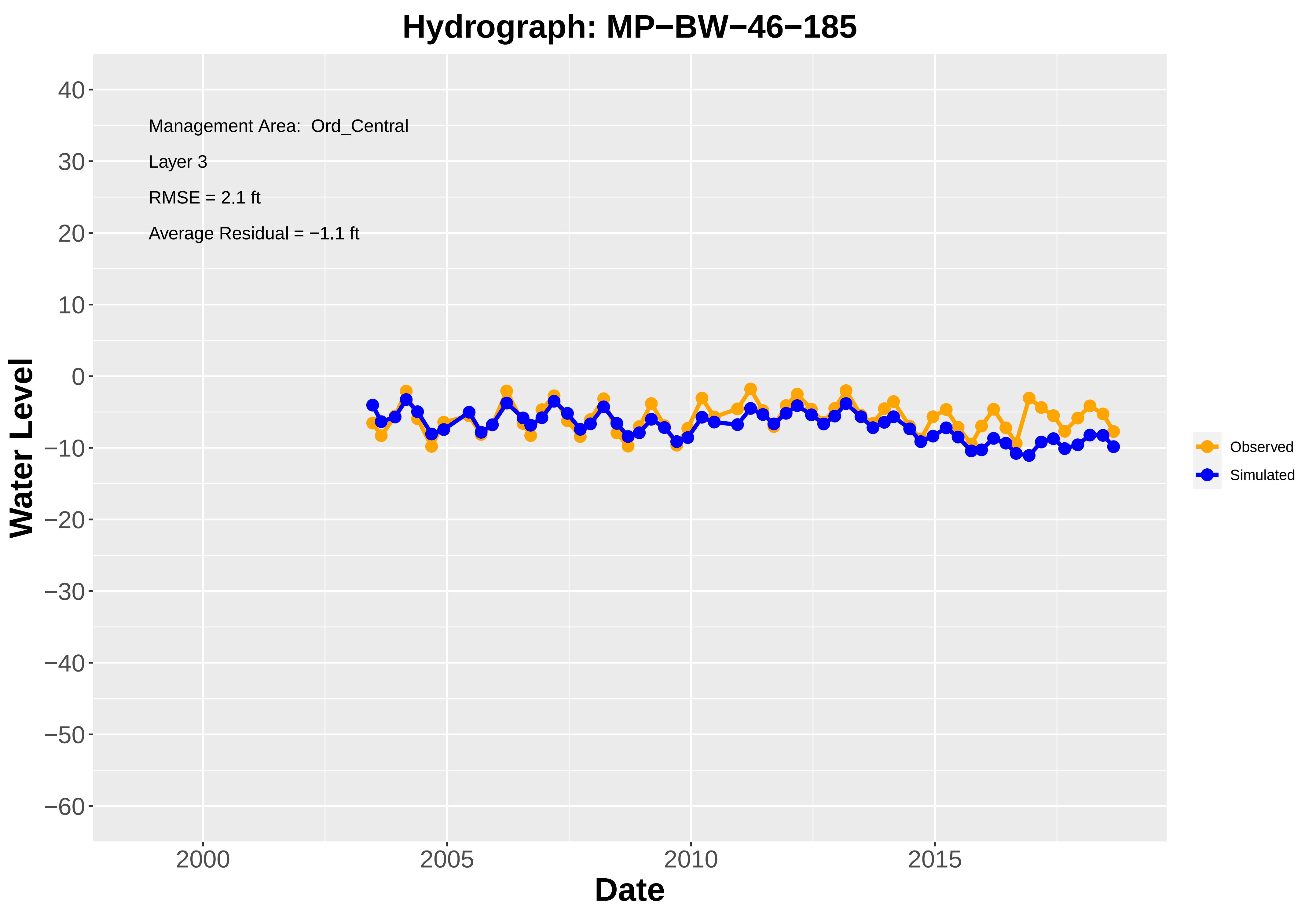
Hydrograph: MP−BW−42−400
Management Area: Ord_Central
Layer 5
RMSE = 6.3 ft
Average Residual = −6.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

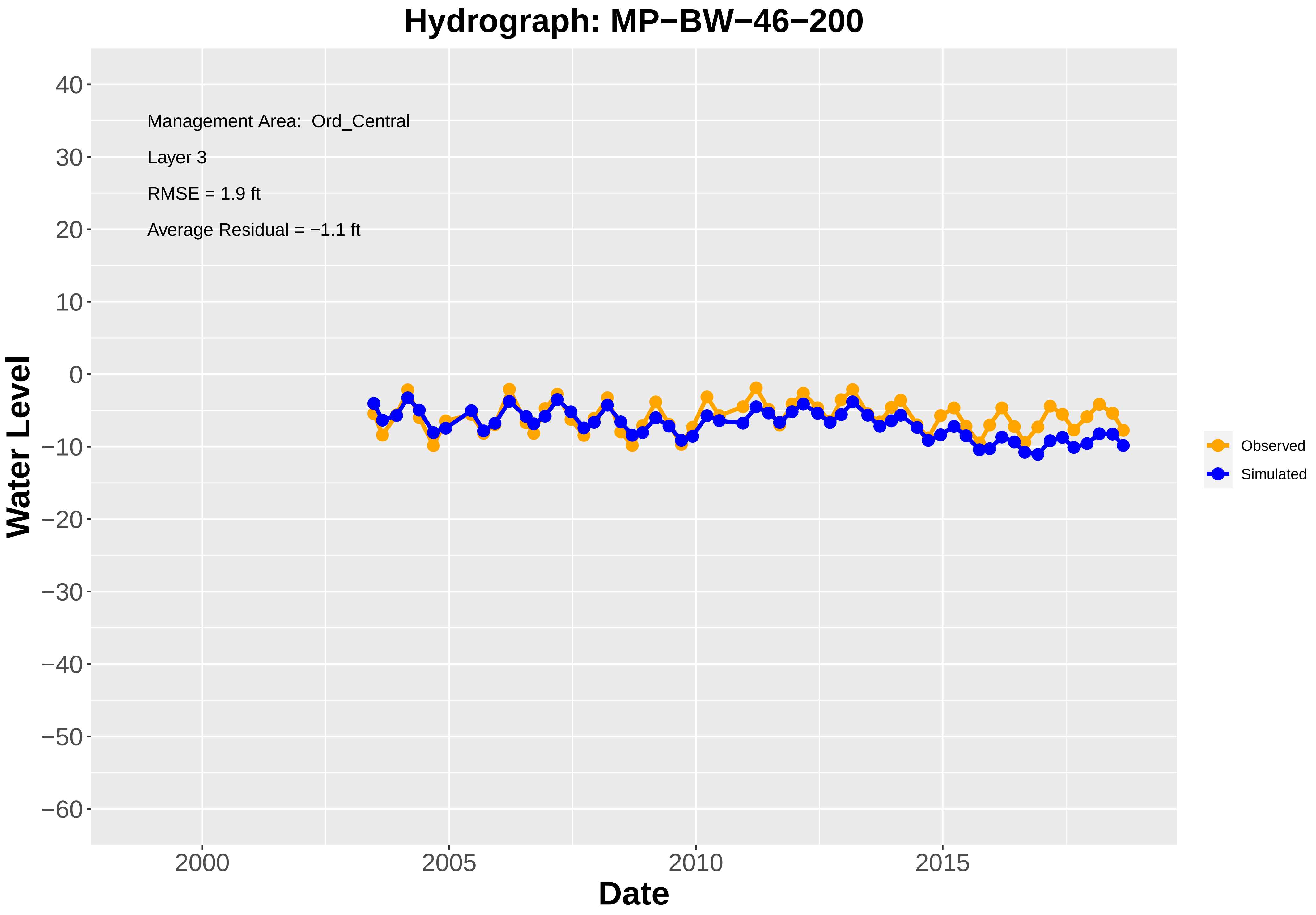

Hydrograph: MP−BW−46−080
Management Area: Ord_Central
Layer 1
RMSE = 14.7 ft
Average Residual = −14.5 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

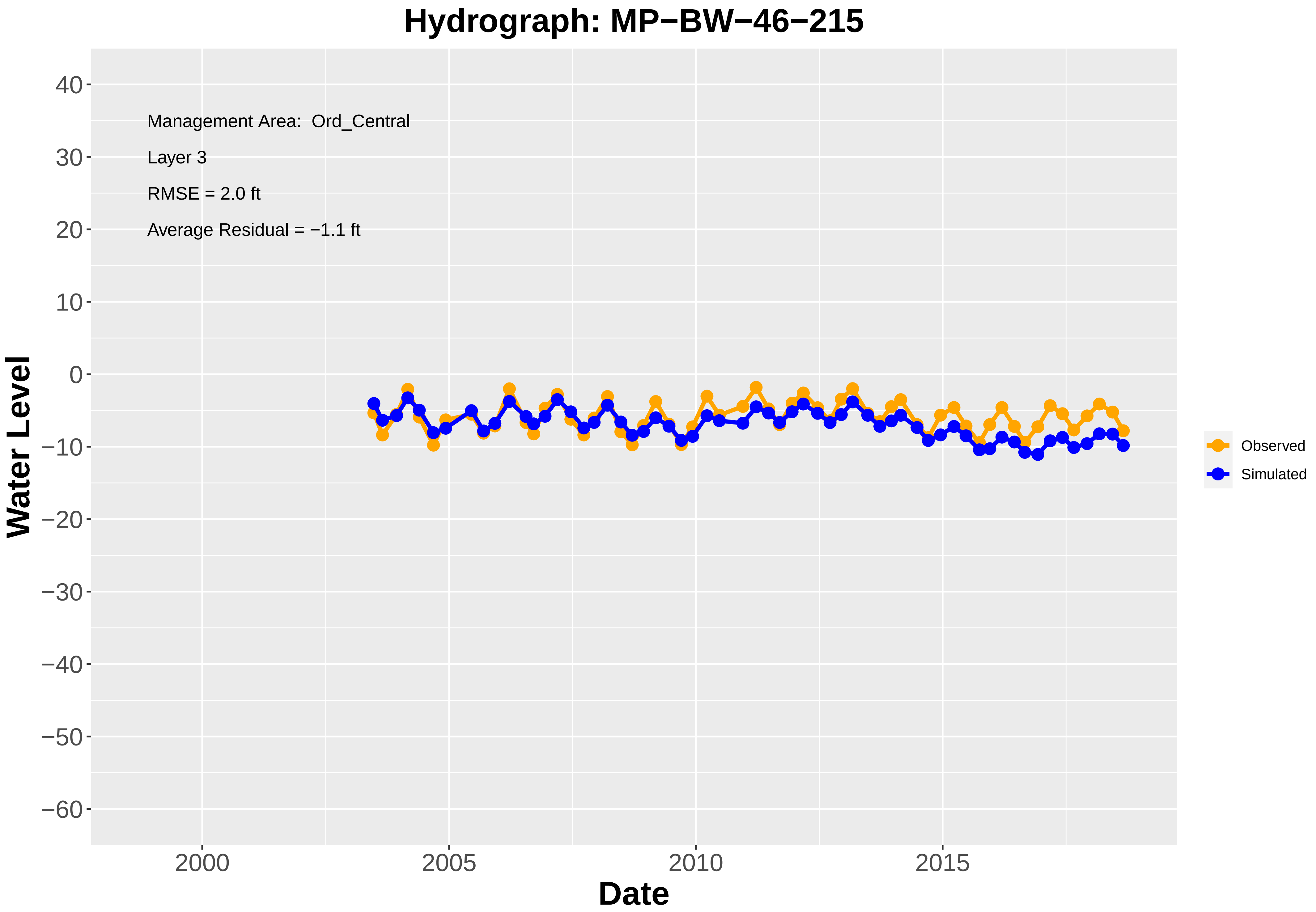


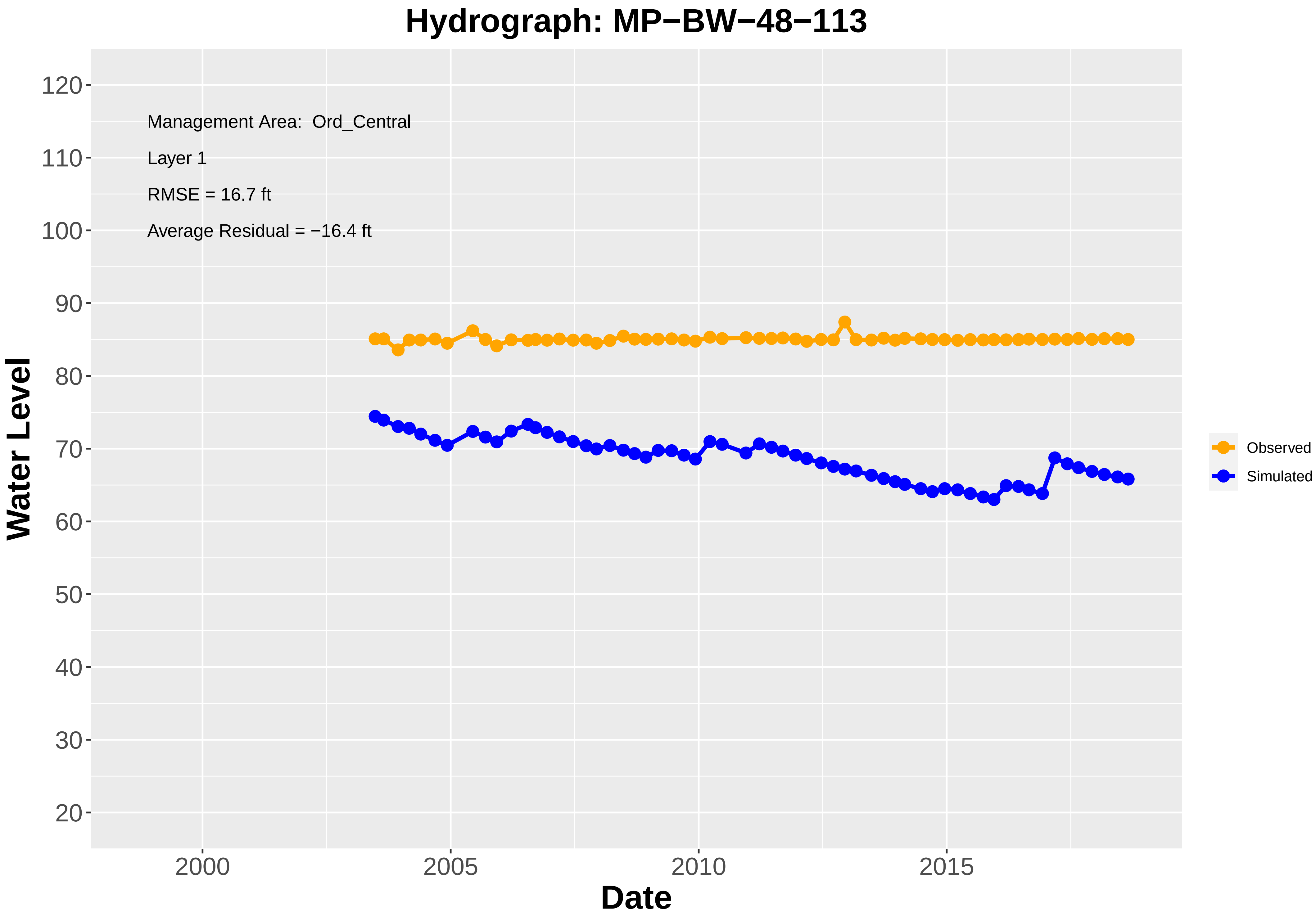
Hydrograph: MP−BW−46−095
Management Area: Ord_Central
Layer 1
RMSE = 13.2 ft
Average Residual = −13.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−46−170
Management Area: Ord_Central
Layer 3
RMSE = 2.1 ft
Average Residual = −1.2 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

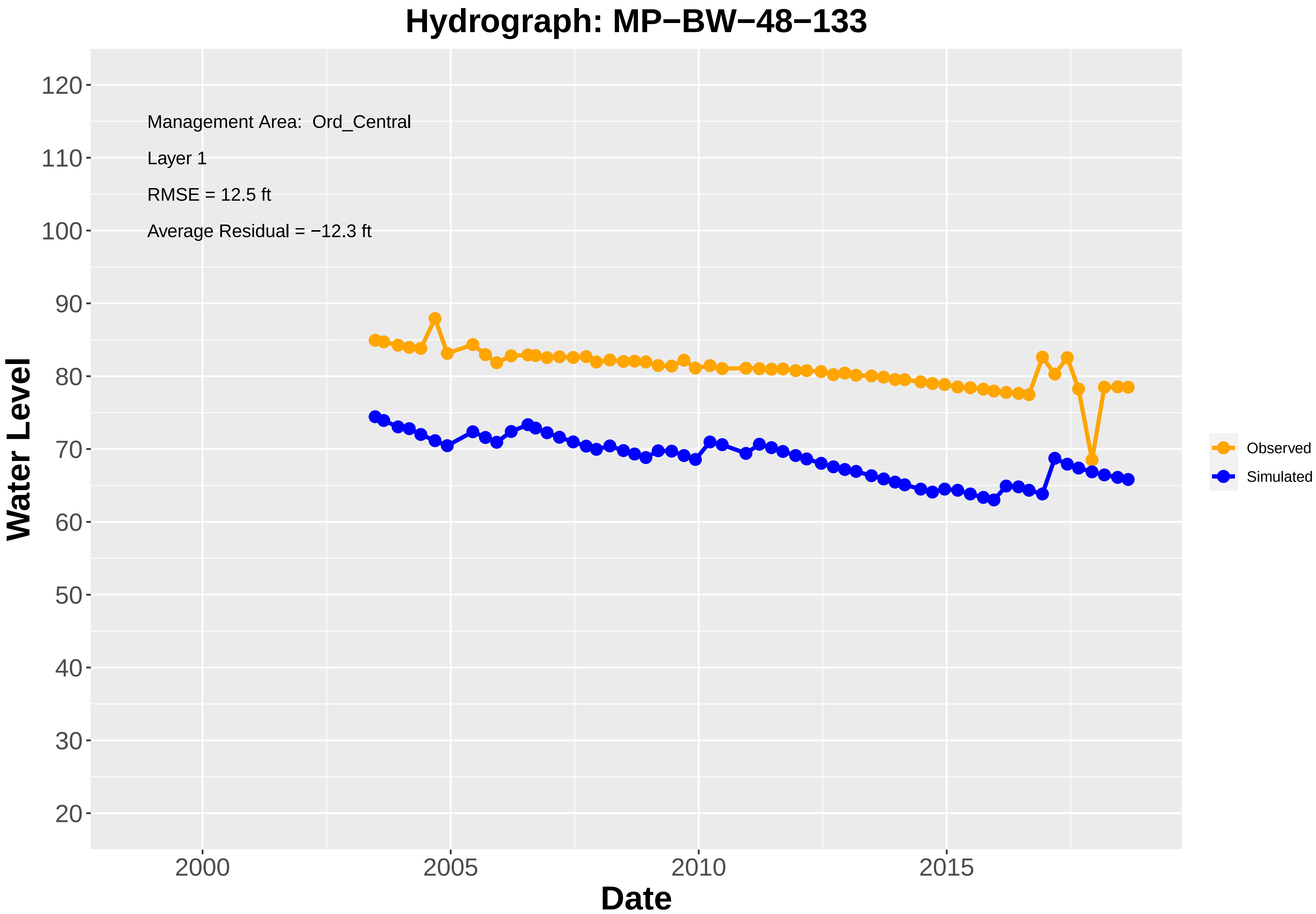

Hydrograph: MP−BW−46−185
Management Area: Ord_Central
Layer 3
RMSE = 2.1 ft
Average Residual = −1.1 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MP−BW−46−200
Management Area: Ord_Central
Layer 3
RMSE = 1.9 ft
Average Residual = −1.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

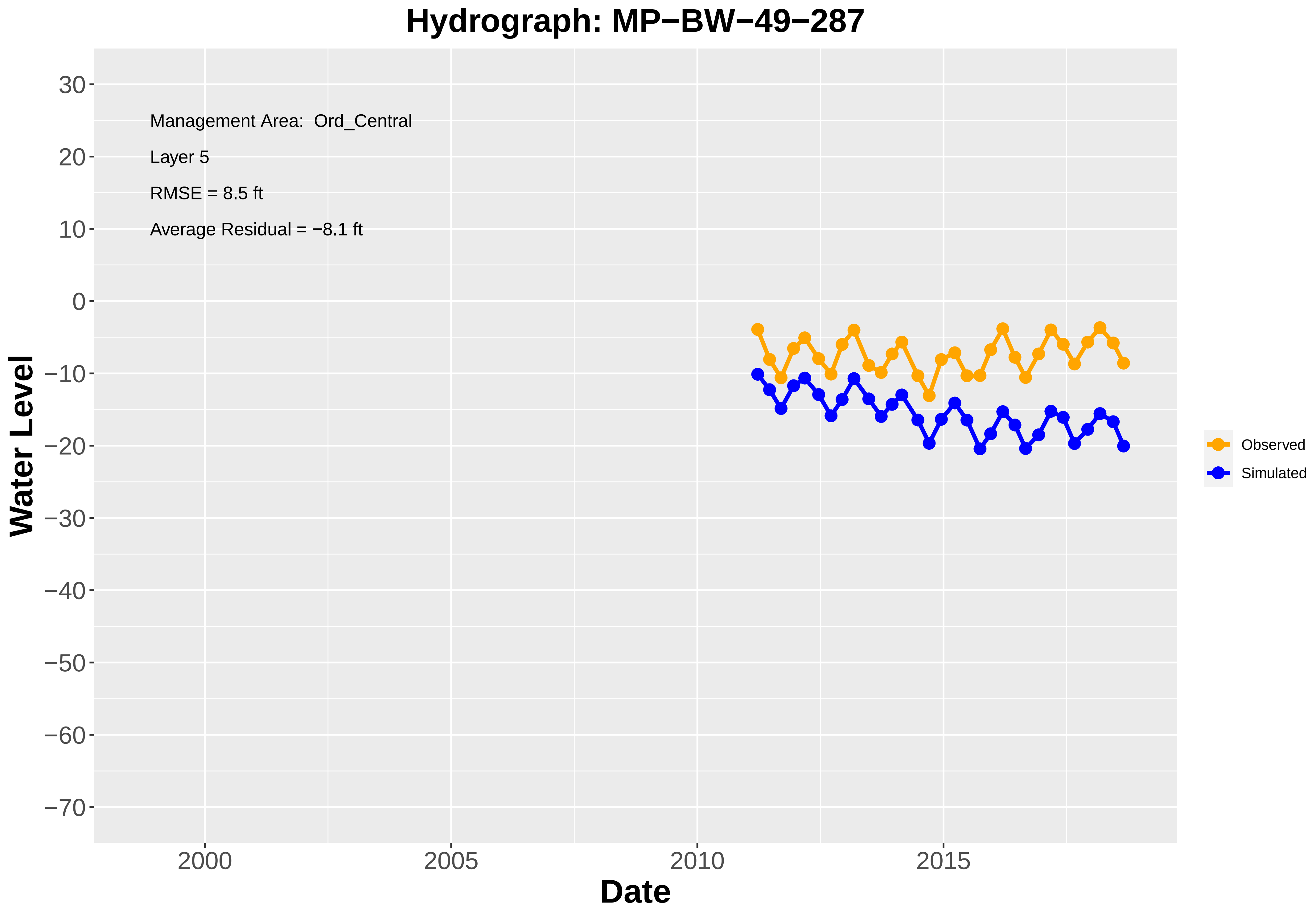

Hydrograph: MP−BW−46−215
Management Area: Ord_Central
Layer 3
RMSE = 2.0 ft
Average Residual = −1.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



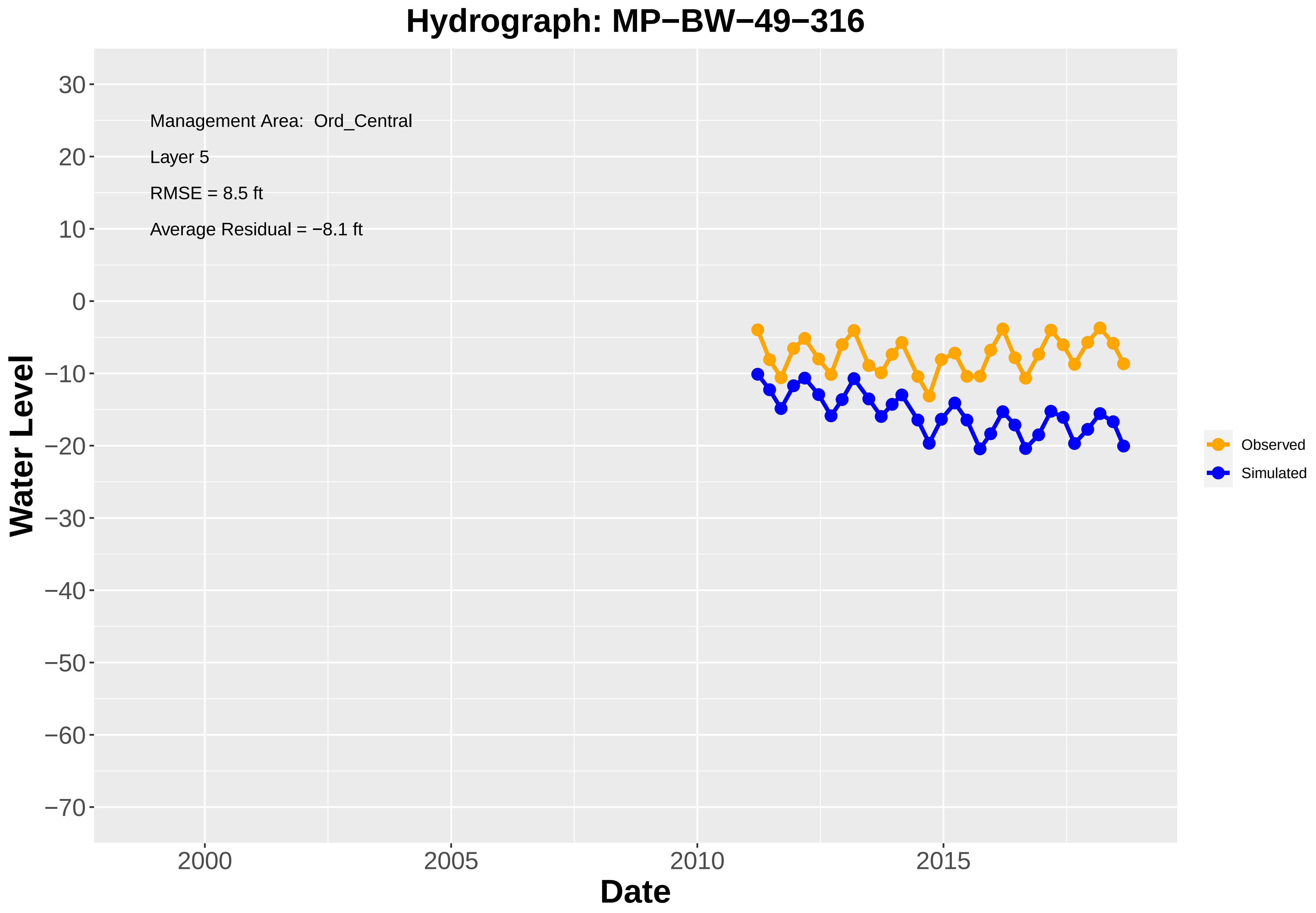
Hydrograph: MP−BW−48−113
Management Area: Ord_Central
Layer 1
RMSE = 16.7 ft
Average Residual = −16.4 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated



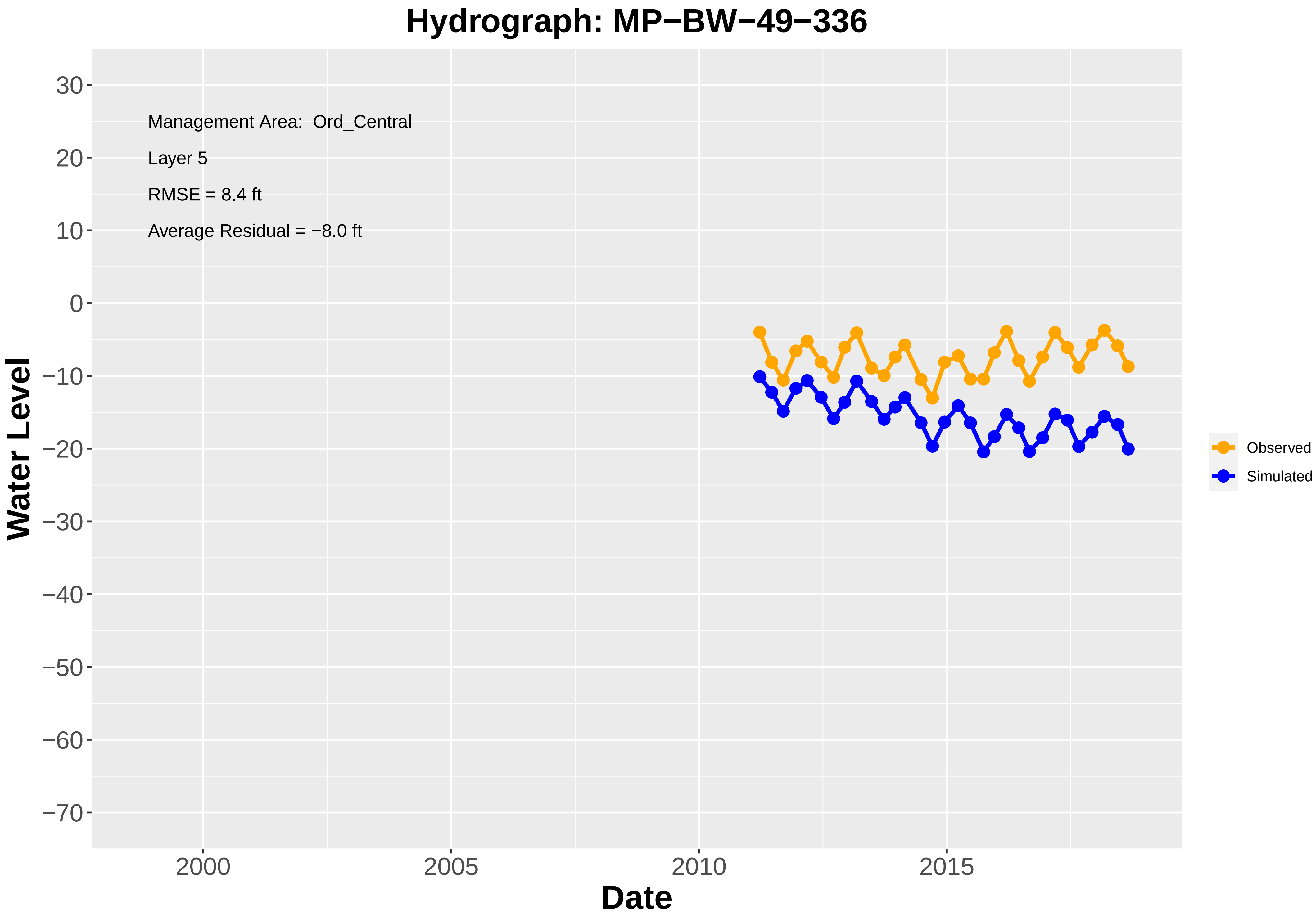
Hydrograph: MP−BW−48−133
Management Area: Ord_Central
Layer 1
RMSE = 12.5 ft
Average Residual = −12.3 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated



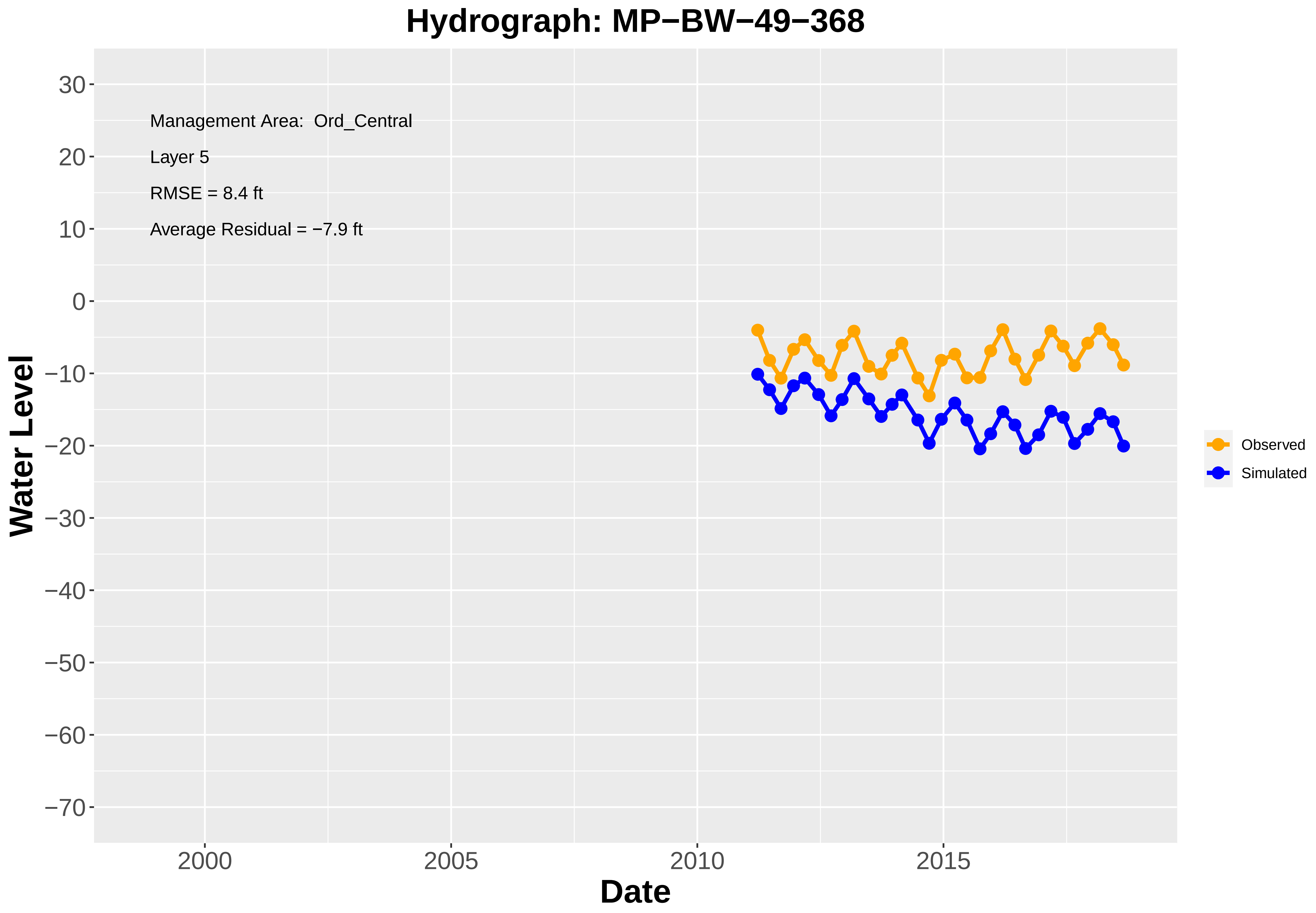
Hydrograph: MP−BW−49−287
Management Area: Ord_Central
Layer 5
RMSE = 8.5 ft
Average Residual = −8.1 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

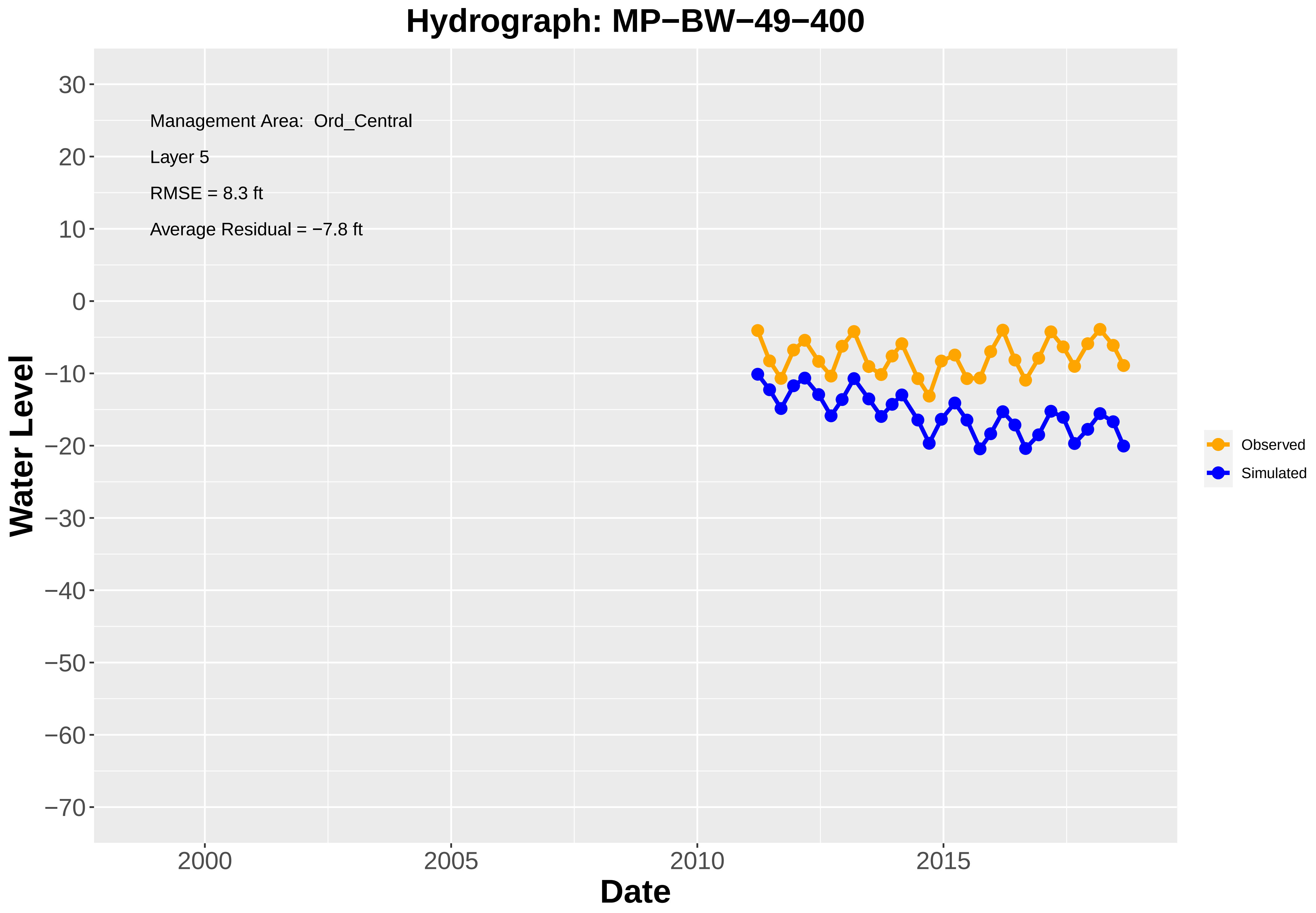


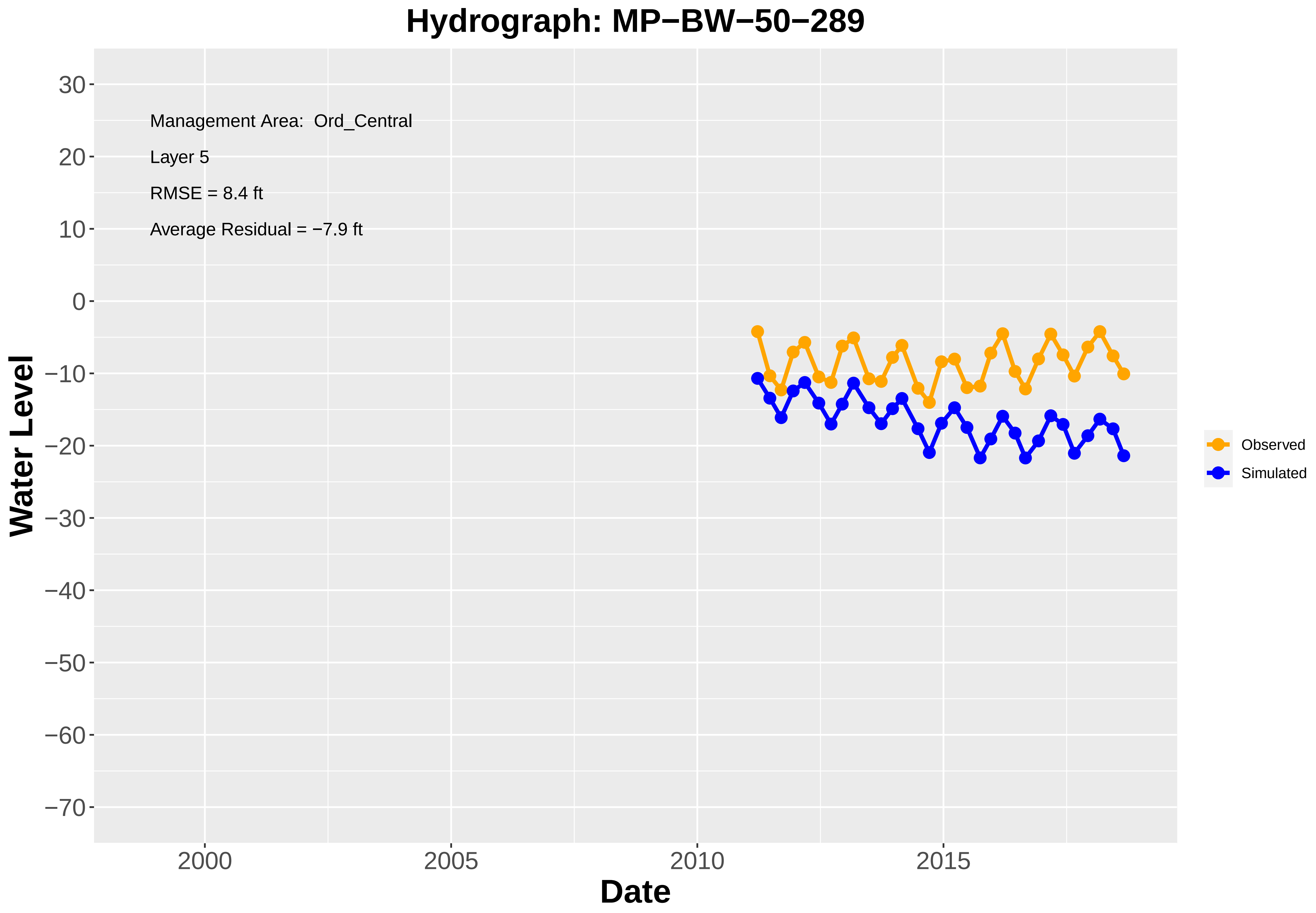
Hydrograph: MP−BW−49−316
Management Area: Ord_Central
Layer 5
RMSE = 8.5 ft
Average Residual = −8.1 ft
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Water Level
2000
2005
2010
2015
Date
Observed
Simulated



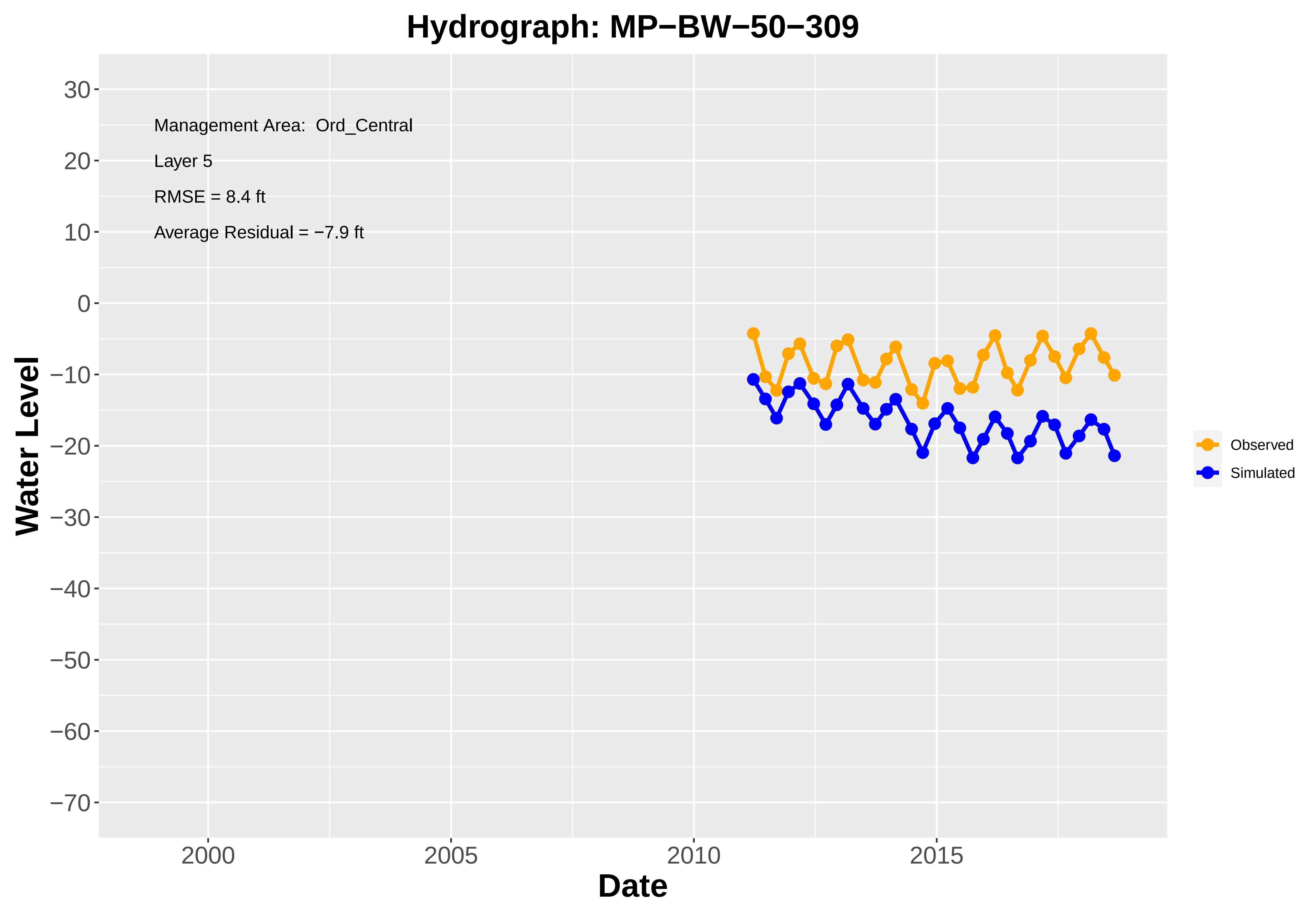
Hydrograph: MP−BW−49−336
Management Area: Ord_Central
Layer 5
RMSE = 8.4 ft
Average Residual = −8.0 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

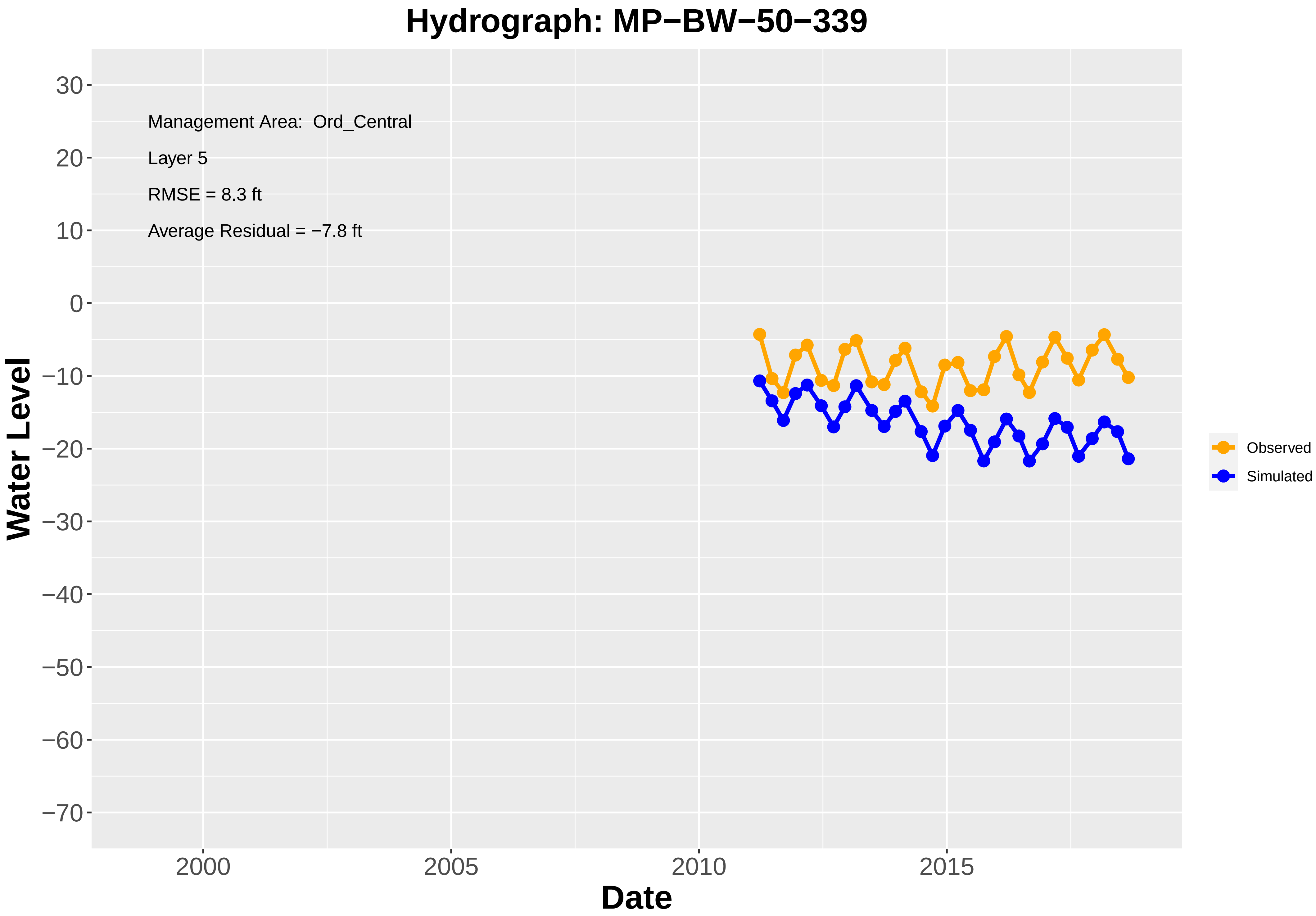

Hydrograph: MP−BW−49−368
Management Area: Ord_Central
Layer 5
RMSE = 8.4 ft
Average Residual = −7.9 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

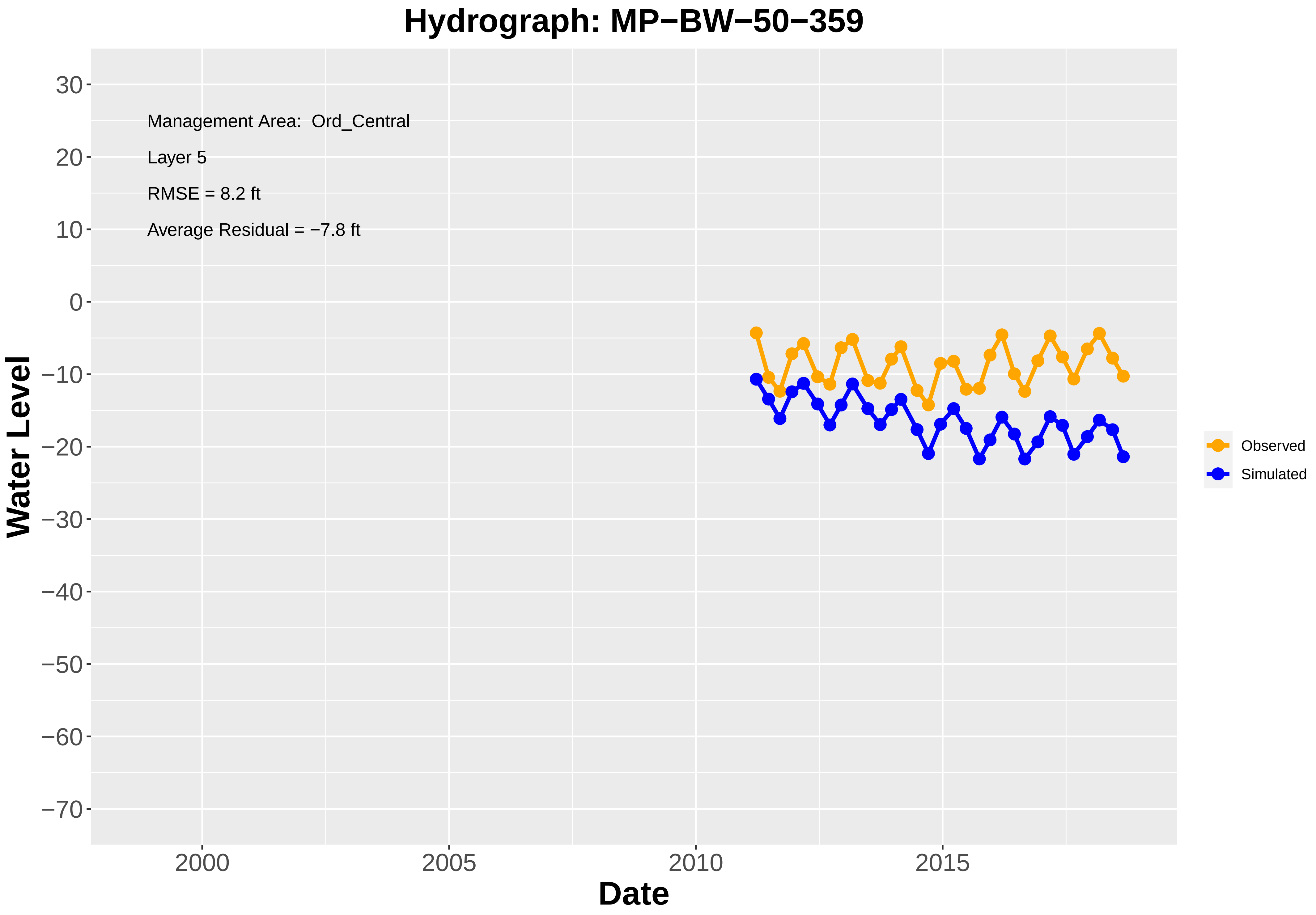

Hydrograph: MP−BW−49−400
Management Area: Ord_Central
Layer 5
RMSE = 8.3 ft
Average Residual = −7.8 ft
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Water Level
2000
2005
2010
2015
Date
Observed
Simulated



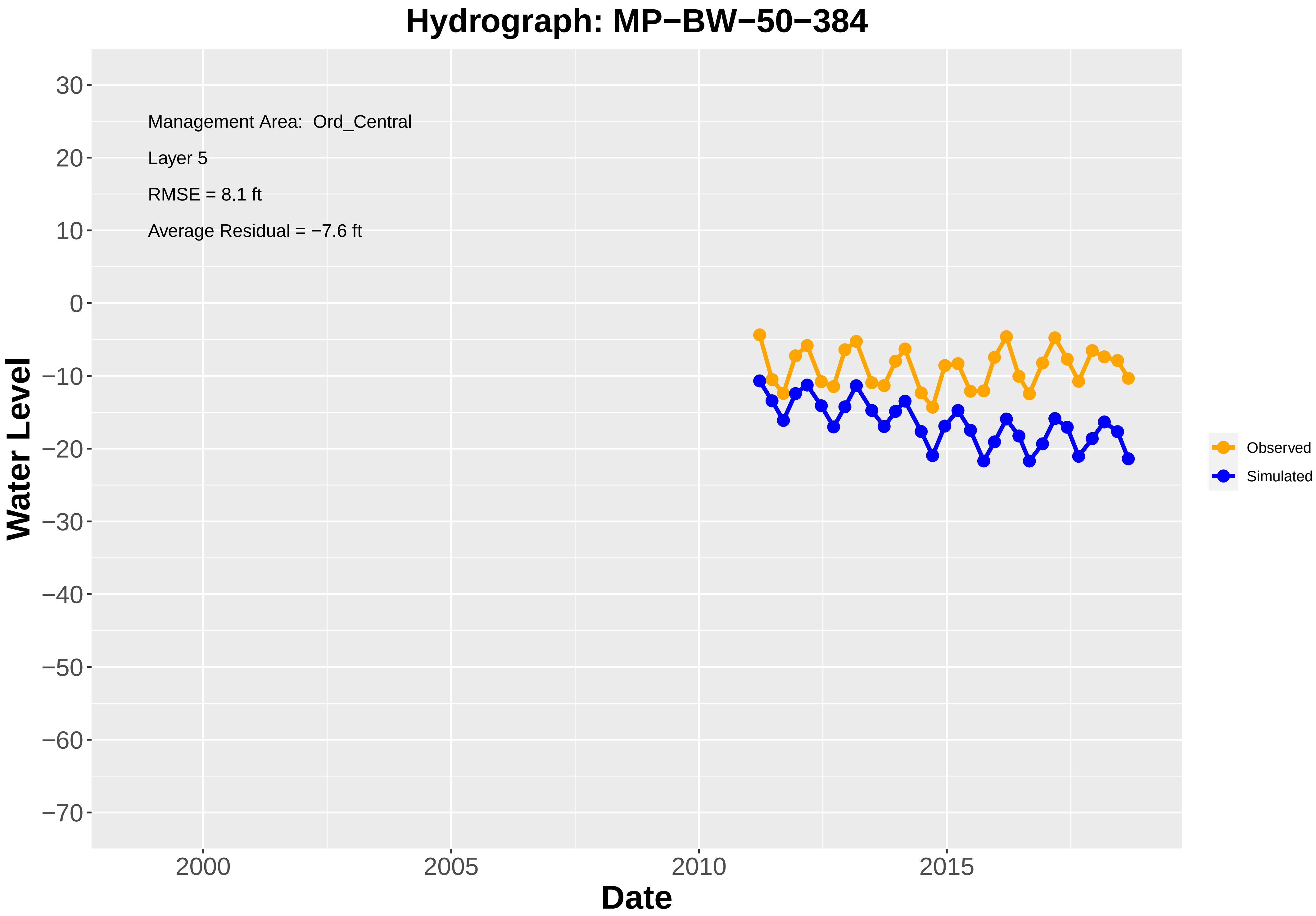
Hydrograph: MP−BW−50−289
Management Area: Ord_Central
Layer 5
RMSE = 8.4 ft
Average Residual = −7.9 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−50−309
Management Area: Ord_Central
Layer 5
RMSE = 8.4 ft
Average Residual = −7.9 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

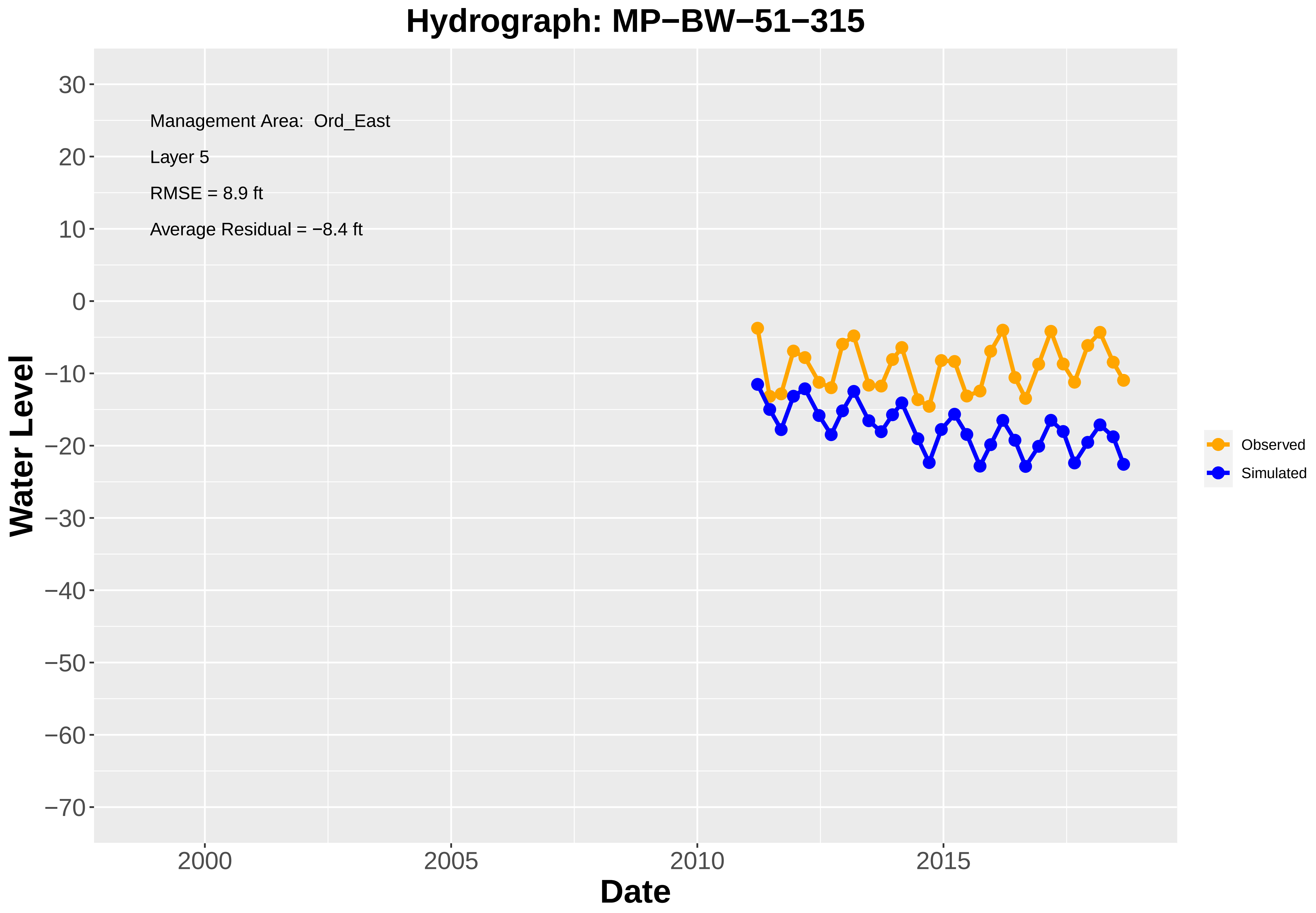

Hydrograph: MP−BW−50−339
Management Area: Ord_Central
Layer 5
RMSE = 8.3 ft
Average Residual = −7.8 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

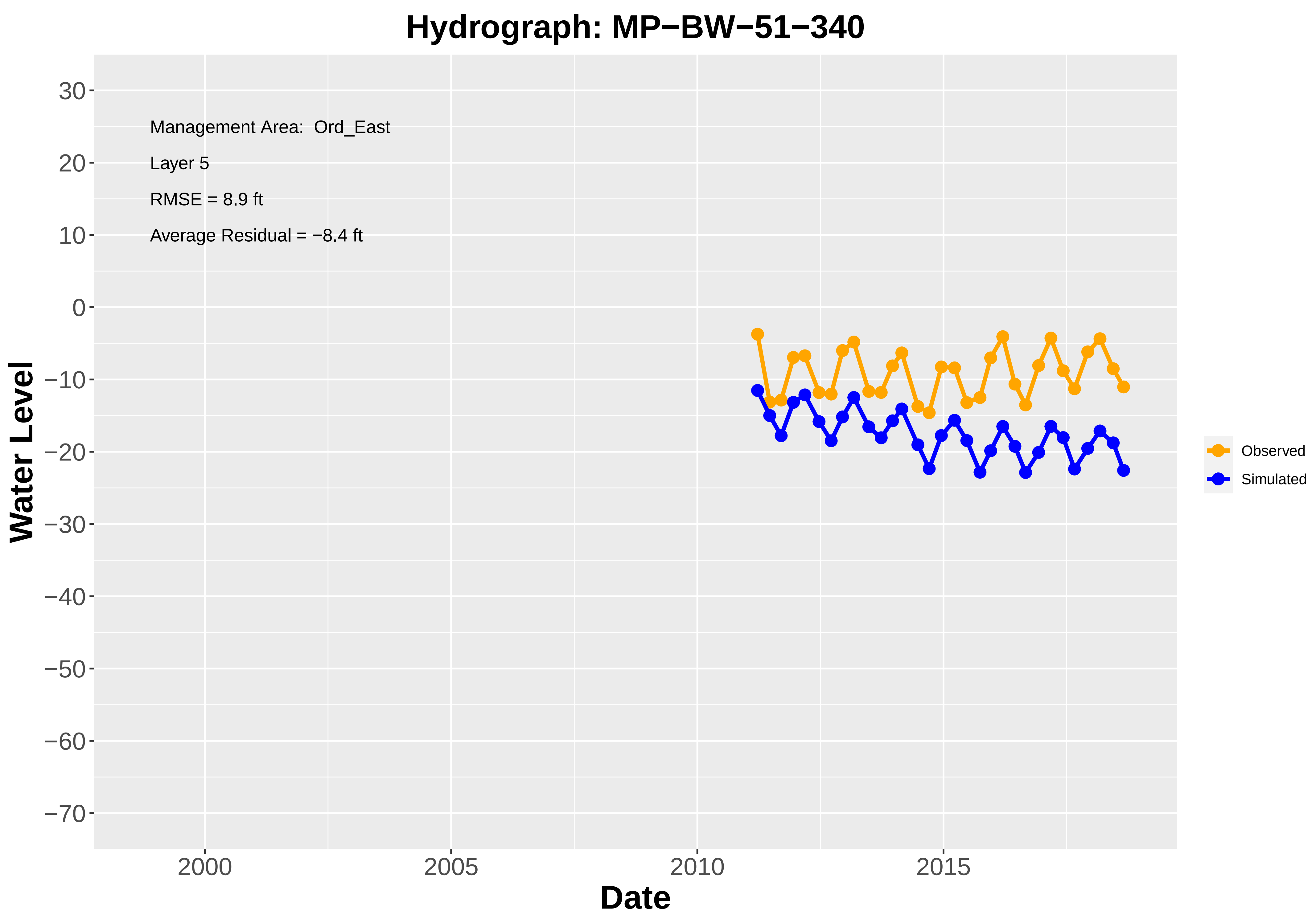


Hydrograph: MP−BW−50−359
Management Area: Ord_Central
Layer 5
RMSE = 8.2 ft
Average Residual = −7.8 ft
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

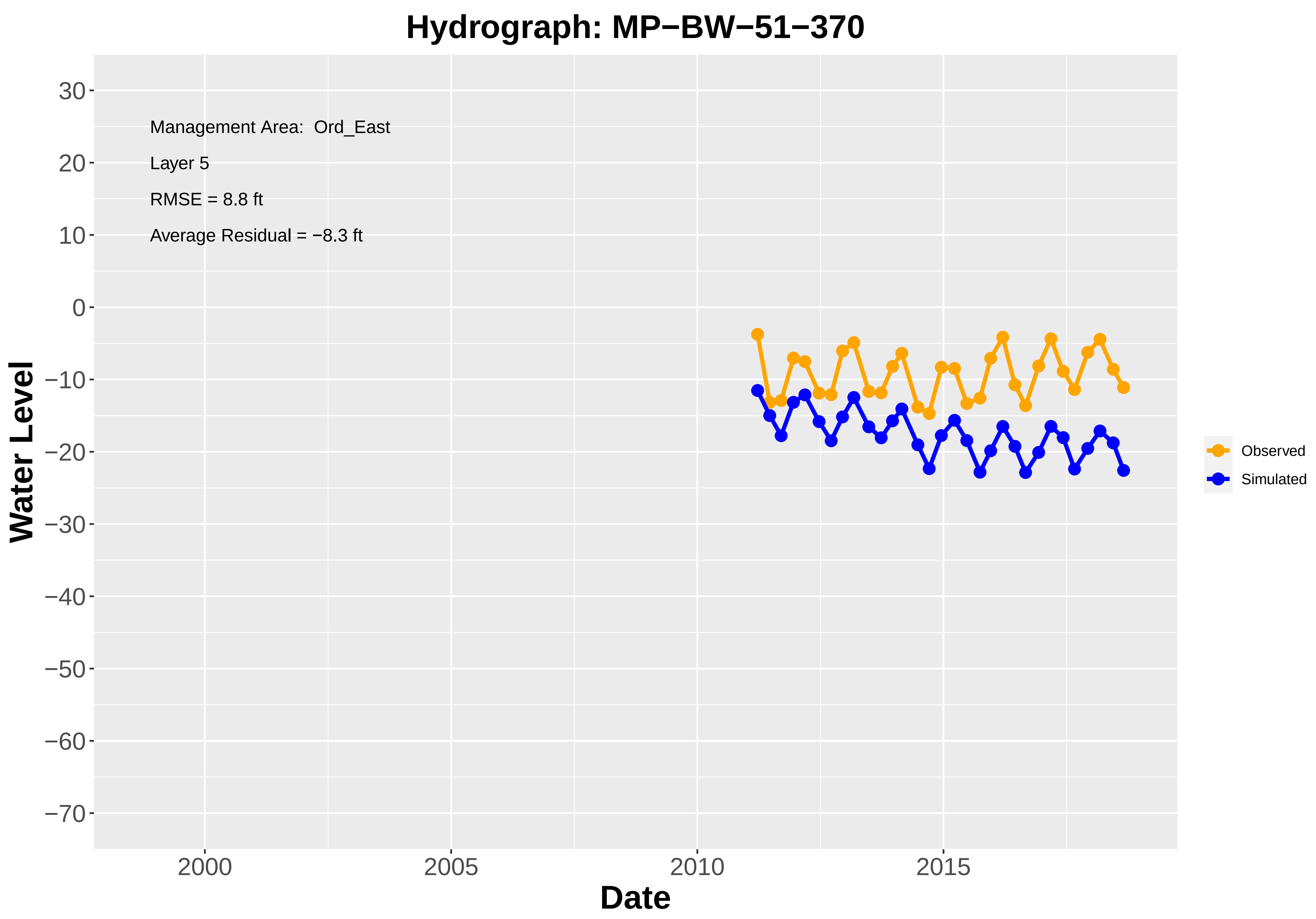


Hydrograph: MP−BW−50−384
Management Area: Ord_Central
Layer 5
RMSE = 8.1 ft
Average Residual = −7.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

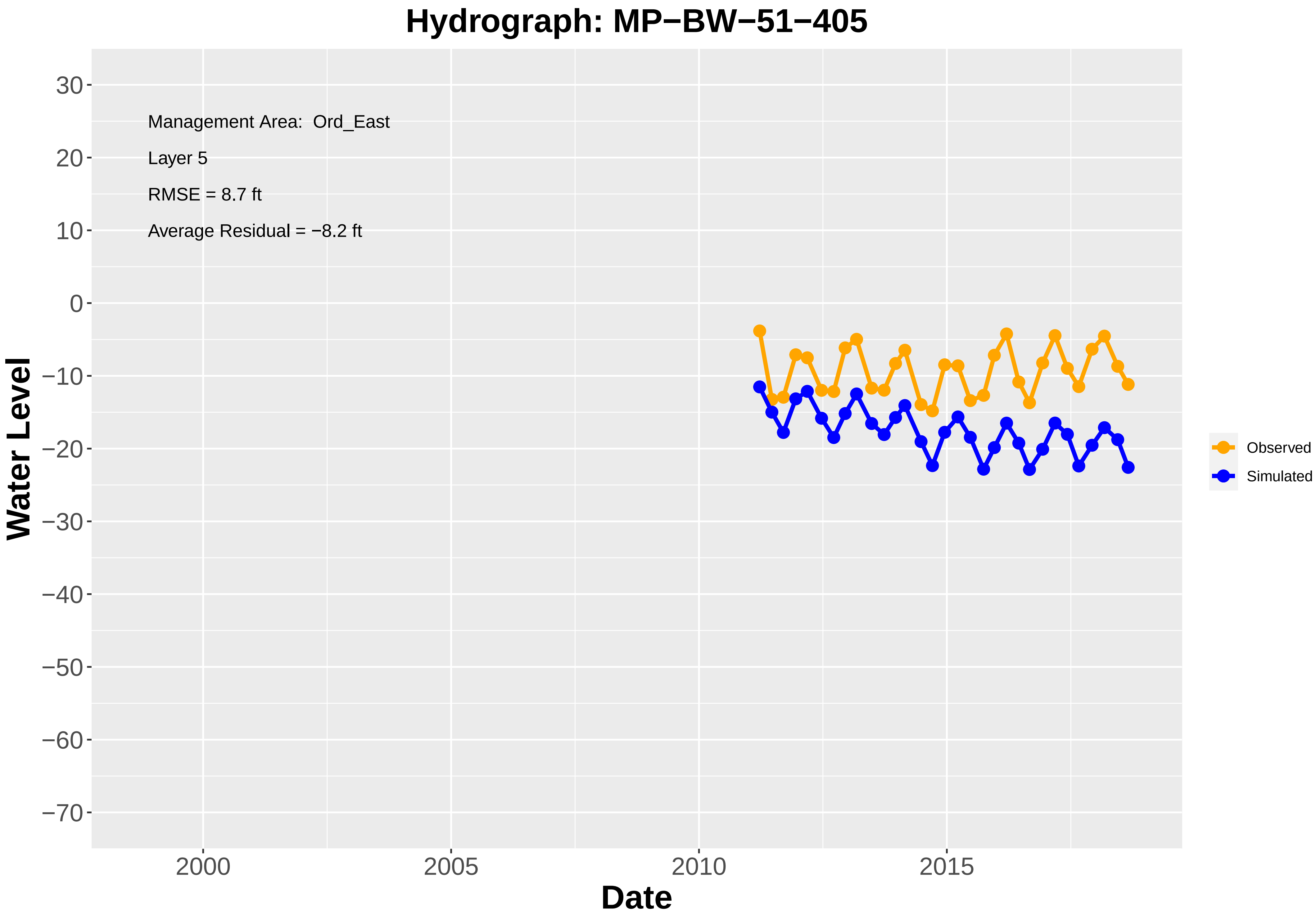

Hydrograph: MP−BW−51−315
Management Area: Ord_East
Layer 5
RMSE = 8.9 ft
Average Residual = −8.4 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

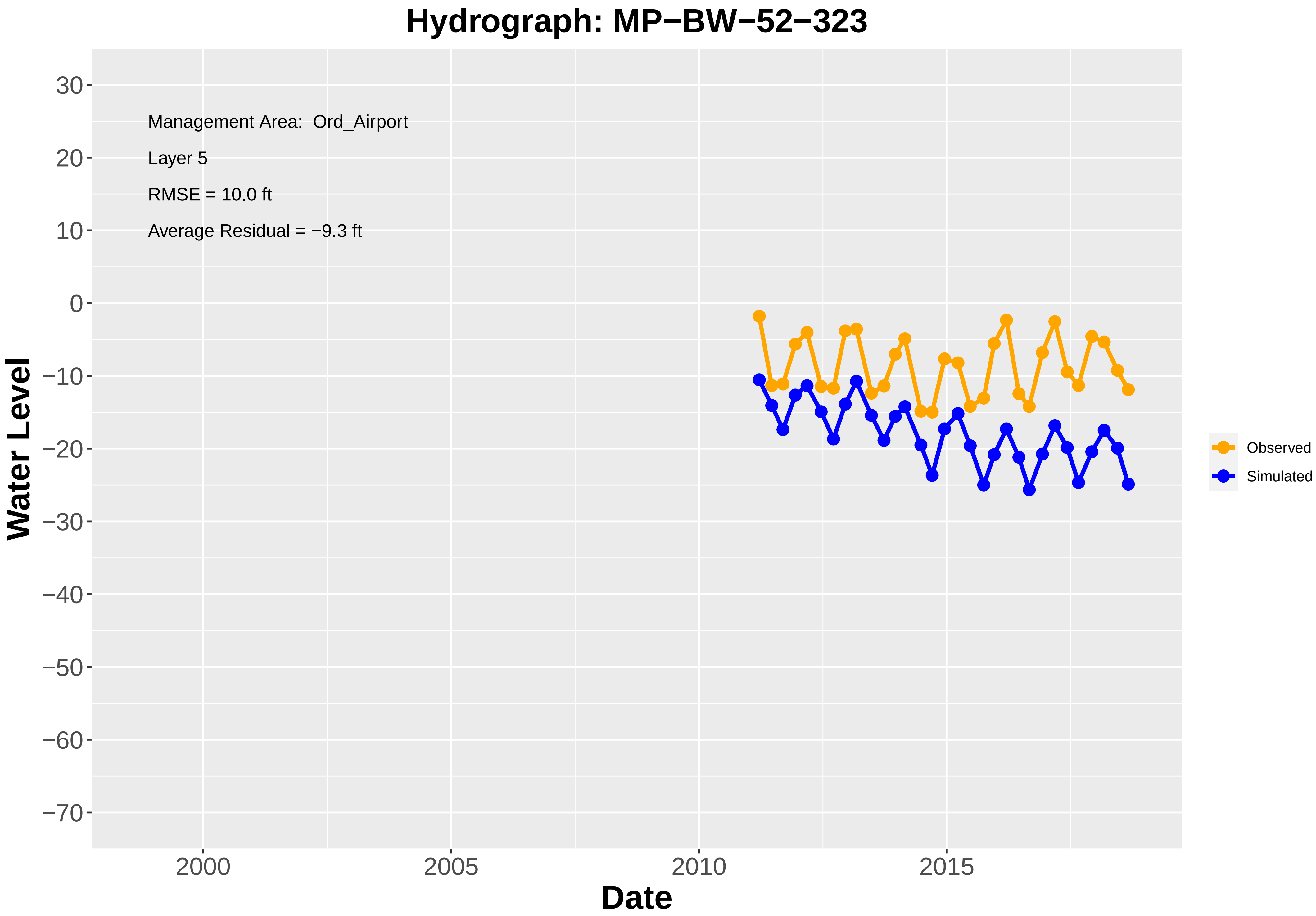


Hydrograph: MP−BW−51−340
Management Area: Ord_East
Layer 5
RMSE = 8.9 ft
Average Residual = −8.4 ft
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

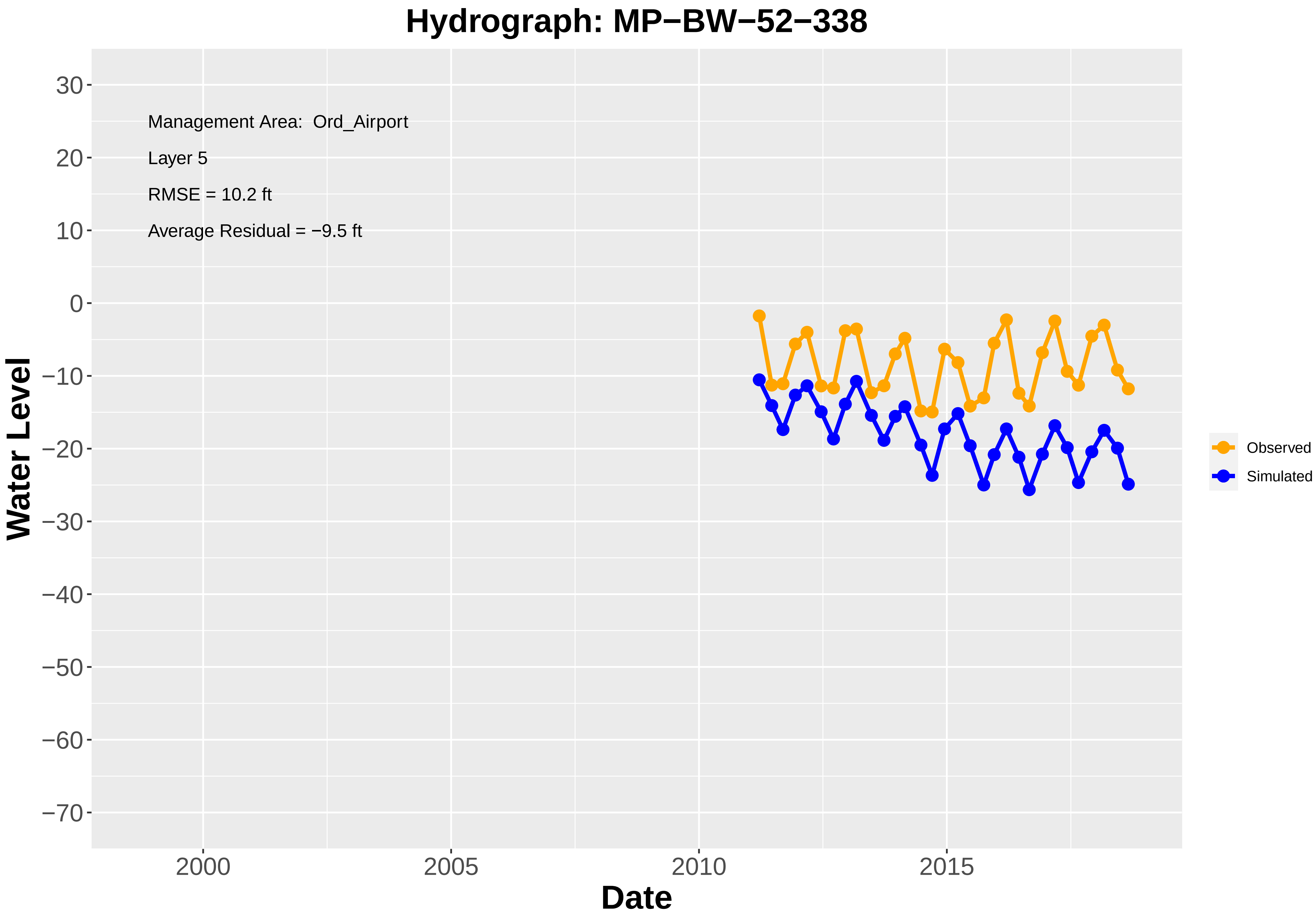


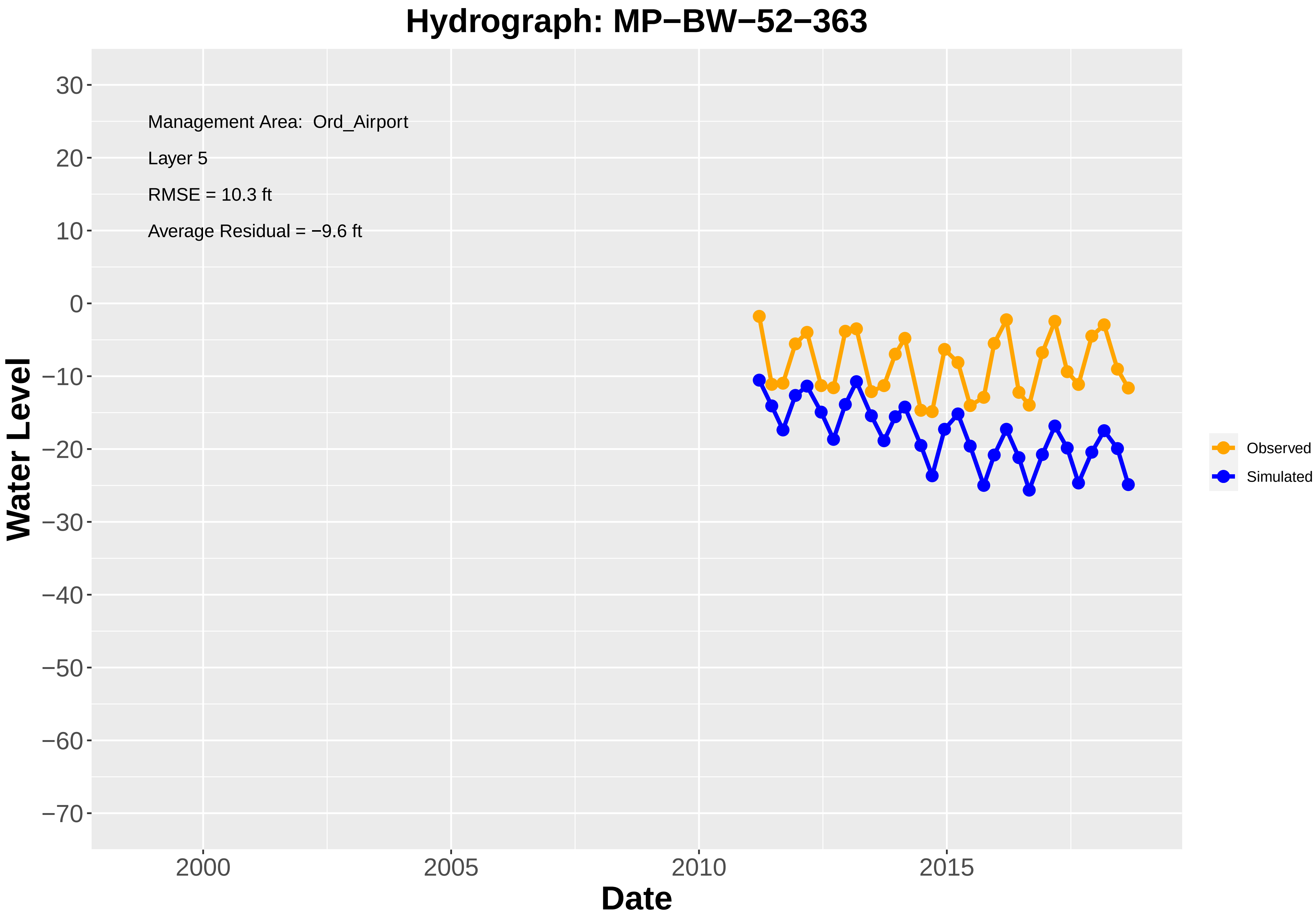
Hydrograph: MP−BW−51−370
Management Area: Ord_East
Layer 5
RMSE = 8.8 ft
Average Residual = −8.3 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−51−405
Management Area: Ord_East
Layer 5
RMSE = 8.7 ft
Average Residual = −8.2 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

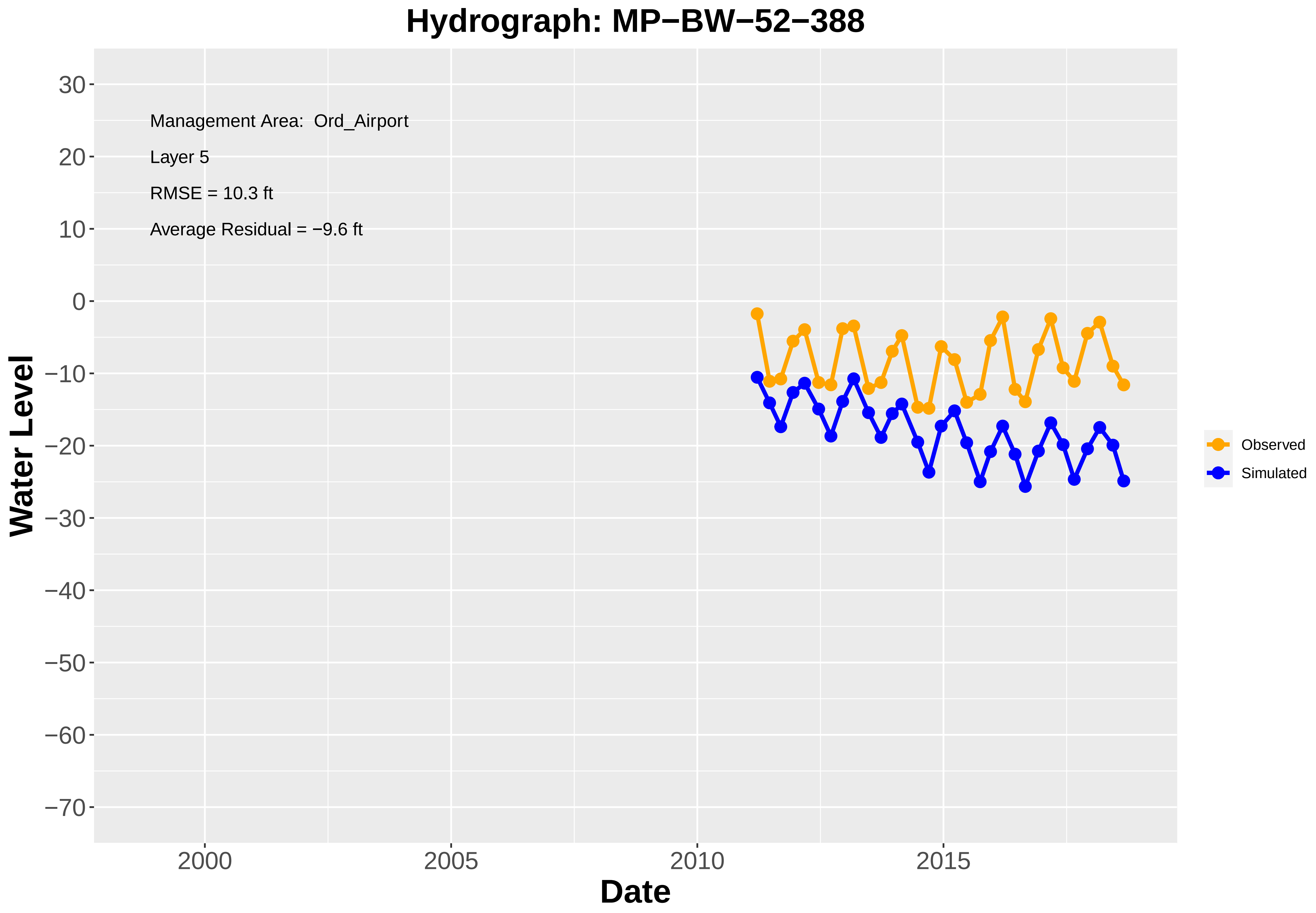


Hydrograph: MP−BW−52−323
Management Area: Ord_Airport
Layer 5
RMSE = 10.0 ft
Average Residual = −9.3 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

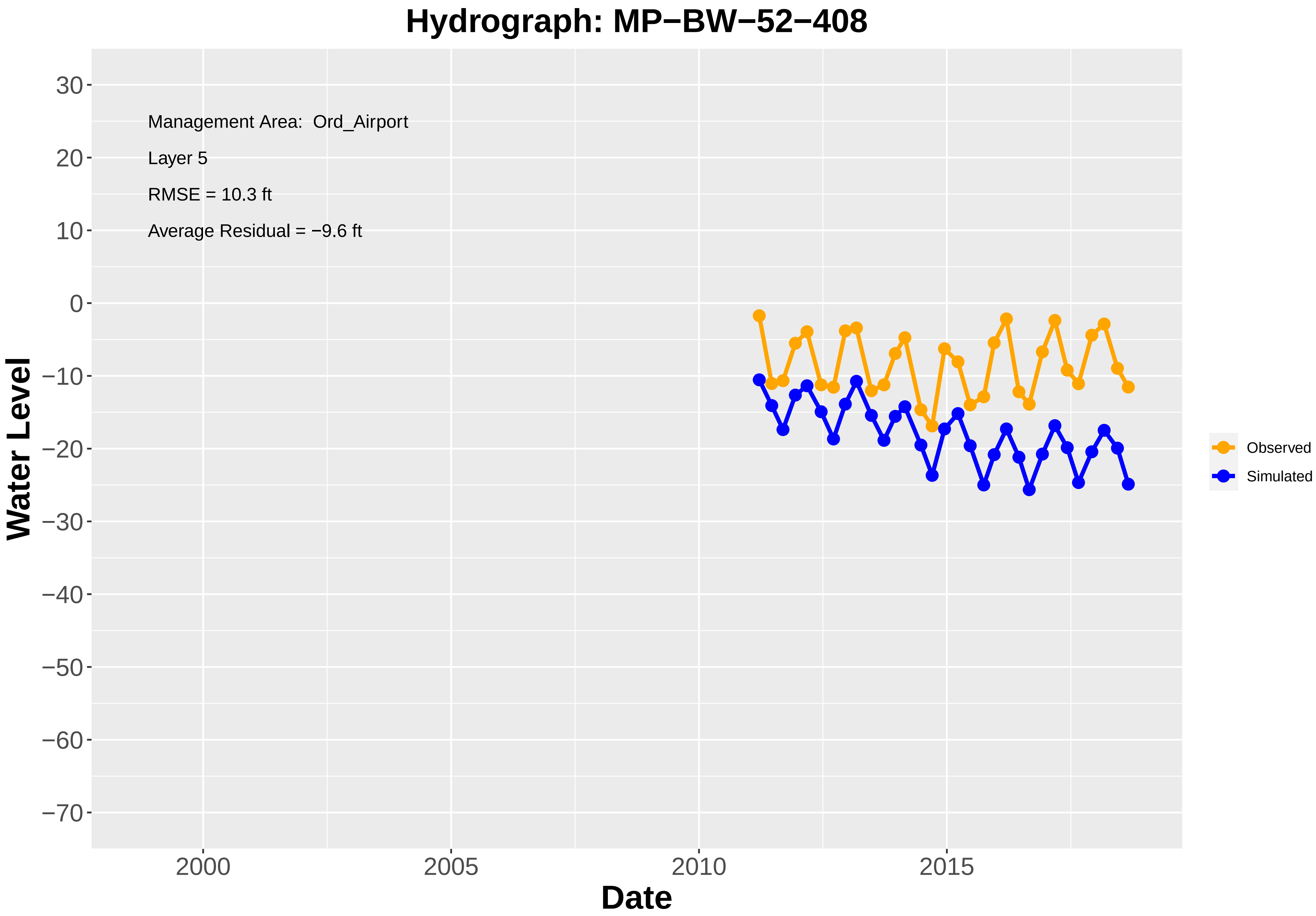

Hydrograph: MP−BW−52−338
Management Area: Ord_Airport
Layer 5
RMSE = 10.2 ft
Average Residual = −9.5 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

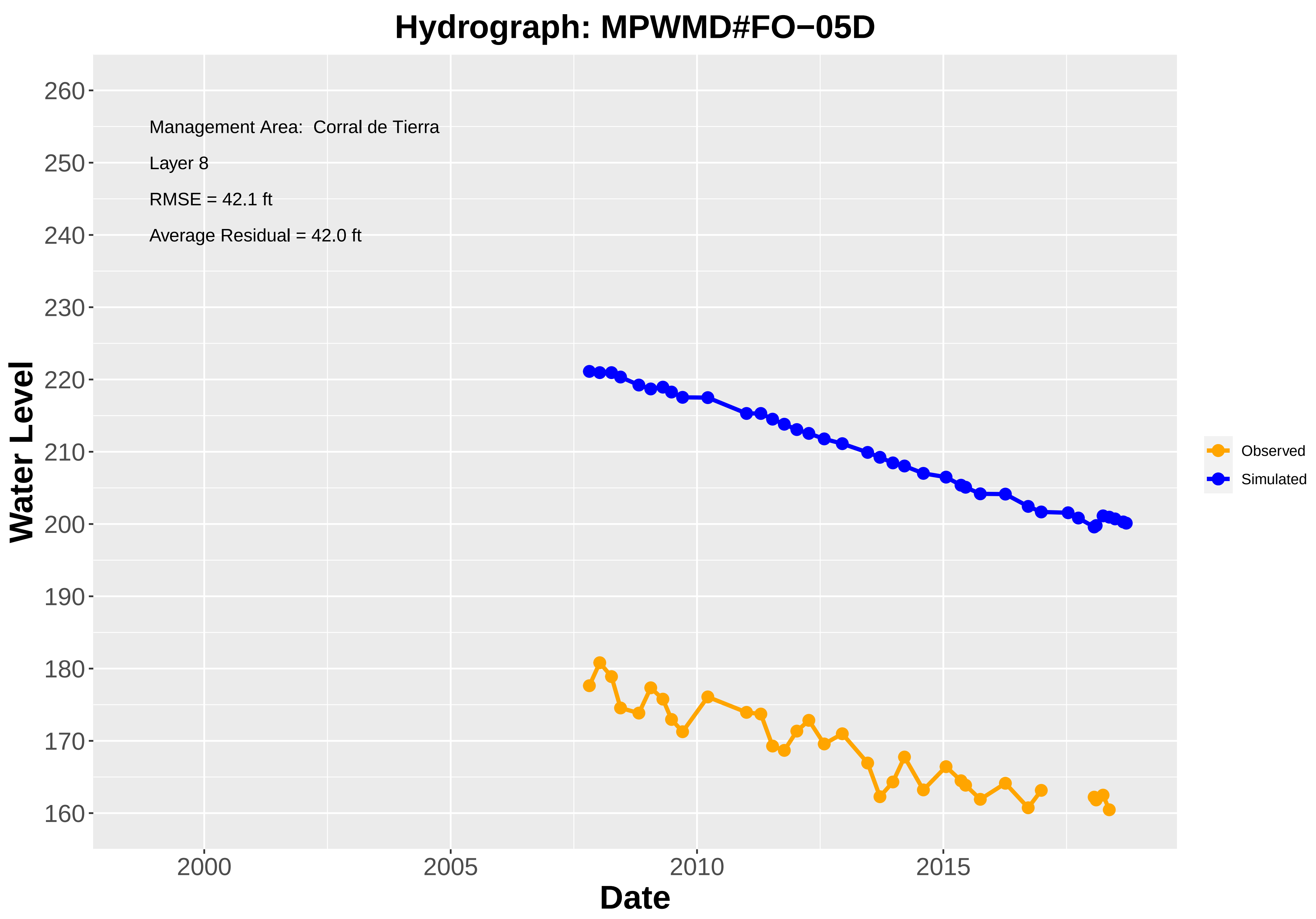


Hydrograph: MP−BW−52−363
Management Area: Ord_Airport
Layer 5
RMSE = 10.3 ft
Average Residual = −9.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

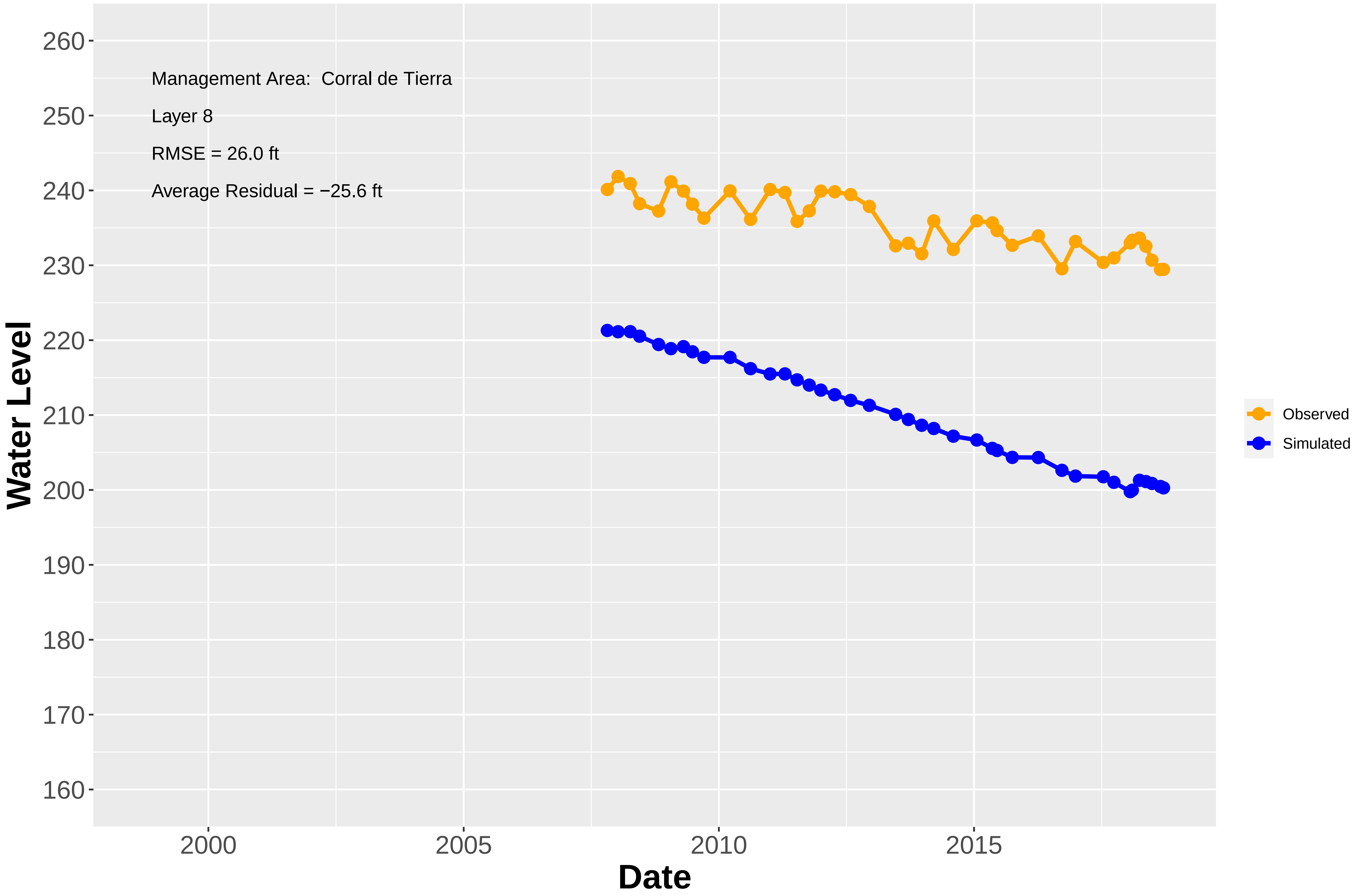


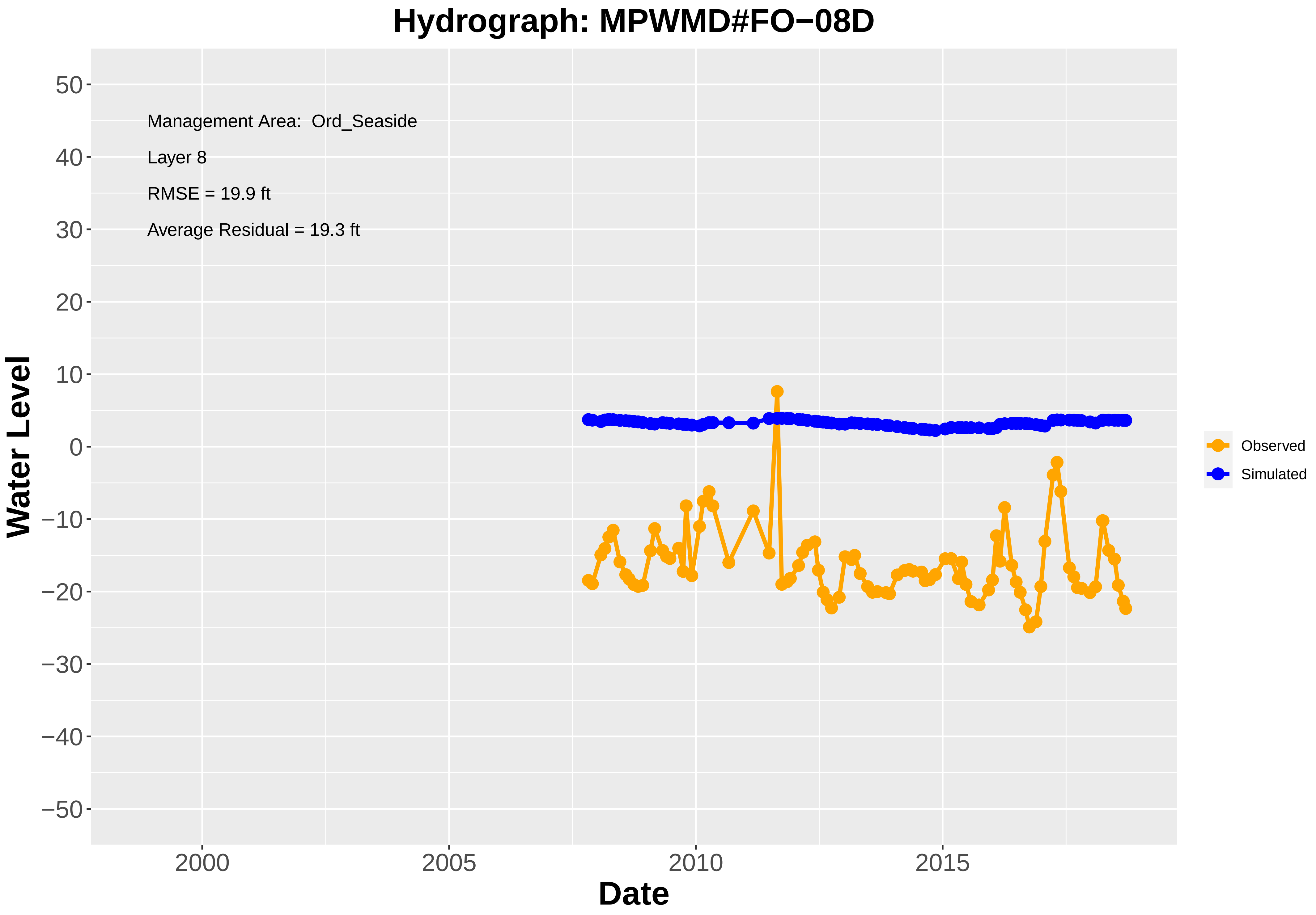
Hydrograph: MP−BW−52−388
Management Area: Ord_Airport
Layer 5
RMSE = 10.3 ft
Average Residual = −9.6 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MP−BW−52−408
Management Area: Ord_Airport
Layer 5
RMSE = 10.3 ft
Average Residual = −9.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

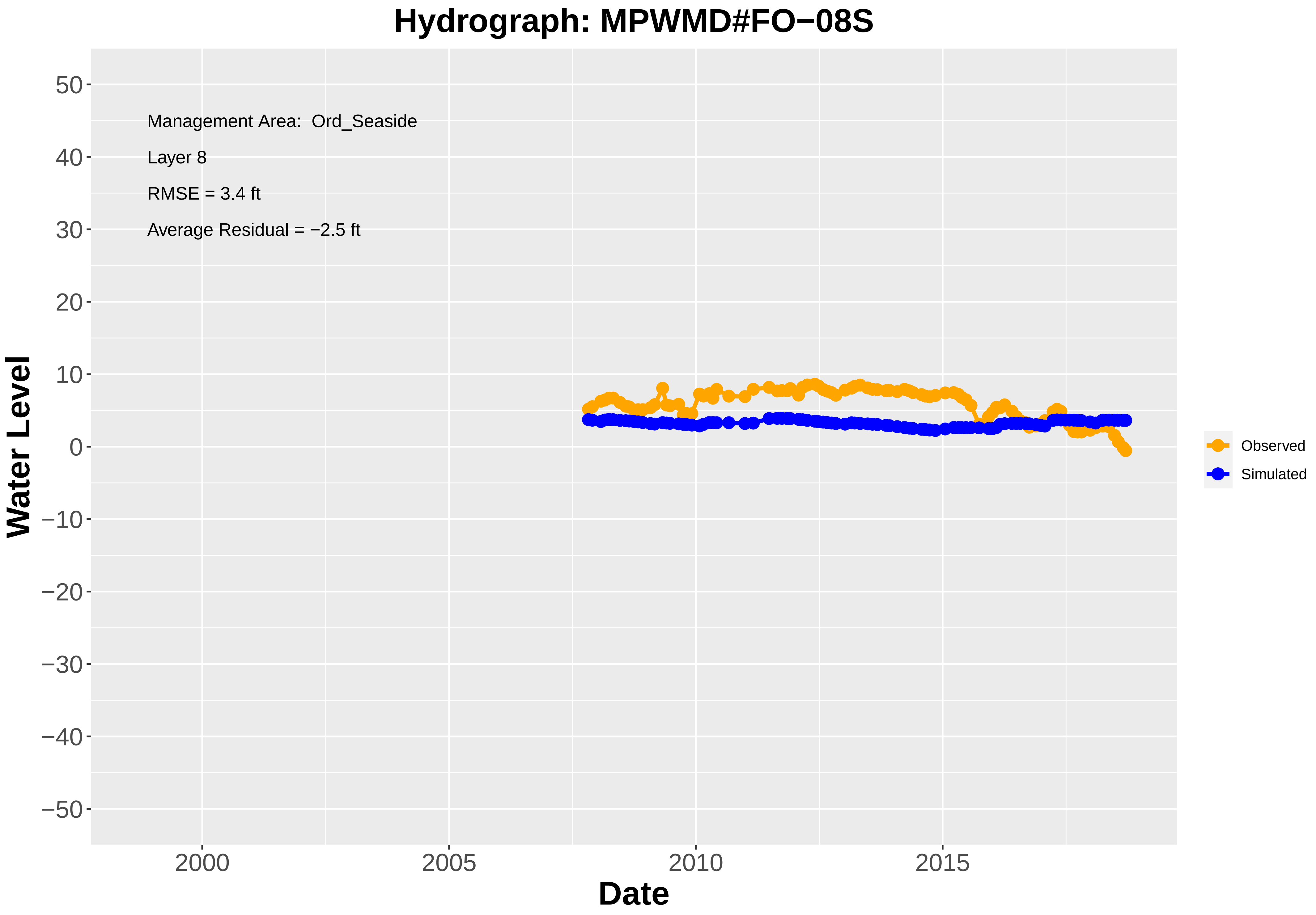

Hydrograph: MPWMD#FO−05D
Management Area: Corral de Tierra
Layer 8
RMSE = 42.1 ft
Average Residual = 42.0 ft
Water Level
Date
Observed
Simulated
260
250
240
230
220
210
200
190
180
170
160
2000
2005
2010
2015

Hydrograph: MPWMD#FO−05S

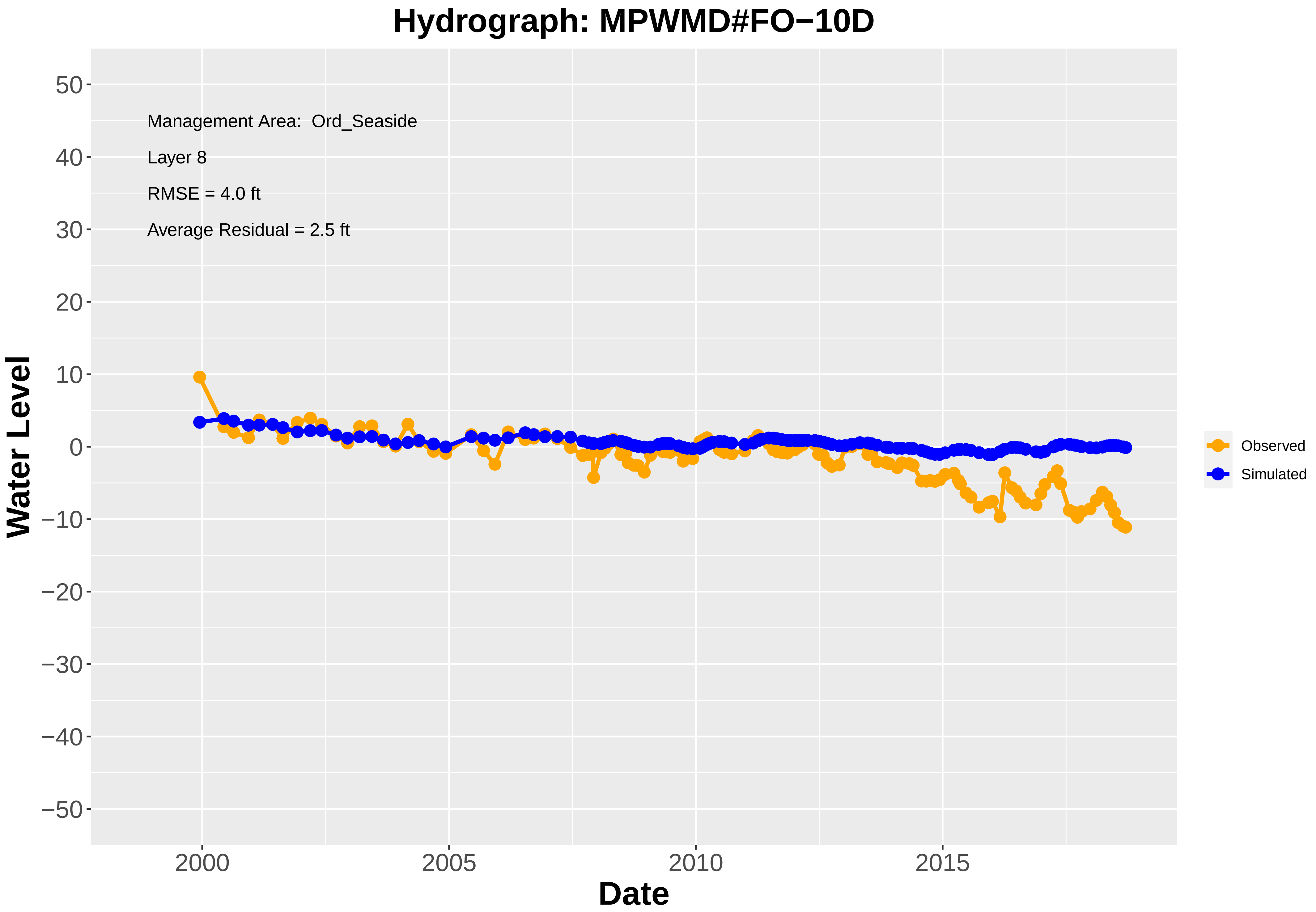




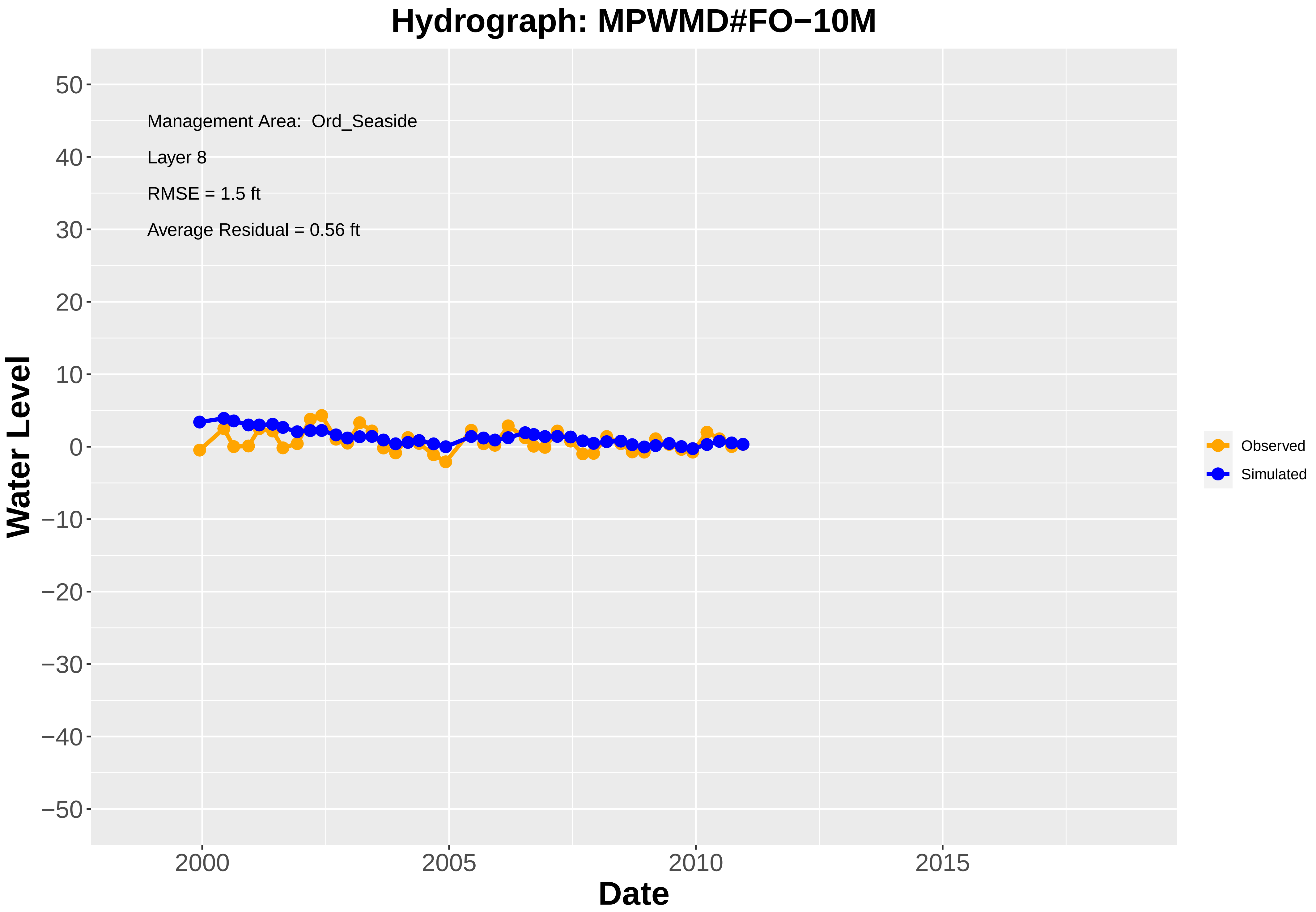
Hydrograph: MPWMD#FO−08D
Management Area: Ord_Seaside
Layer 8
RMSE = 19.9 ft
Average Residual = 19.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

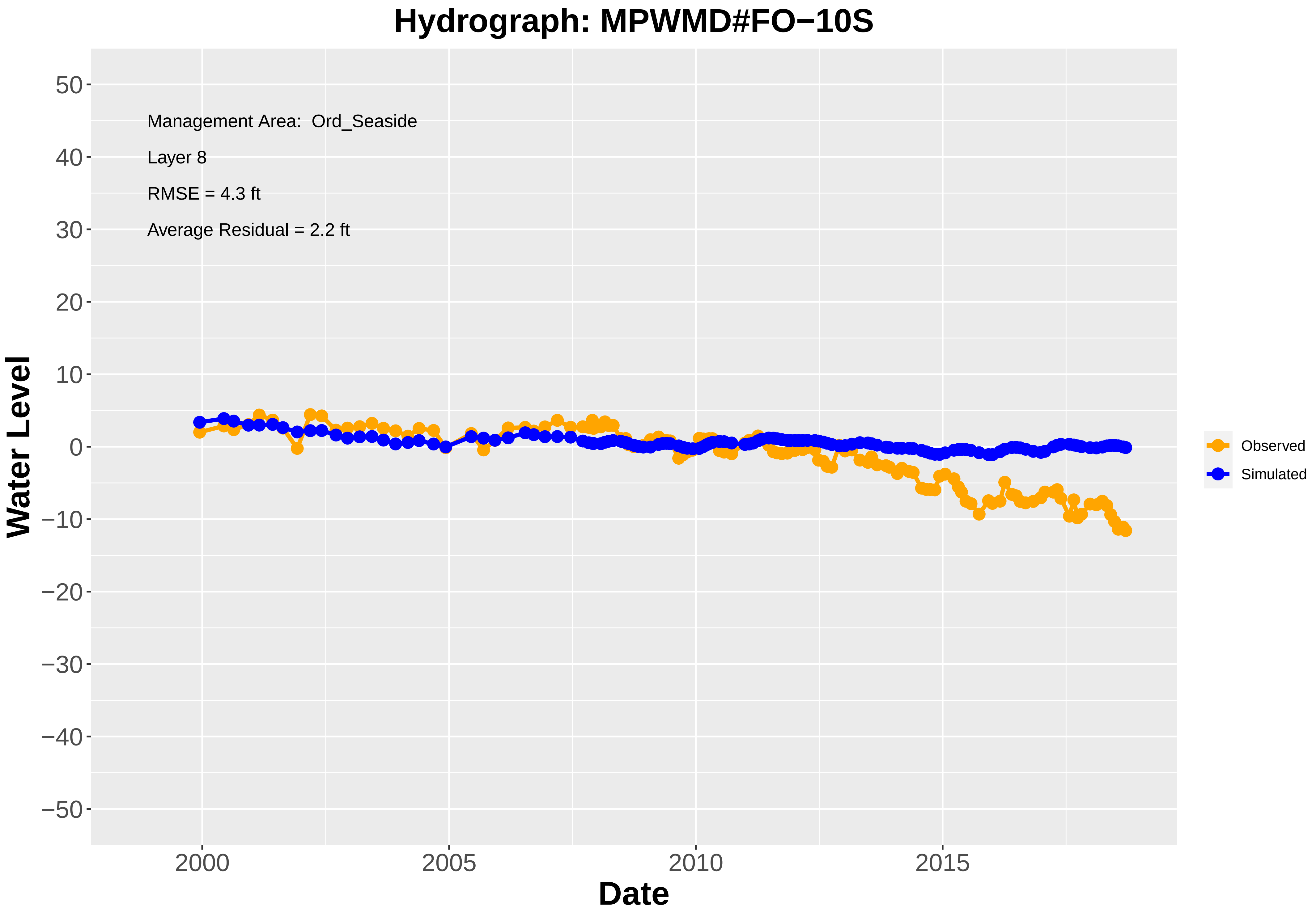


Hydrograph: MPWMD#FO−08S
Management Area: Ord_Seaside
Layer 8
RMSE = 3.4 ft
Average Residual = −2.5 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

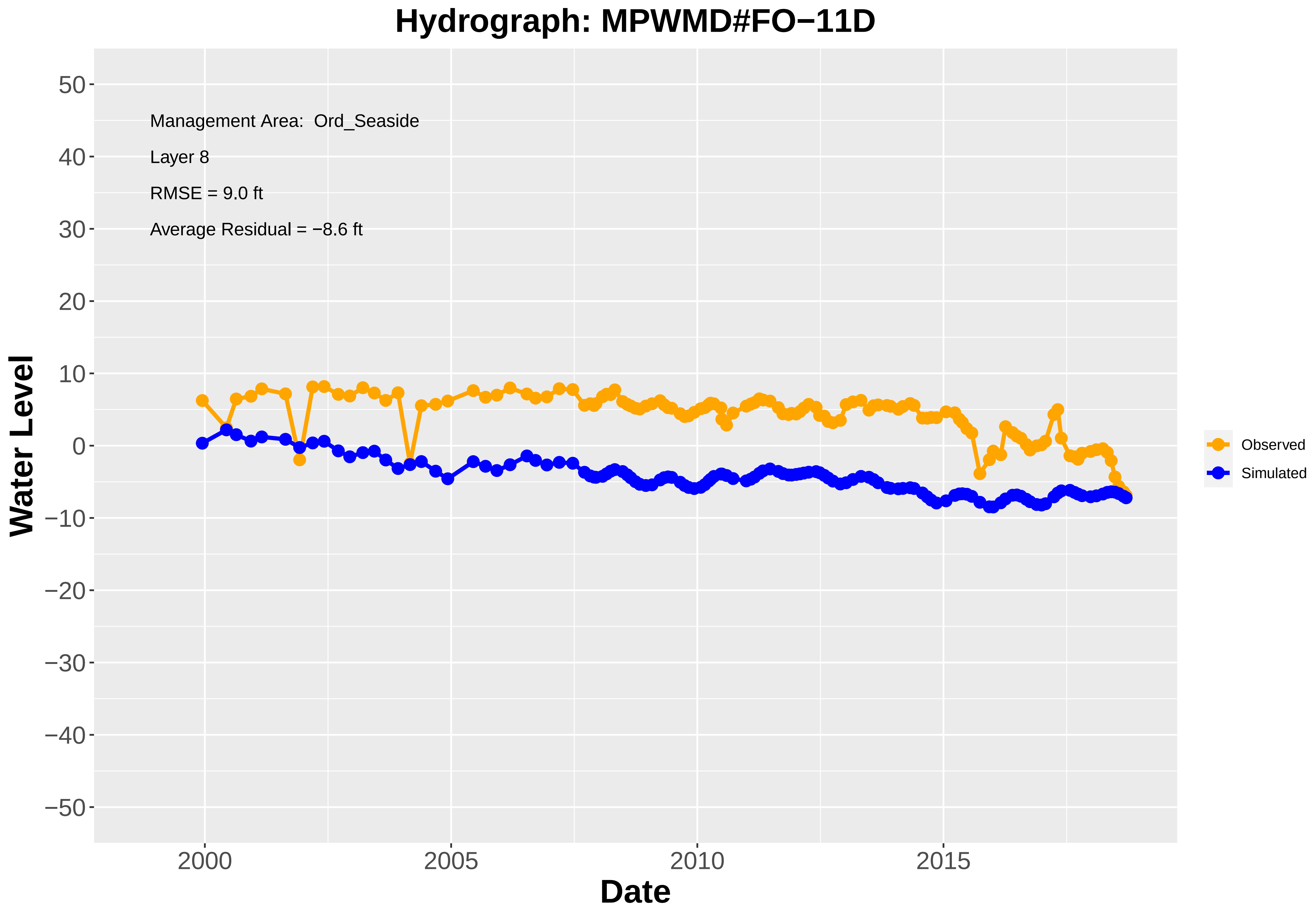


Hydrograph: MPWMD#FO−10D
Management Area: Ord_Seaside
Layer 8
RMSE = 4.0 ft
Average Residual = 2.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

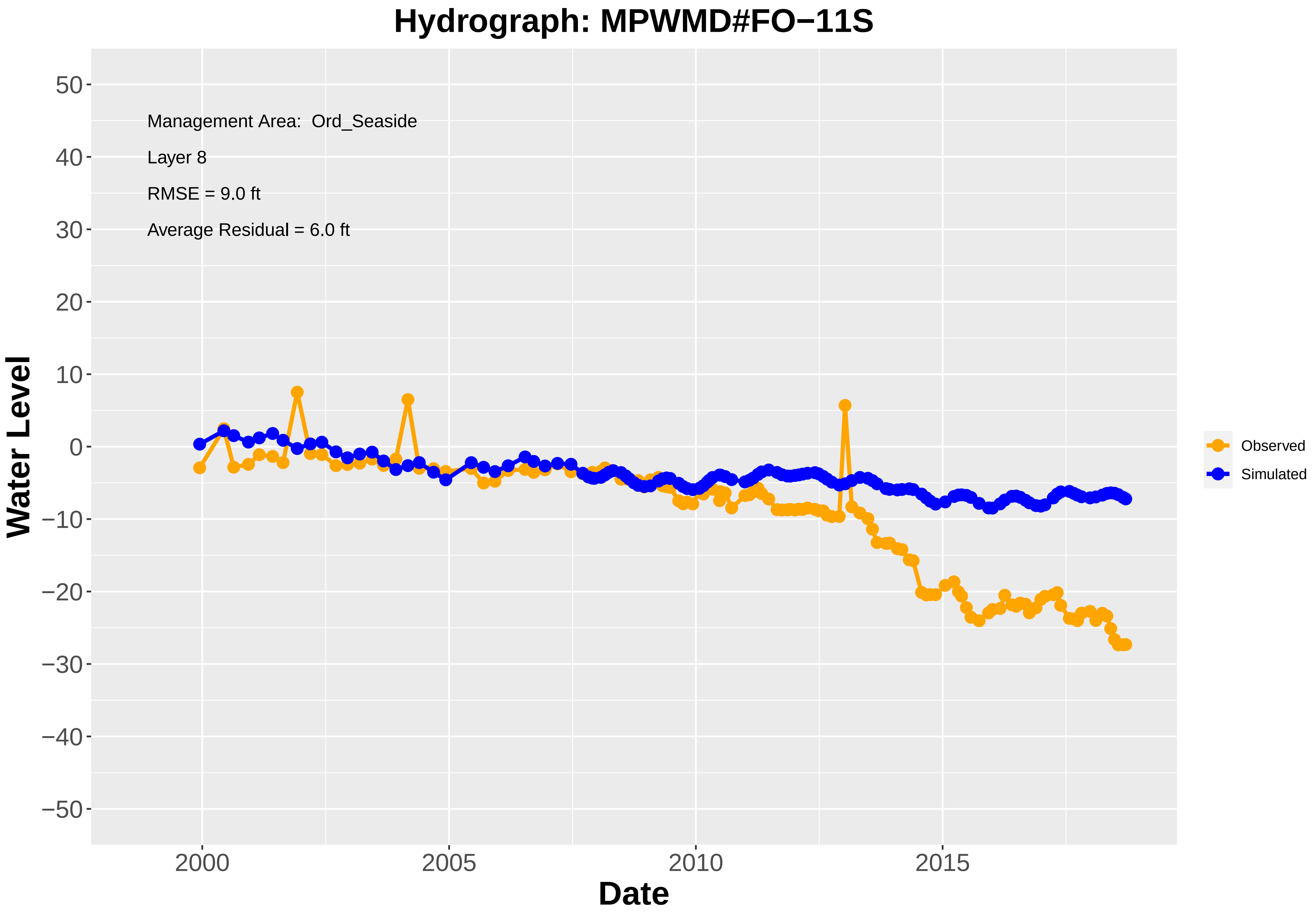

Hydrograph: MPWMD#FO−10M
Management Area: Ord_Seaside
Layer 8
RMSE = 1.5 ft
Average Residual = 0.56 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



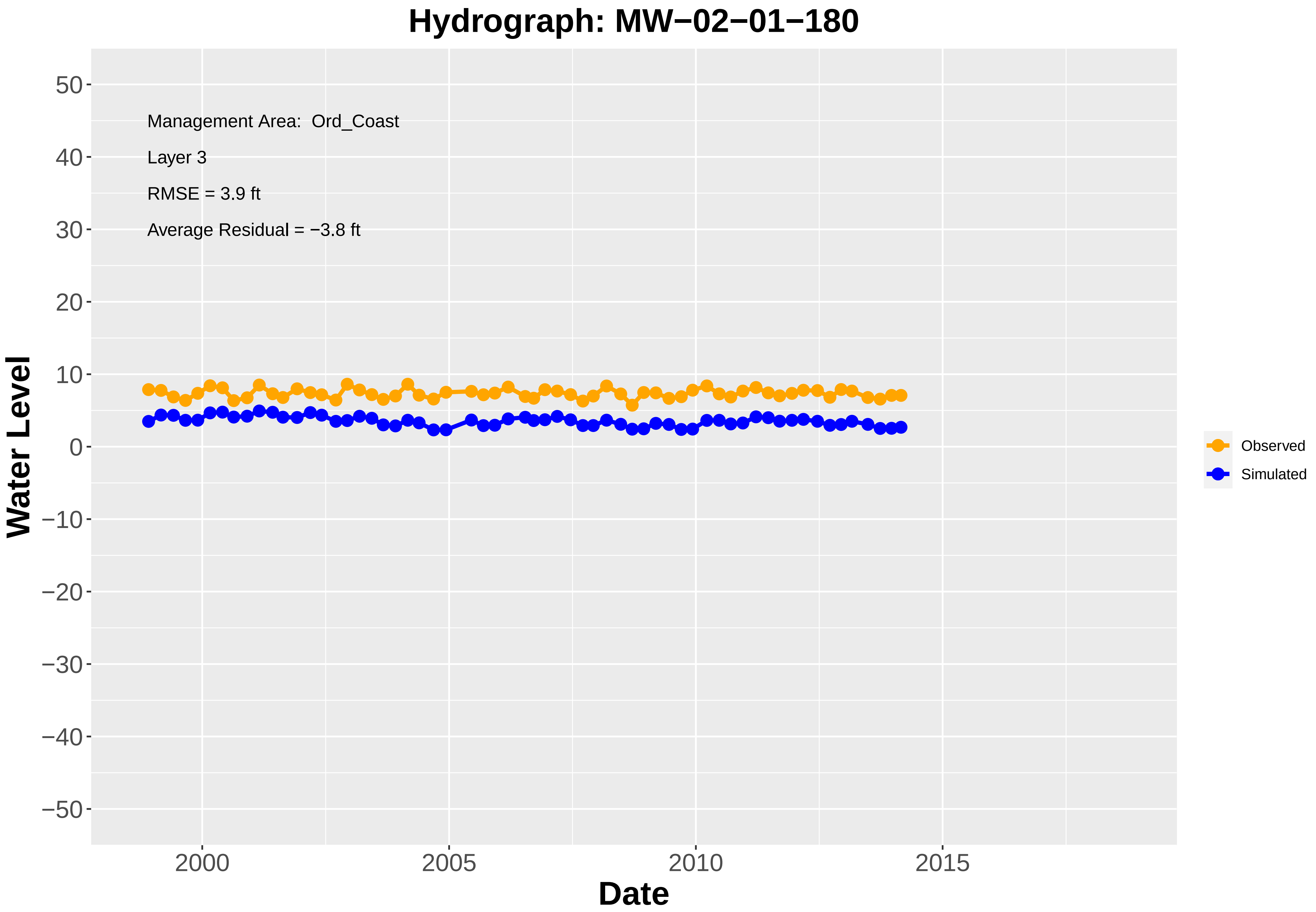
Hydrograph: MPWMD#FO−10S
Management Area: Ord_Seaside
Layer 8
RMSE = 4.3 ft
Average Residual = 2.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



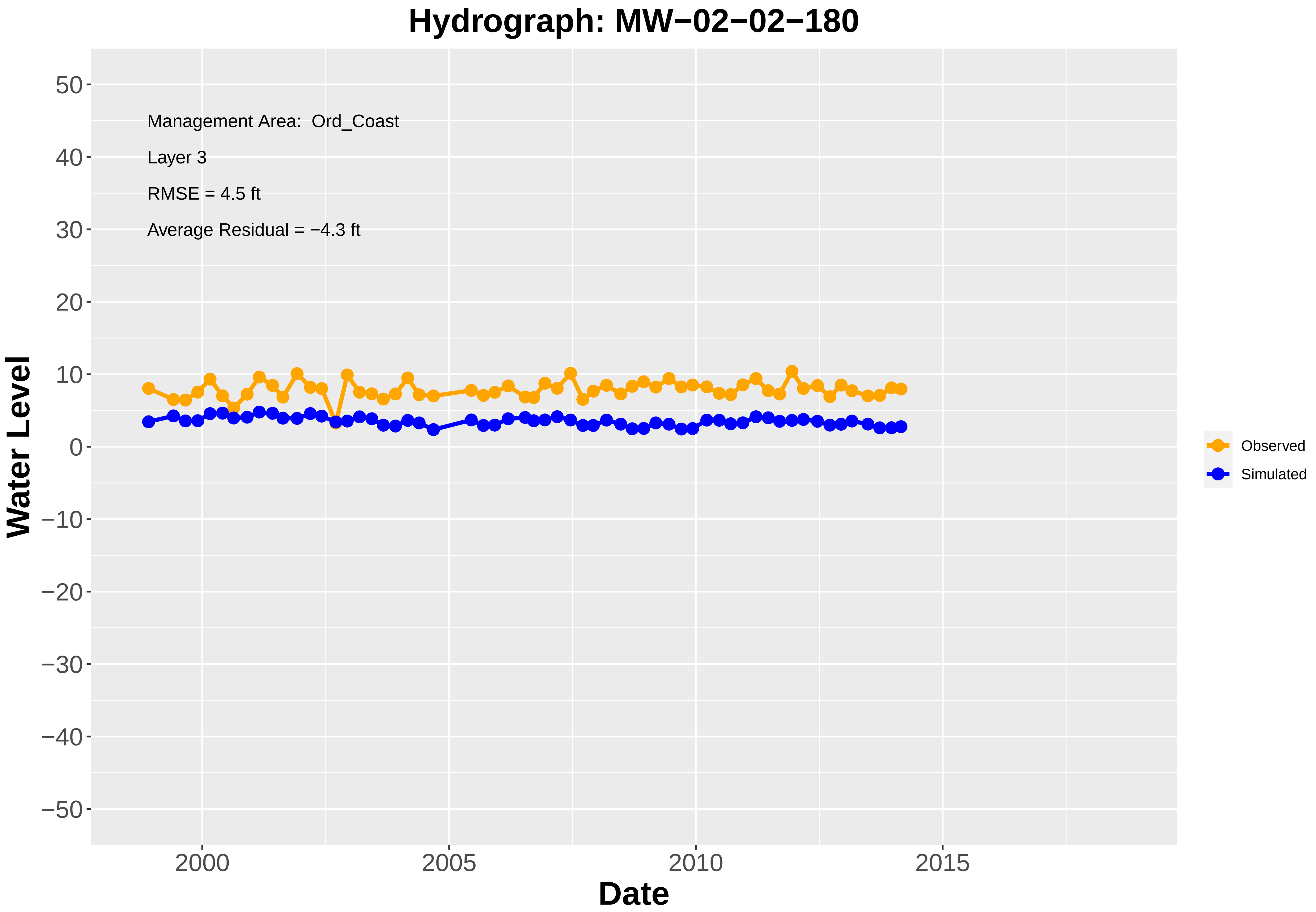
Hydrograph: MPWMD#FO−11D
Management Area: Ord_Seaside
Layer 8
RMSE = 9.0 ft
Average Residual = −8.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



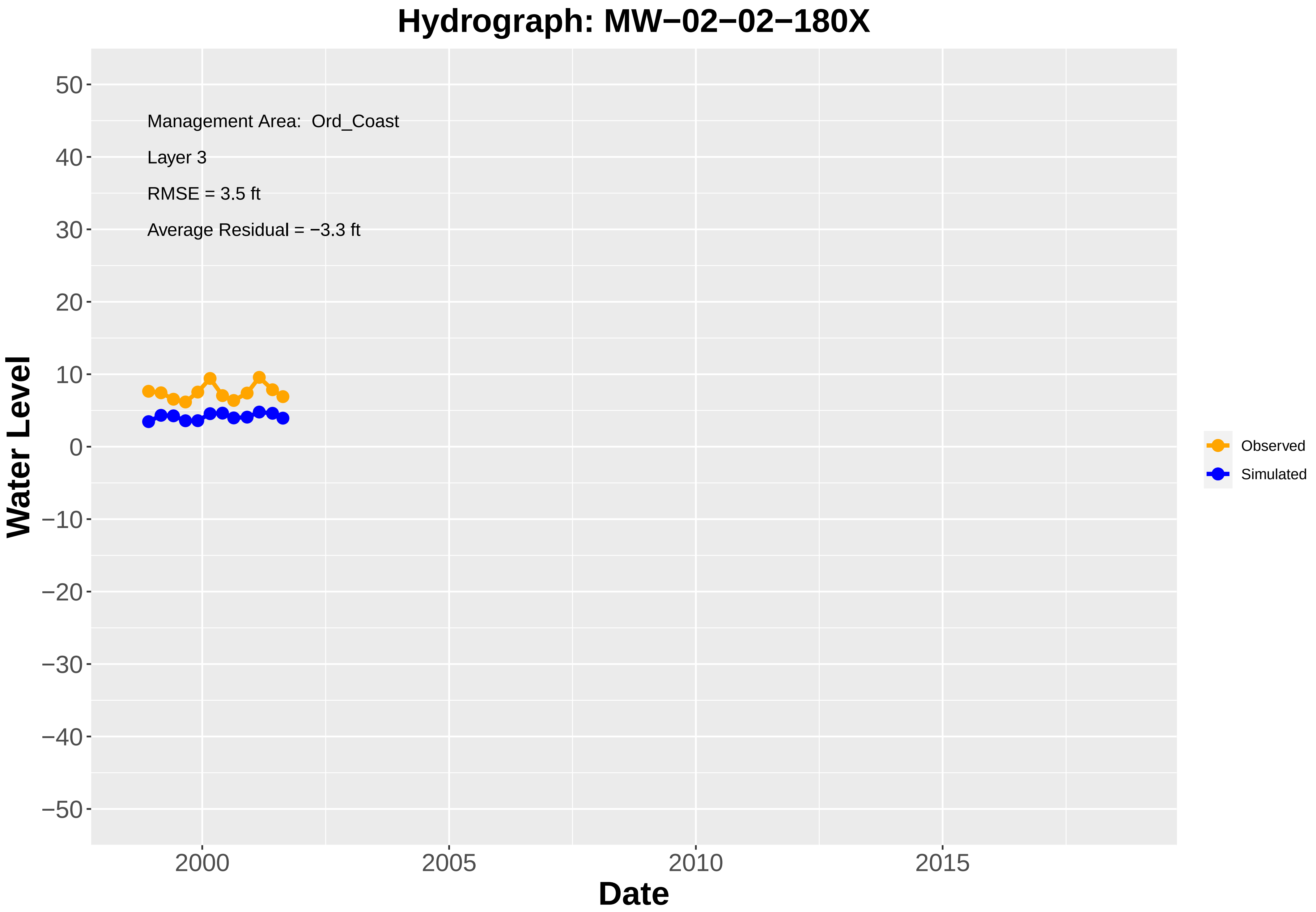
Hydrograph: MPWMD#FO−11S
Management Area: Ord_Seaside
Layer 8
RMSE = 9.0 ft
Average Residual = 6.0 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



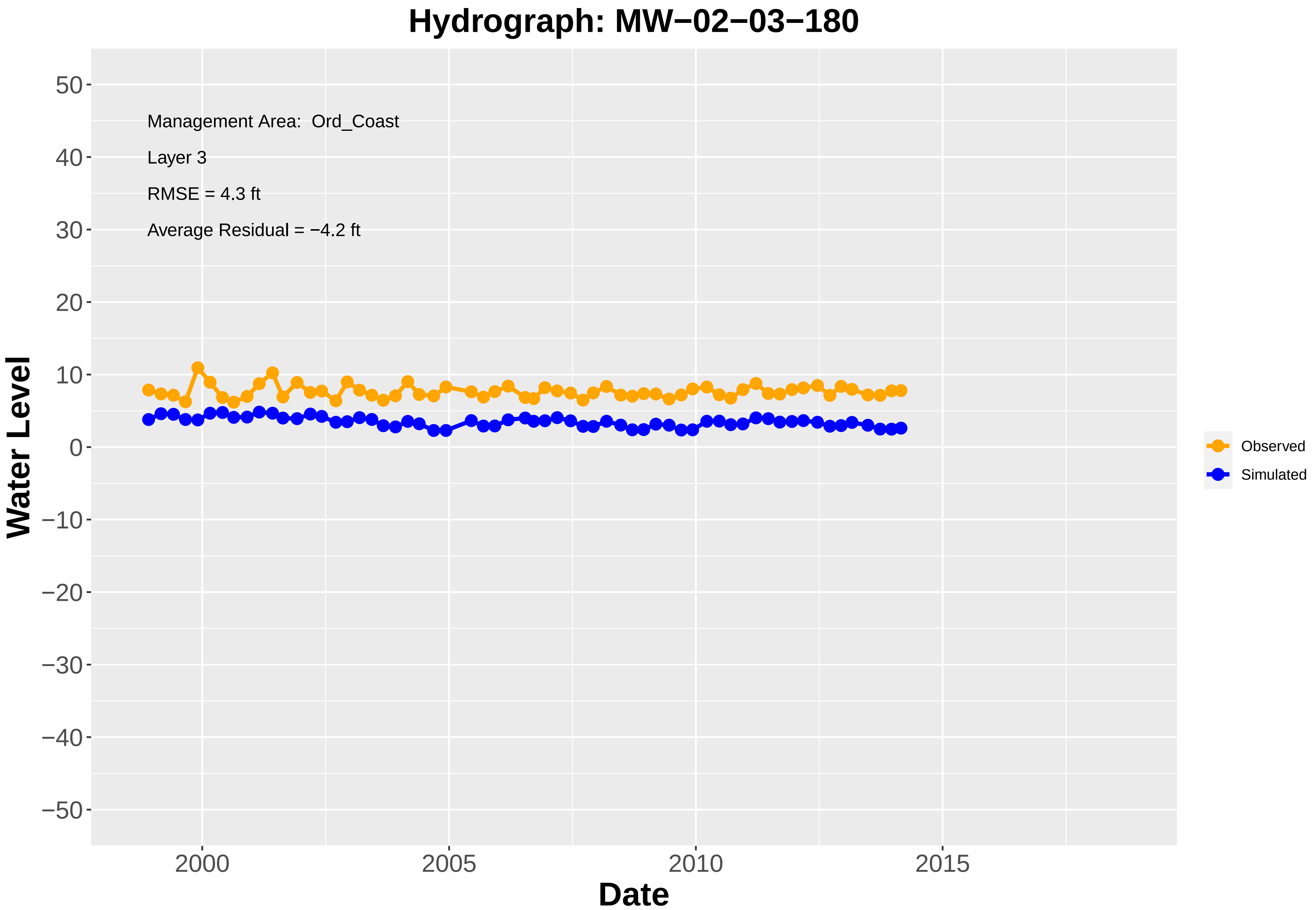
Hydrograph: MW−02−01−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.9 ft
Average Residual = −3.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



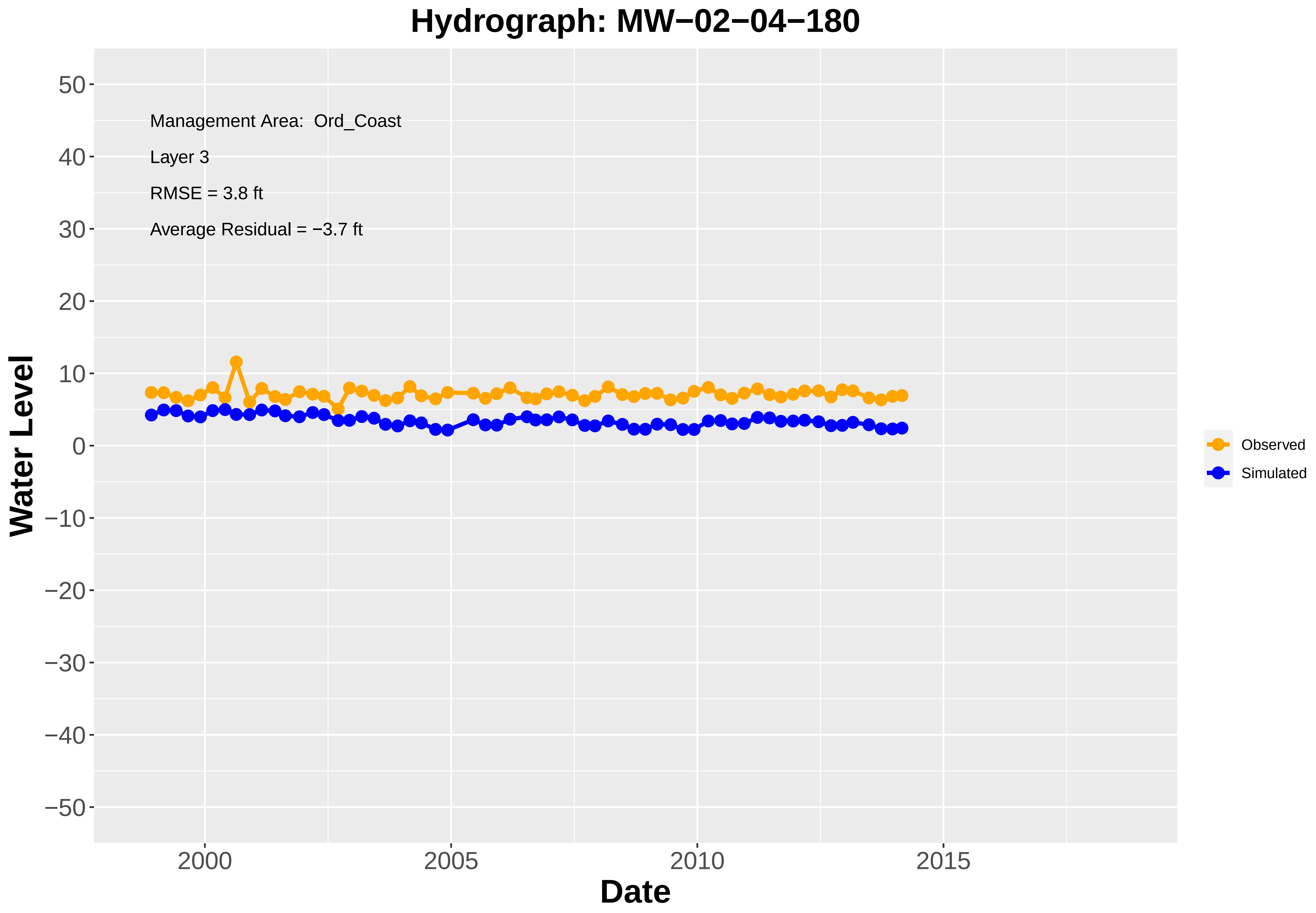
Hydrograph: MW−02−02−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.5 ft
Average Residual = −4.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

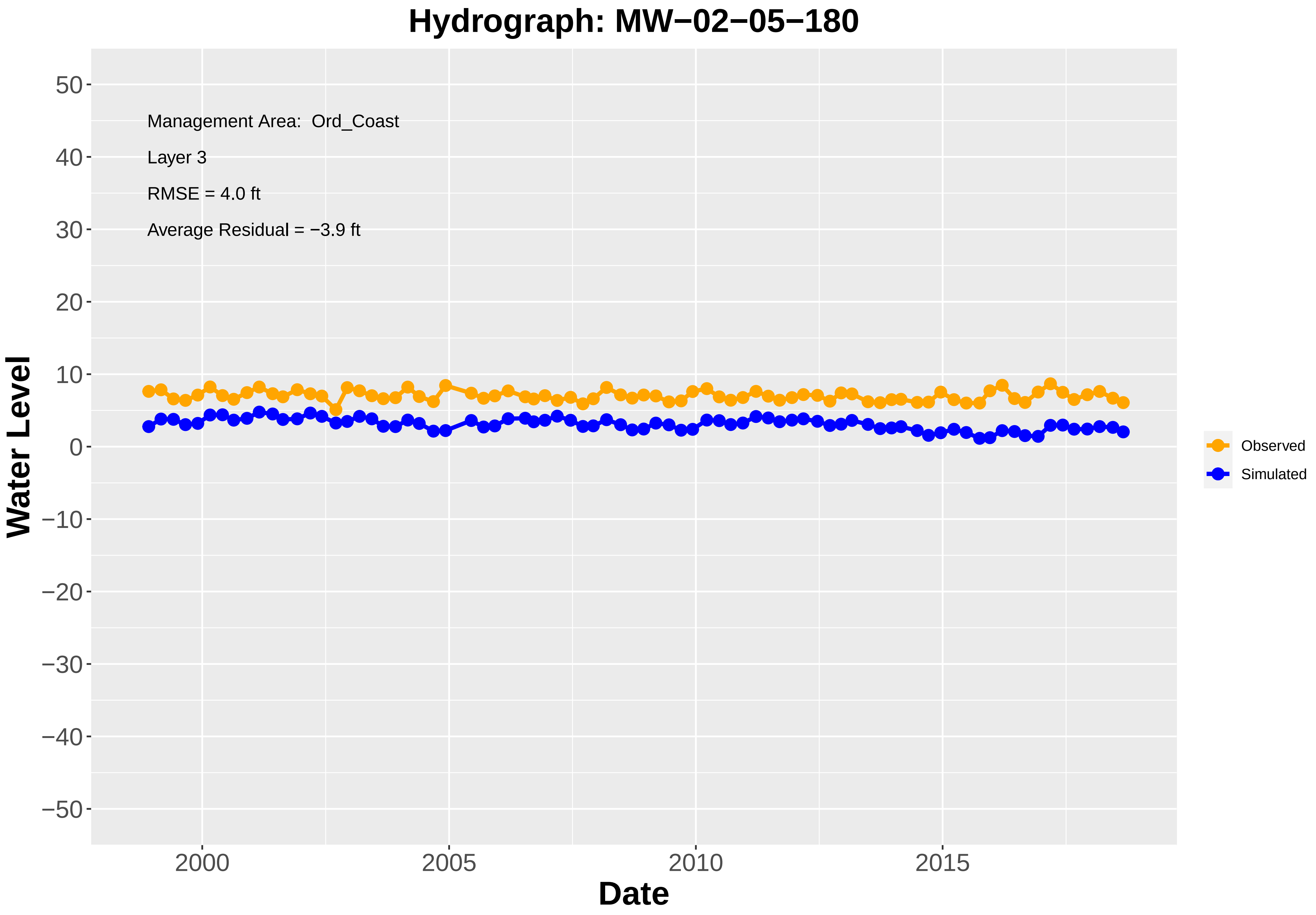


Hydrograph: MW−02−02−180X
Management Area: Ord_Coast
Layer 3
RMSE = 3.5 ft
Average Residual = −3.3 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

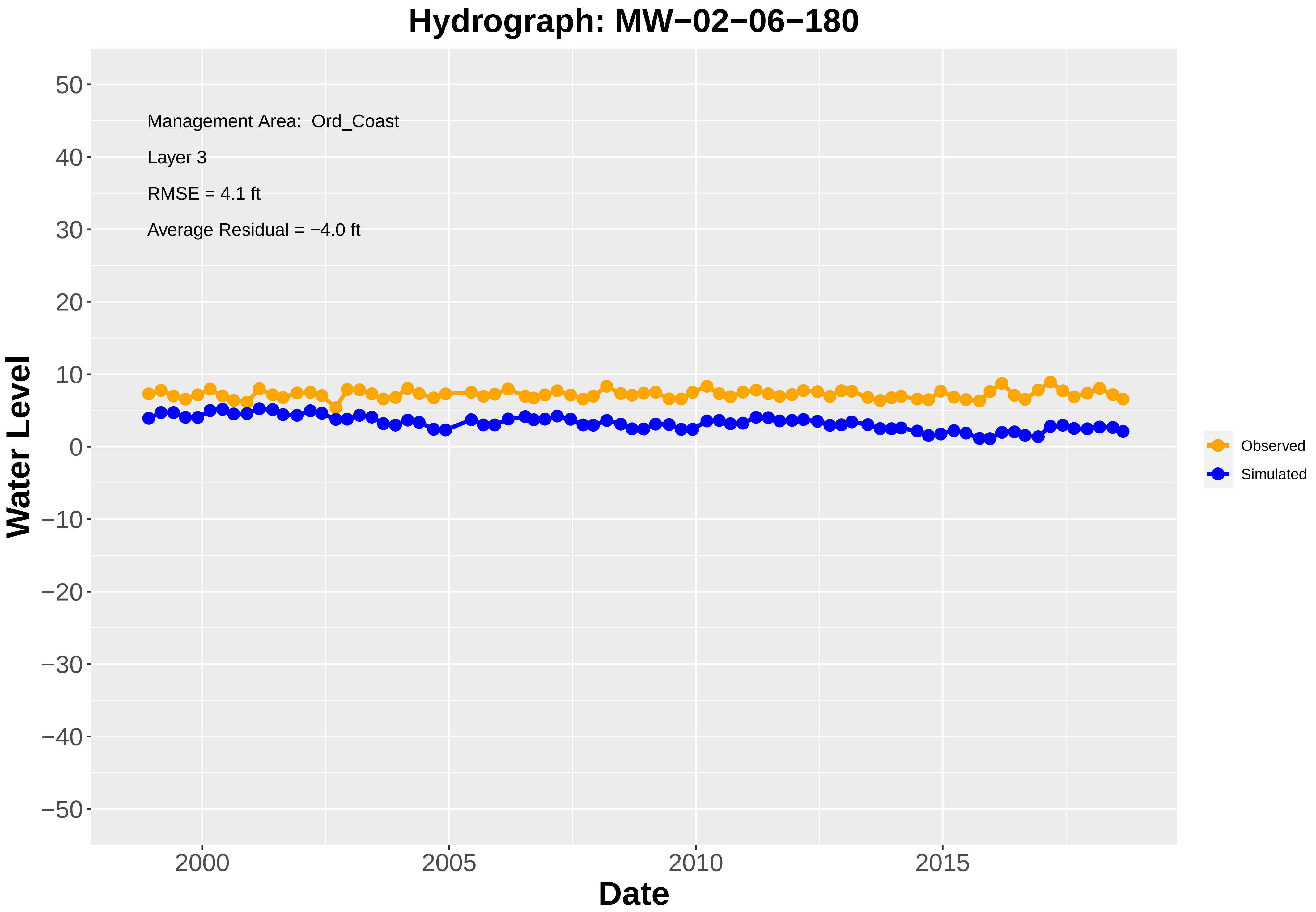


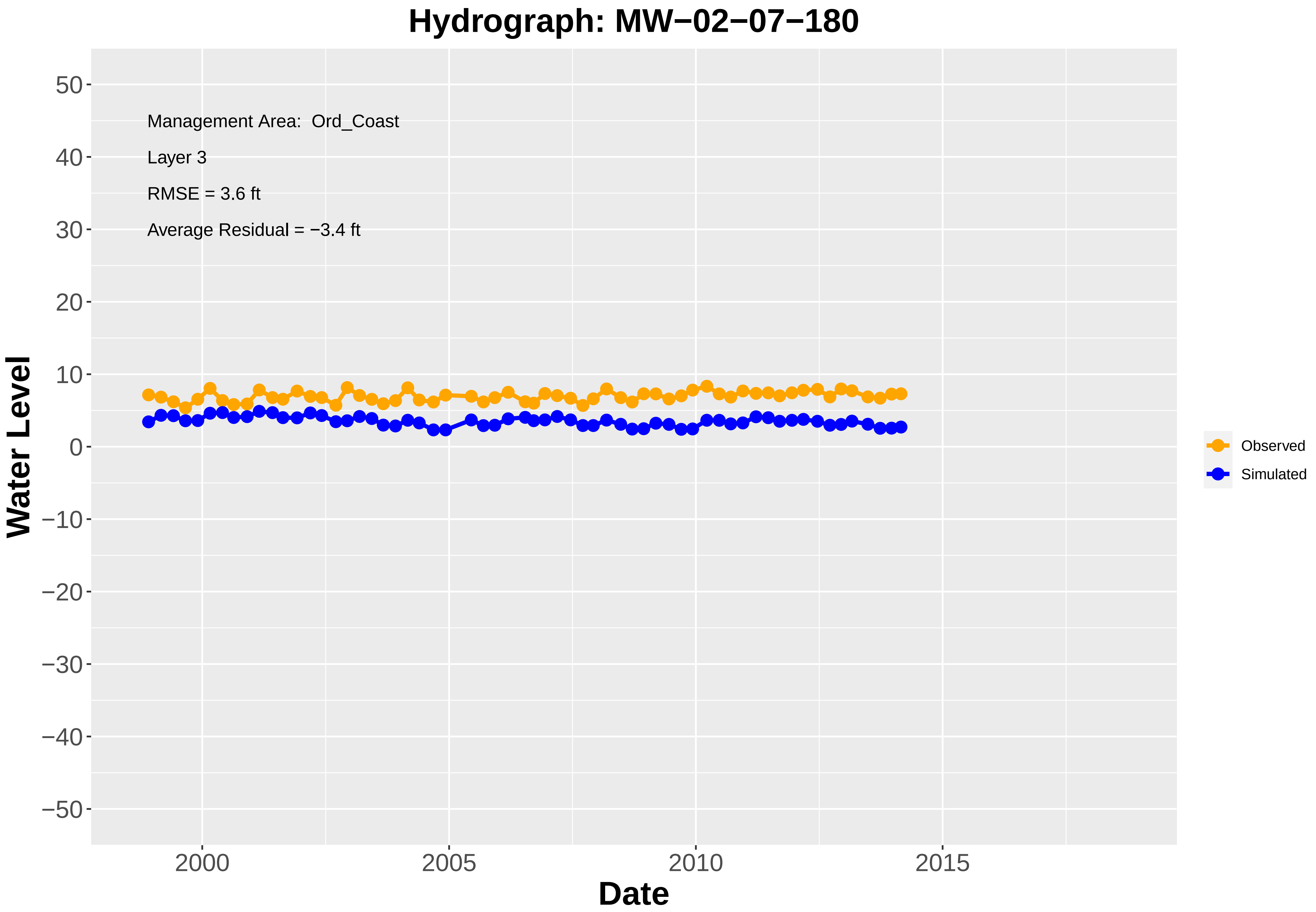
Hydrograph: MW−02−03−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.3 ft
Average Residual = −4.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

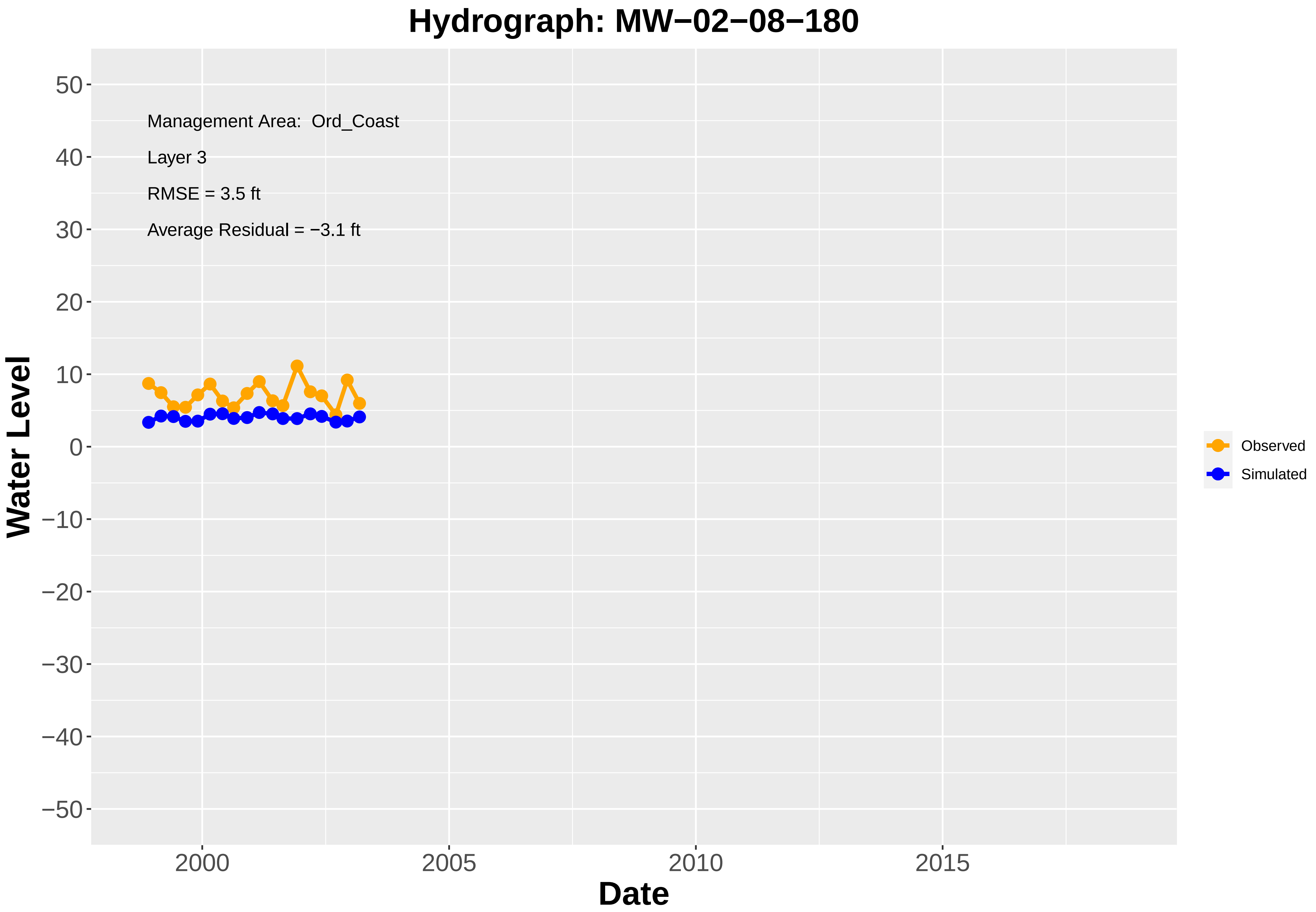

Hydrograph: MW−02−04−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



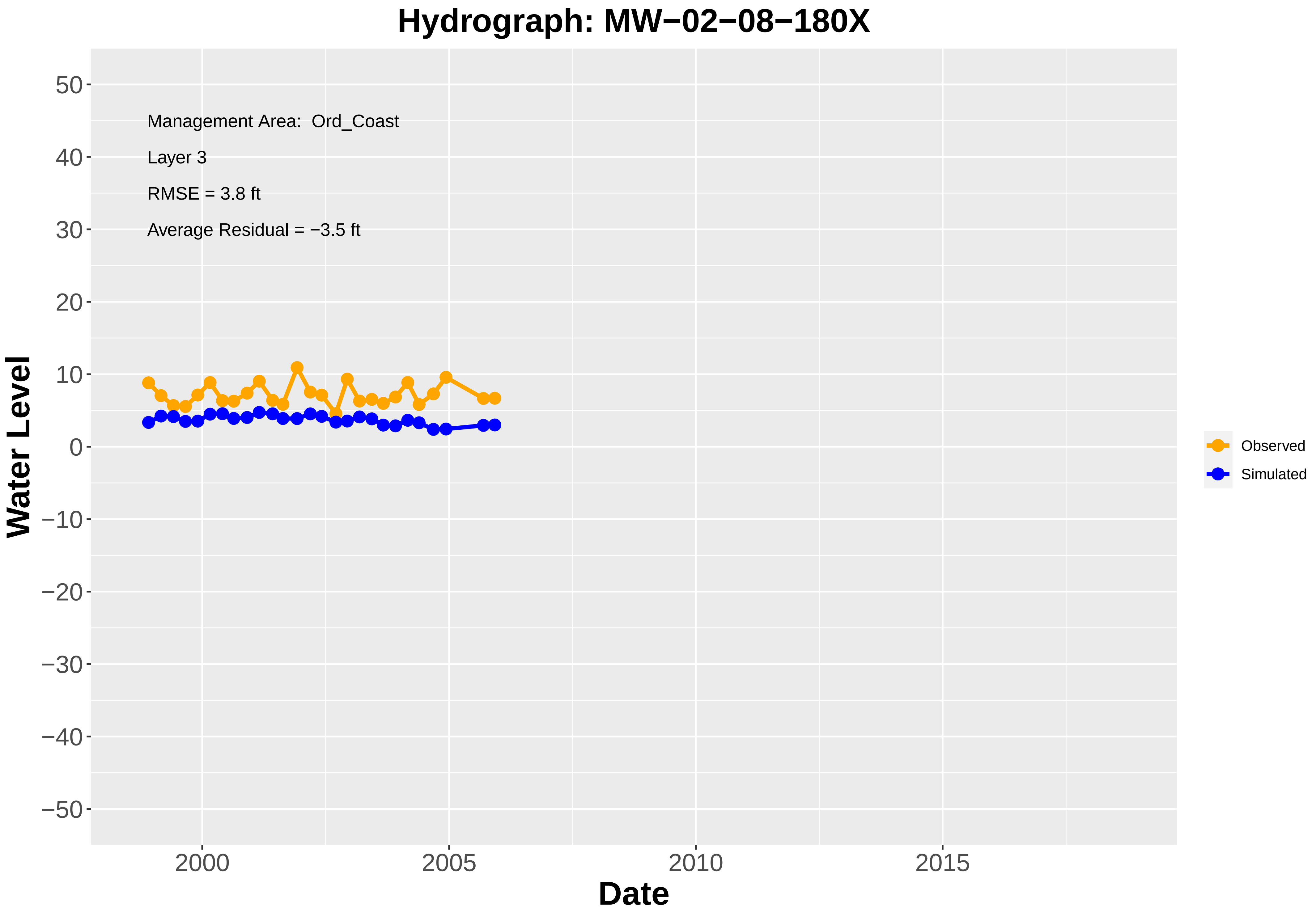
Hydrograph: MW−02−05−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.0 ft
Average Residual = −3.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−02−06−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.1 ft
Average Residual = −4.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

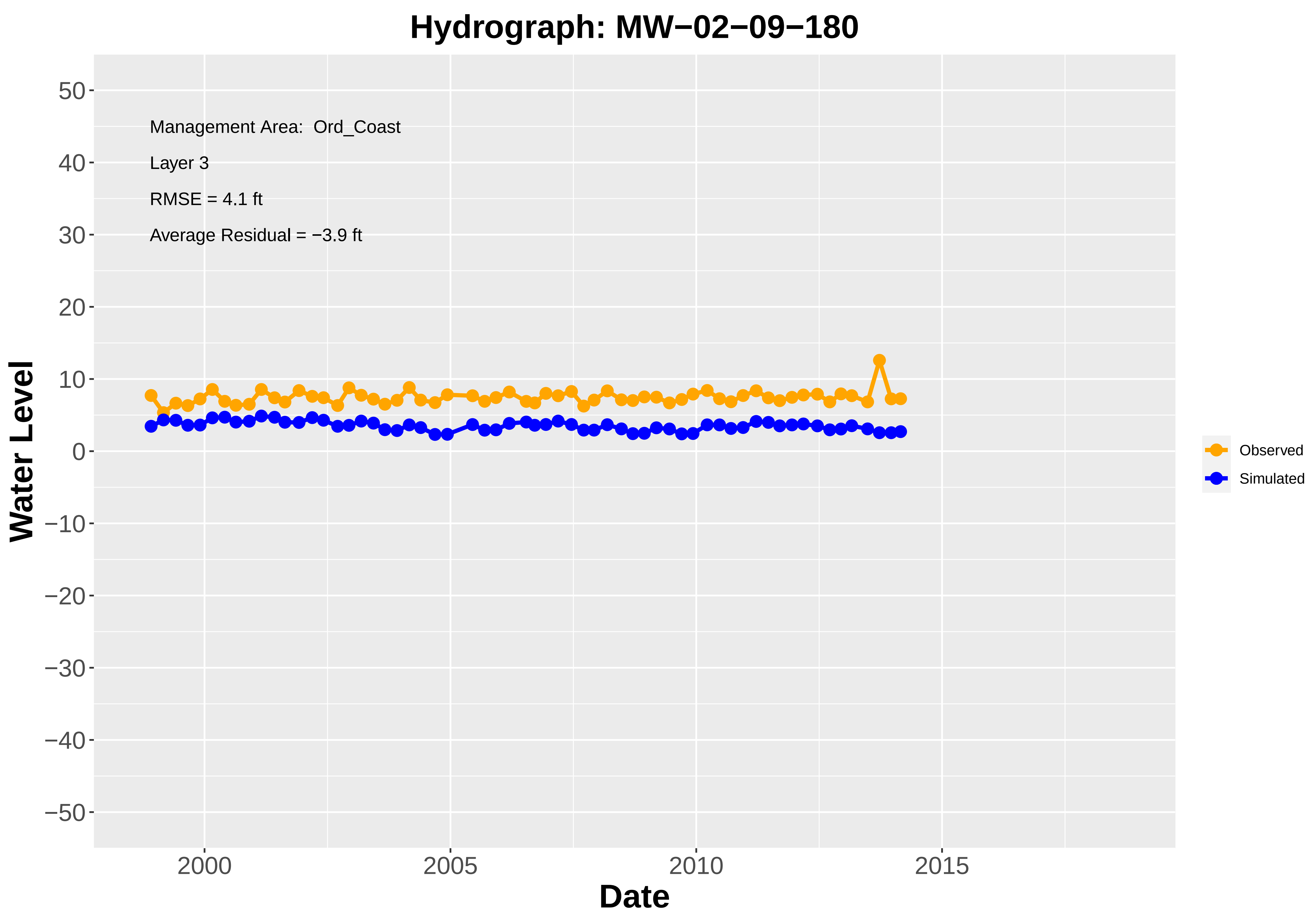

Hydrograph: MW−02−07−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.6 ft
Average Residual = −3.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

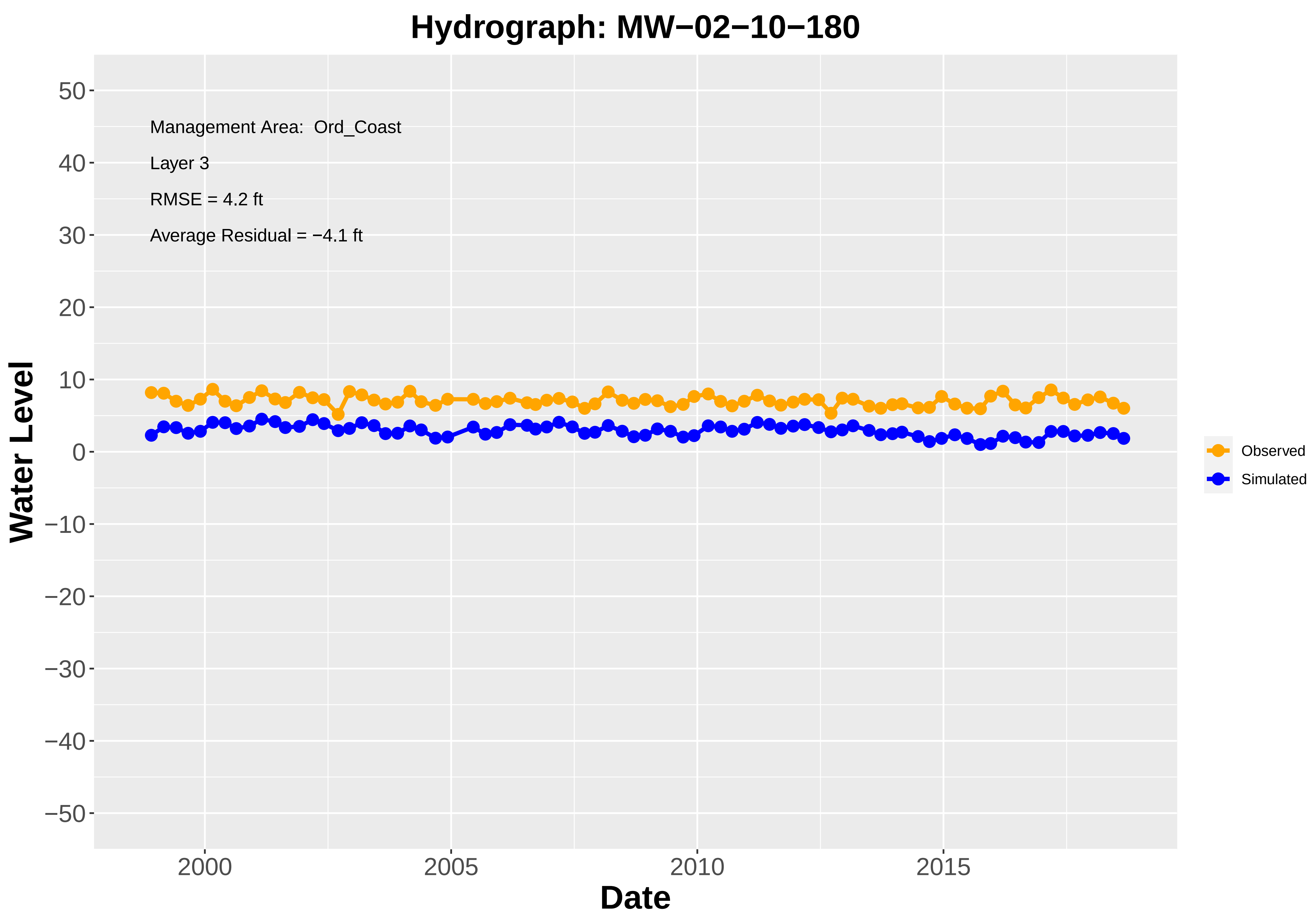


Hydrograph: MW−02−08−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.5 ft
Average Residual = −3.1 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

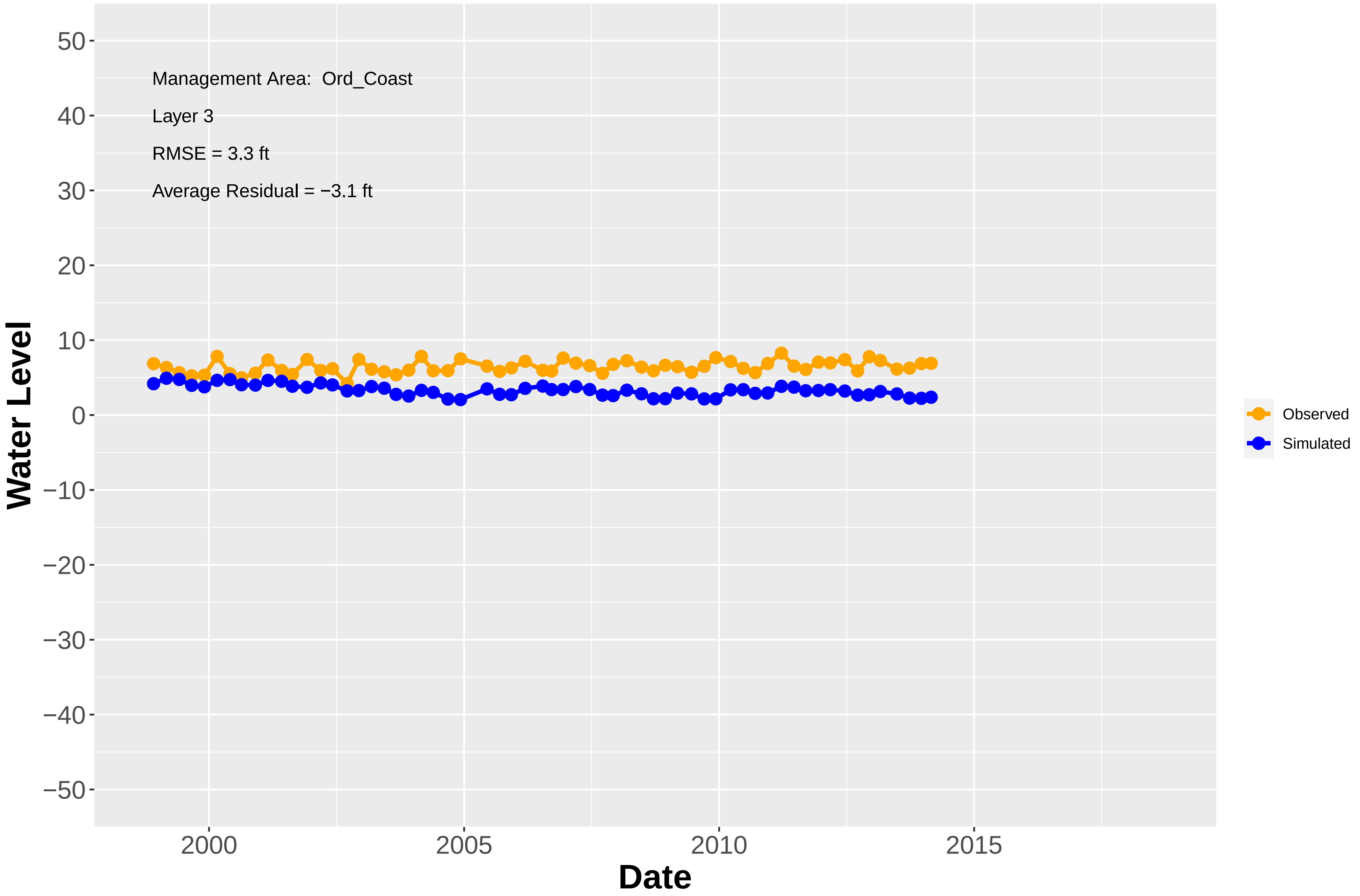


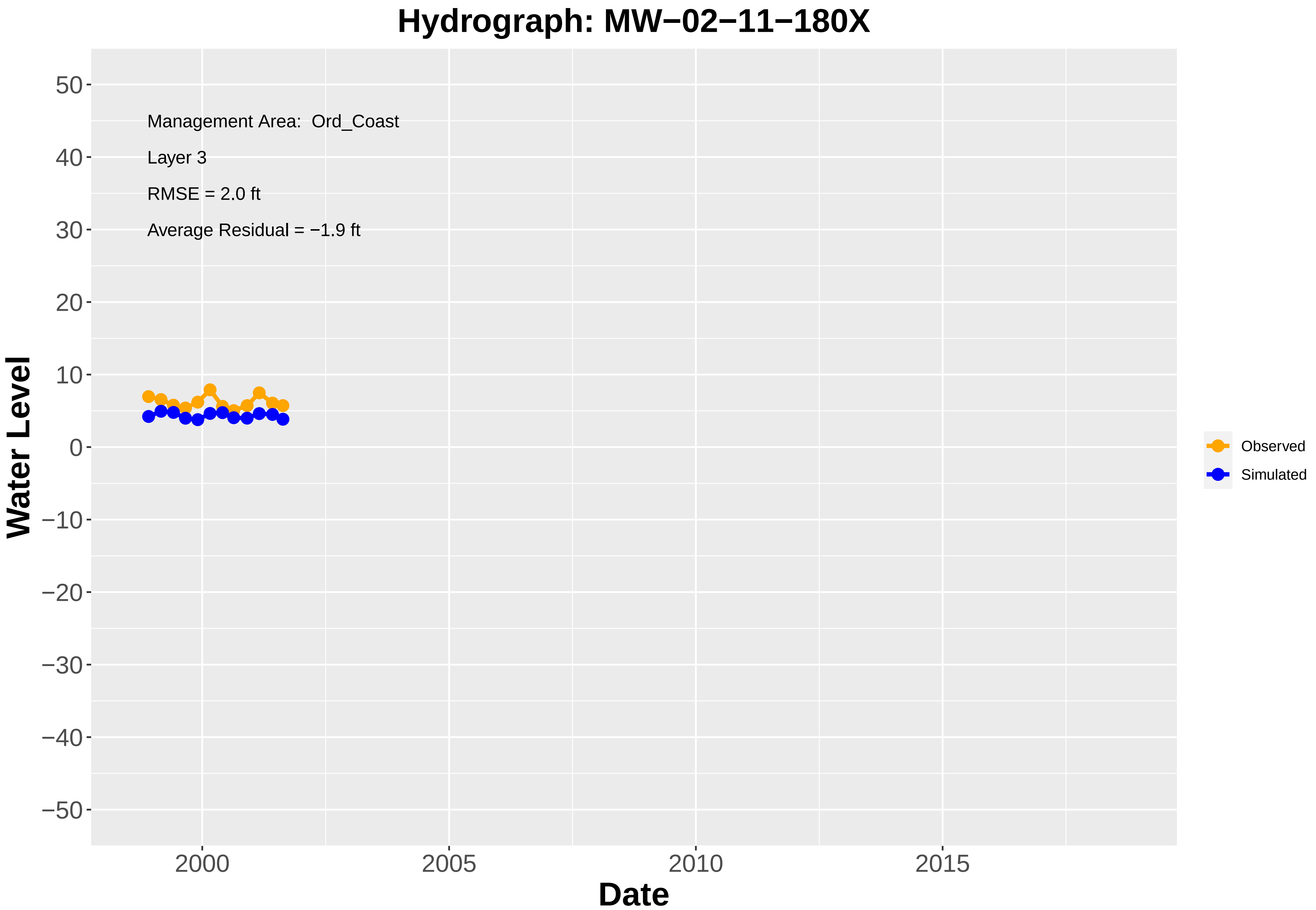
Hydrograph: MW−02−08−180X
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.5 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−02−09−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.1 ft
Average Residual = −3.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

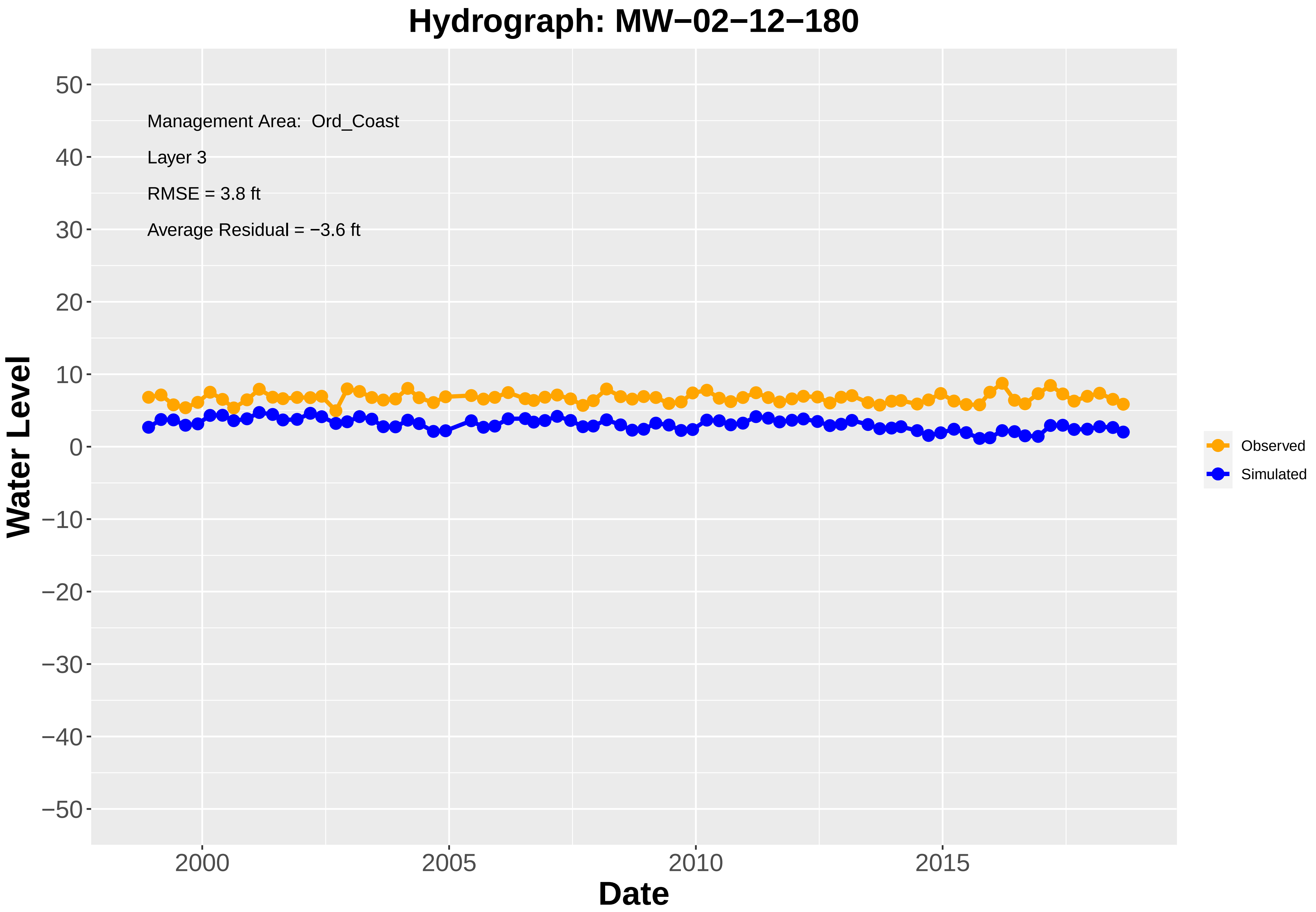

Hydrograph: MW−02−10−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.2 ft
Average Residual = −4.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

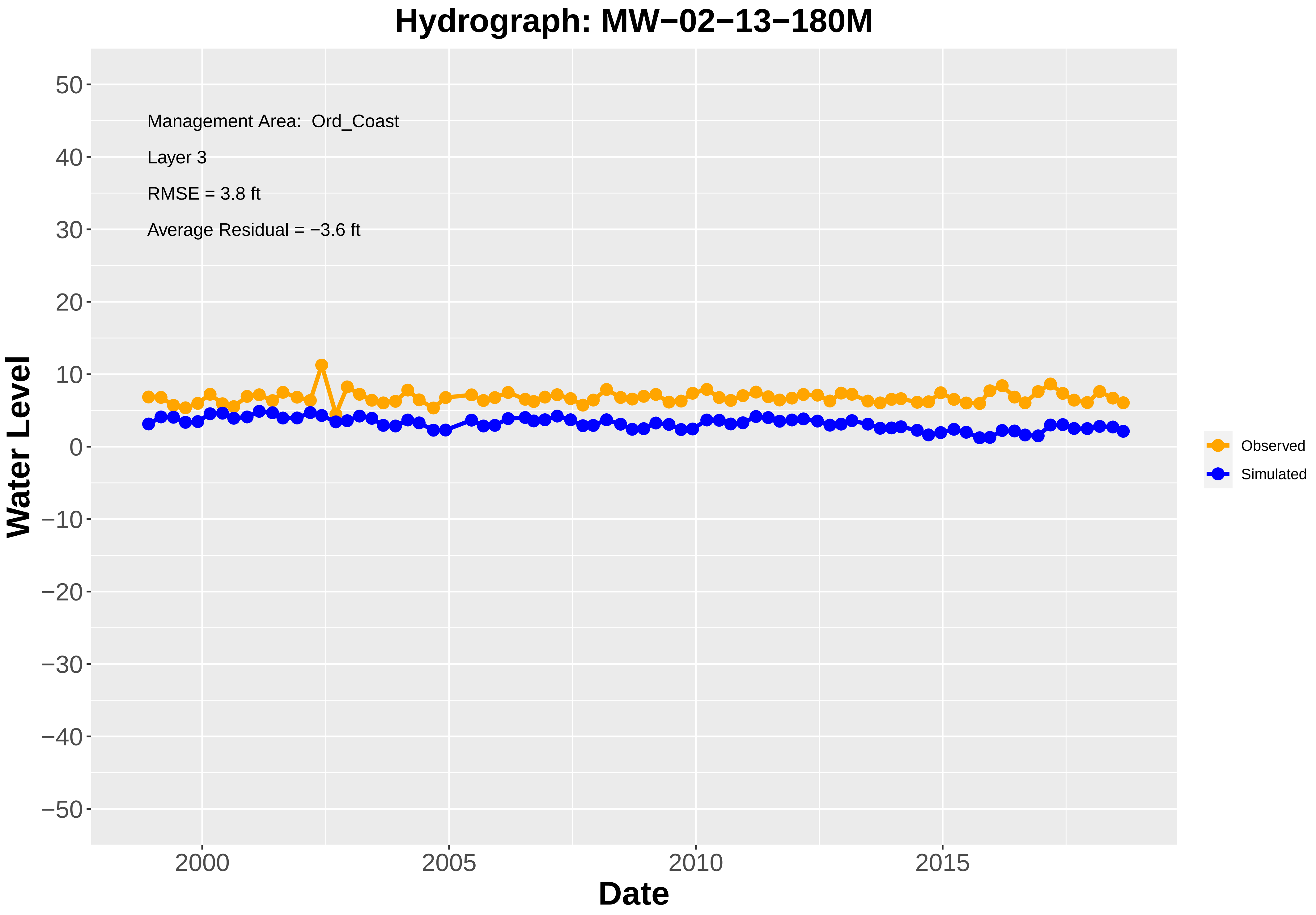
Hydrograph: MW−02−11−180

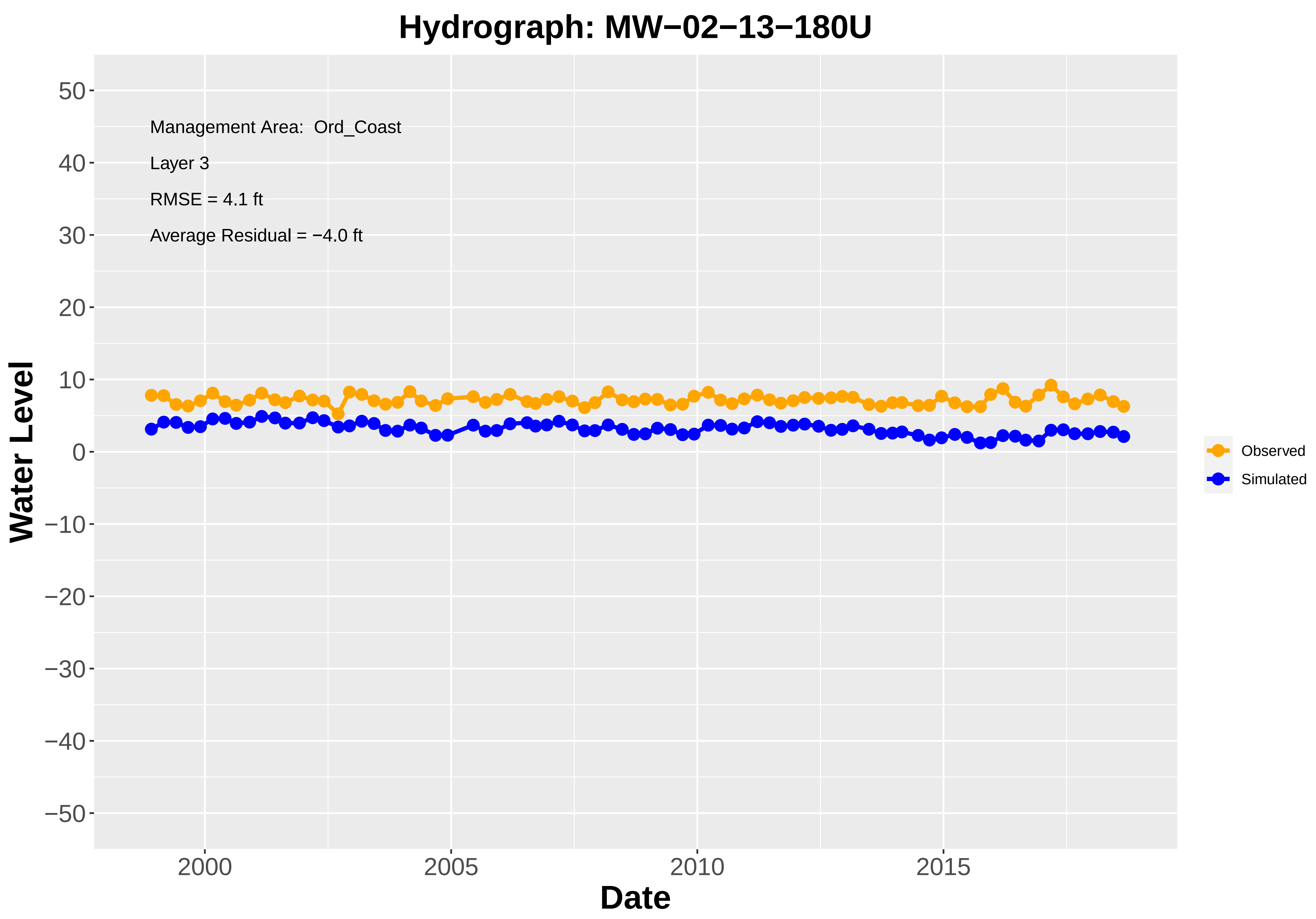




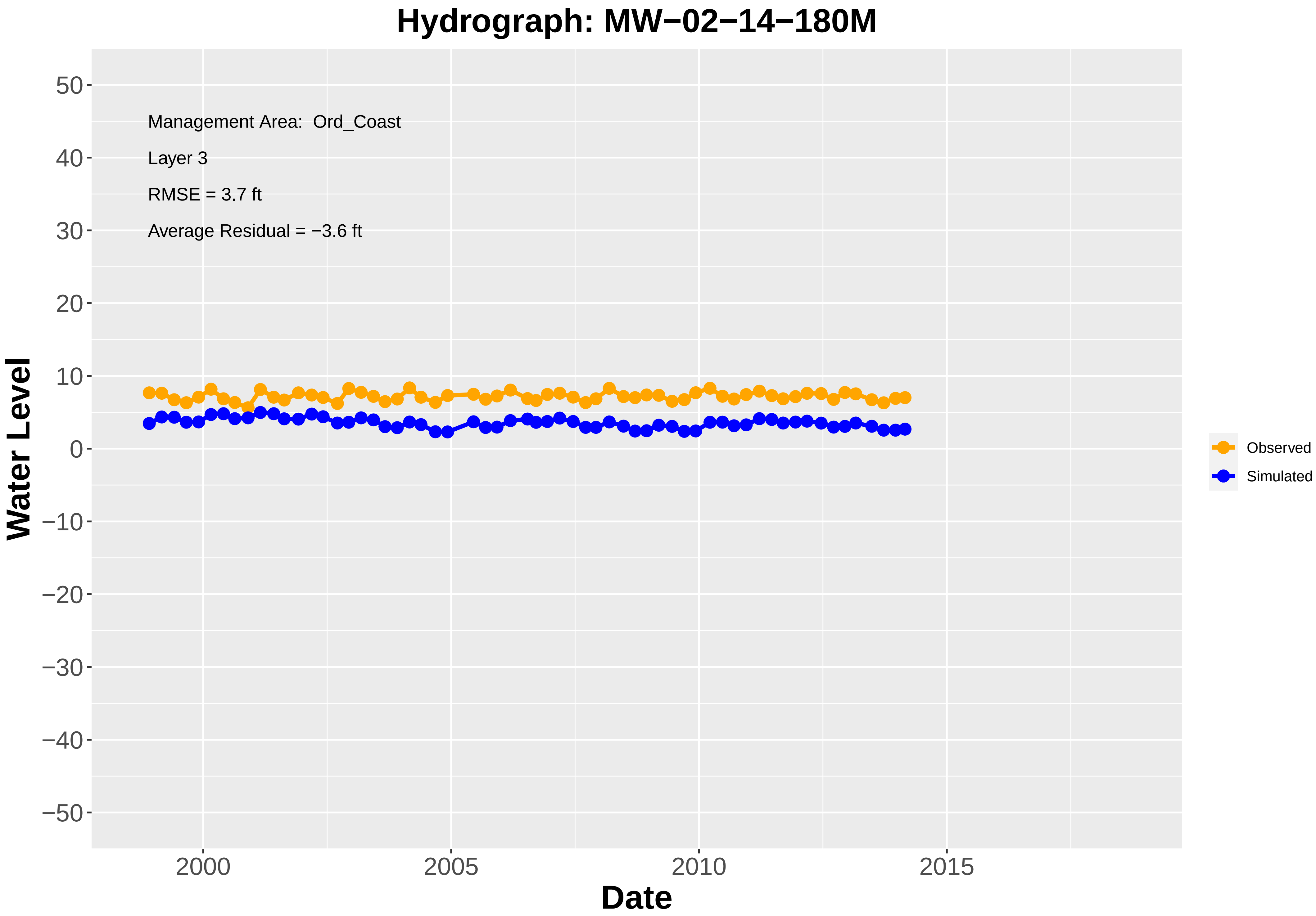
Hydrograph: MW−02−11−180X
Management Area: Ord_Coast
Layer 3
RMSE = 2.0 ft
Average Residual = −1.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

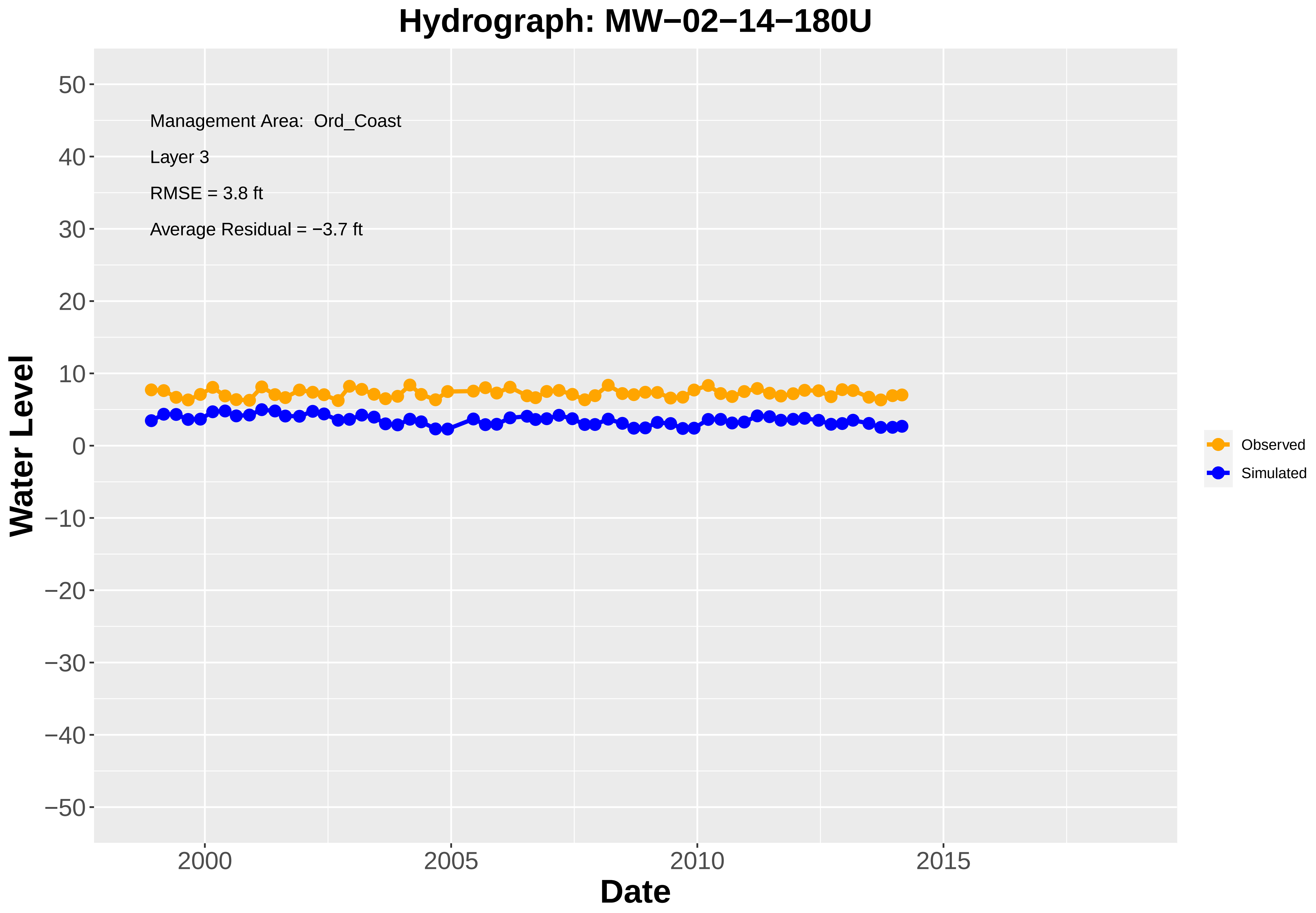

Hydrograph: MW−02−12−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.6 ft
50
40
30
20
10
0
−10
−20
−30
−40
−50
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

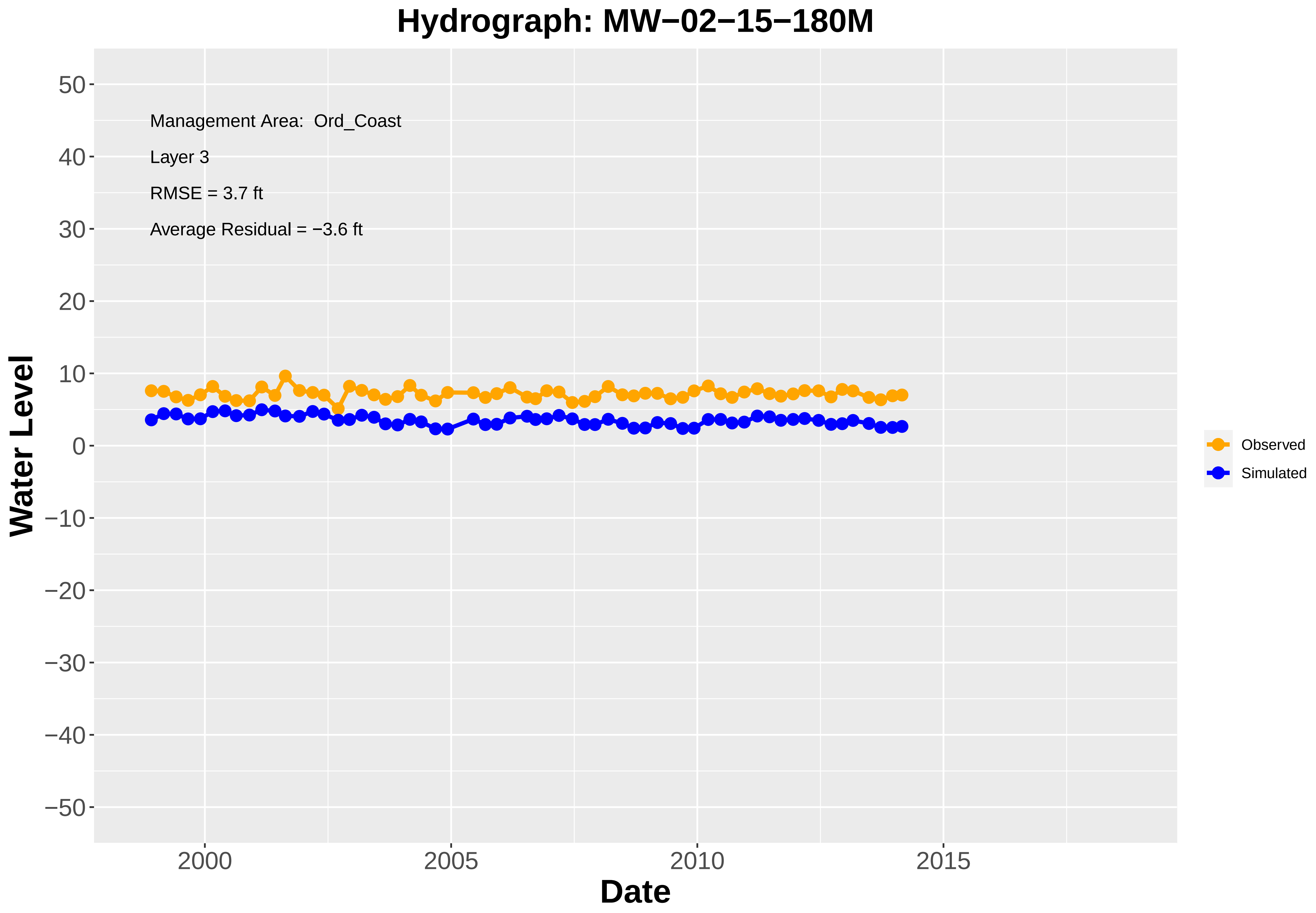

Hydrograph: MW−02−13−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



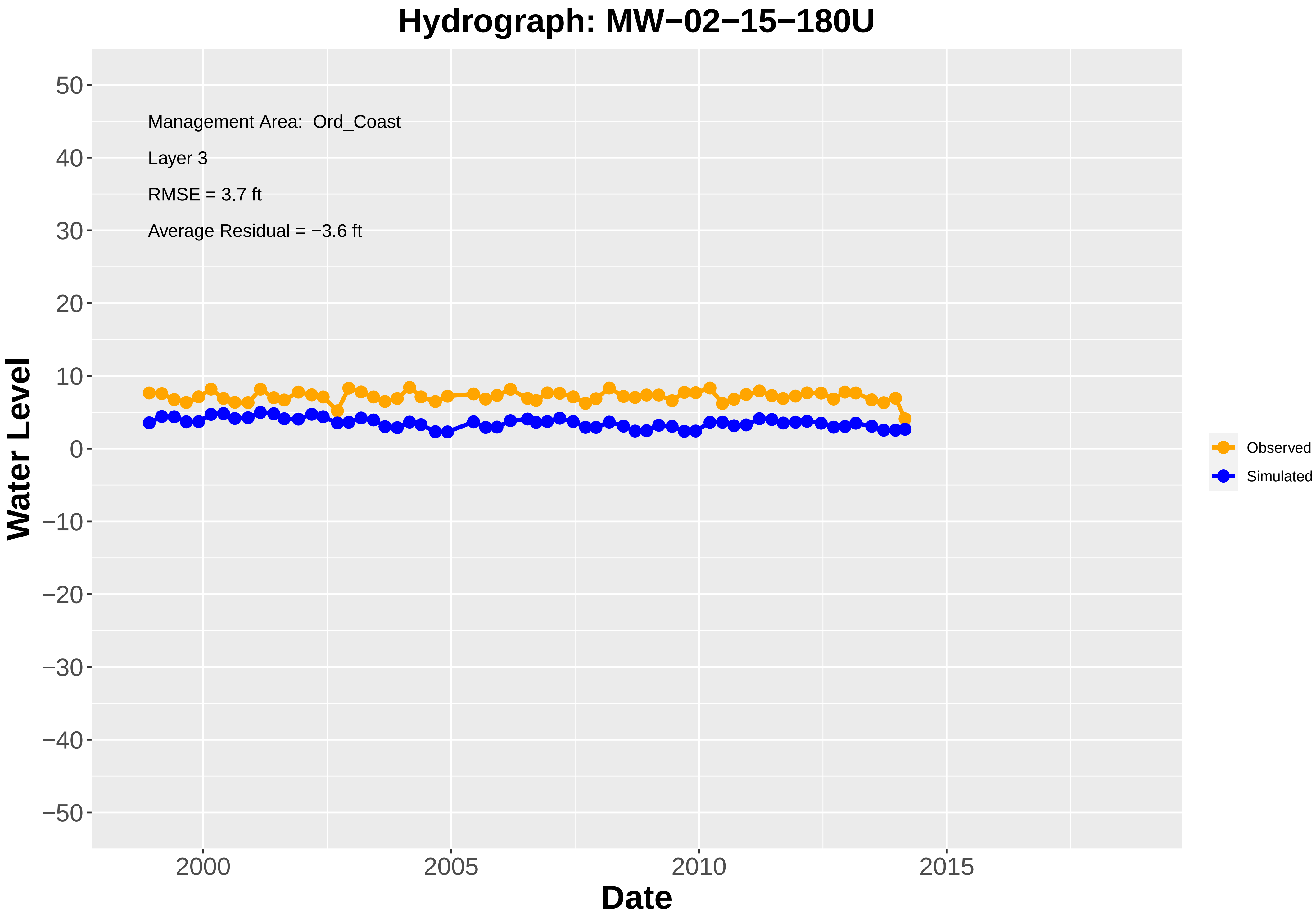
Hydrograph: MW−02−13−180U
Management Area: Ord_Coast
Layer 3
RMSE = 4.1 ft
Average Residual = −4.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

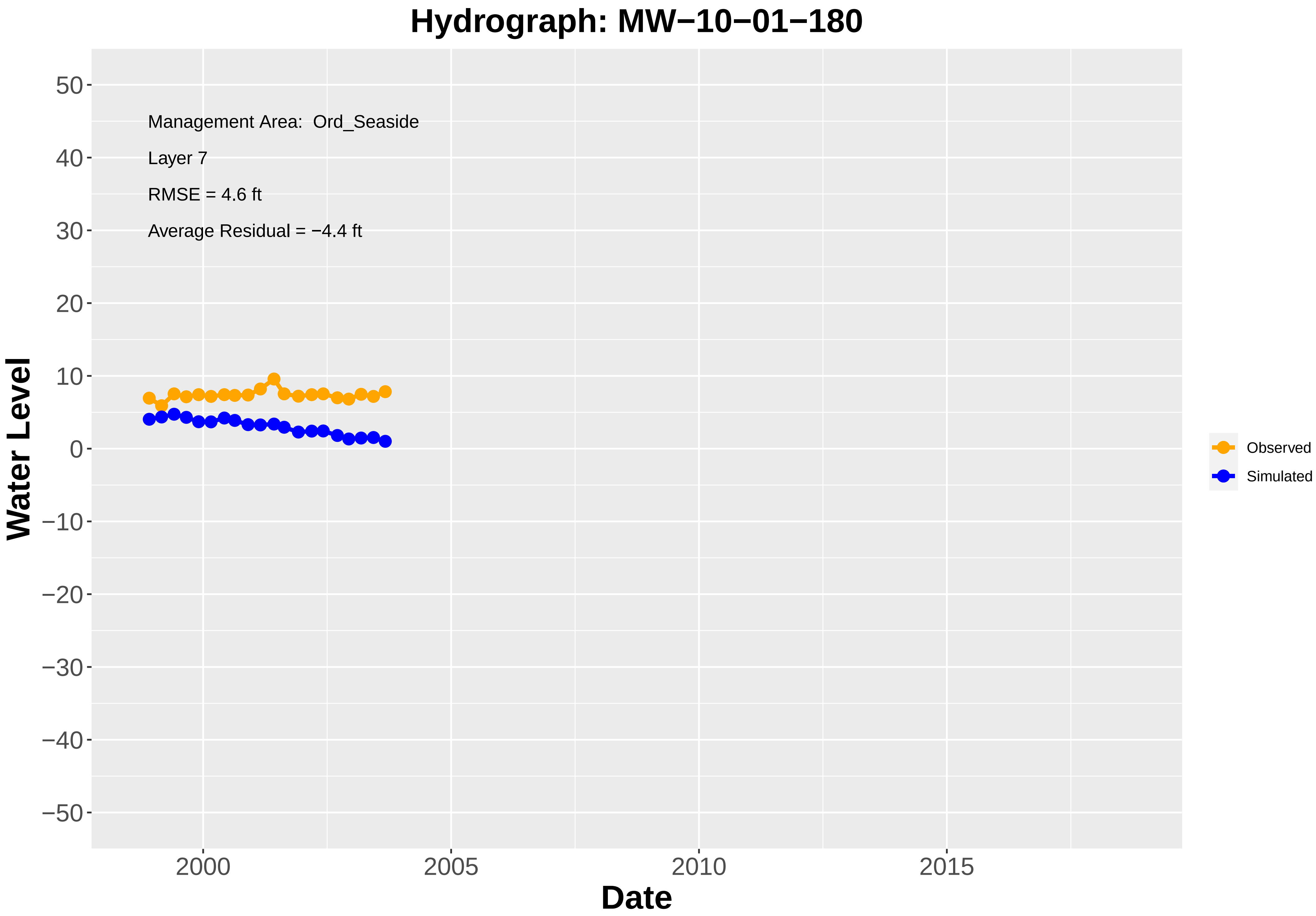

Hydrograph: MW−02−14−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.7 ft
Average Residual = −3.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−02−14−180U
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

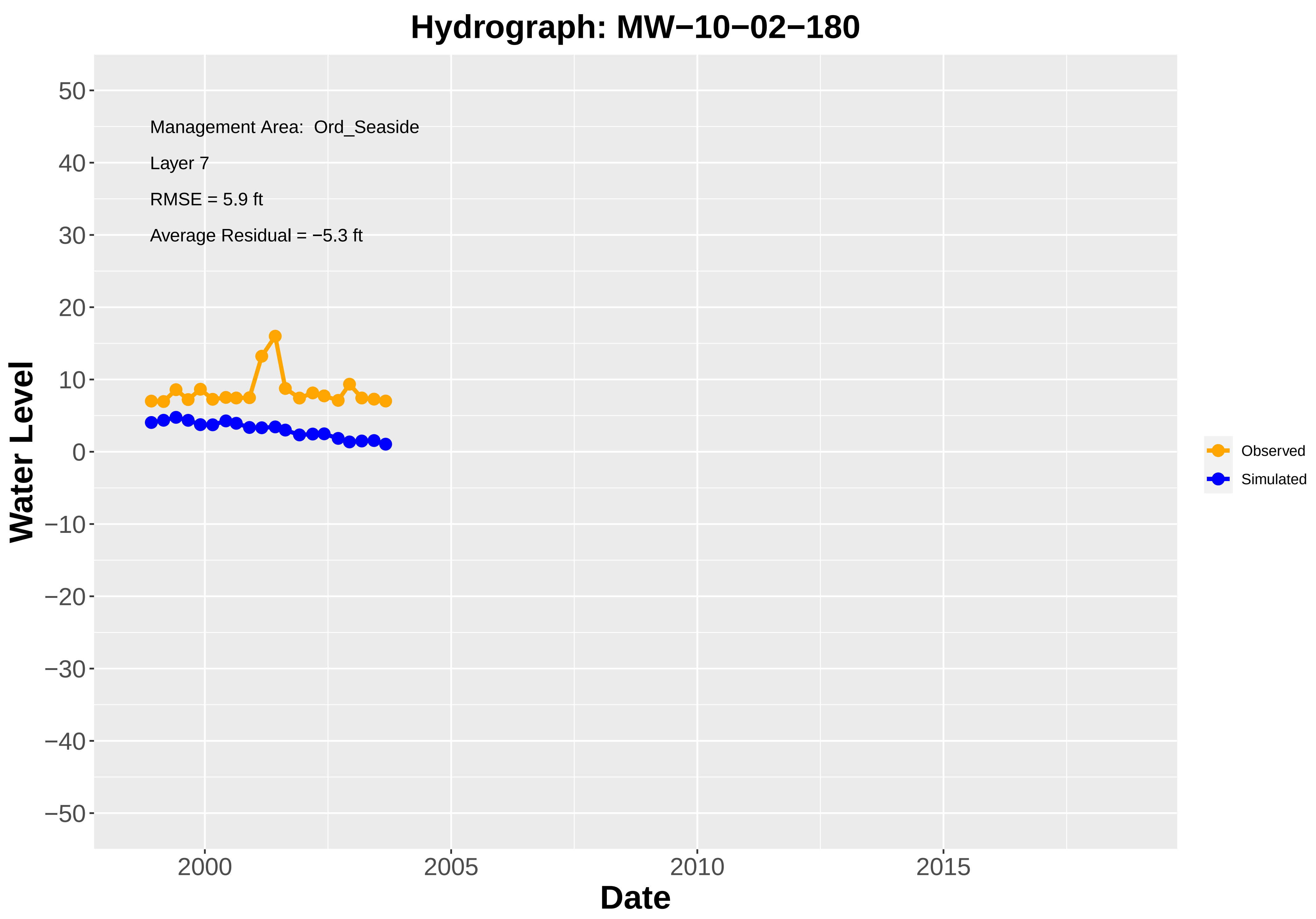


Hydrograph: MW−02−15−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.7 ft
Average Residual = −3.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

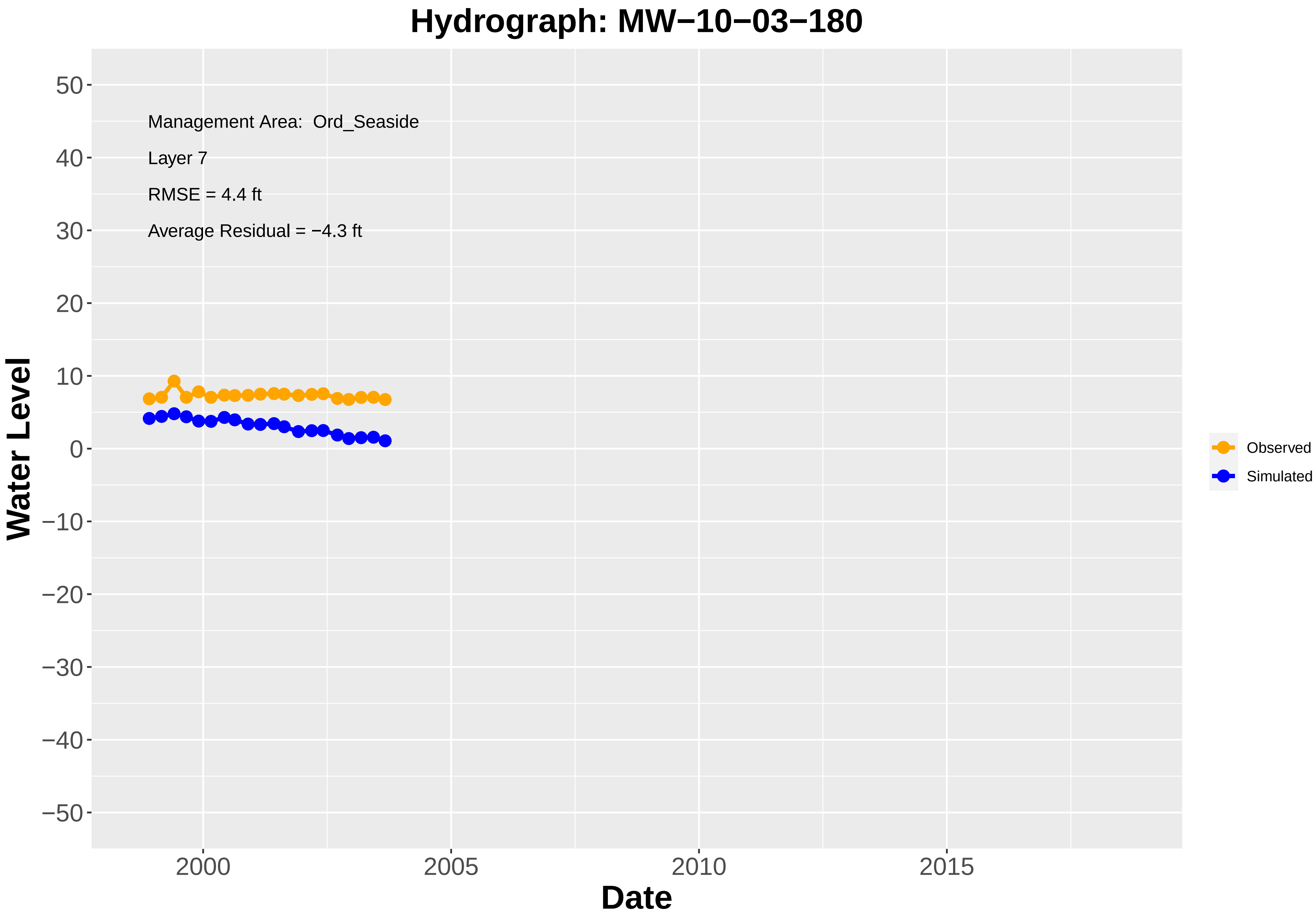

Hydrograph: MW−02−15−180U
Management Area: Ord_Coast
Layer 3
RMSE = 3.7 ft
Average Residual = −3.6 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



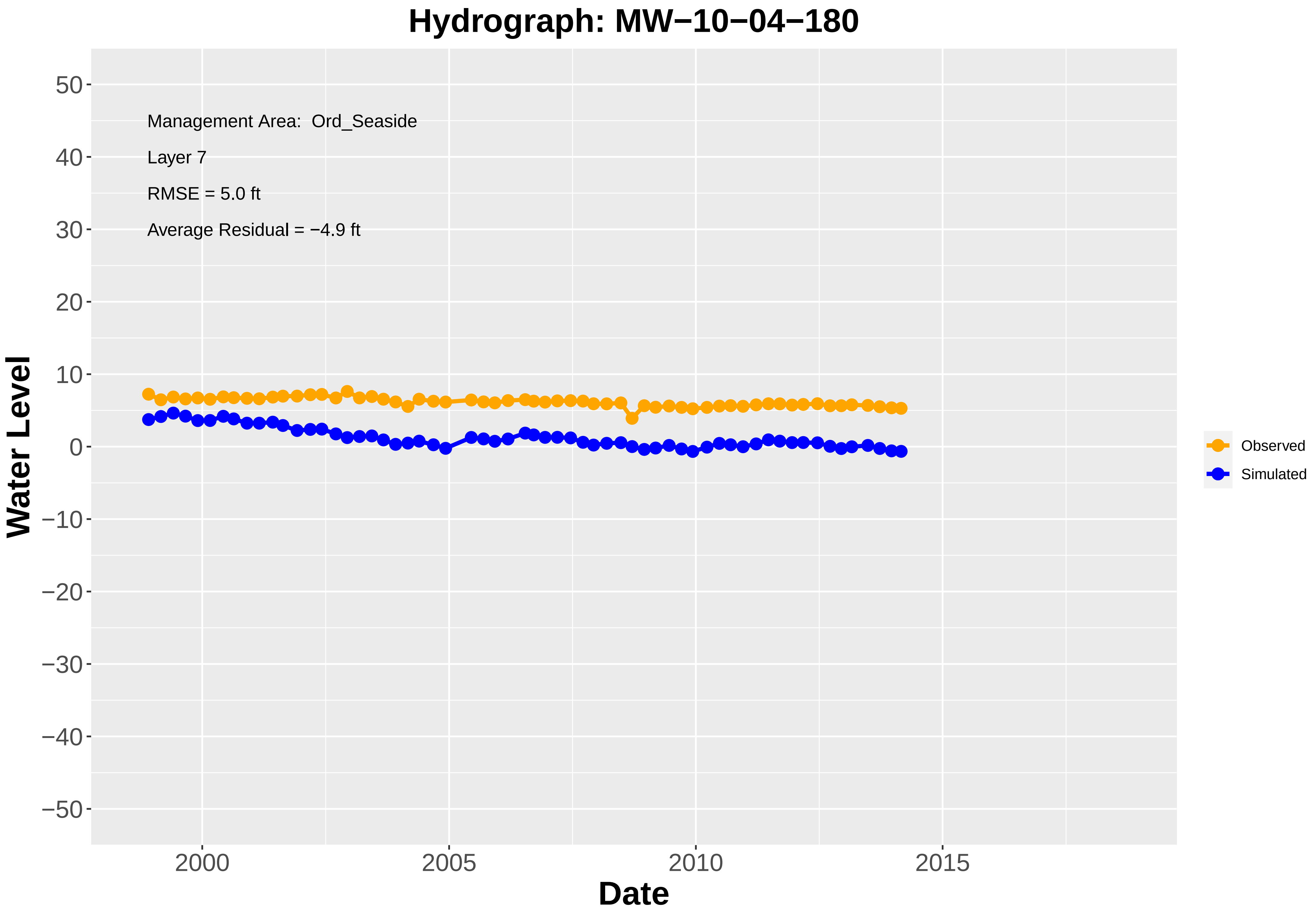
Hydrograph: MW−10−01−180
Management Area: Ord_Seaside
Layer 7
RMSE = 4.6 ft
Average Residual = −4.4 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



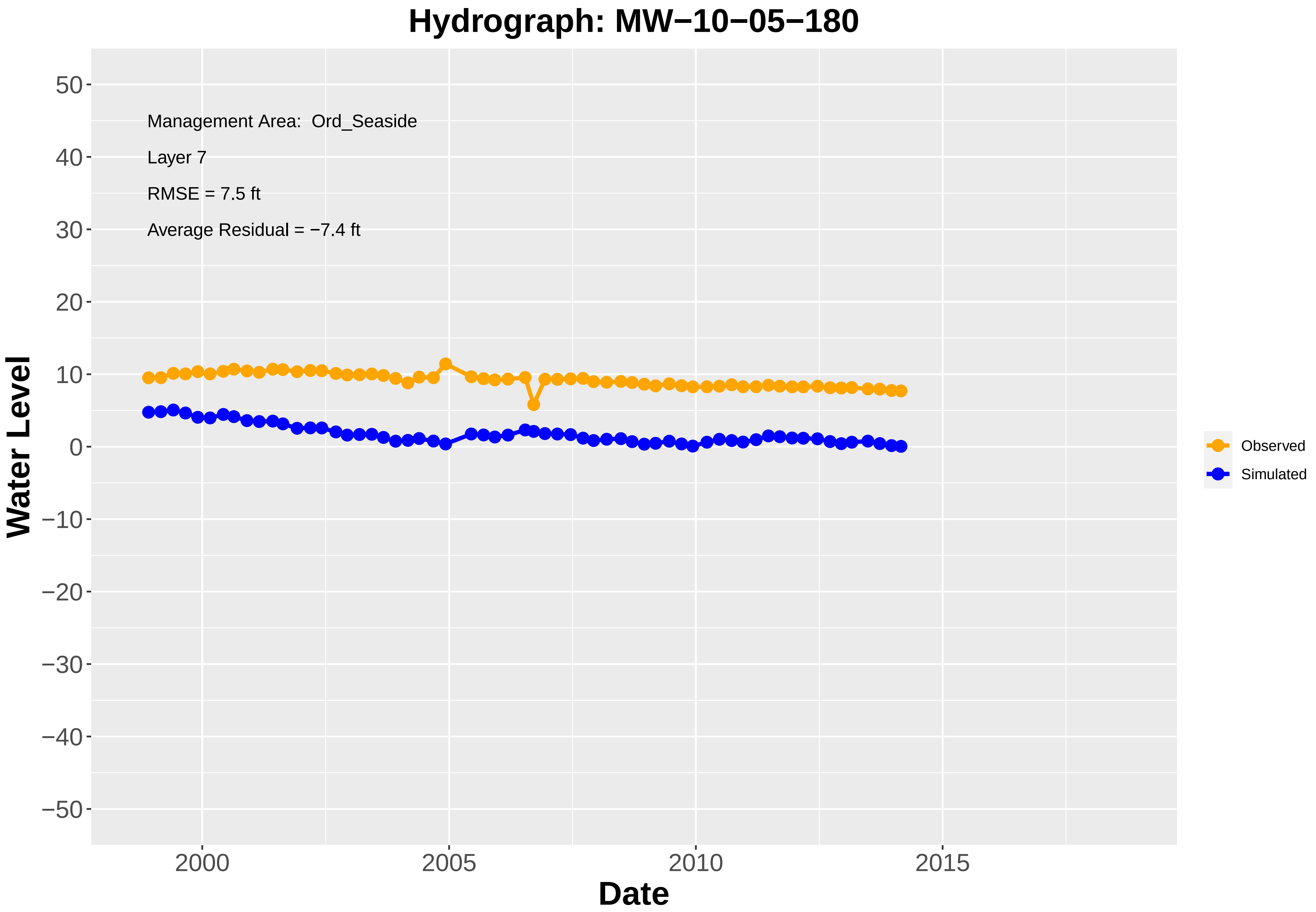
Hydrograph: MW−10−02−180
Management Area: Ord_Seaside
Layer 7
RMSE = 5.9 ft
Average Residual = −5.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



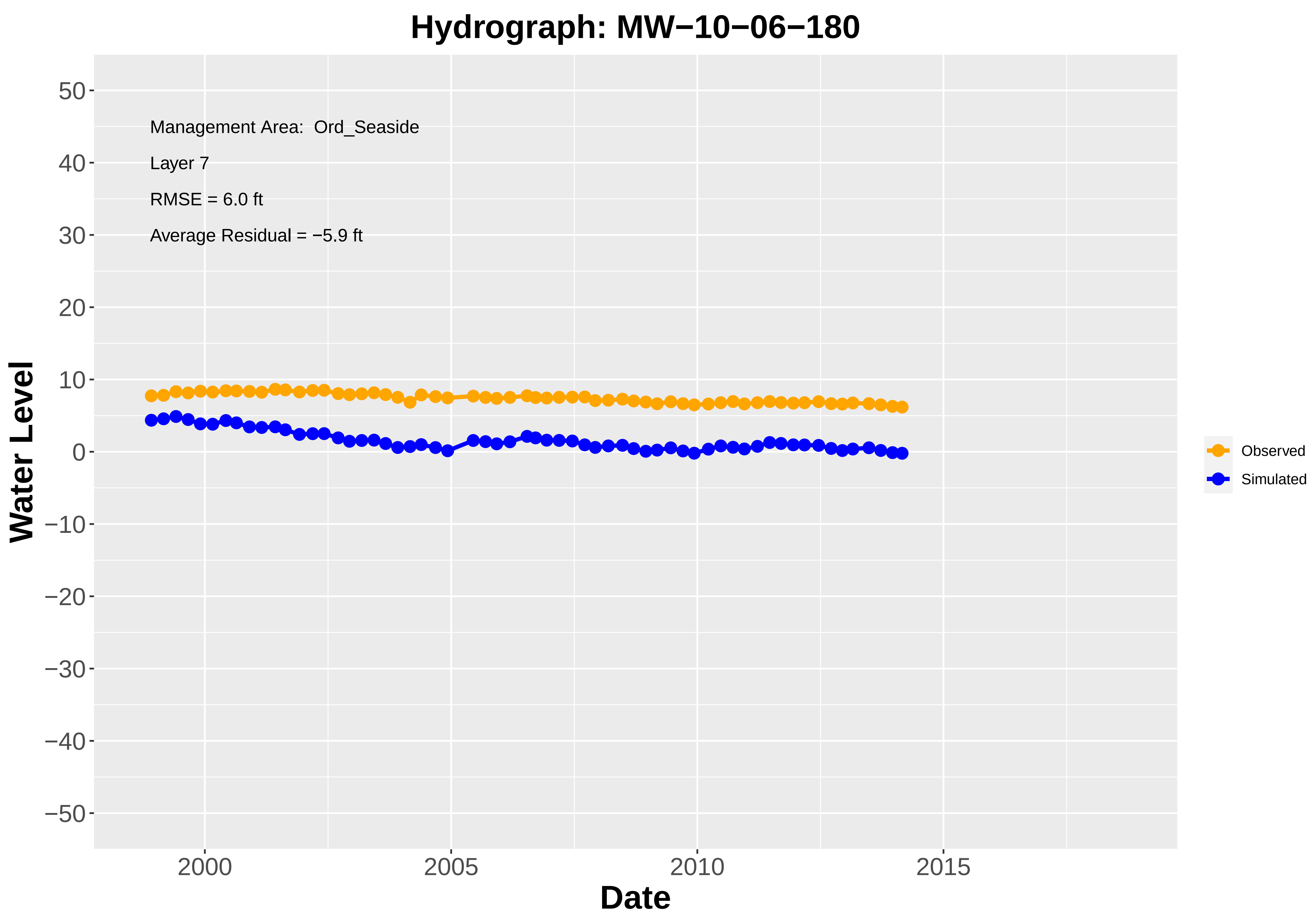
Hydrograph: MW−10−03−180
Management Area: Ord_Seaside
Layer 7
RMSE = 4.4 ft
Average Residual = −4.3 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
Date
2000
2005
2010
2015
Observed
Simulated

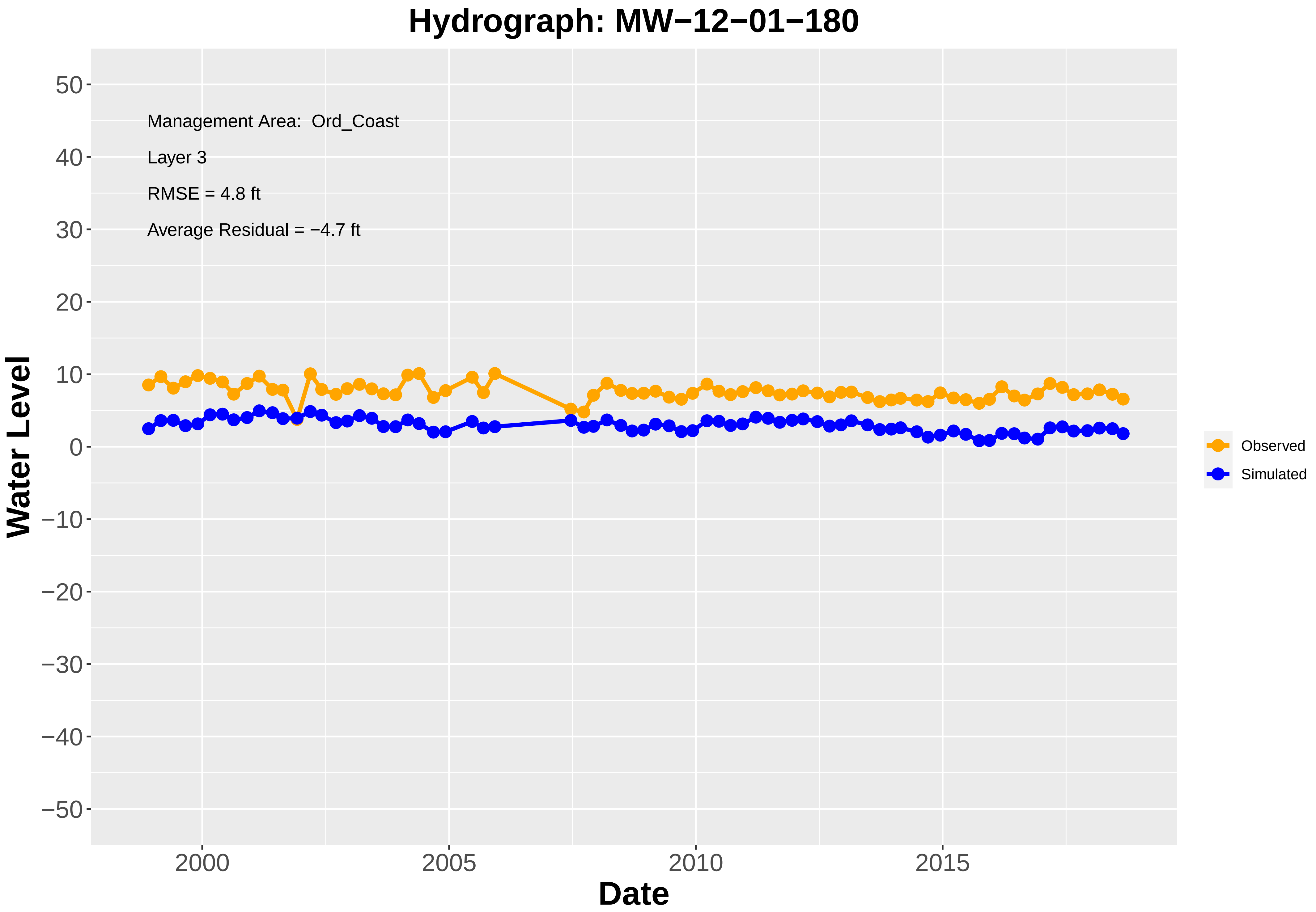


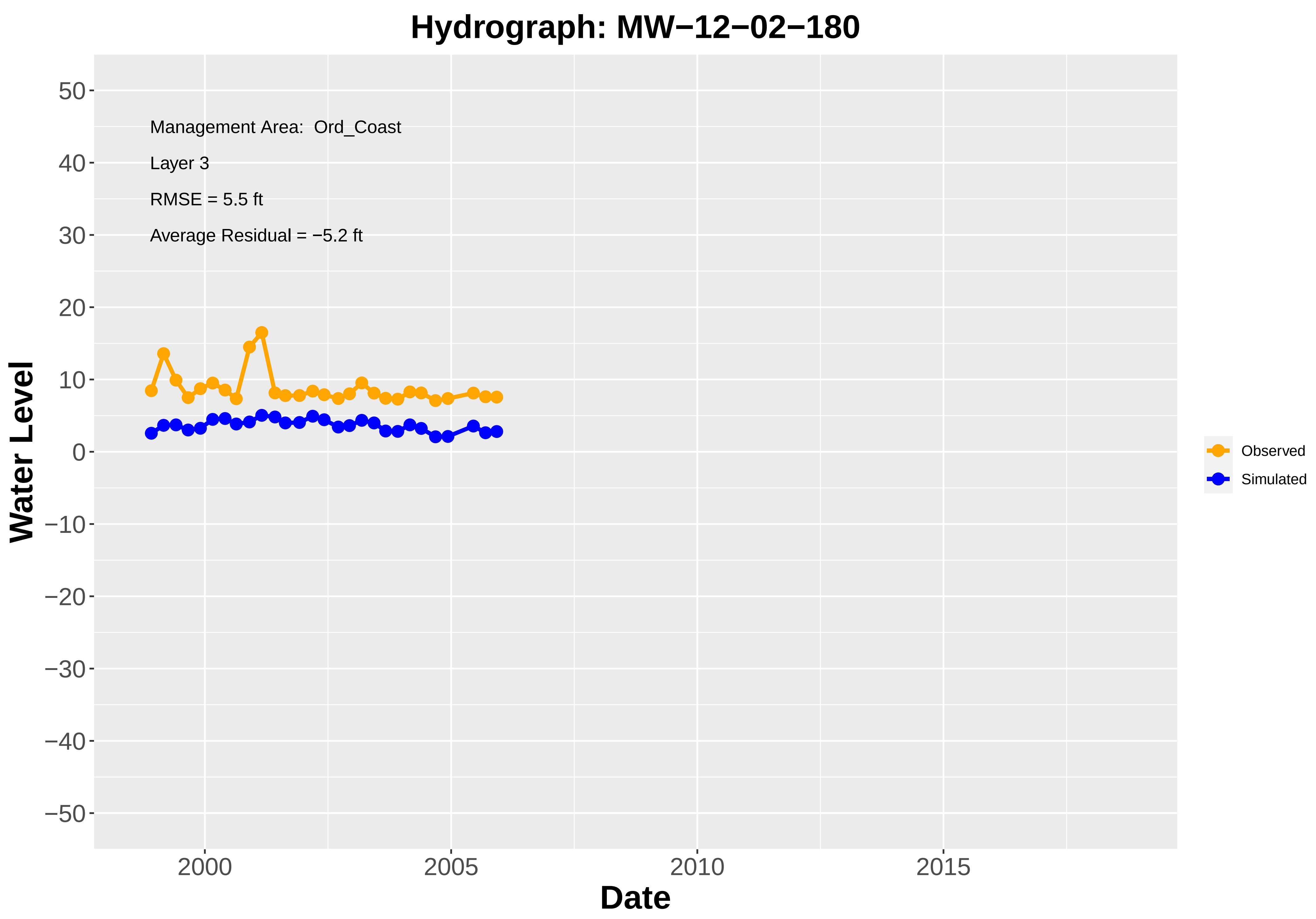
Hydrograph: MW−10−04−180
Management Area: Ord_Seaside
Layer 7
RMSE = 5.0 ft
Average Residual = −4.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

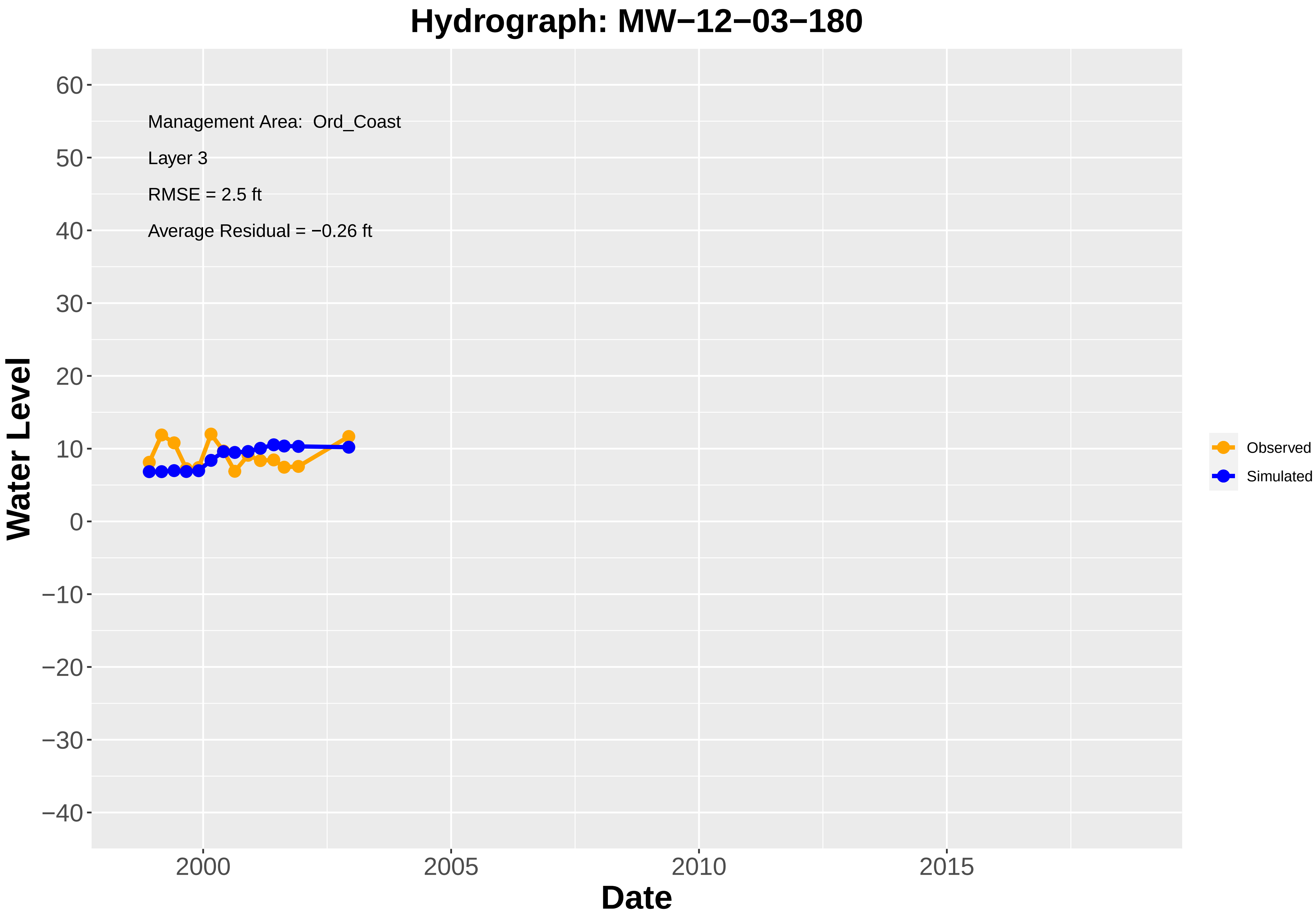


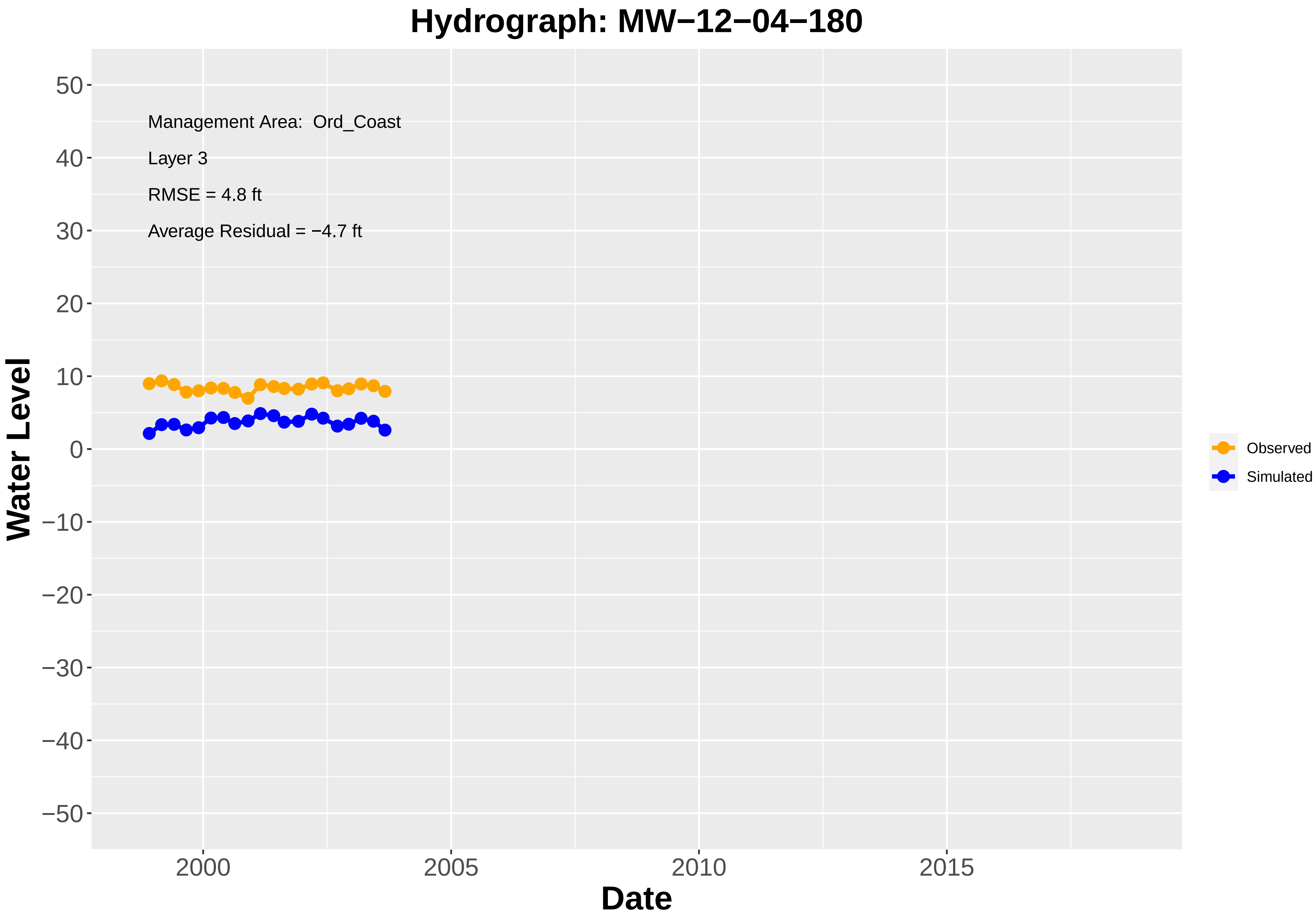
Hydrograph: MW−10−05−180
Management Area: Ord_Seaside
Layer 7
RMSE = 7.5 ft
Average Residual = −7.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−10−06−180
Management Area: Ord_Seaside
Layer 7
RMSE = 6.0 ft
Average Residual = −5.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

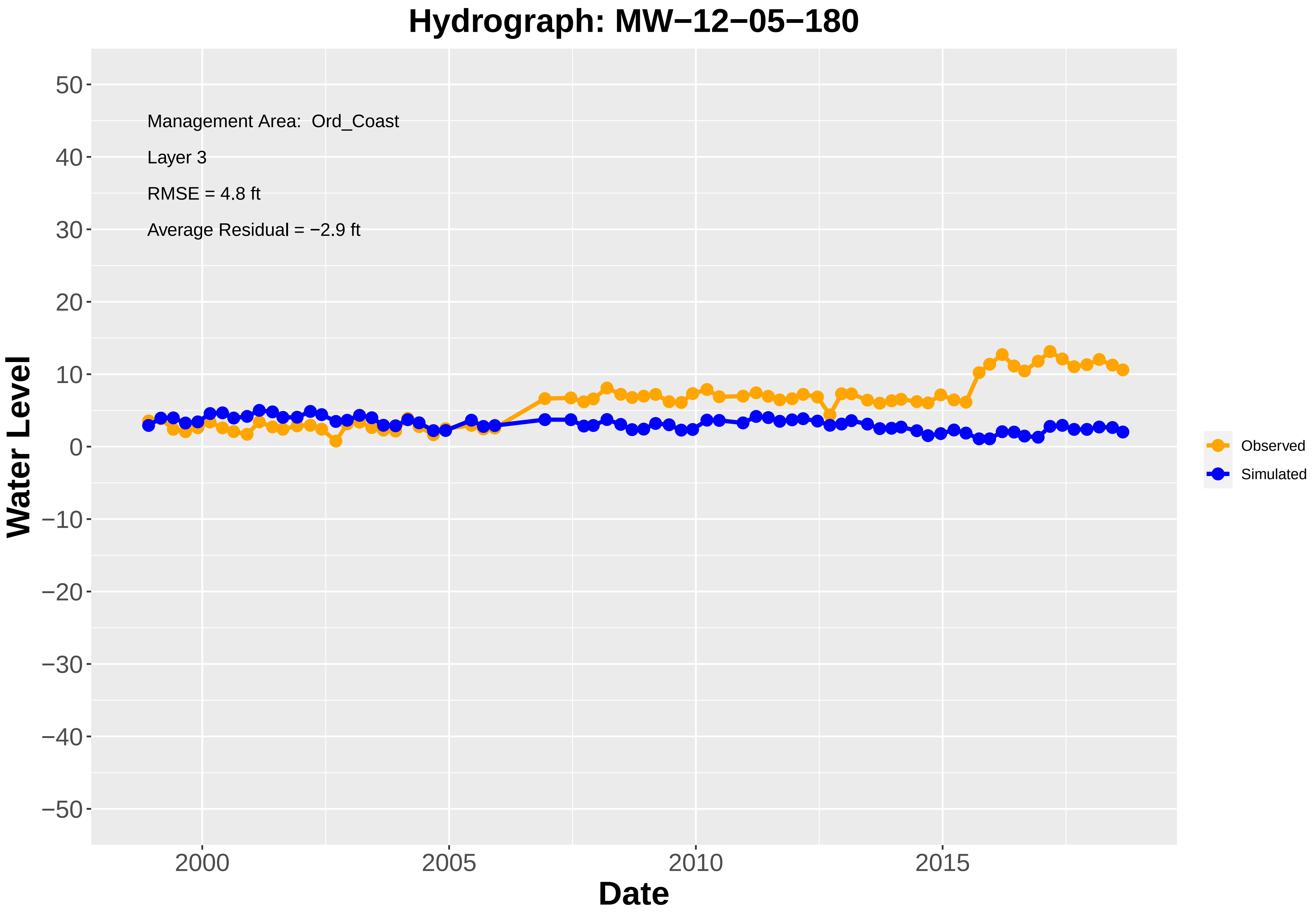

Hydrograph: MW−12−01−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.8 ft
Average Residual = −4.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−12−02−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.5 ft
Average Residual = −5.2 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

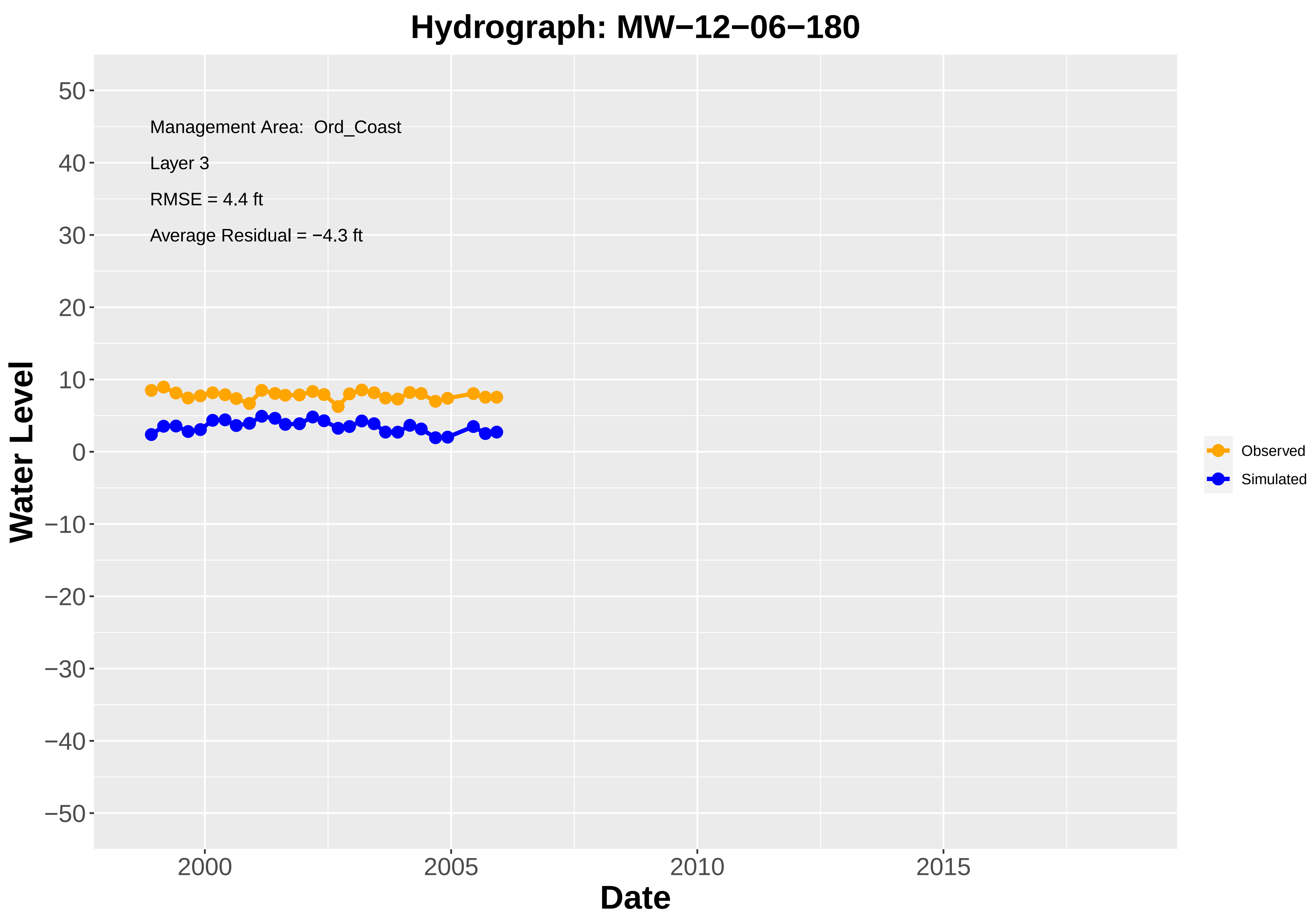

Hydrograph: MW−12−03−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.5 ft
Average Residual = −0.26 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated



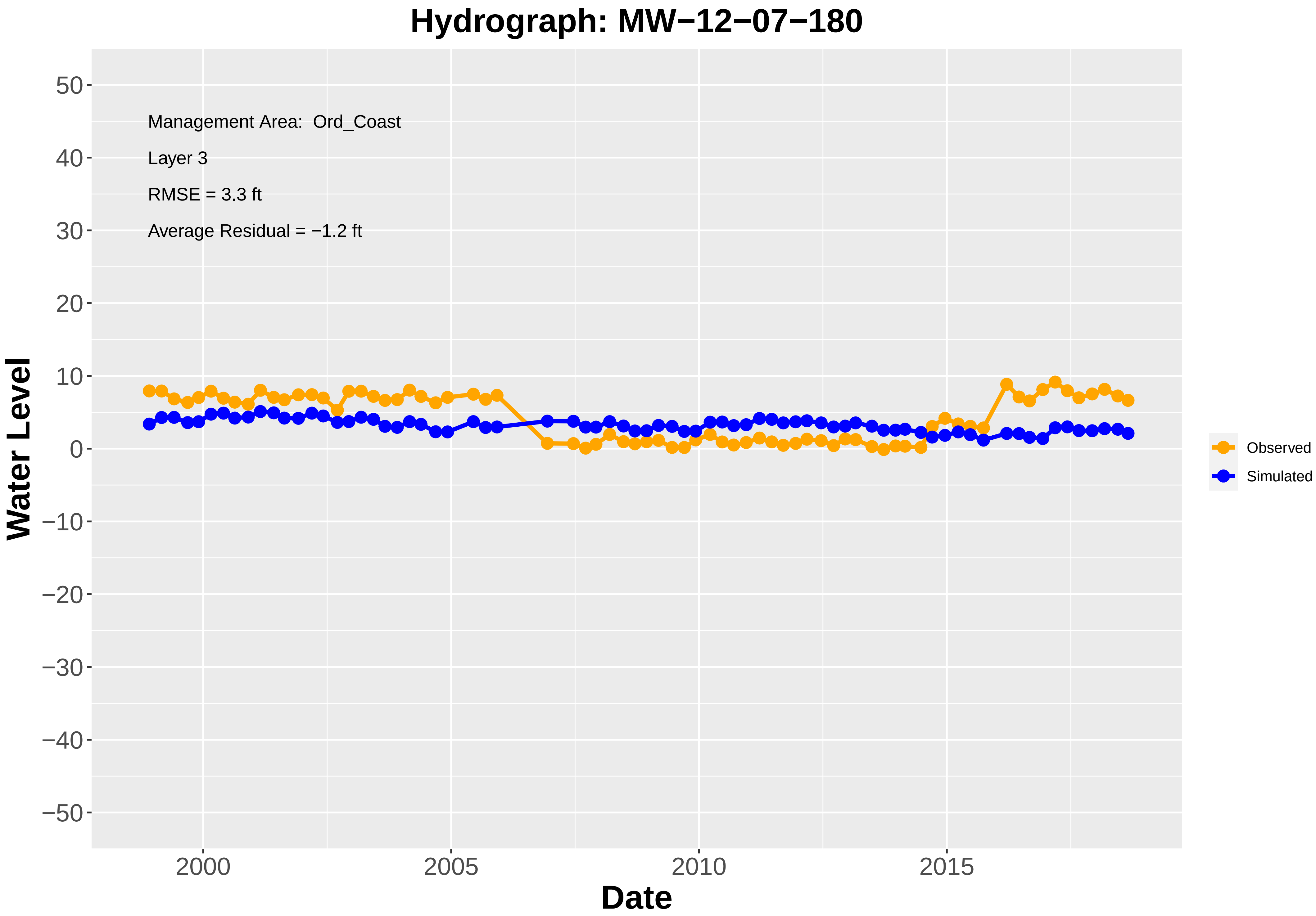
Hydrograph: MW−12−04−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.8 ft
Average Residual = −4.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



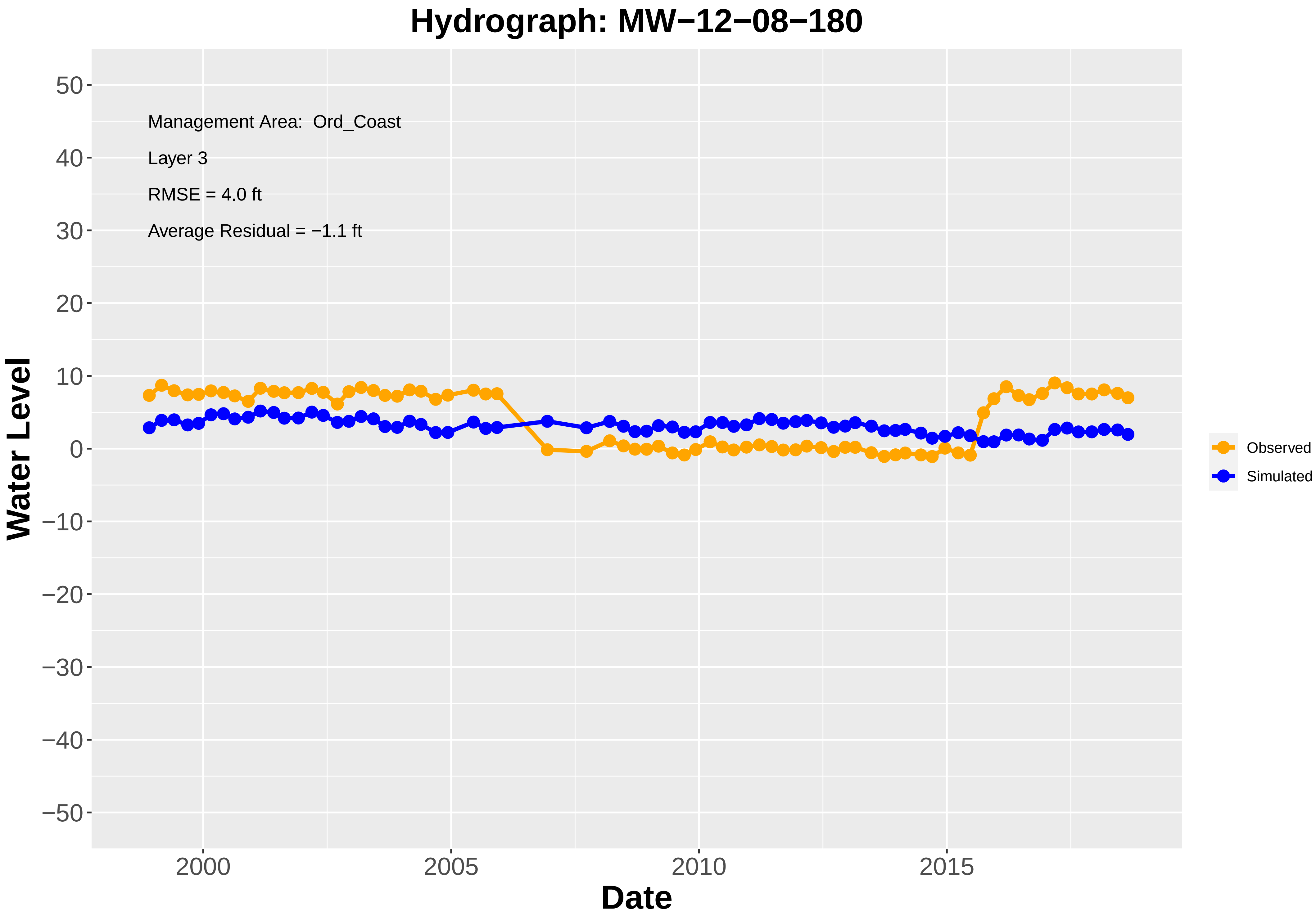
Hydrograph: MW−12−05−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.8 ft
Average Residual = −2.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



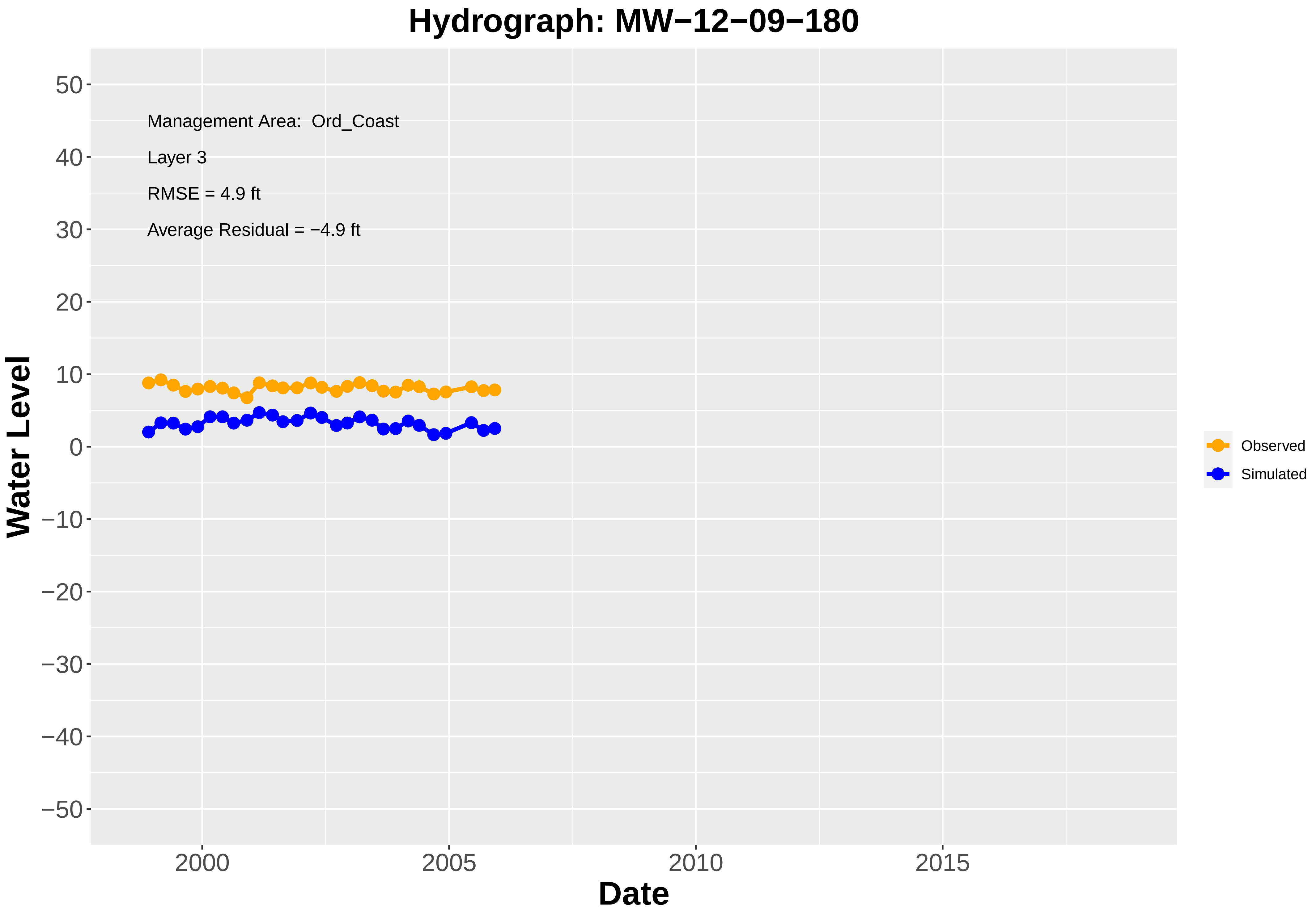
Hydrograph: MW−12−06−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.4 ft
Average Residual = −4.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

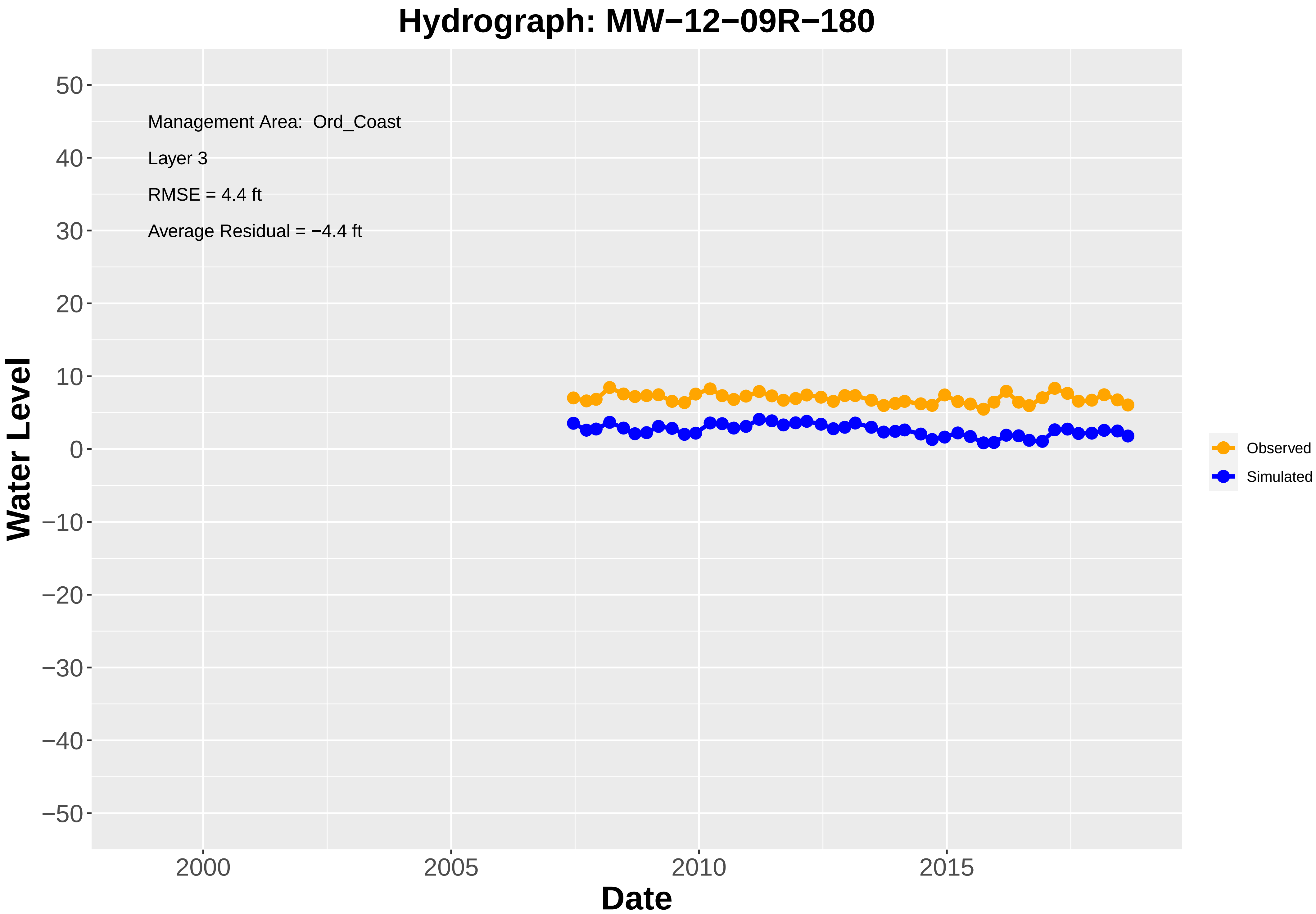


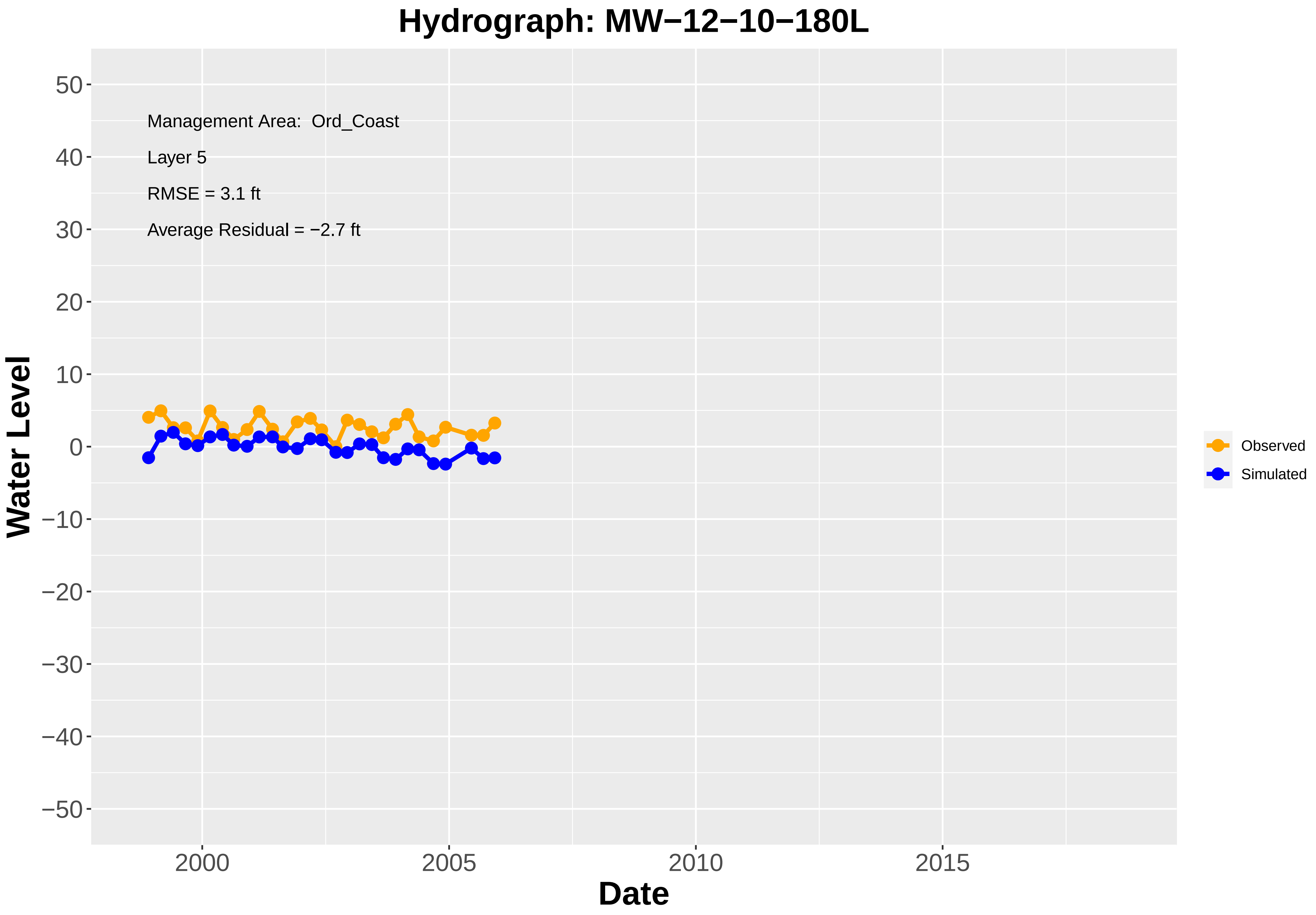
Hydrograph: MW−12−07−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.3 ft
Average Residual = −1.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

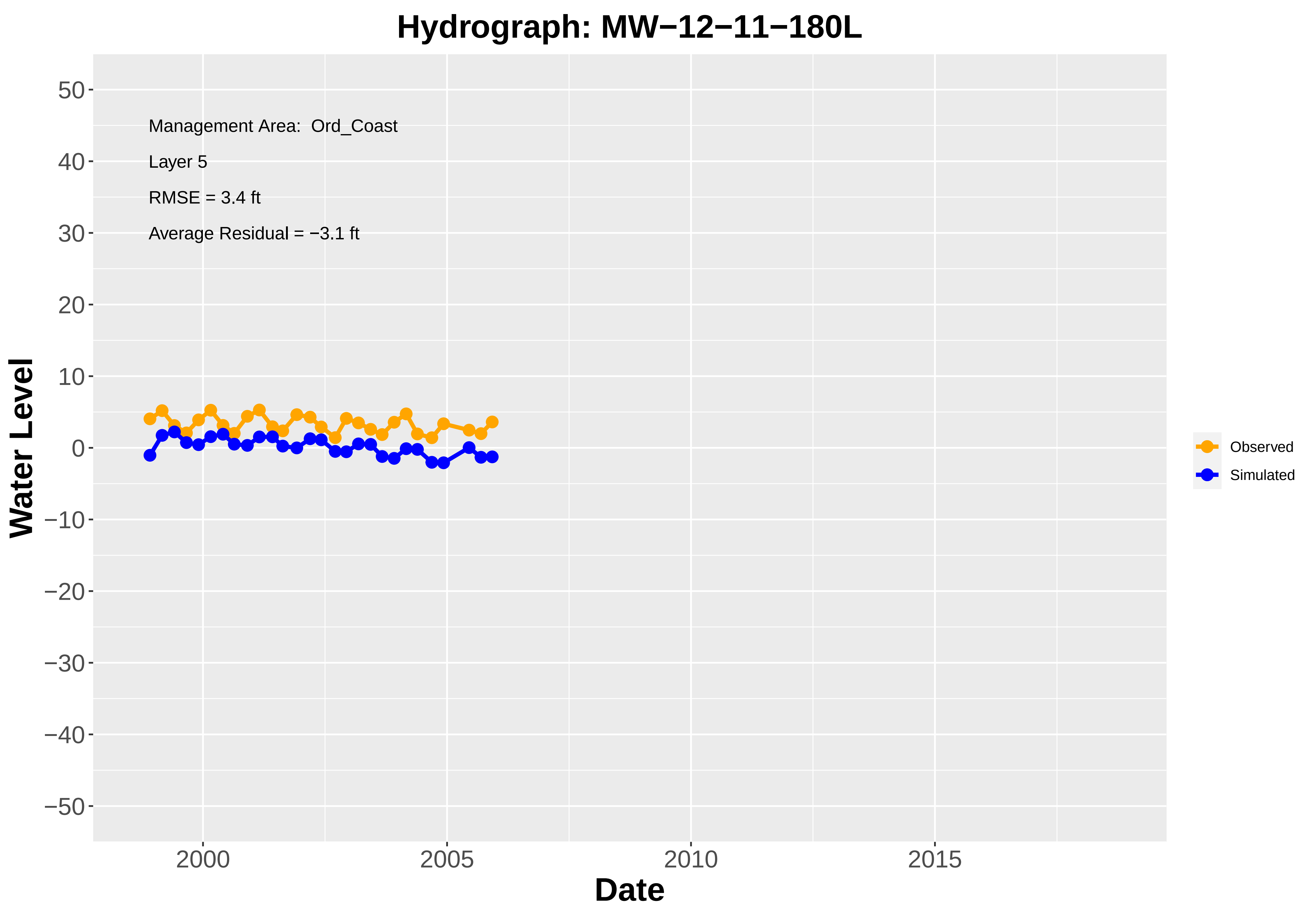


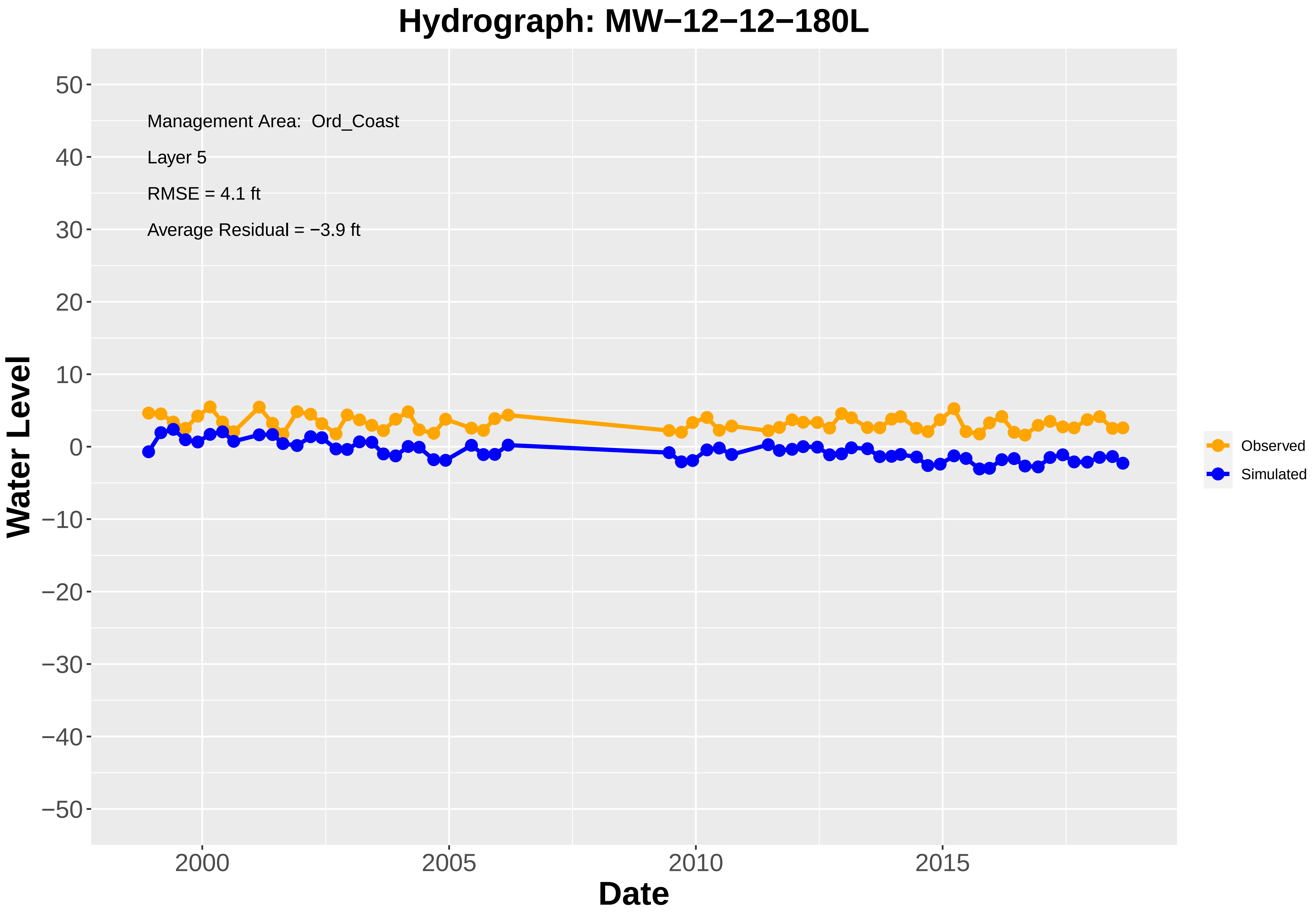
Hydrograph: MW−12−08−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.0 ft
Average Residual = −1.1 ft
50
40
30
20
10
0
−10
−20
−30
−40
−50
Water Level
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−12−09−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.9 ft
Average Residual = −4.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

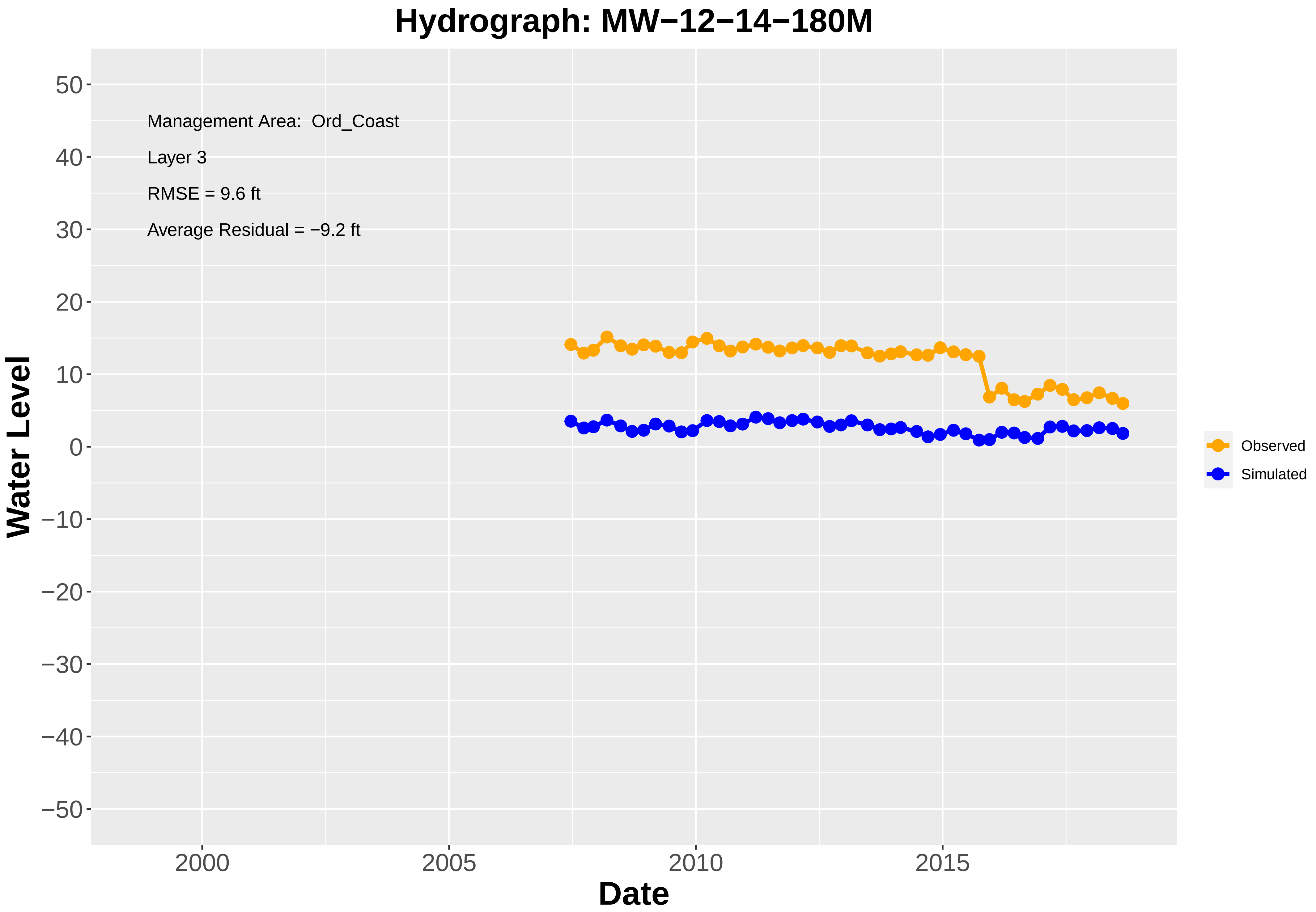

Hydrograph: MW−12−09R−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.4 ft
Average Residual = −4.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

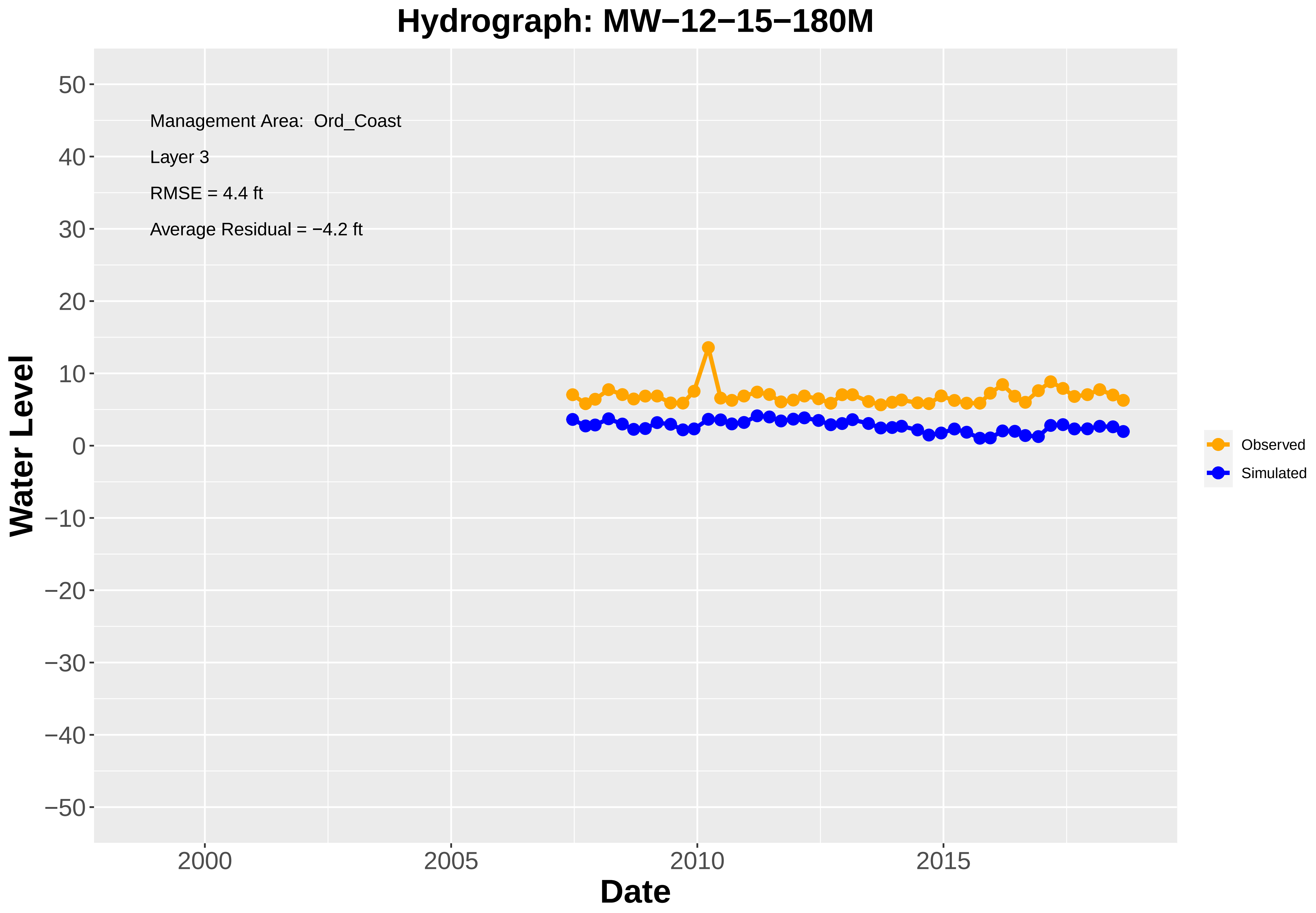

Hydrograph: MW−12−10−180L
Management Area: Ord_Coast
Layer 5
RMSE = 3.1 ft
Average Residual = −2.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

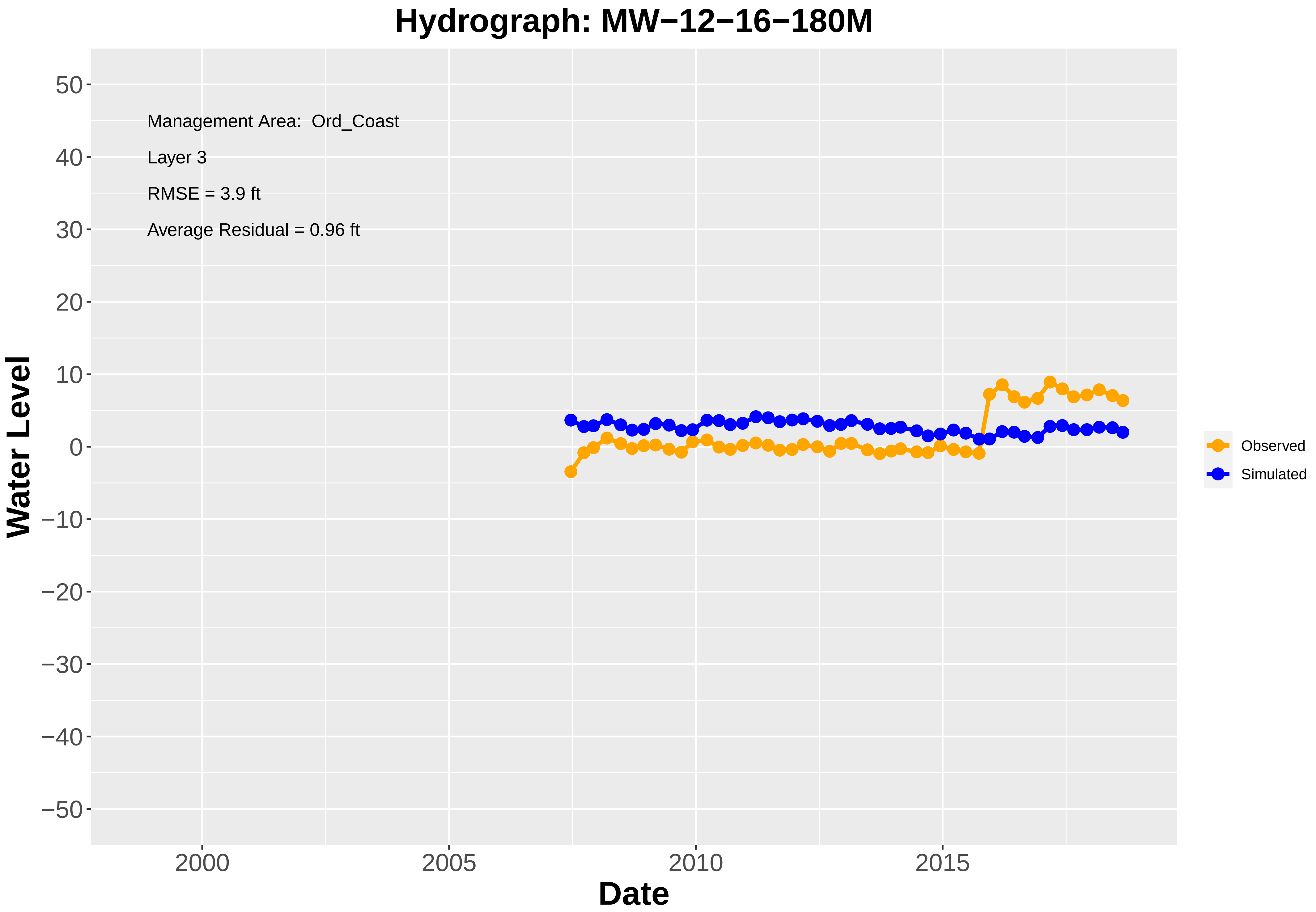

Hydrograph: MW−12−11−180L
Management Area: Ord_Coast
Layer 5
RMSE = 3.4 ft
Average Residual = −3.1 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

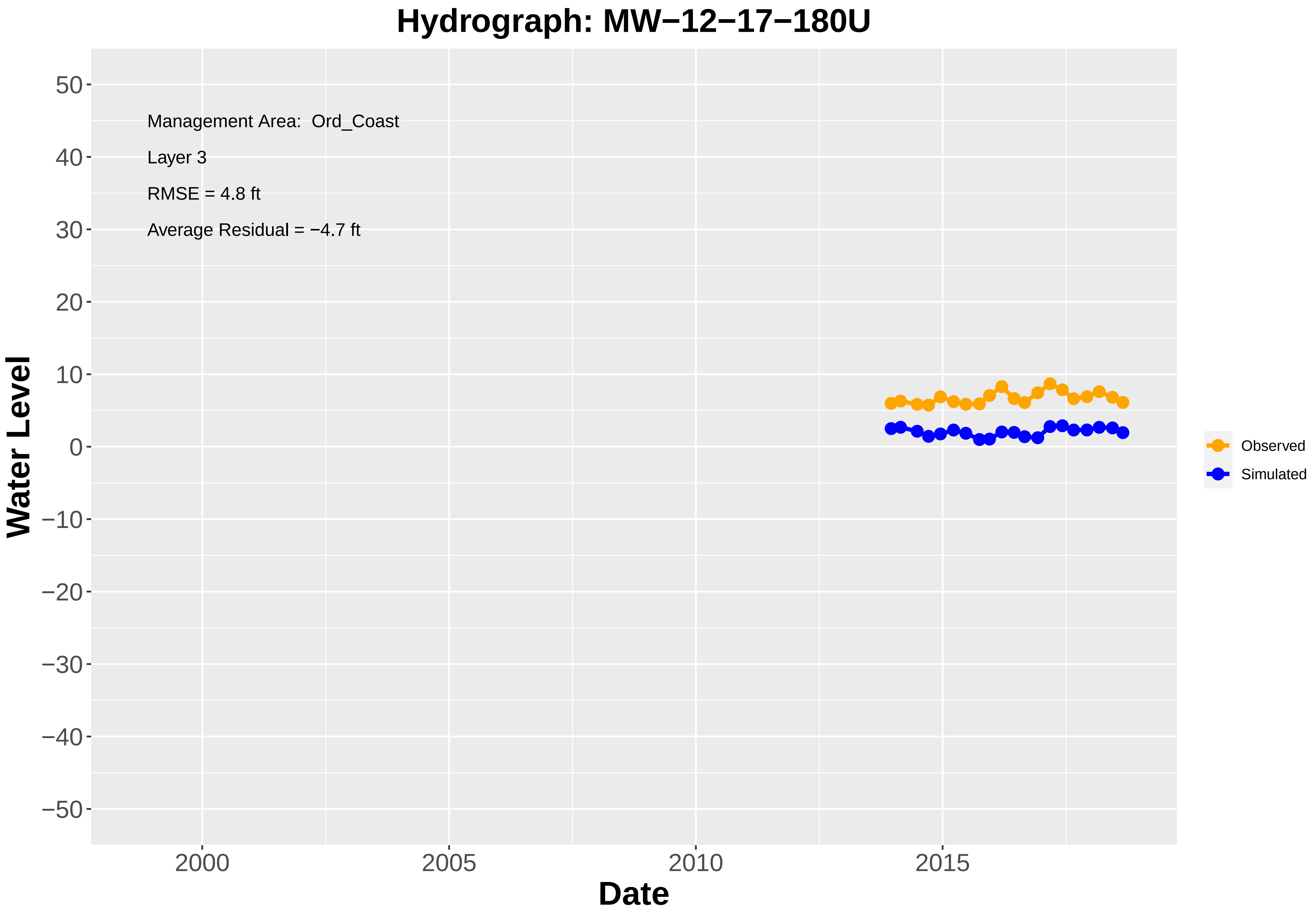


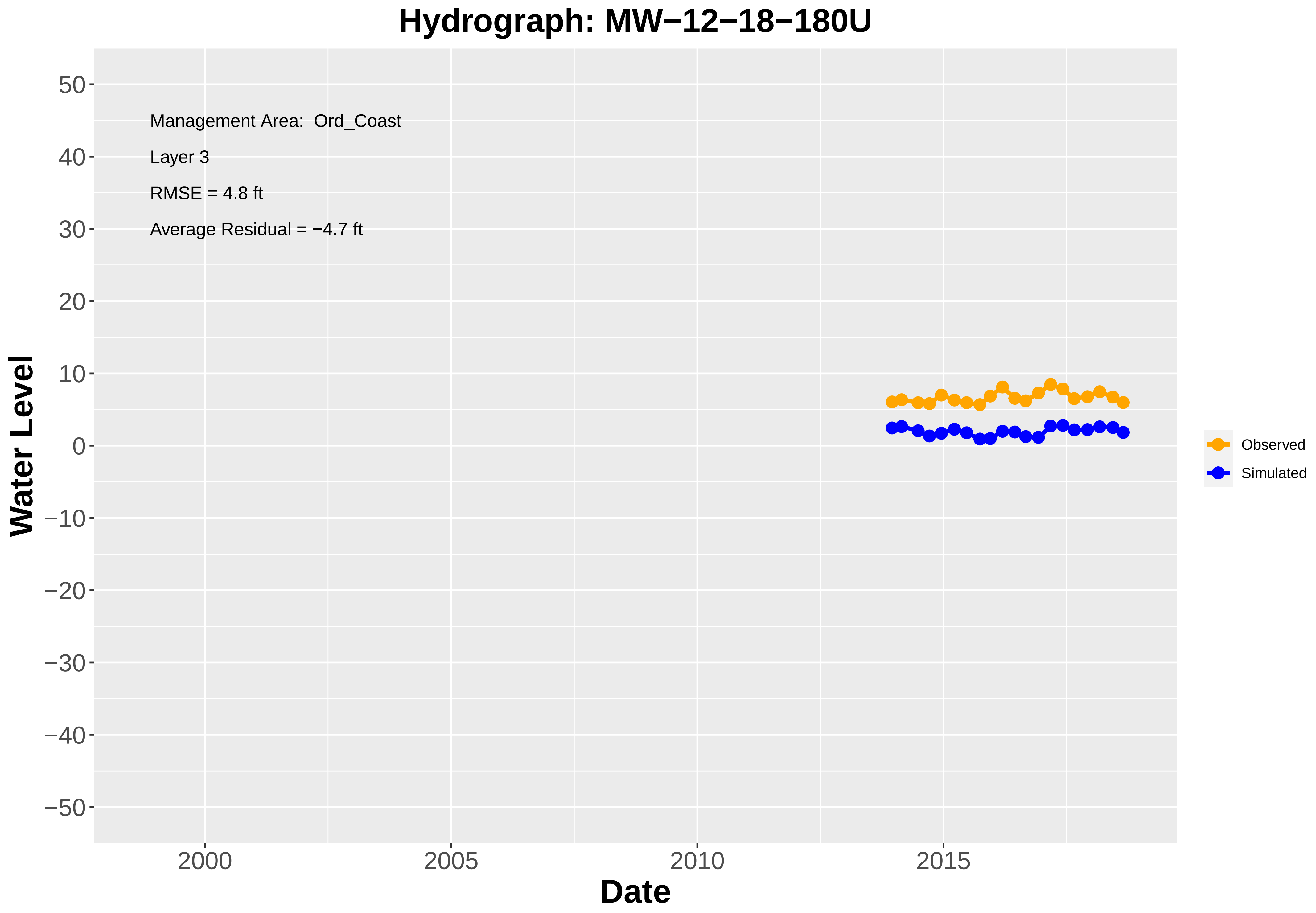
Hydrograph: MW−12−12−180L
Management Area: Ord_Coast
Layer 5
RMSE = 4.1 ft
Average Residual = −3.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−12−14−180M
Management Area: Ord_Coast
Layer 3
RMSE = 9.6 ft
Average Residual = −9.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−12−15−180M
Management Area: Ord_Coast
Layer 3
RMSE = 4.4 ft
Average Residual = −4.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

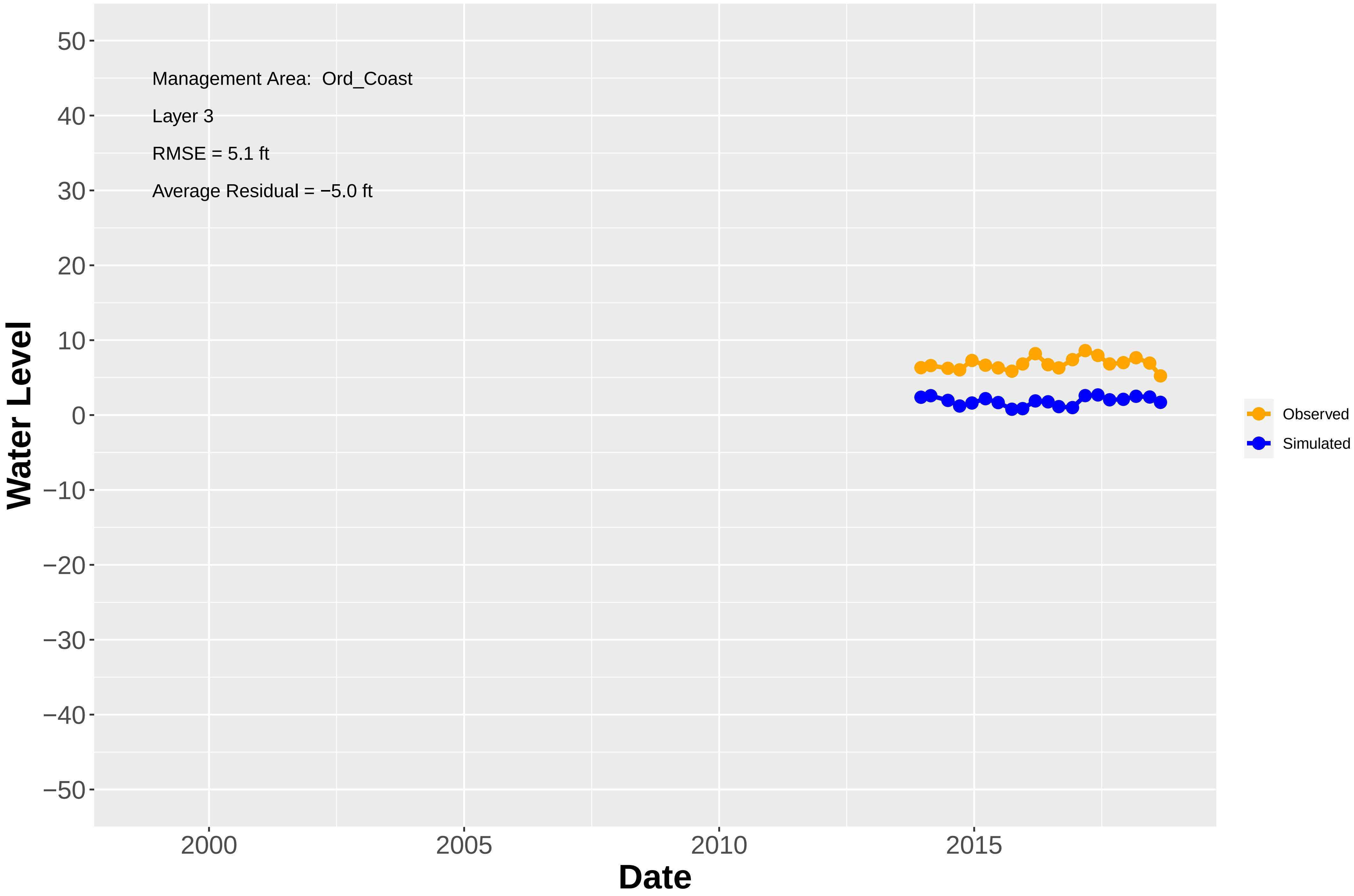

Hydrograph: MW−12−16−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.9 ft
Average Residual = 0.96 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

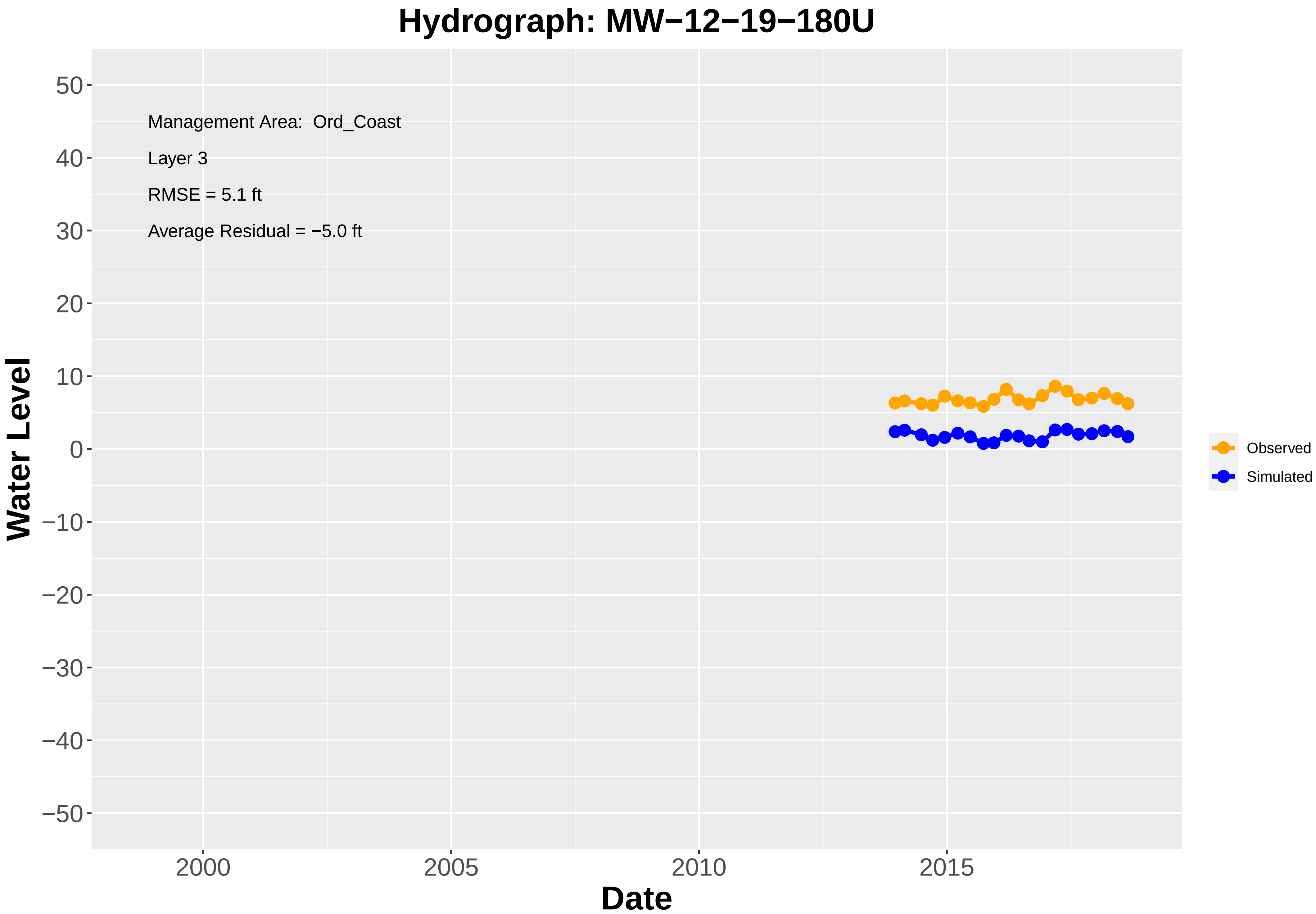

Hydrograph: MW−12−17−180U
Management Area: Ord_Coast
Layer 3
RMSE = 4.8 ft
Average Residual = −4.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

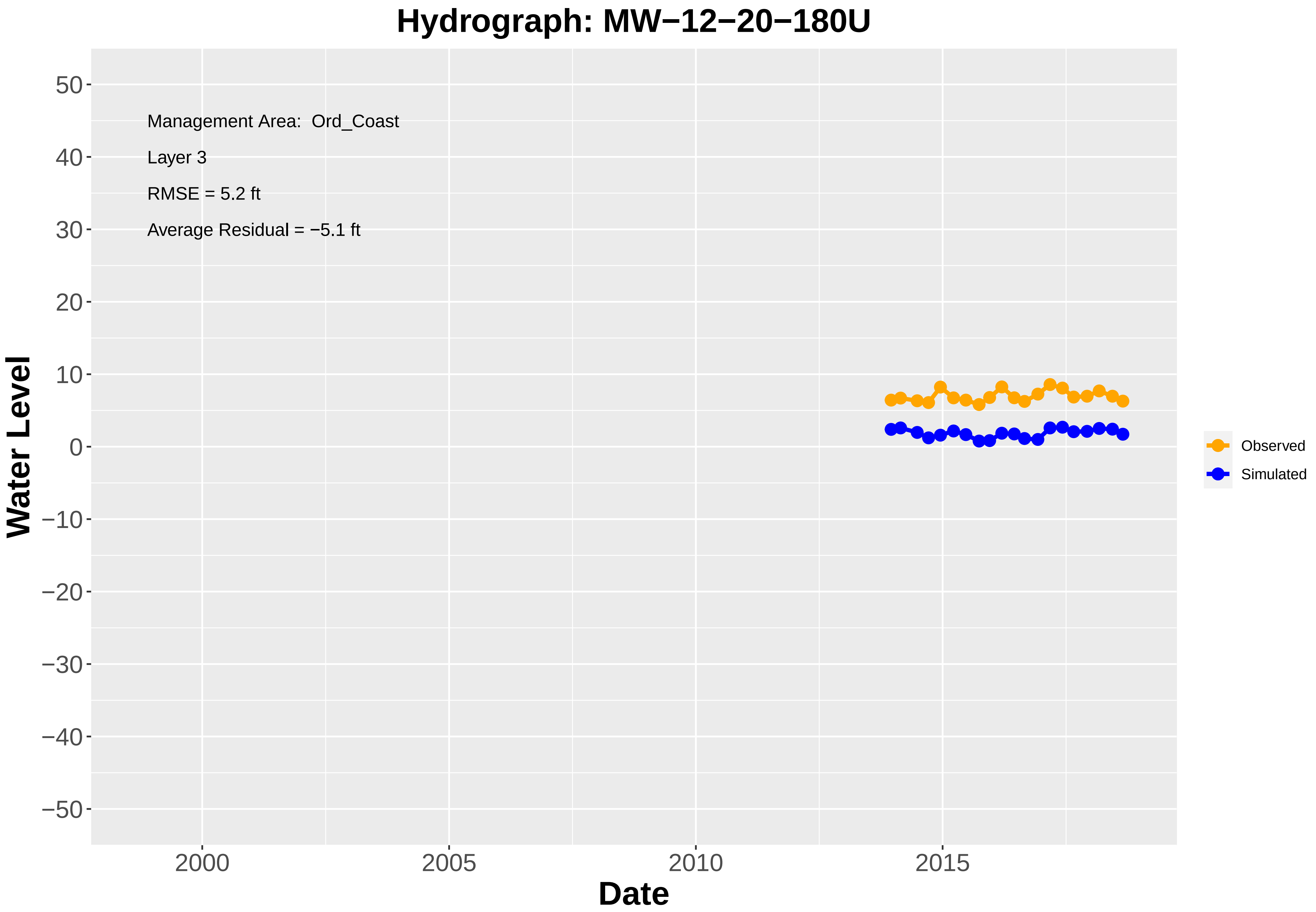


Hydrograph: MW−12−18−180U
Management Area: Ord_Coast
Layer 3
RMSE = 4.8 ft
Average Residual = −4.7 ft
50
40
30
20
10
0
−10
−20
−30
−40
−50
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

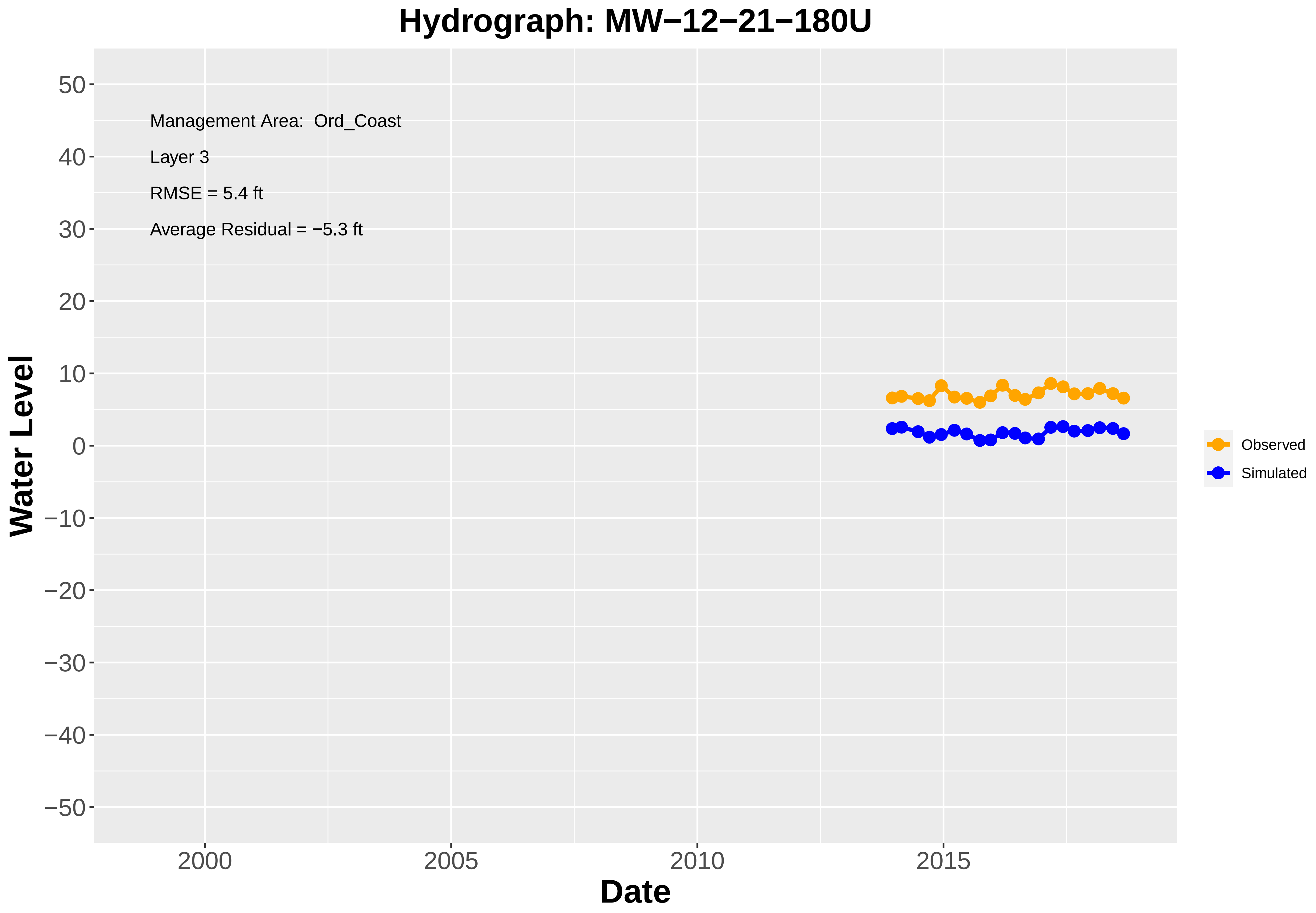
Hydrograph: MW−12−19−180M

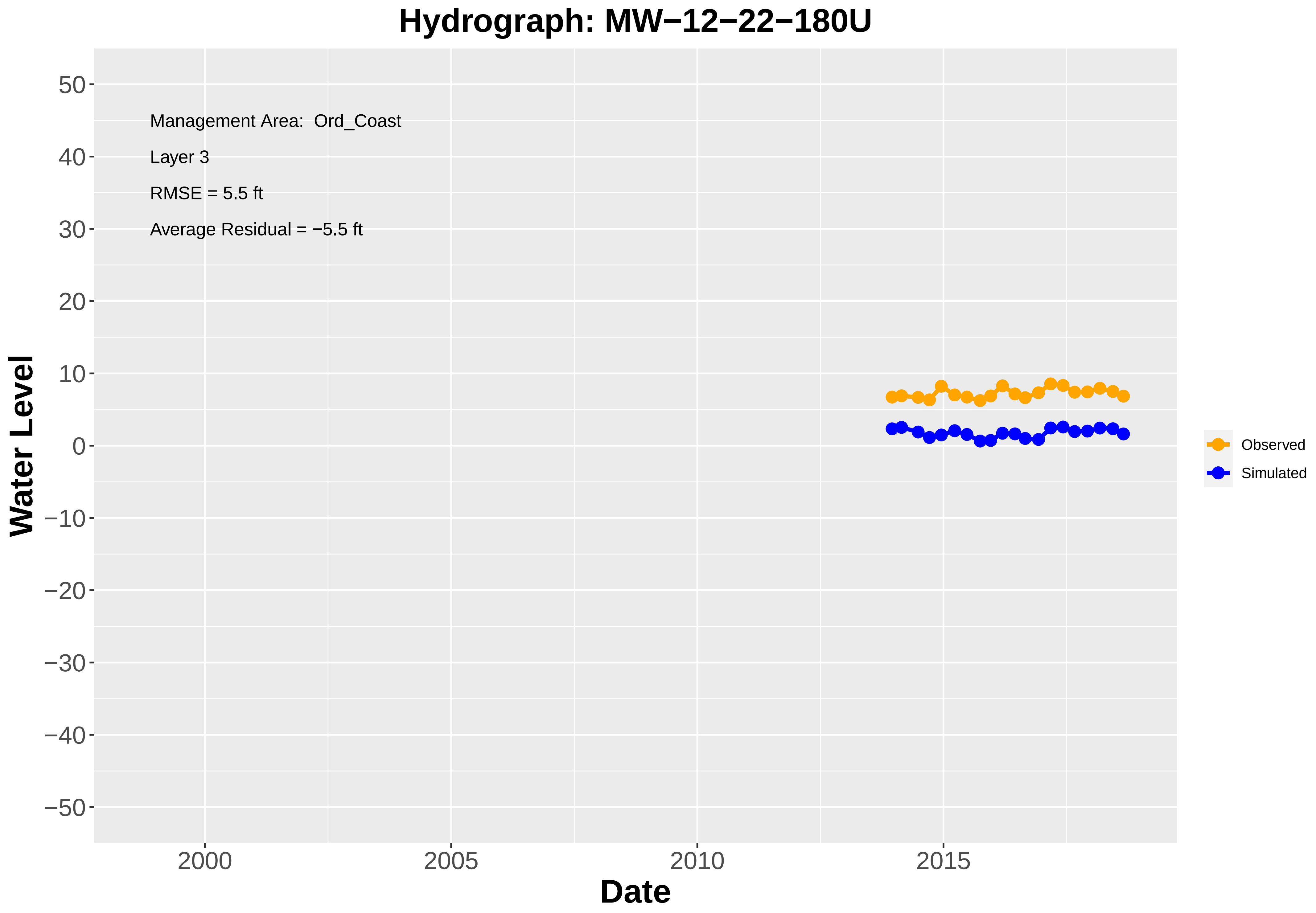



Hydrograph: MW−12−19−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.1 ft
Average Residual = −5.0 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

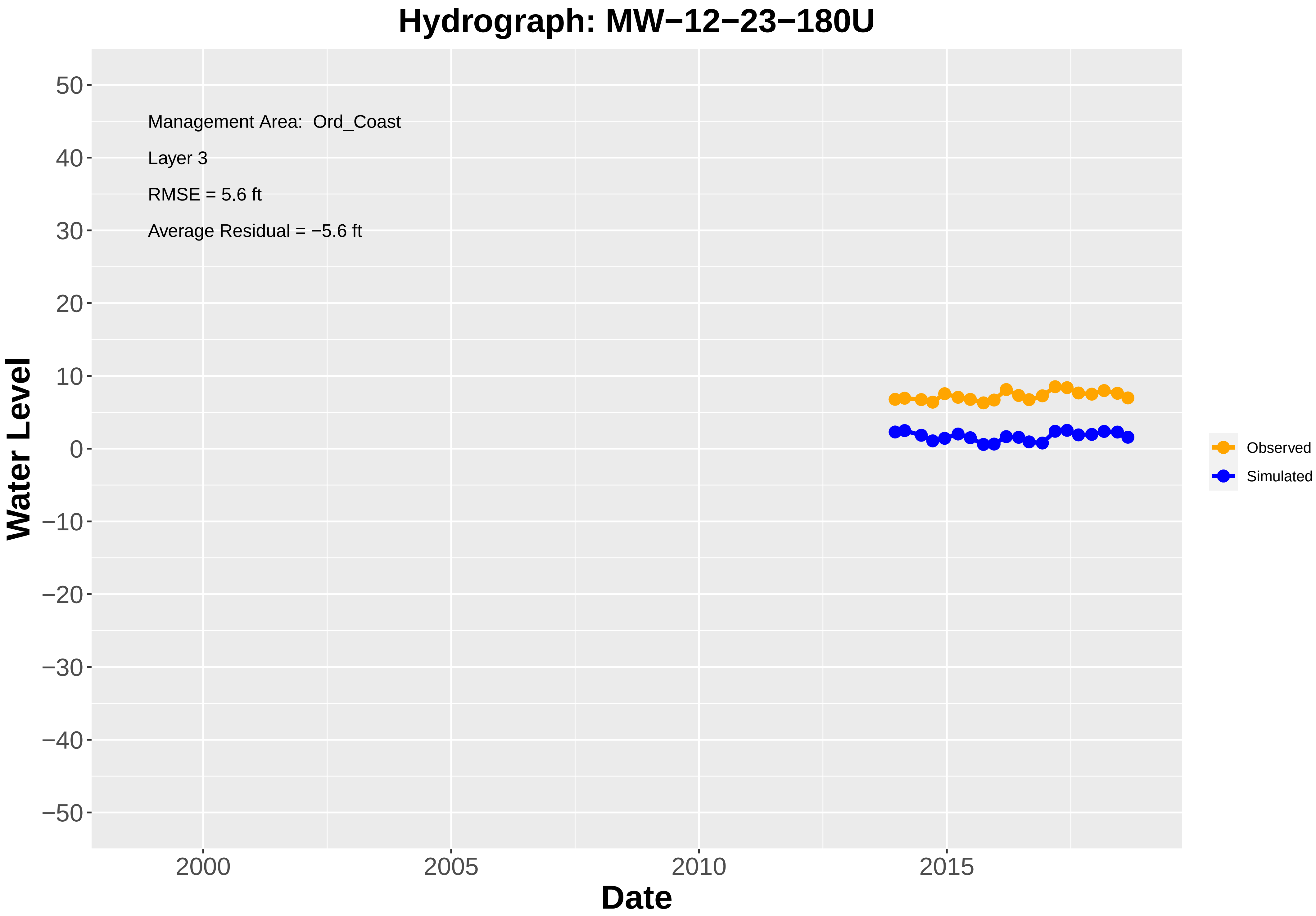


Hydrograph: MW−12−20−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.2 ft
Average Residual = −5.1 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

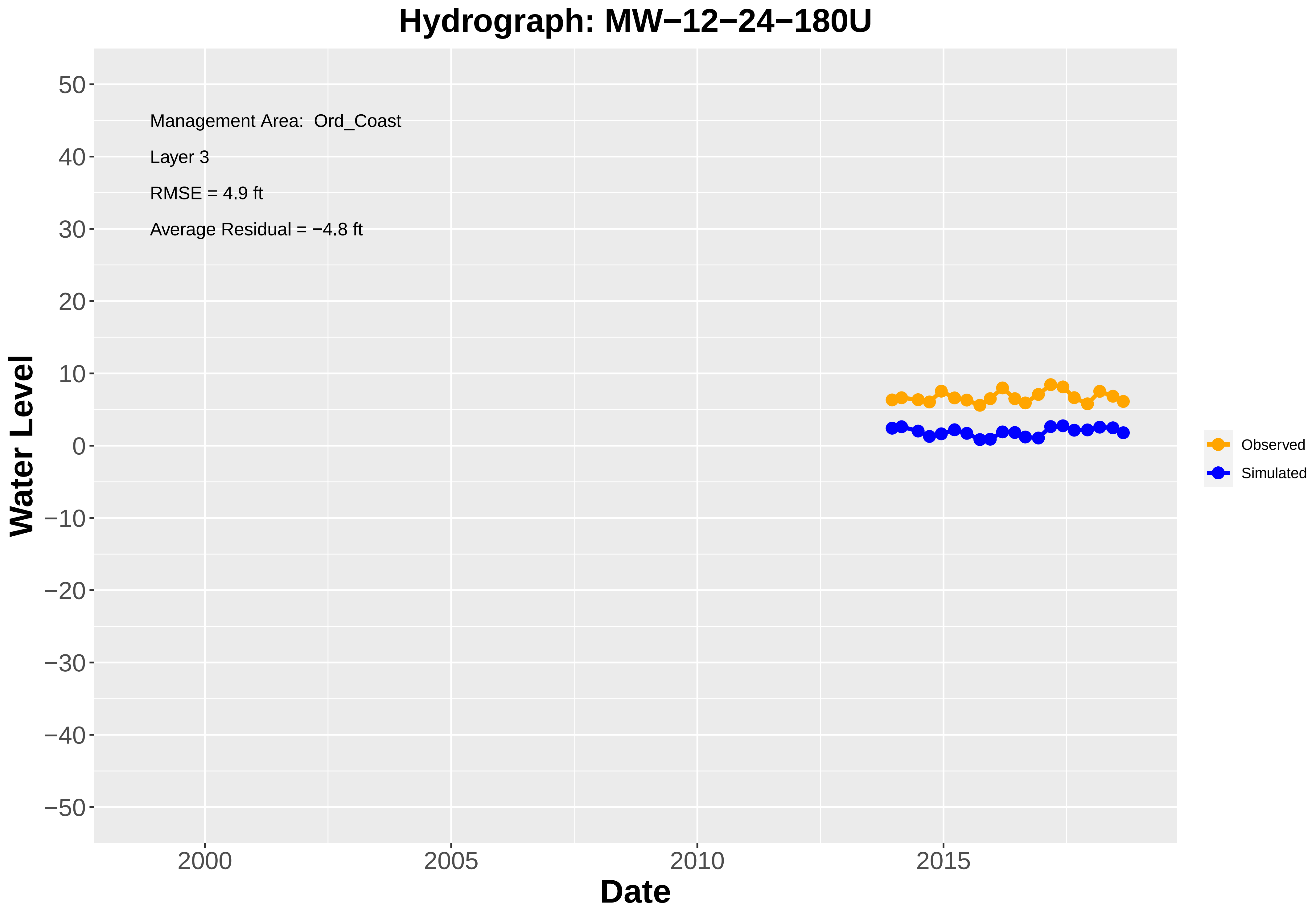

Hydrograph: MW−12−21−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.4 ft
Average Residual = −5.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



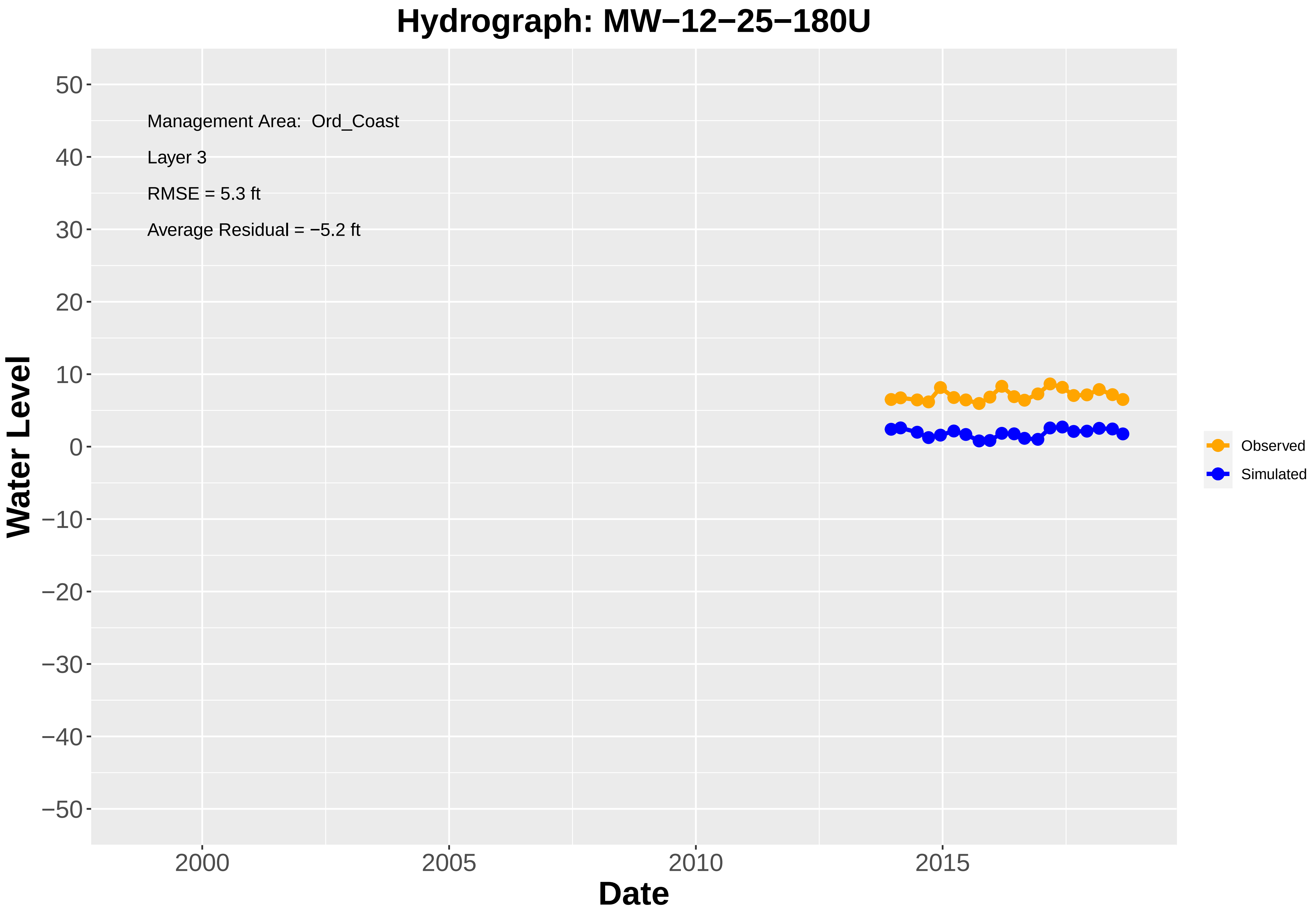
Hydrograph: MW−12−22−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.5 ft
Average Residual = −5.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



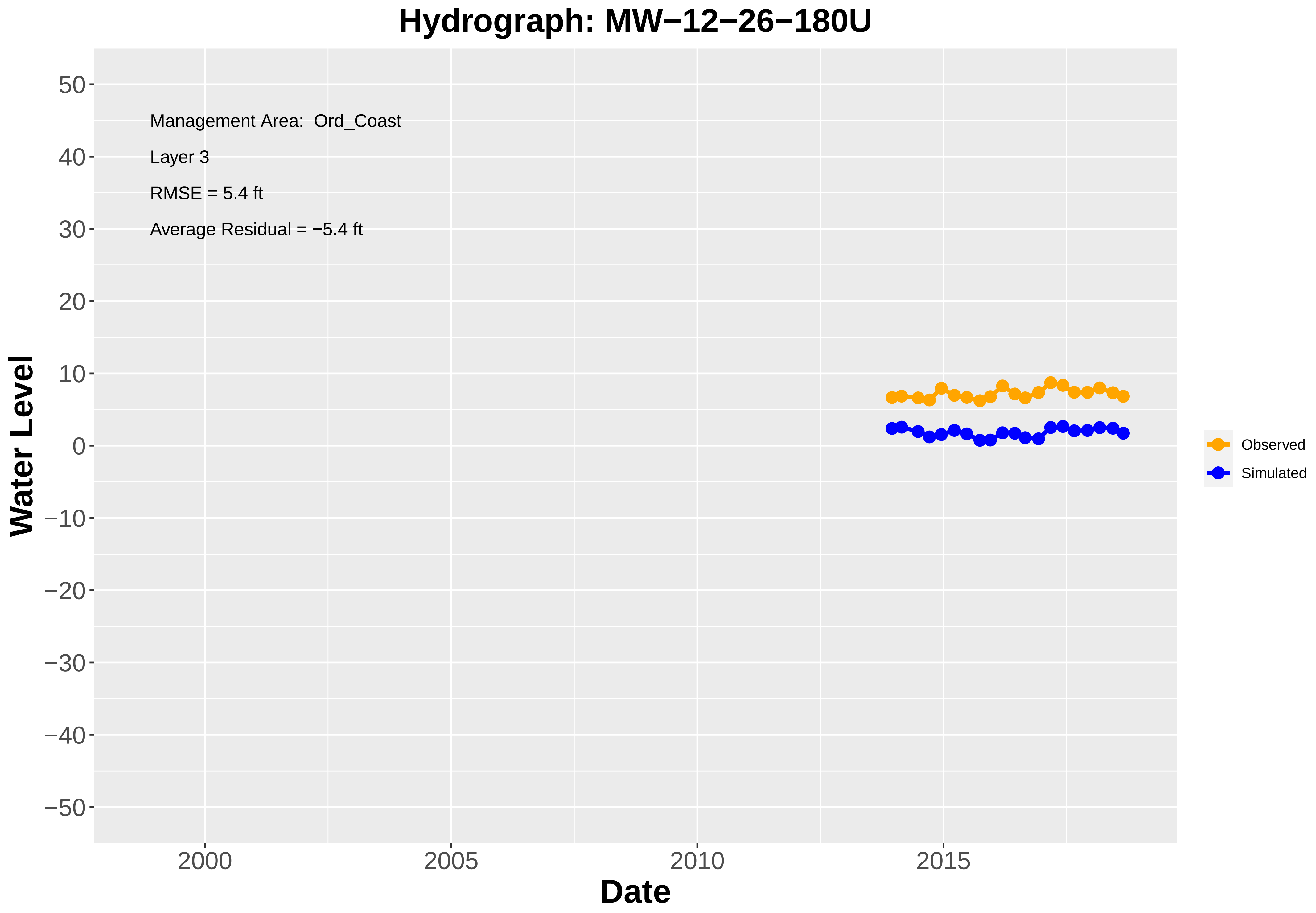
Hydrograph: MW−12−23−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.6 ft
Average Residual = −5.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

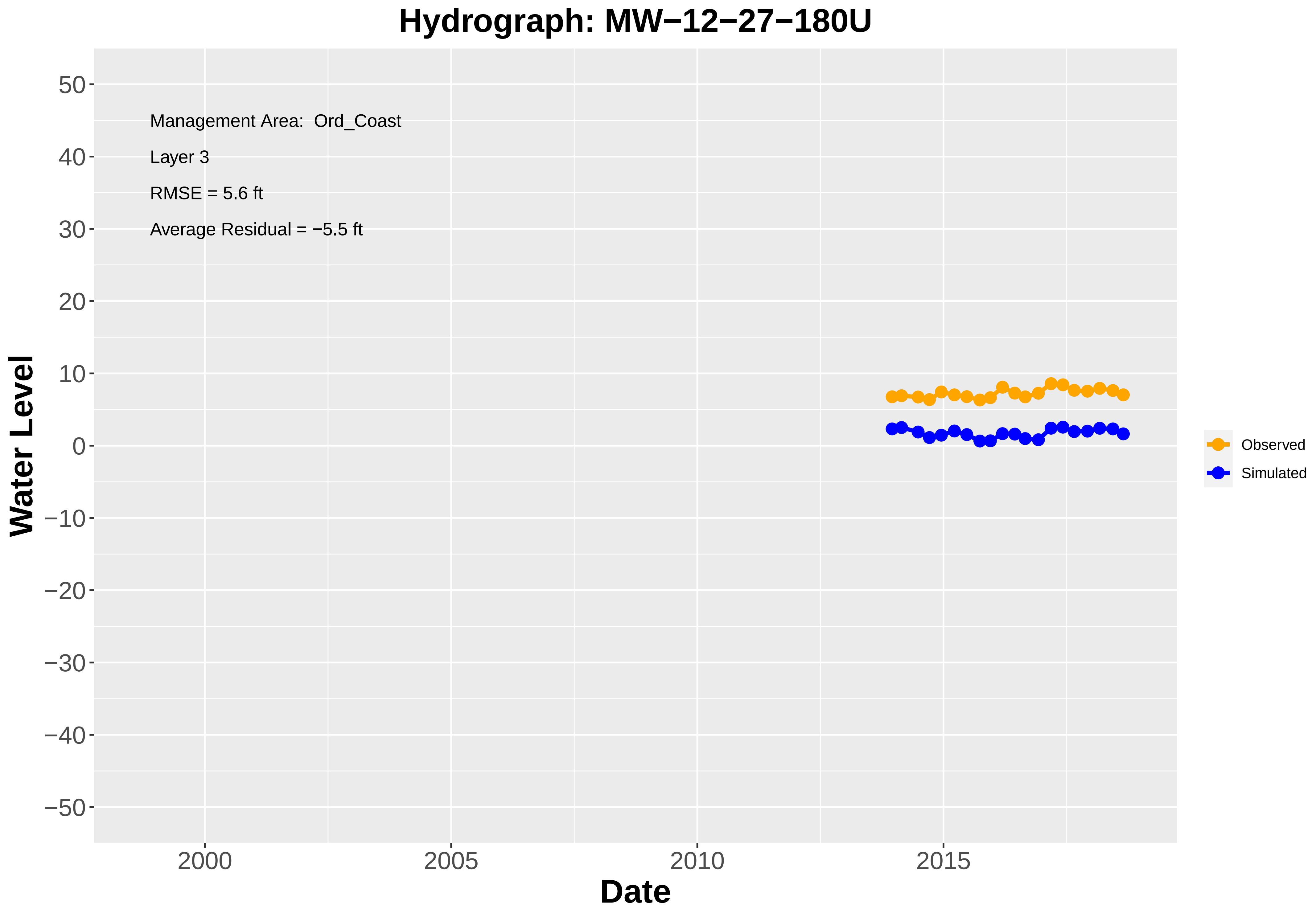


Hydrograph: MW−12−24−180U
Management Area: Ord_Coast
Layer 3
RMSE = 4.9 ft
Average Residual = −4.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

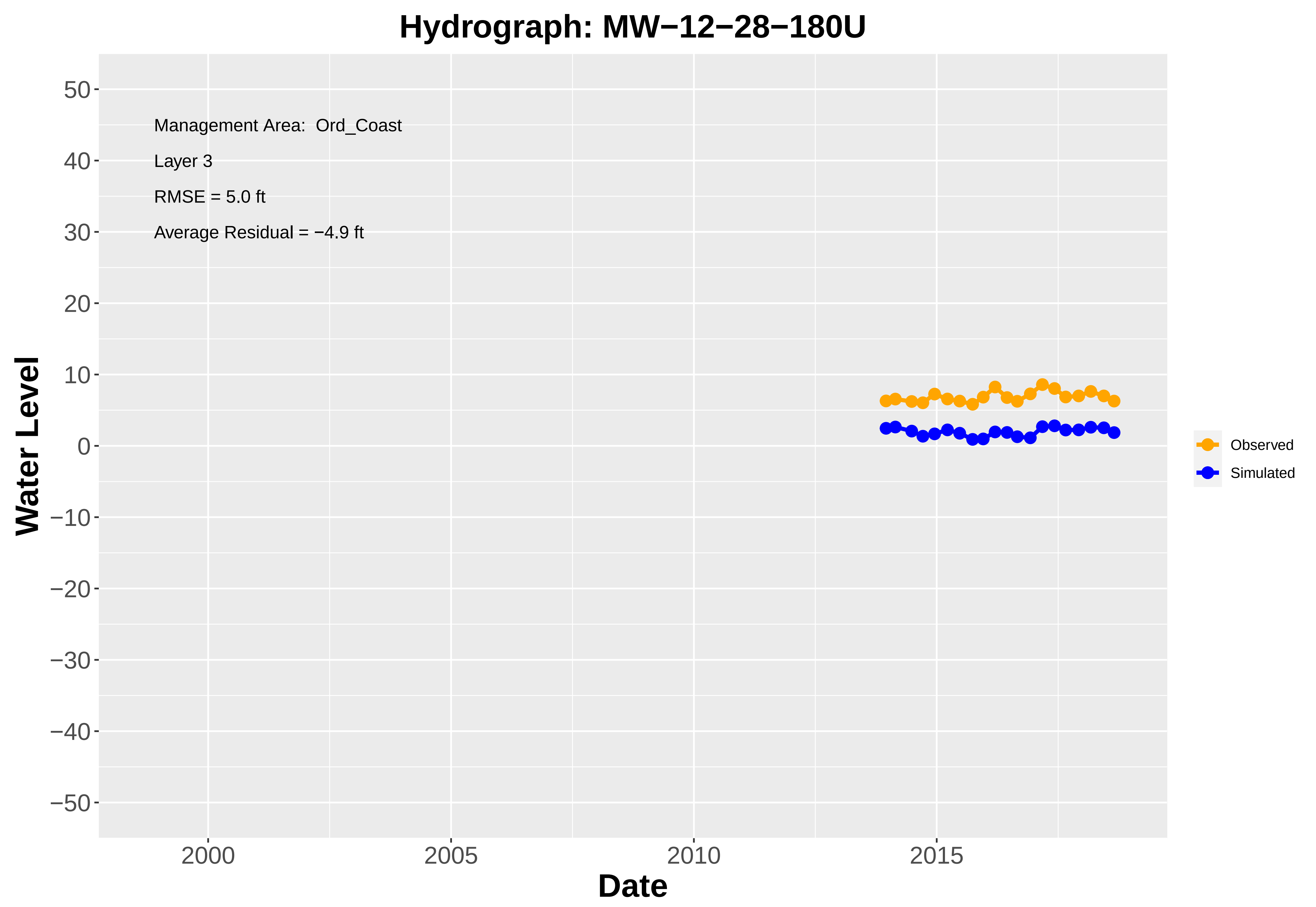


Hydrograph: MW−12−25−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.3 ft
Average Residual = −5.2 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

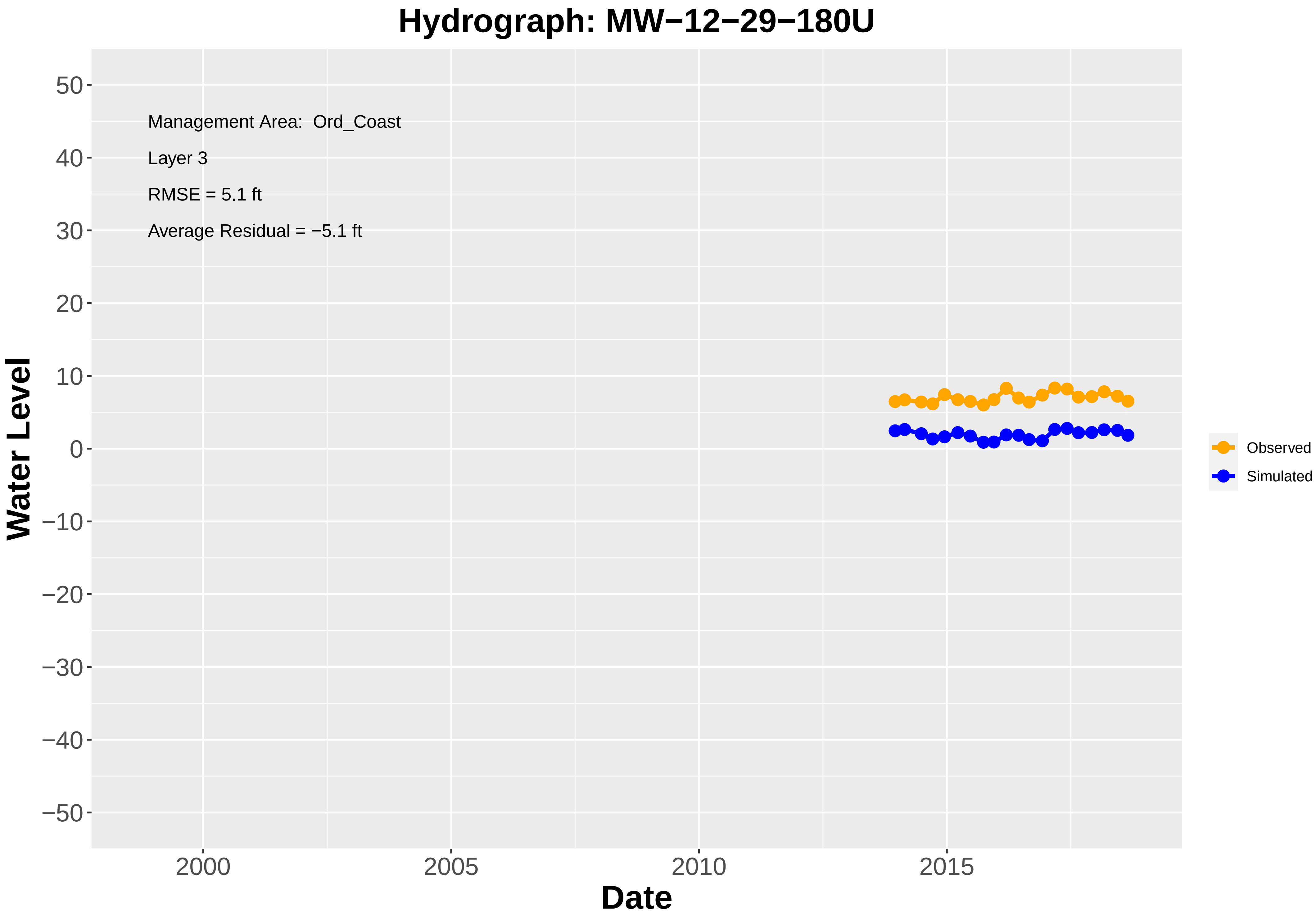

Hydrograph: MW−12−26−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.4 ft
Average Residual = −5.4 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



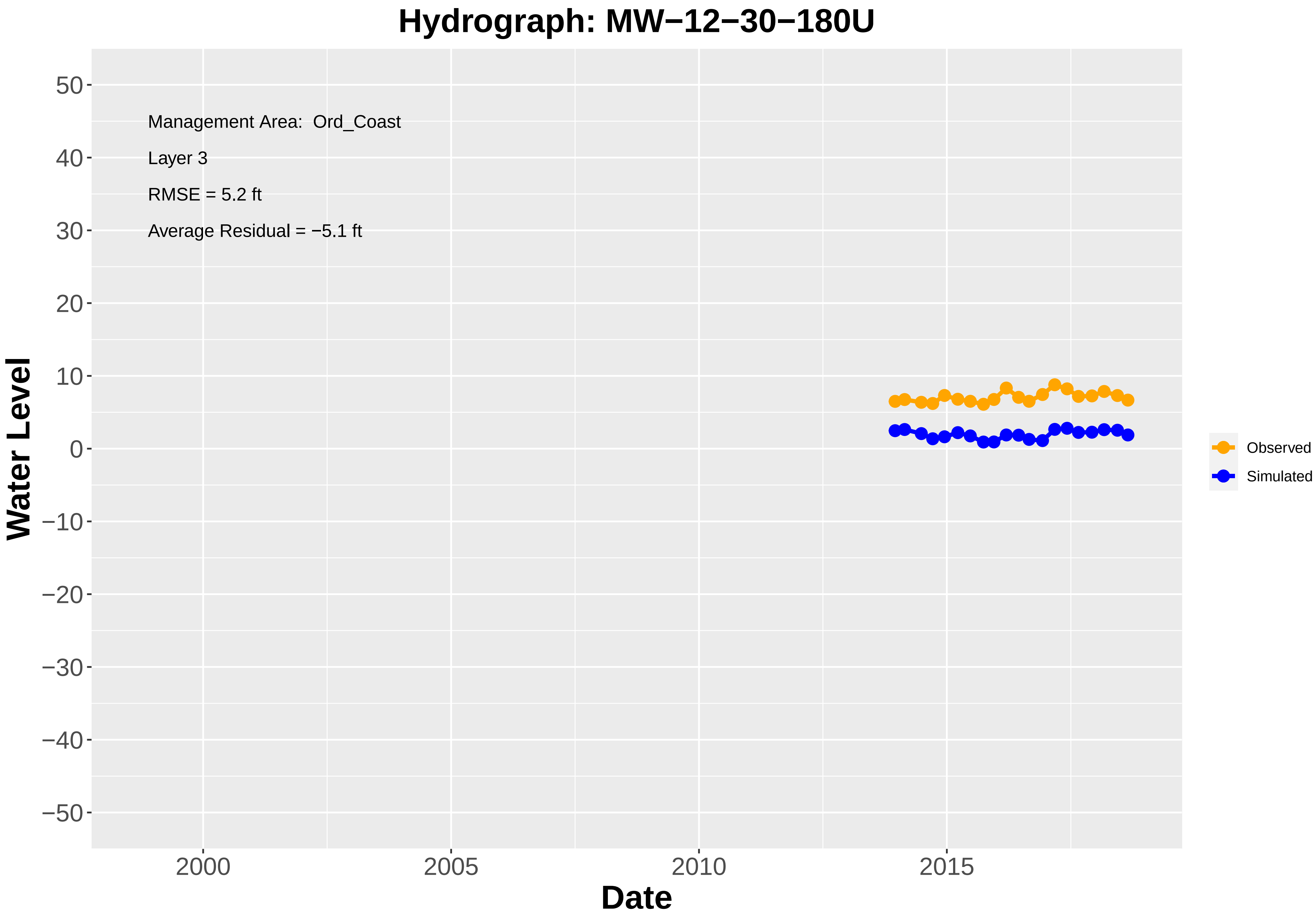
Hydrograph: MW−12−27−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.6 ft
Average Residual = −5.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

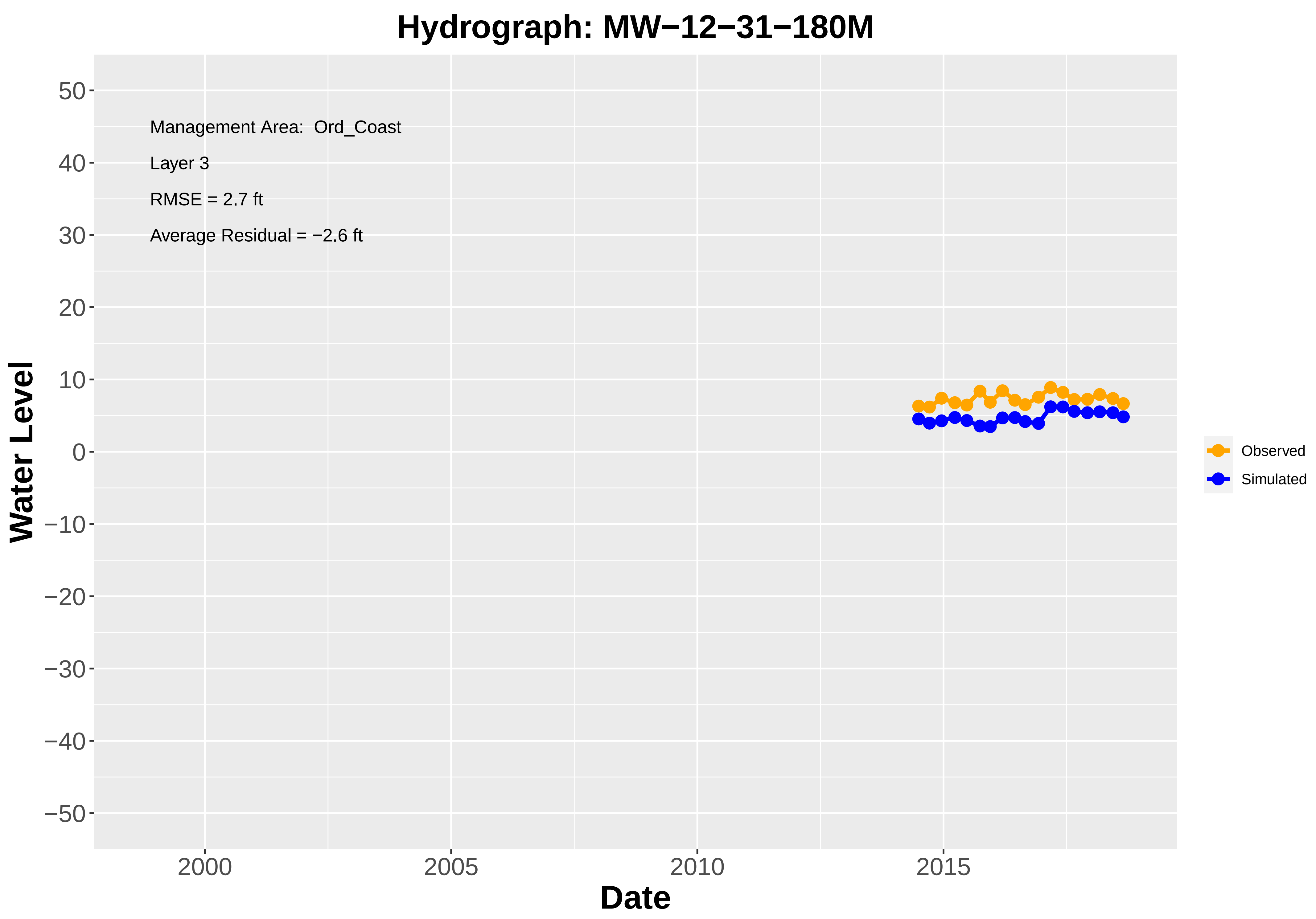


Hydrograph: MW−12−28−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.0 ft
Average Residual = −4.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

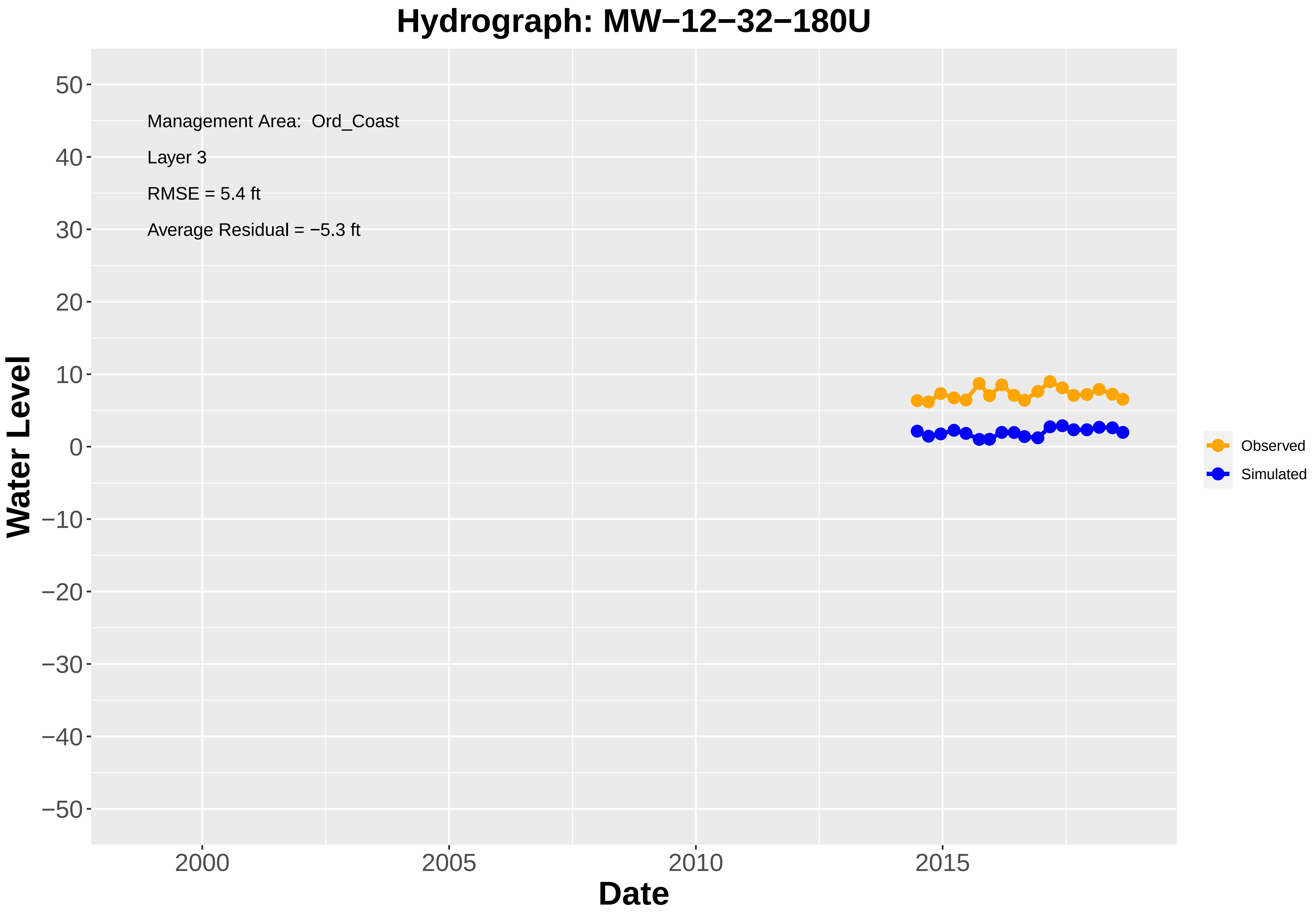


Hydrograph: MW−12−29−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.1 ft
Average Residual = −5.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

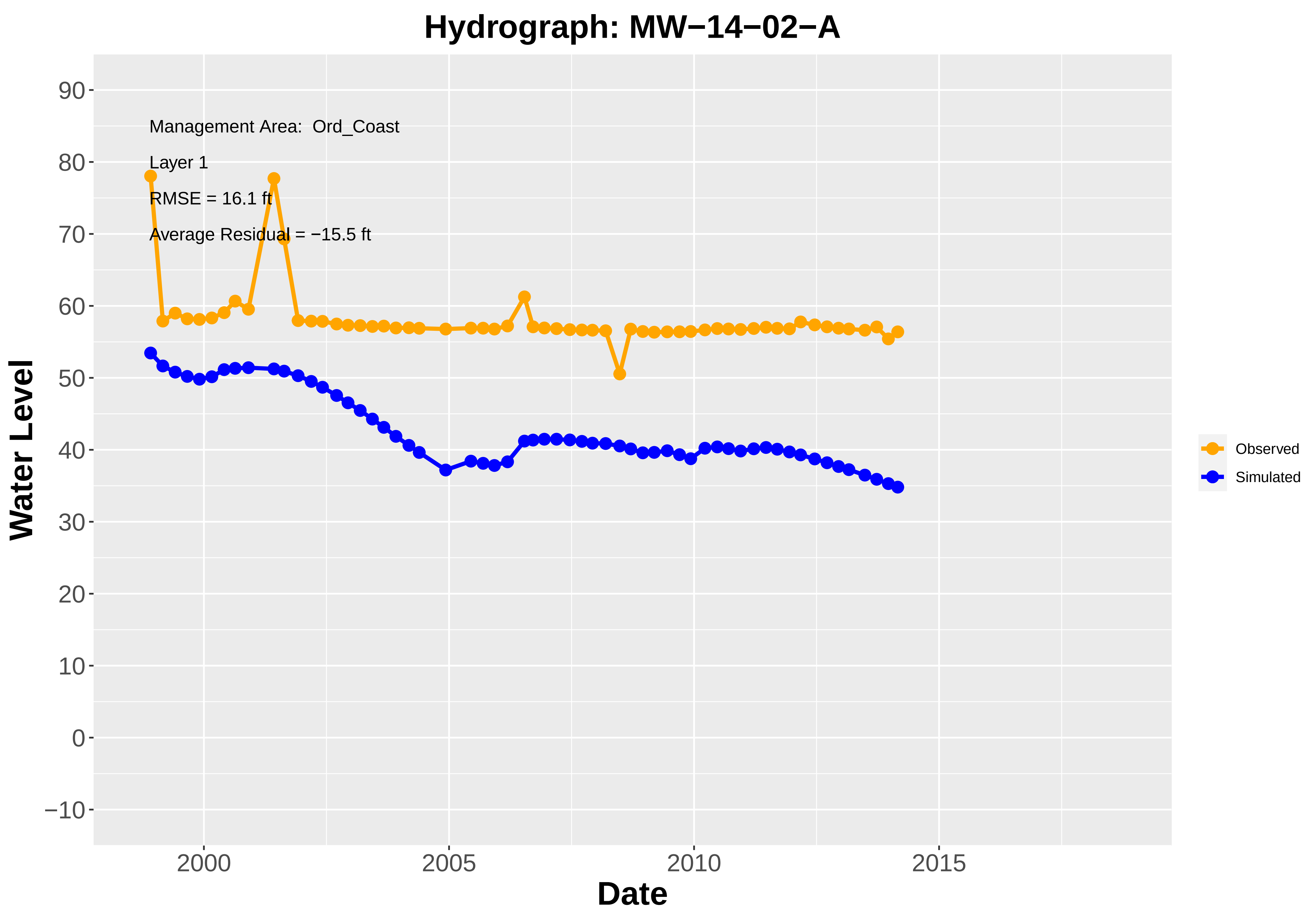

Hydrograph: MW−12−30−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.2 ft
Average Residual = −5.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

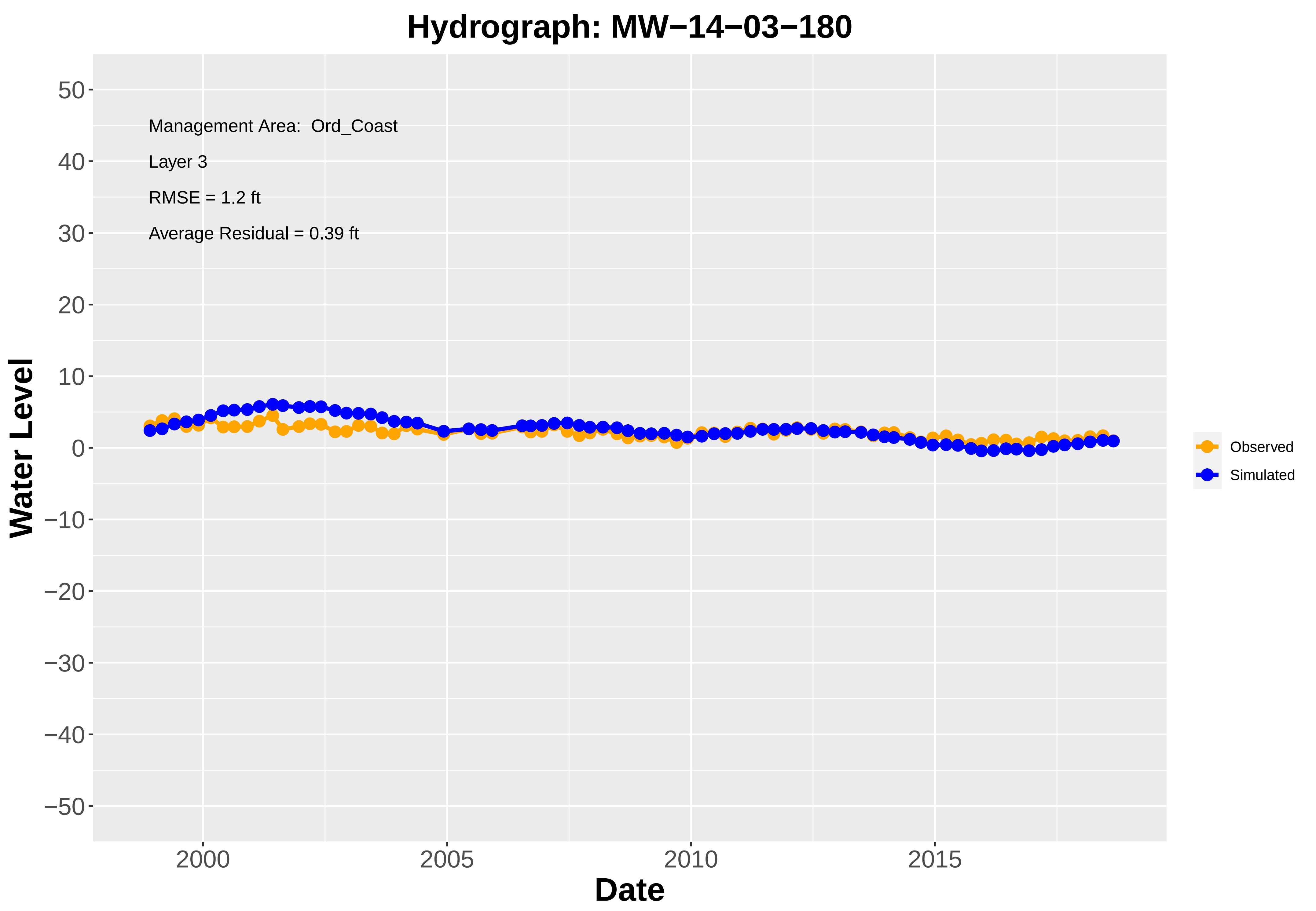


Hydrograph: MW−12−31−180M
Management Area: Ord_Coast
Layer 3
RMSE = 2.7 ft
Average Residual = −2.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

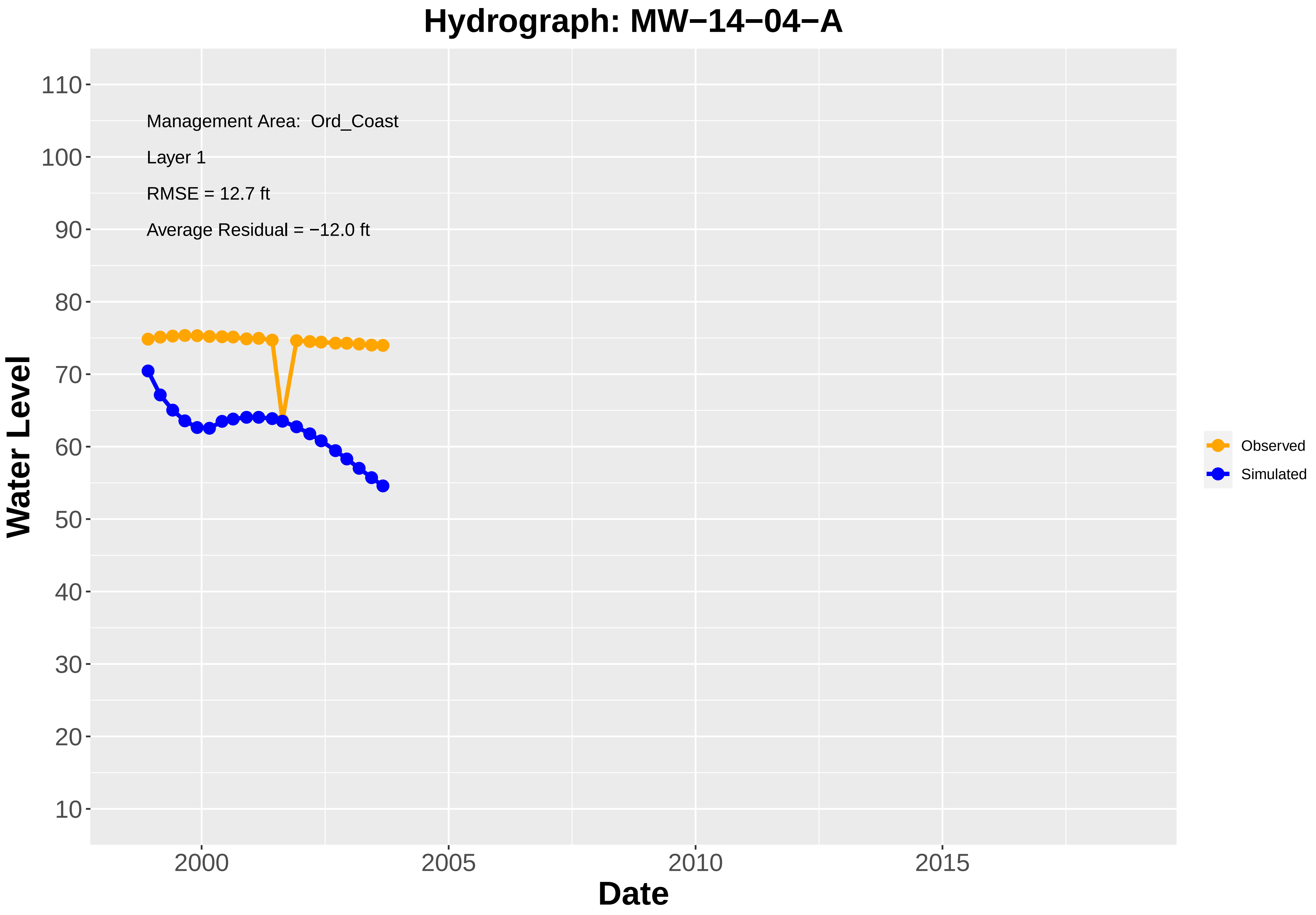


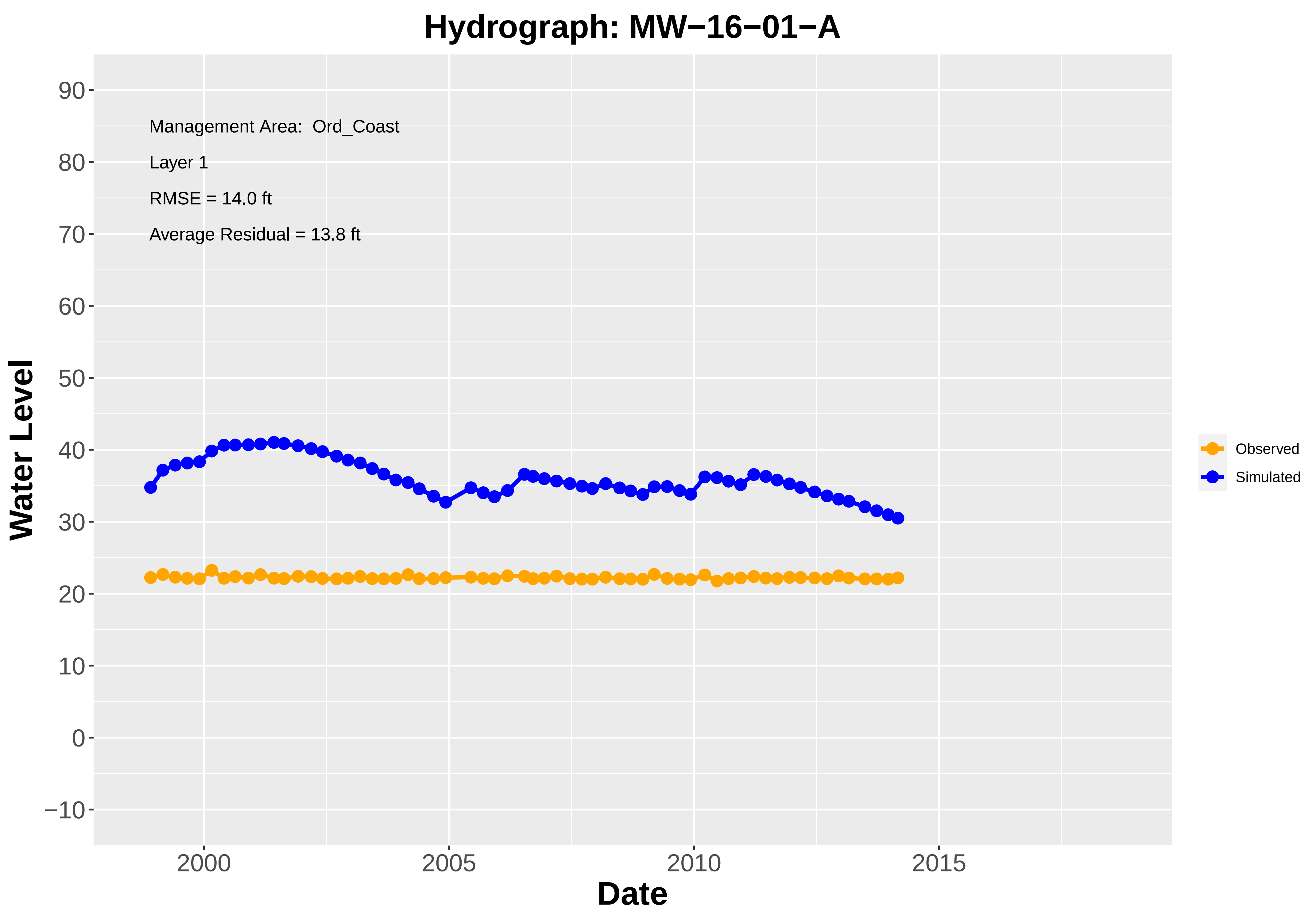
Hydrograph: MW−12−32−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.4 ft
Average Residual = −5.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−14−02−A
Management Area: Ord_Coast
Layer 1
RMSE = 16.1 ft
Average Residual = −15.5 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated

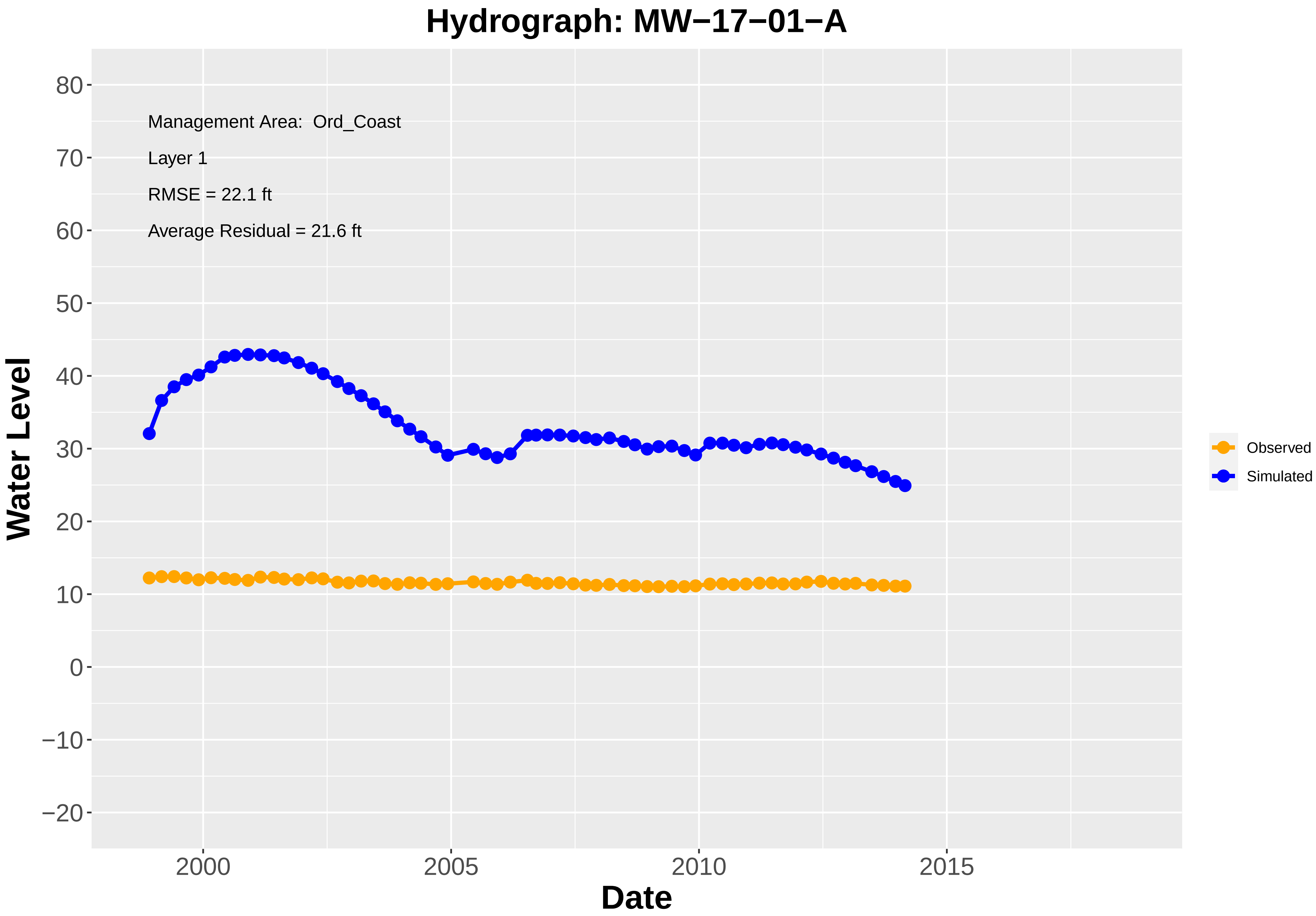


Hydrograph: MW−14−03−180
Management Area: Ord_Coast
Layer 3
RMSE = 1.2 ft
Average Residual = 0.39 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

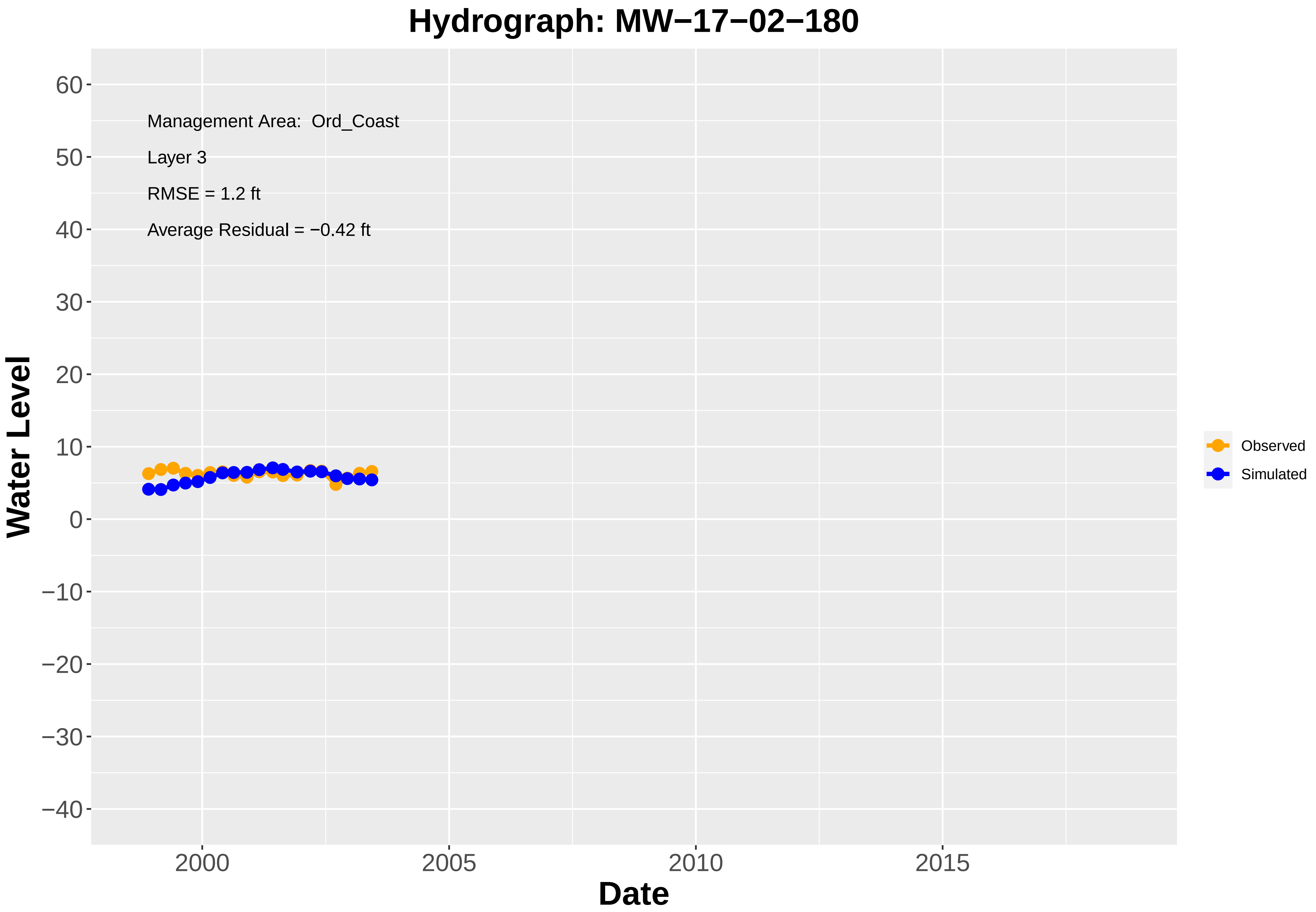

Hydrograph: MW−14−04−A
Management Area: Ord_Coast
Layer 1
RMSE = 12.7 ft
Average Residual = −12.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



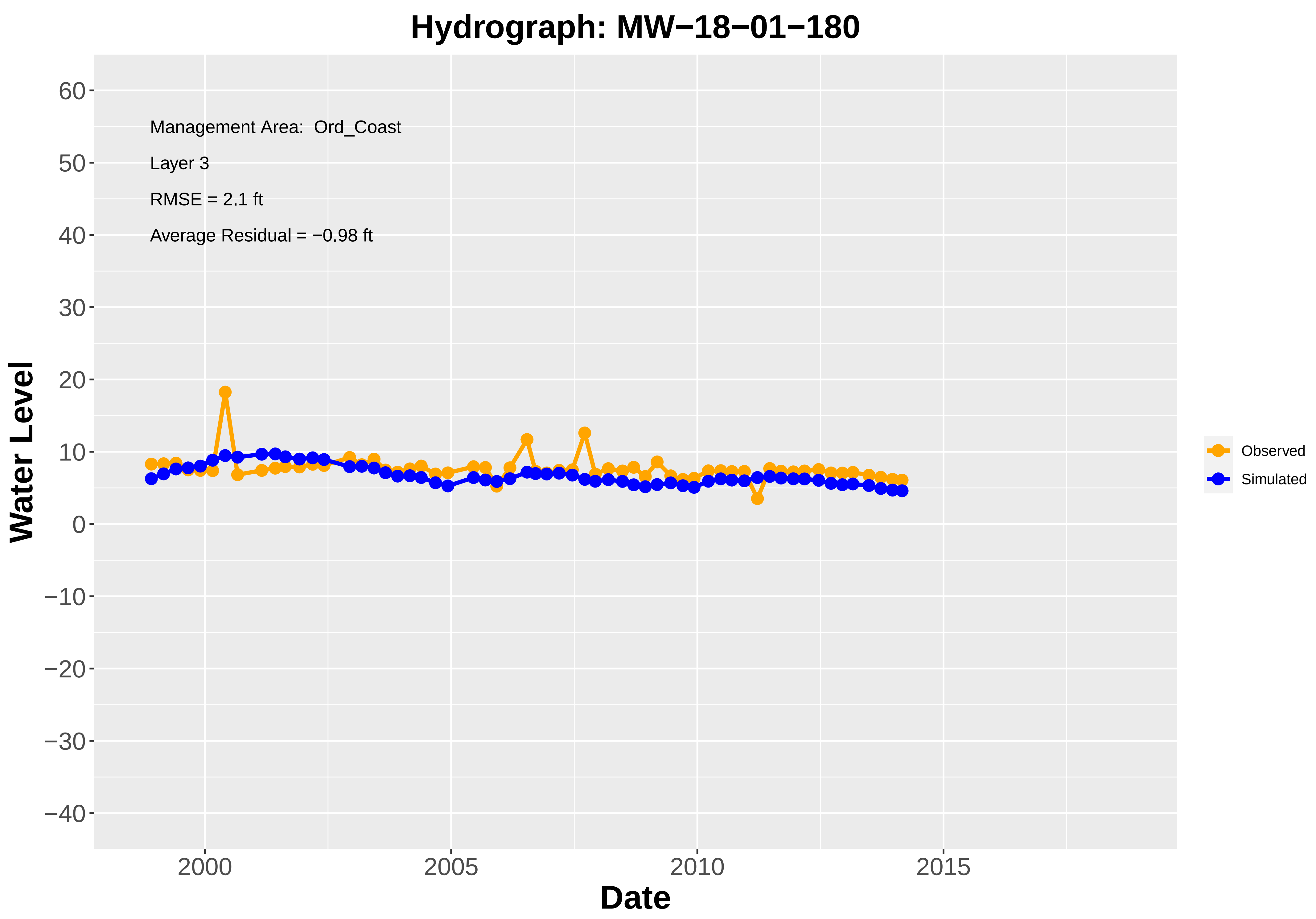
Hydrograph: MW−16−01−A
Management Area: Ord_Coast
Layer 1
RMSE = 14.0 ft
Average Residual = 13.8 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



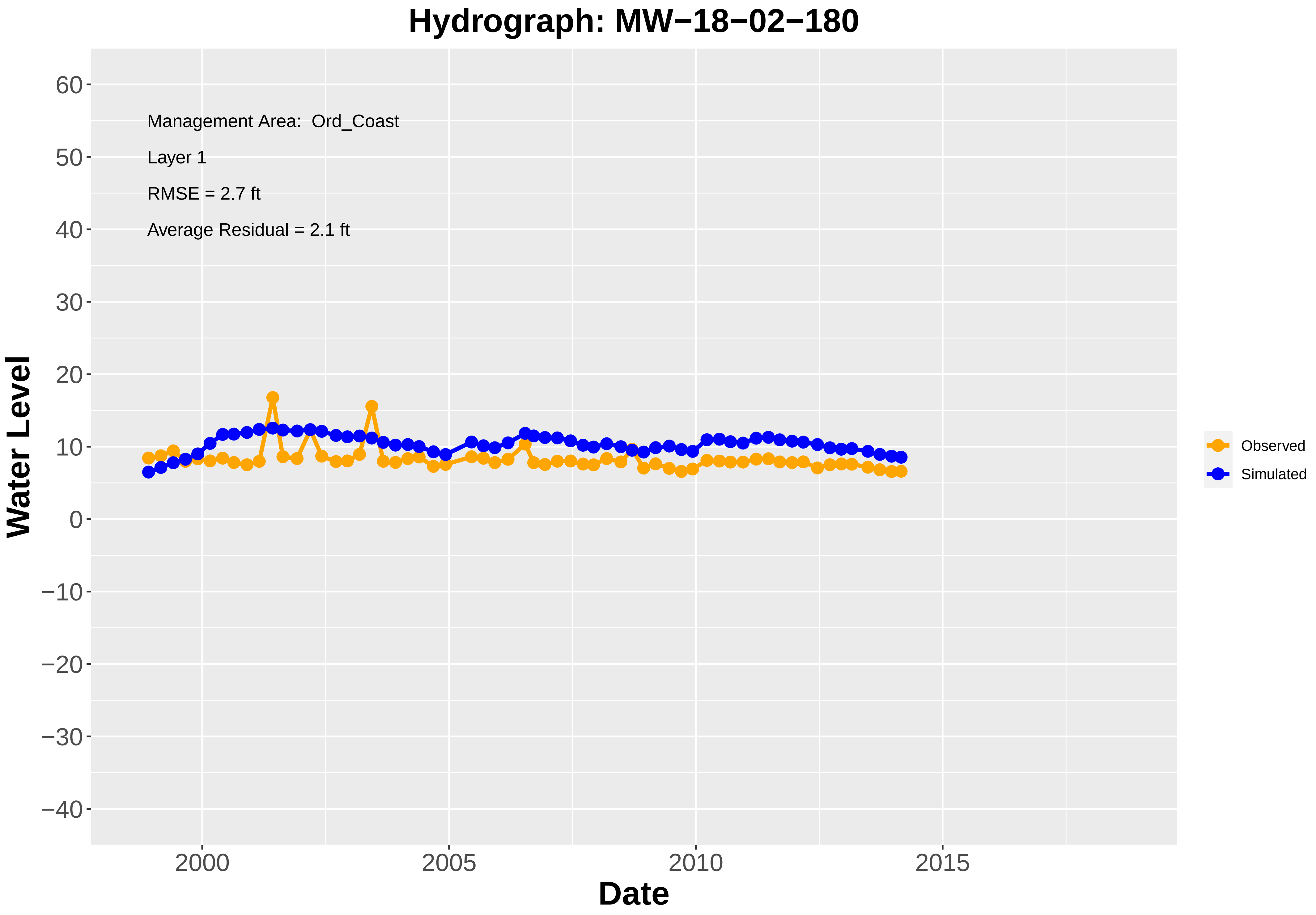
Hydrograph: MW−17−01−A
Management Area: Ord_Coast
Layer 1
RMSE = 22.1 ft
Average Residual = 21.6 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

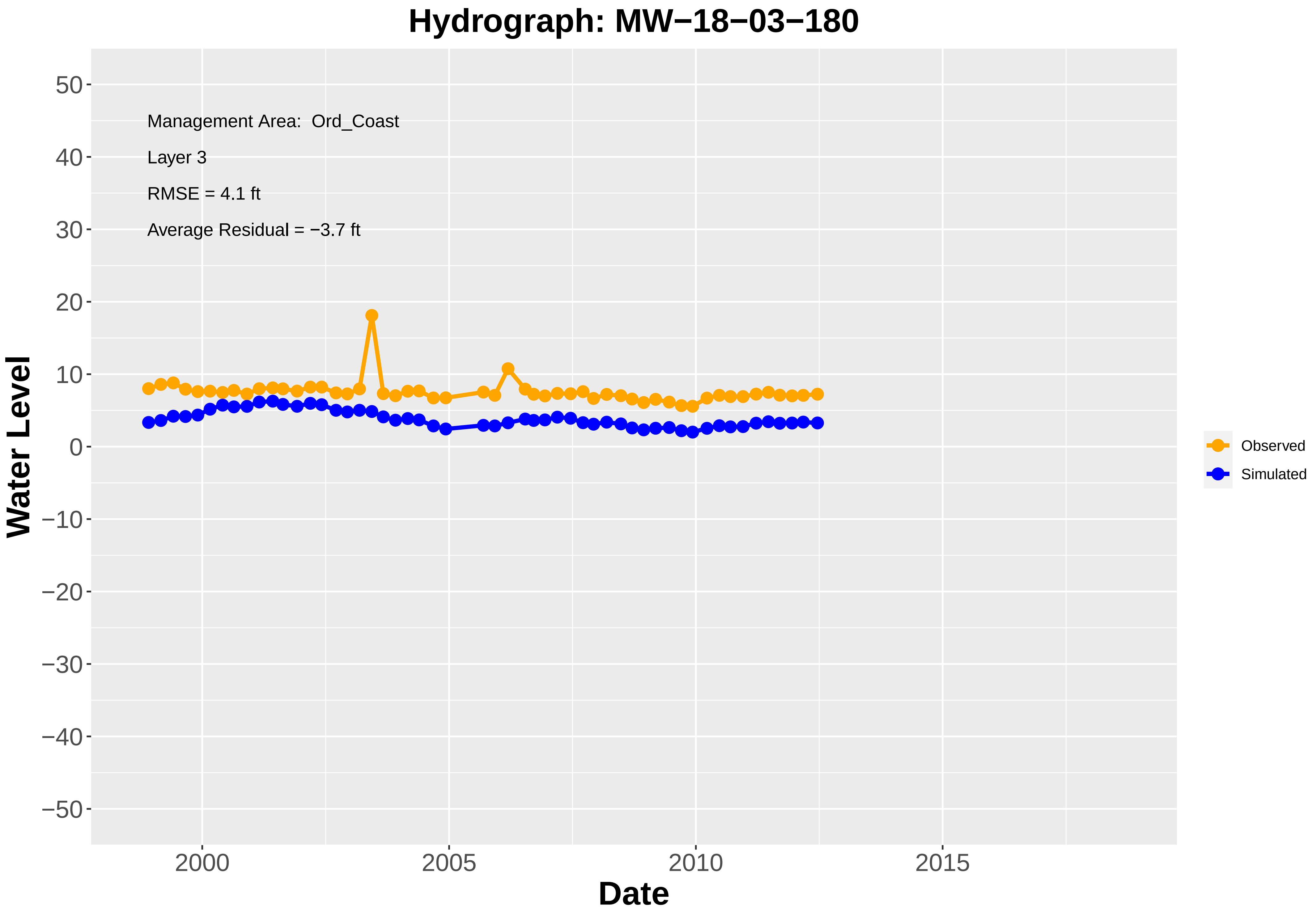


Hydrograph: MW−17−02−180
Management Area: Ord_Coast
Layer 3
RMSE = 1.2 ft
Average Residual = −0.42 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

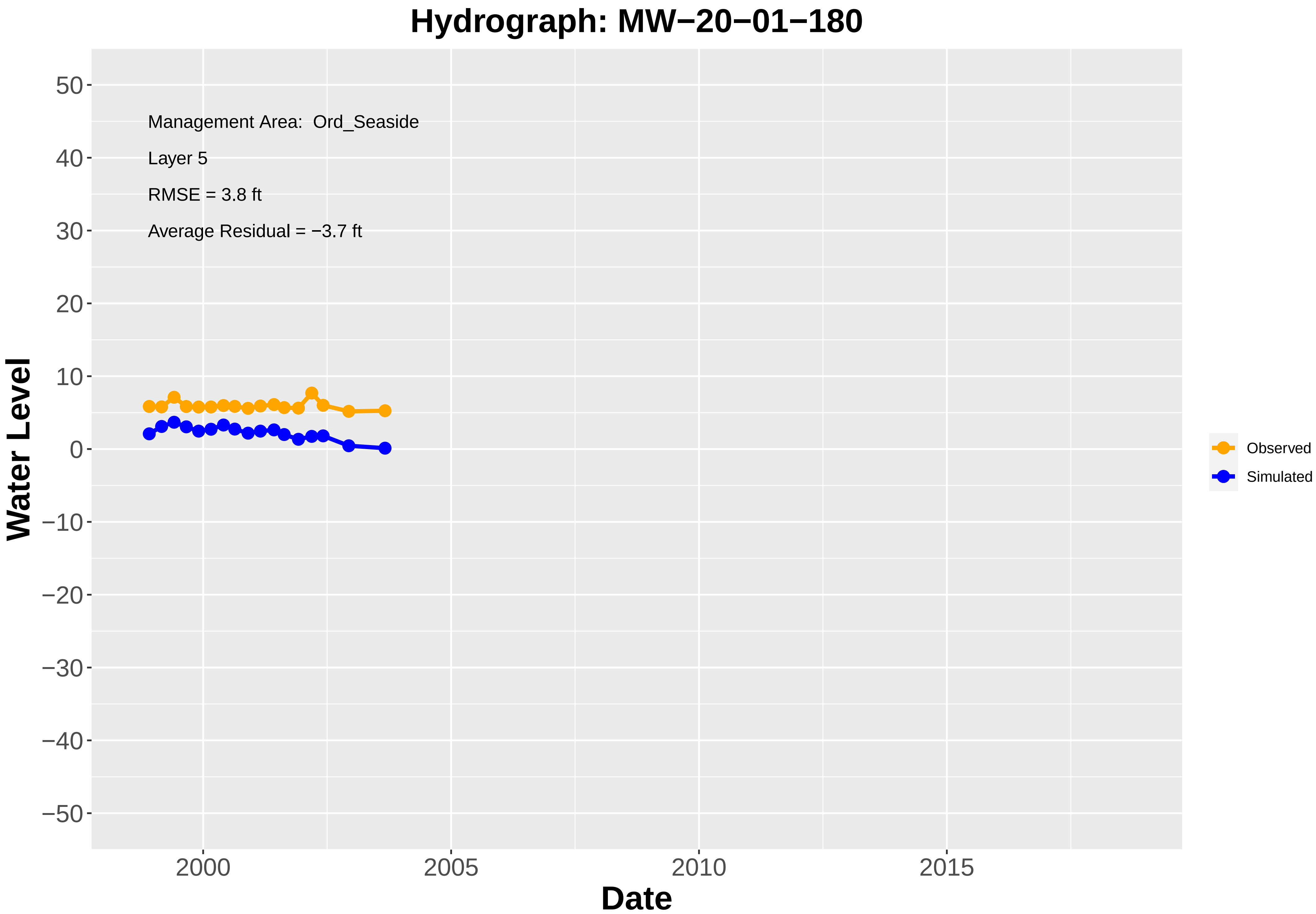


Hydrograph: MW−18−01−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.1 ft
Average Residual = −0.98 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

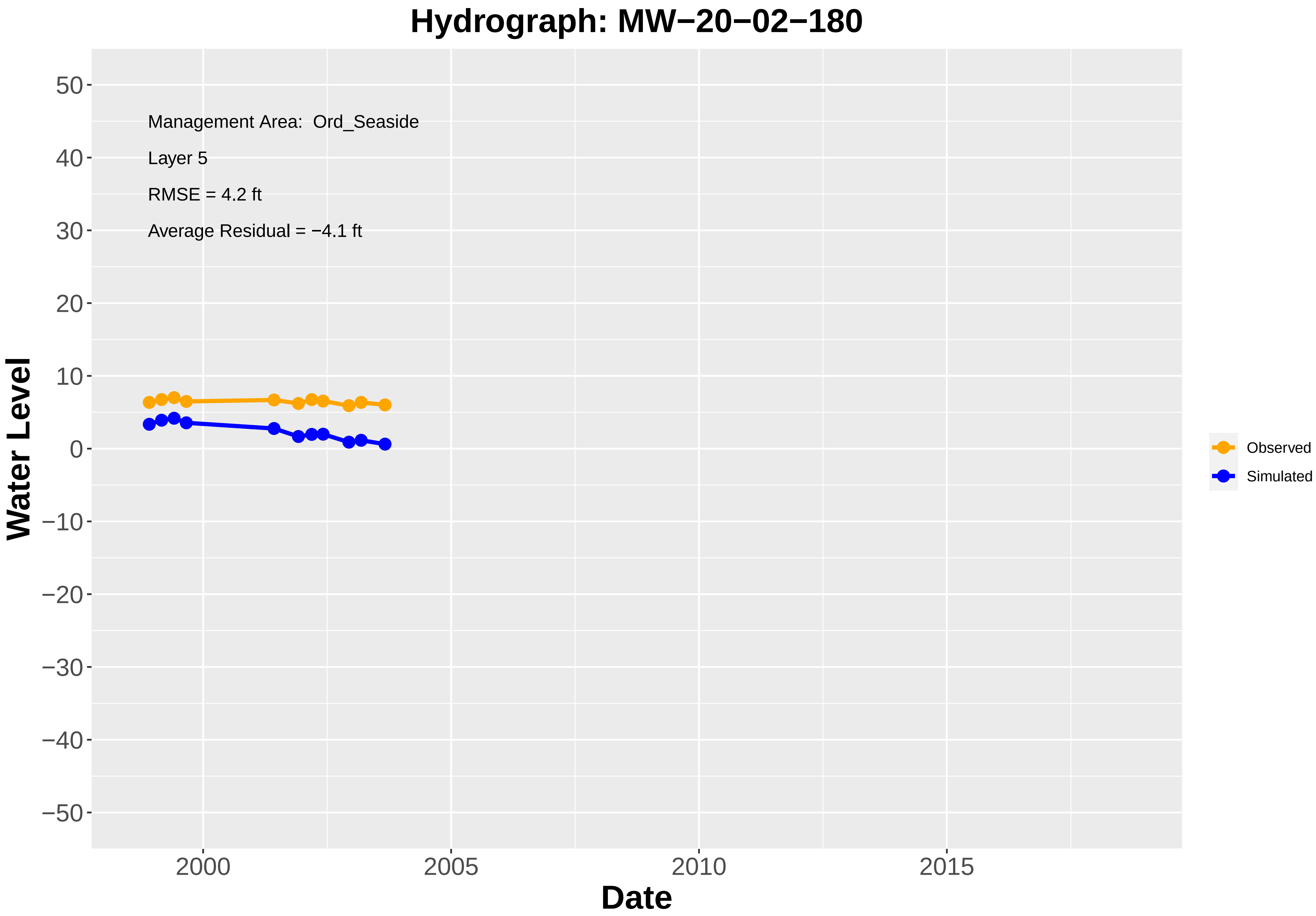

Hydrograph: MW−18−02−180
Management Area: Ord_Coast
Layer 1
RMSE = 2.7 ft
Average Residual = 2.1 ft
Water Level
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Date
Observed
Simulated



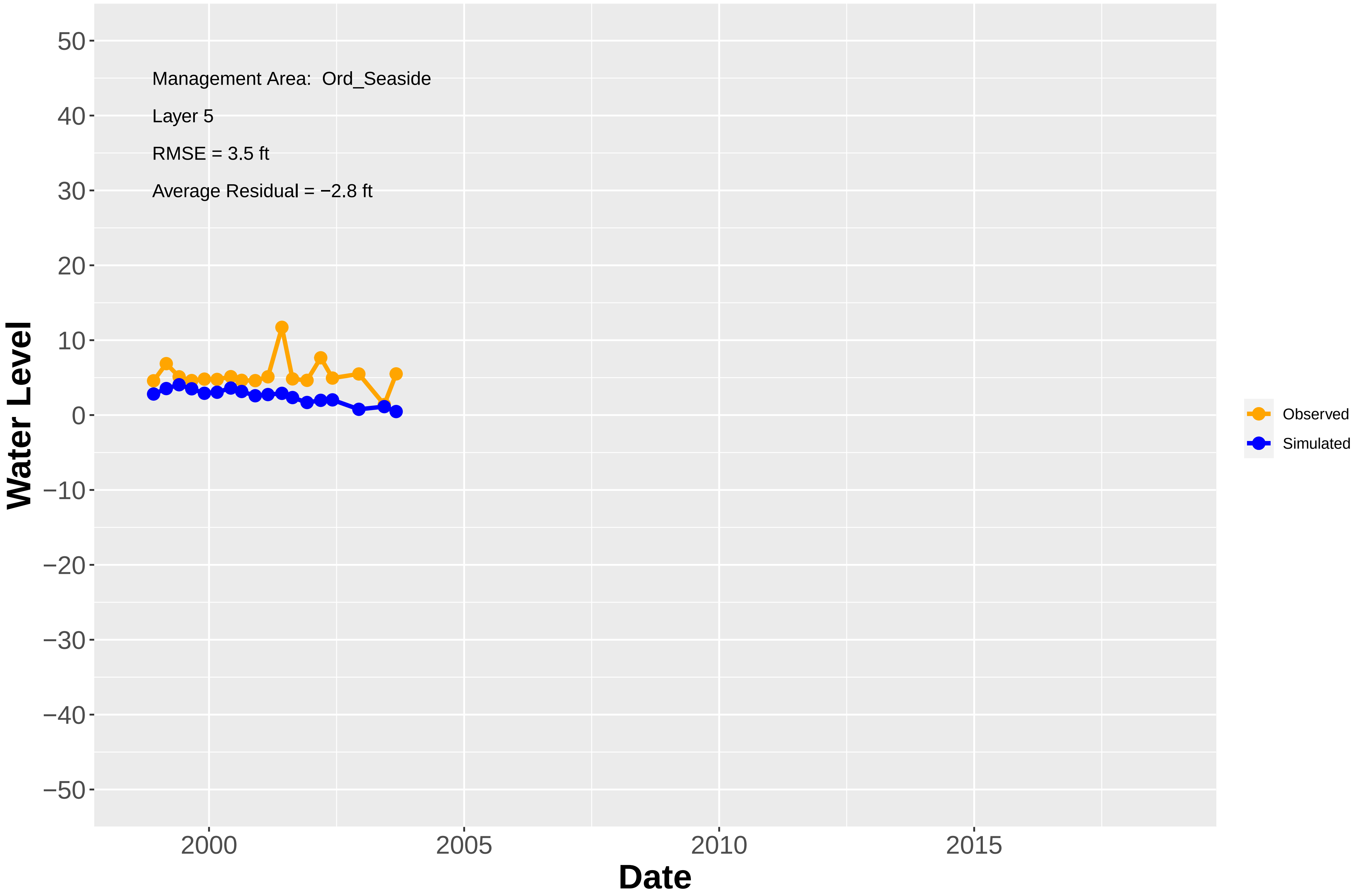
Hydrograph: MW−18−03−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.1 ft
Average Residual = −3.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

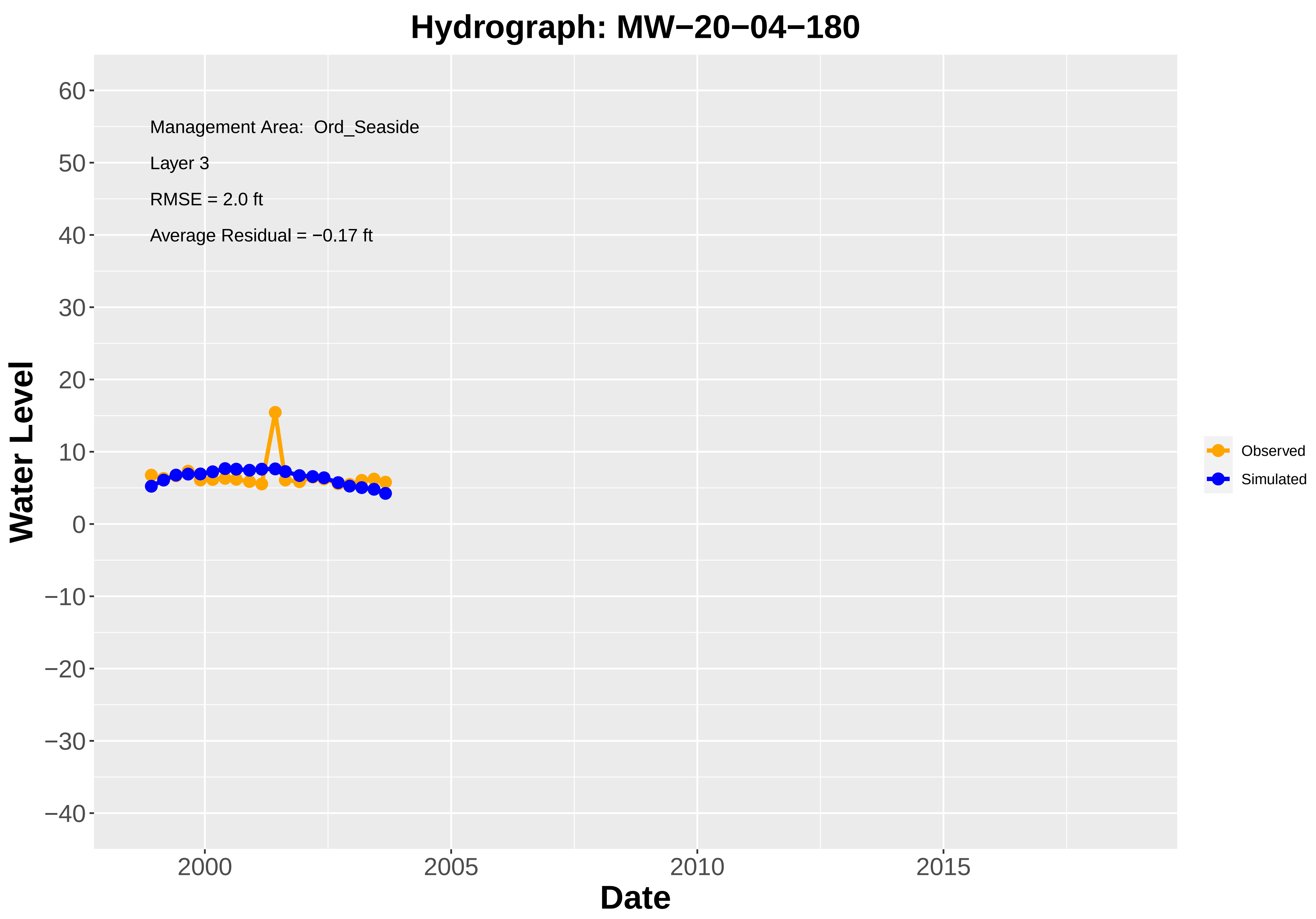


Hydrograph: MW−20−01−180
Management Area: Ord_Seaside
Layer 5
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

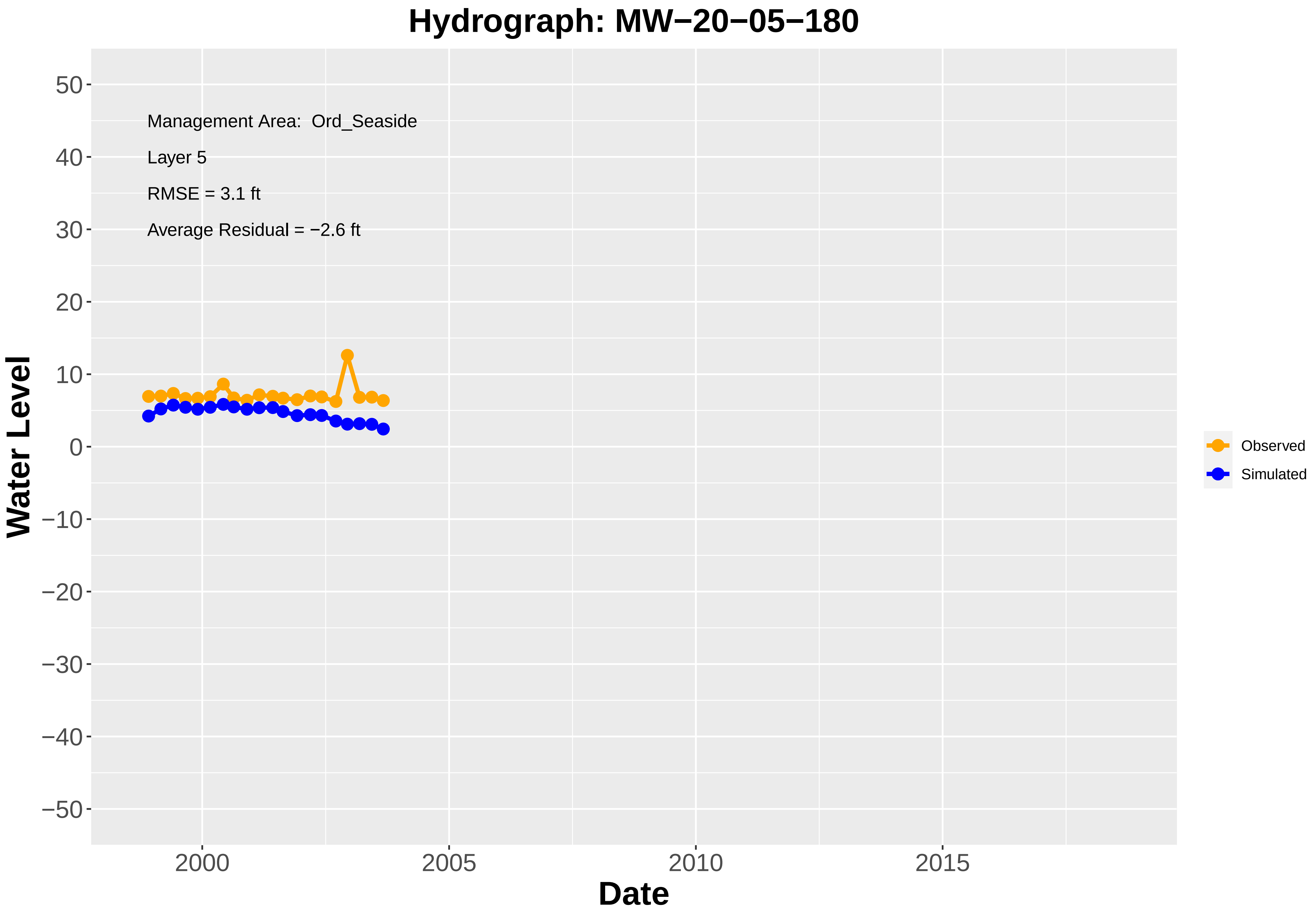

Hydrograph: MW−20−02−180
Management Area: Ord_Seaside
Layer 5
RMSE = 4.2 ft
Average Residual = −4.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

Hydrograph: MW−20−03−180

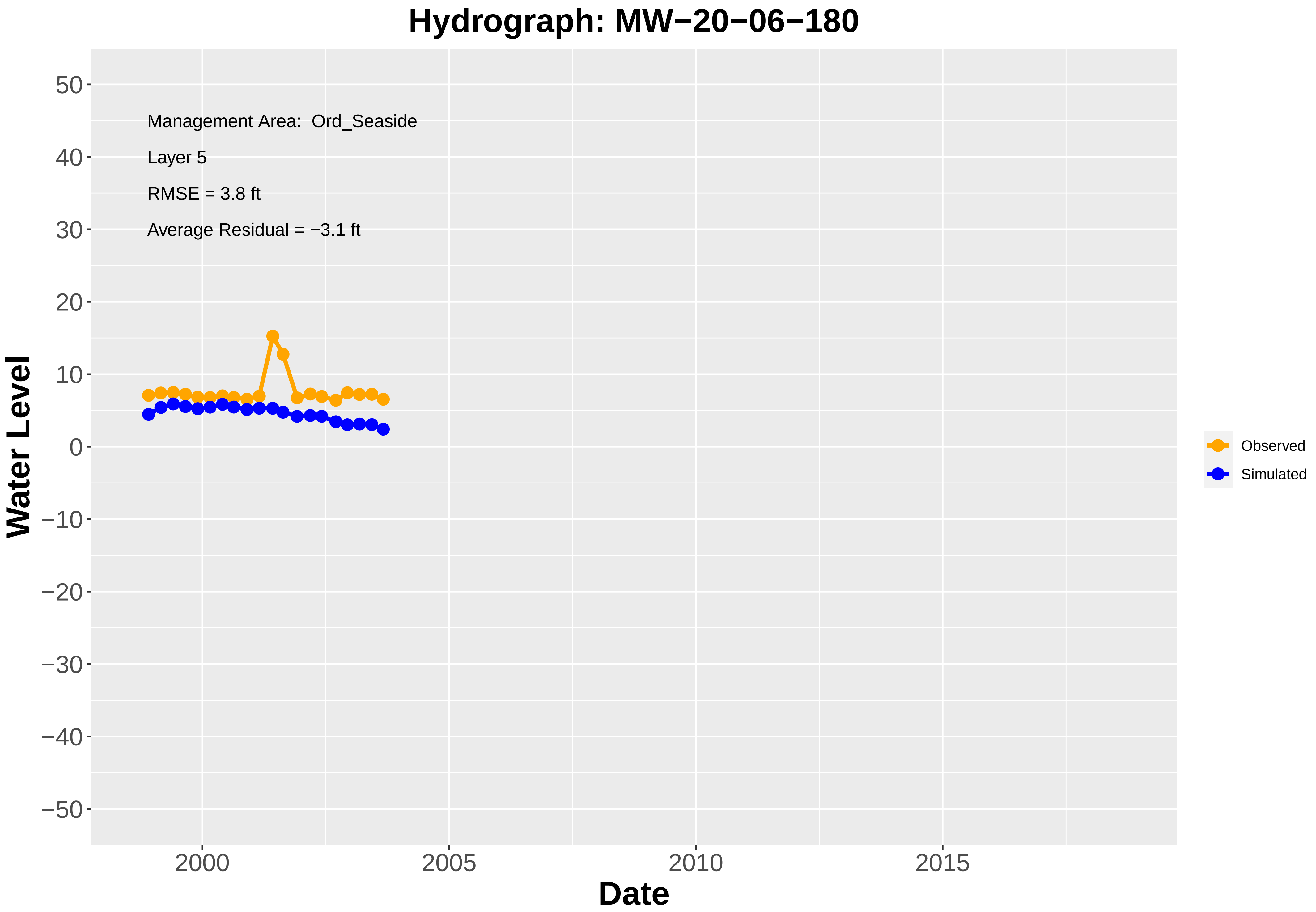


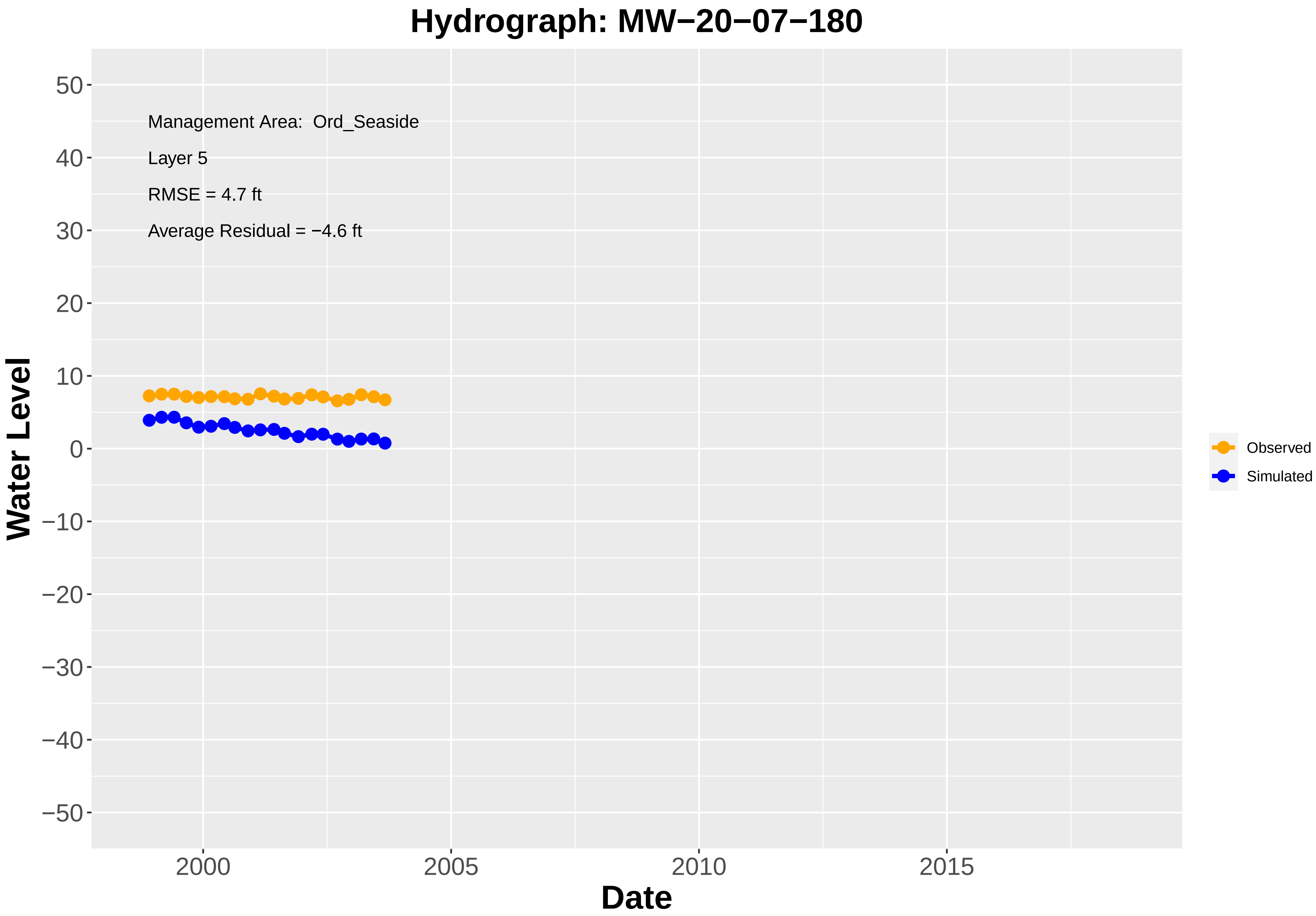


Hydrograph: MW−20−04−180
Management Area: Ord_Seaside
Layer 3
RMSE = 2.0 ft
Average Residual = −0.17 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated



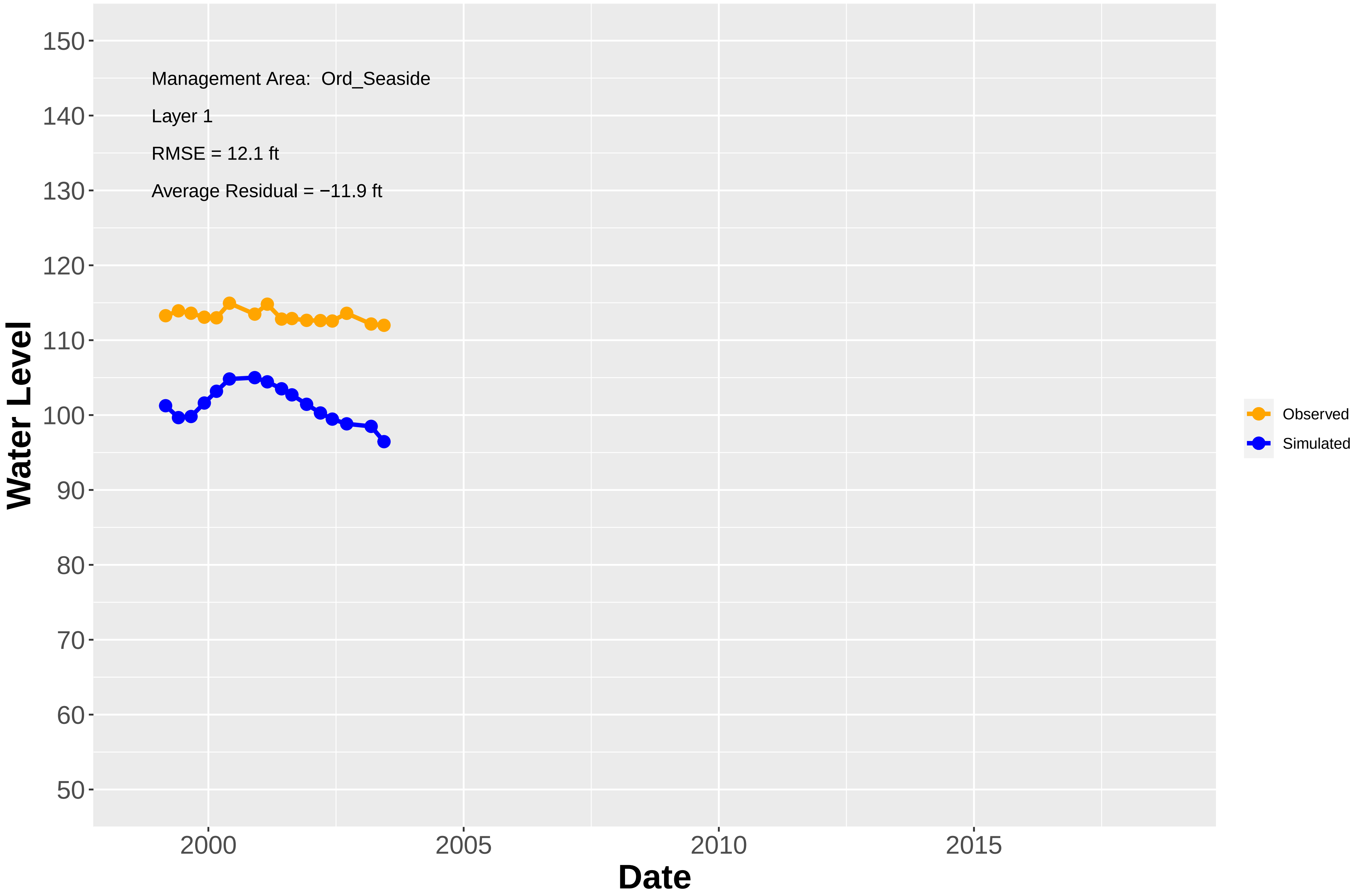
Hydrograph: MW−20−05−180
Management Area: Ord_Seaside
Layer 5
RMSE = 3.1 ft
Average Residual = −2.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

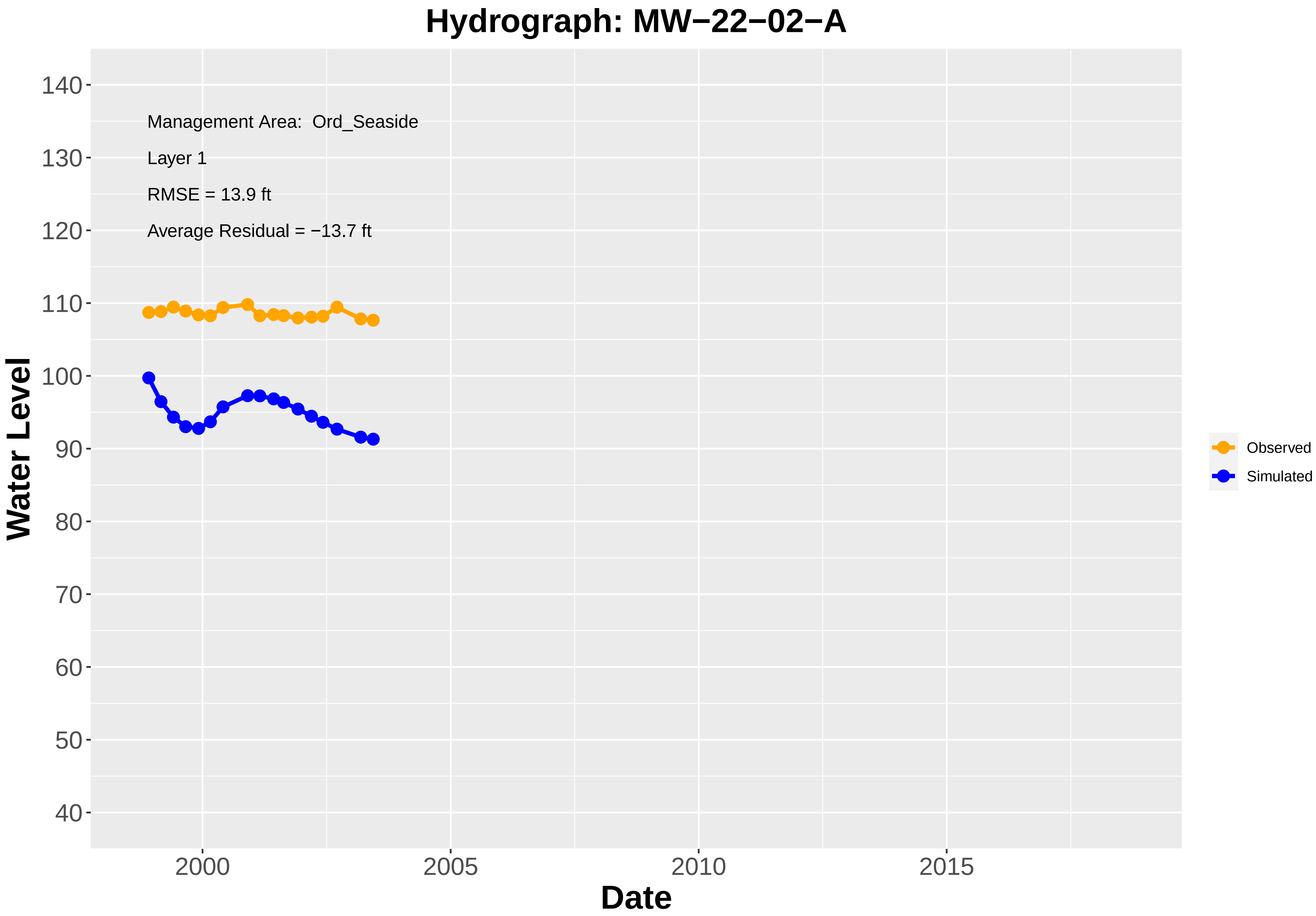

Hydrograph: MW−20−06−180
Management Area: Ord_Seaside
Layer 5
RMSE = 3.8 ft
Average Residual = −3.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

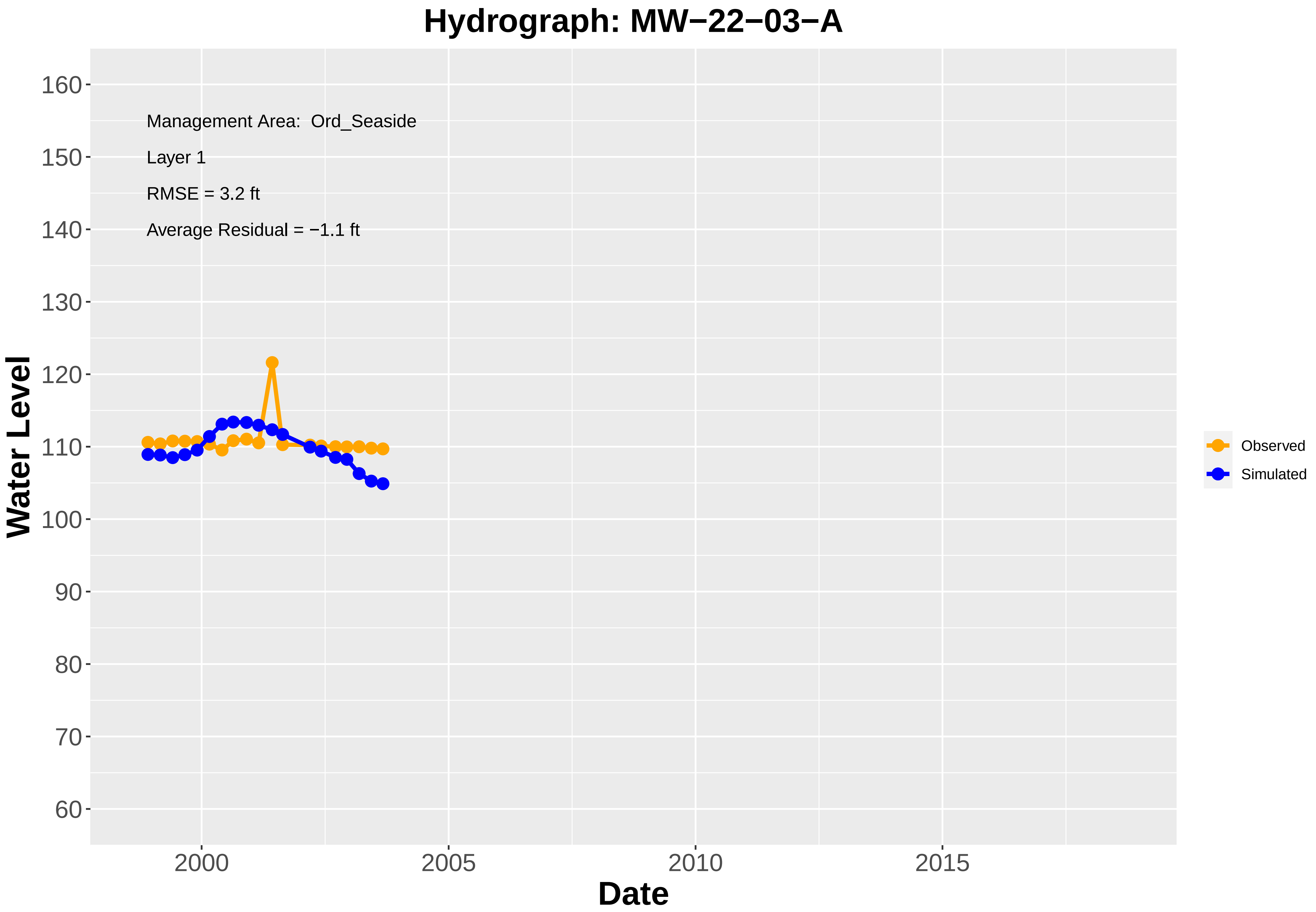


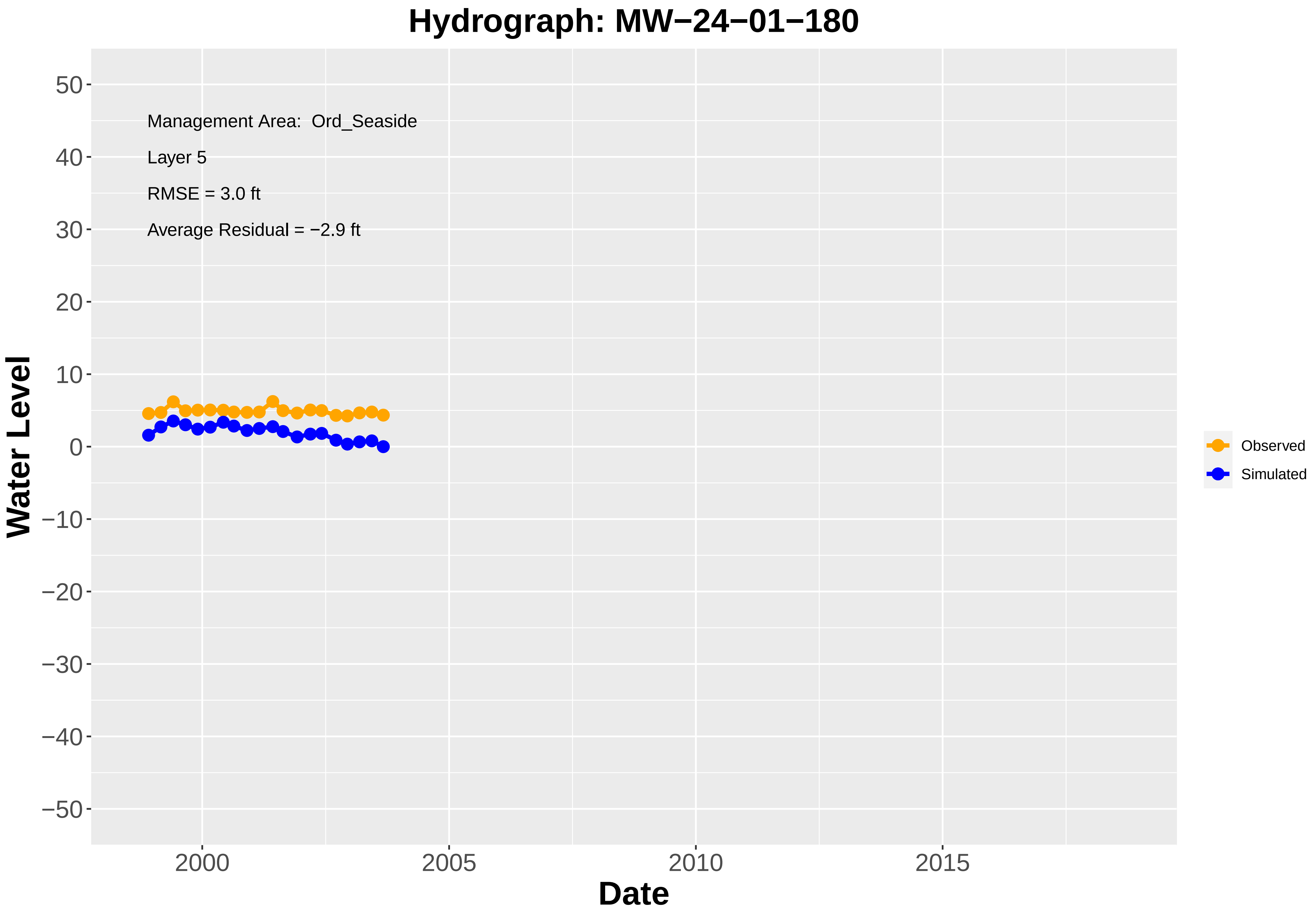
Hydrograph: MW−20−07−180
Management Area: Ord_Seaside
Layer 5
RMSE = 4.7 ft
Average Residual = −4.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

Hydrograph: MW−22−01−A

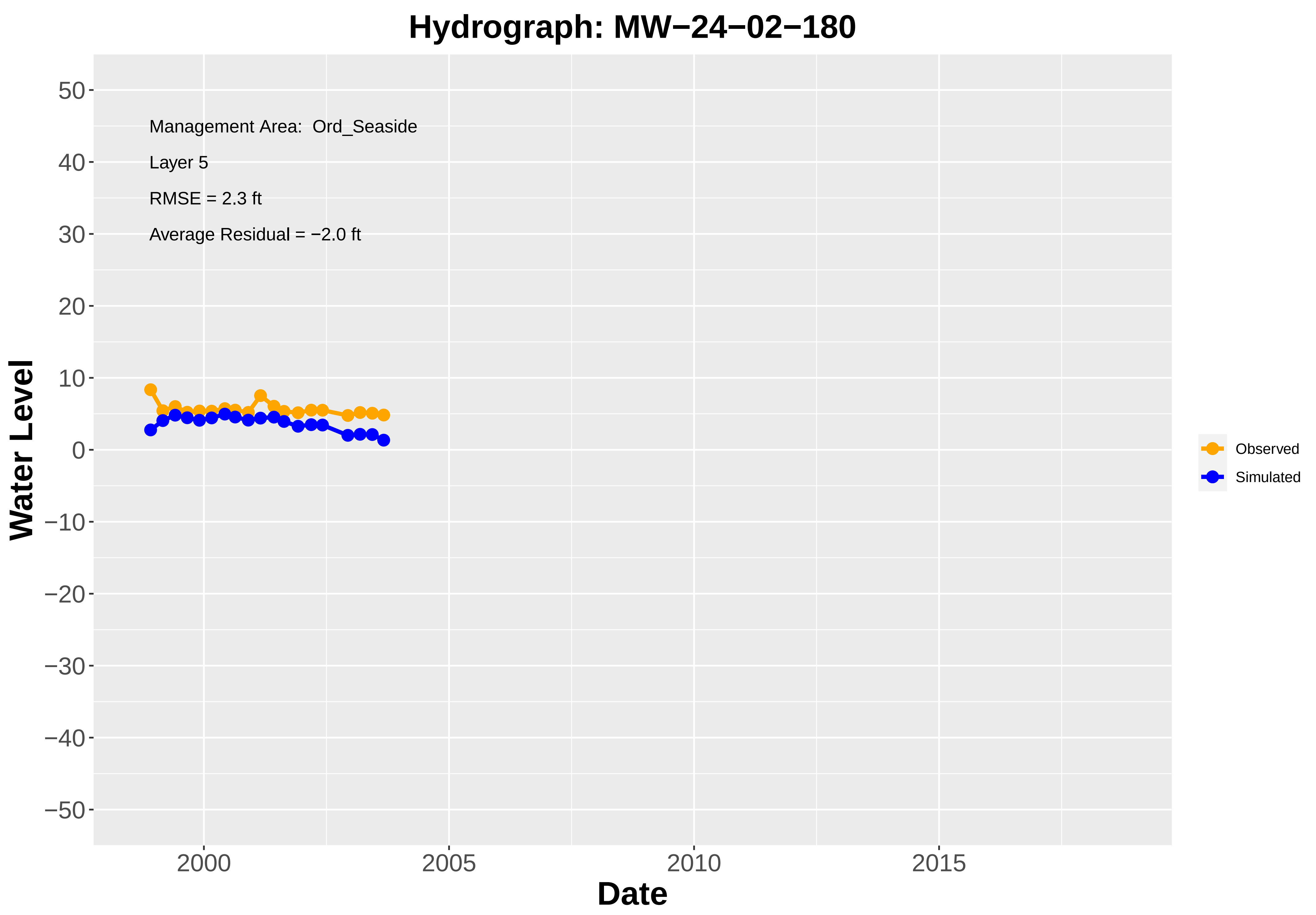



Hydrograph: MW−22−02−A
Management Area: Ord_Seaside
Layer 1
RMSE = 13.9 ft
Average Residual = −13.7 ft
Water Level
140
130
120
110
100
90
80
70
60
50
40
2000
2005
2010
2015
Date
Observed
Simulated

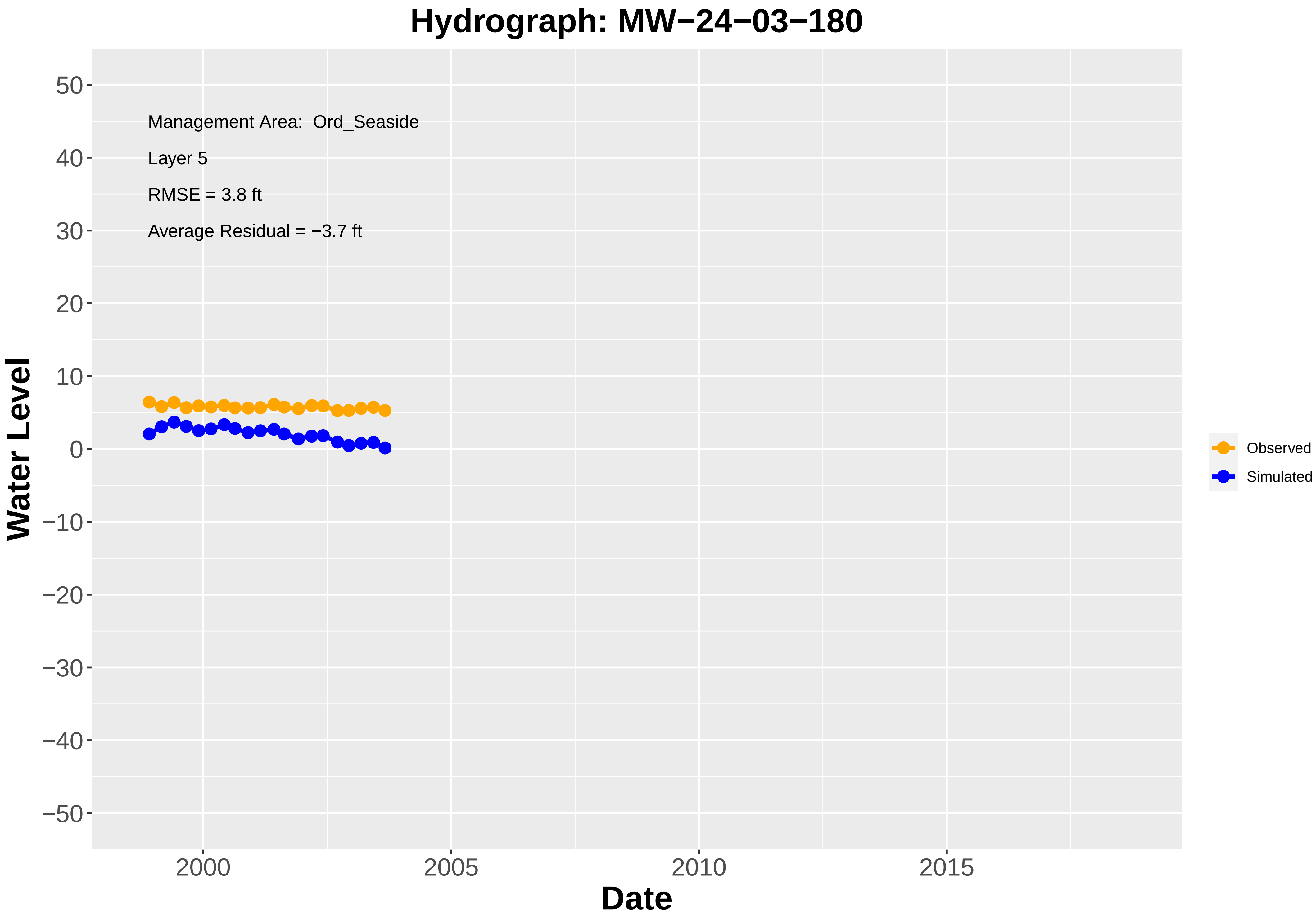

Hydrograph: MW−22−03−A
Management Area: Ord_Seaside
Layer 1
RMSE = 3.2 ft
Average Residual = −1.1 ft
Water Level
160
150
140
130
120
110
100
90
80
70
60
2000
2005
2010
2015
Date
Observed
Simulated



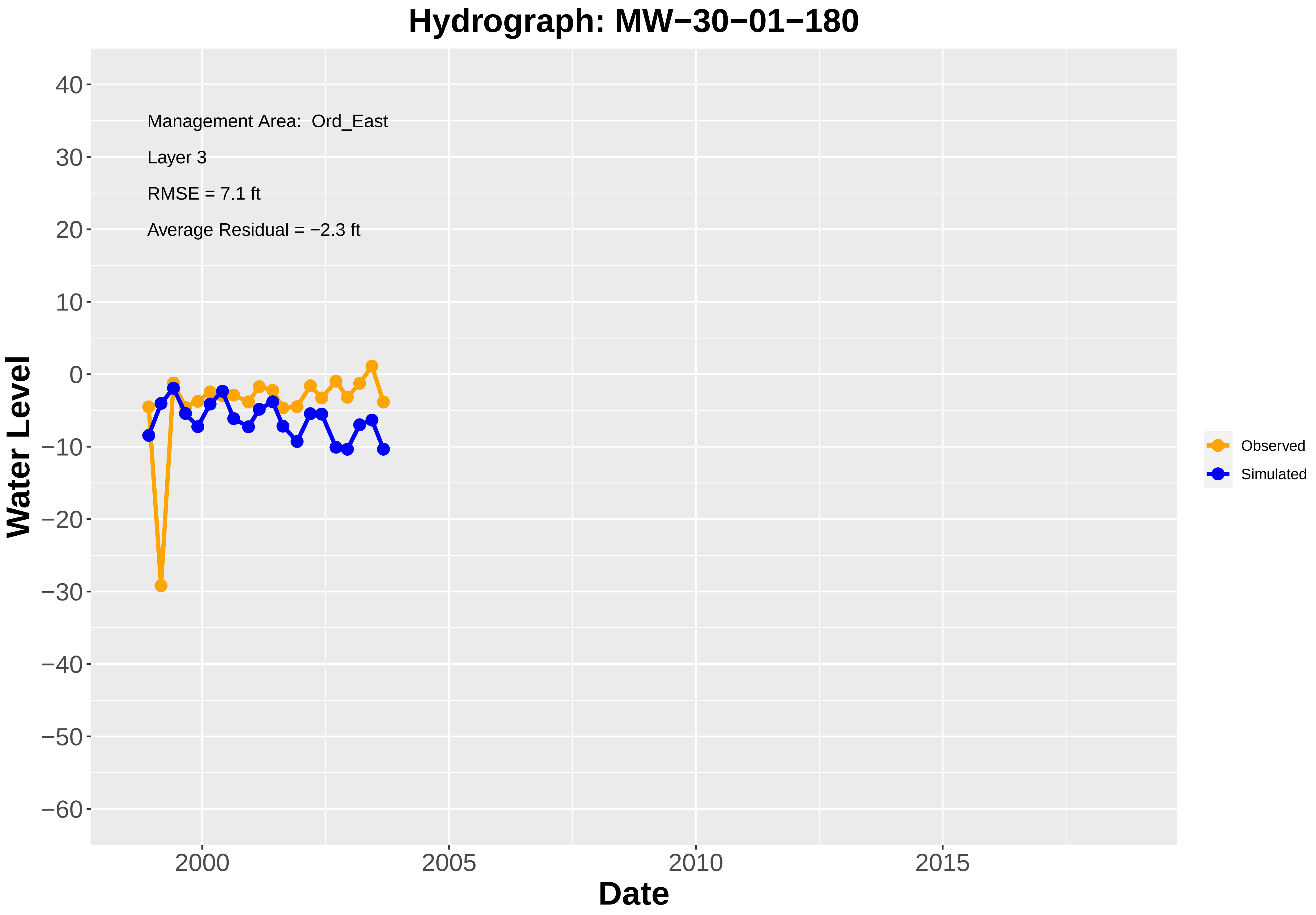
Hydrograph: MW−24−01−180
Management Area: Ord_Seaside
Layer 5
RMSE = 3.0 ft
Average Residual = −2.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

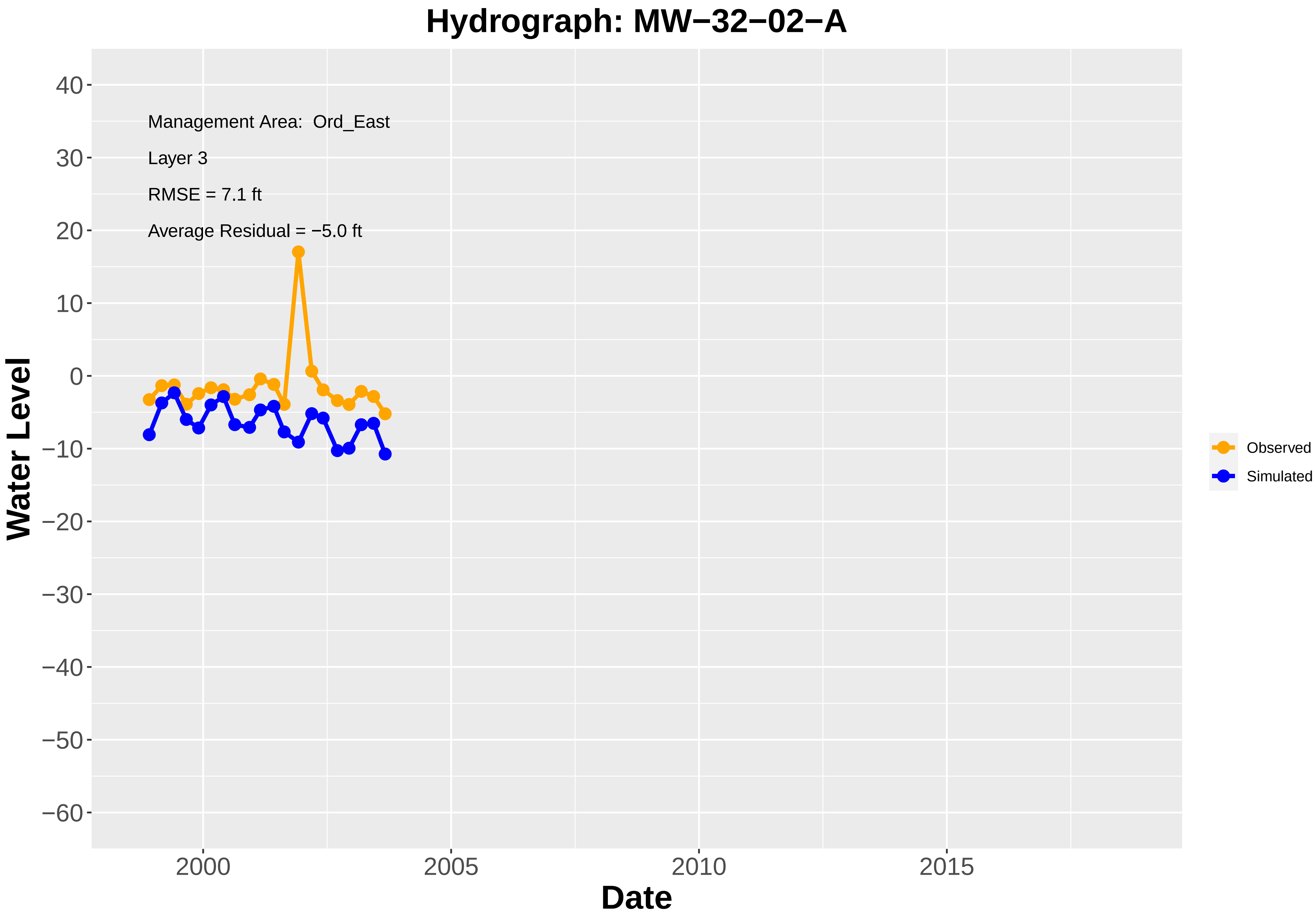


Hydrograph: MW−24−02−180
Management Area: Ord_Seaside
Layer 5
RMSE = 2.3 ft
Average Residual = −2.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



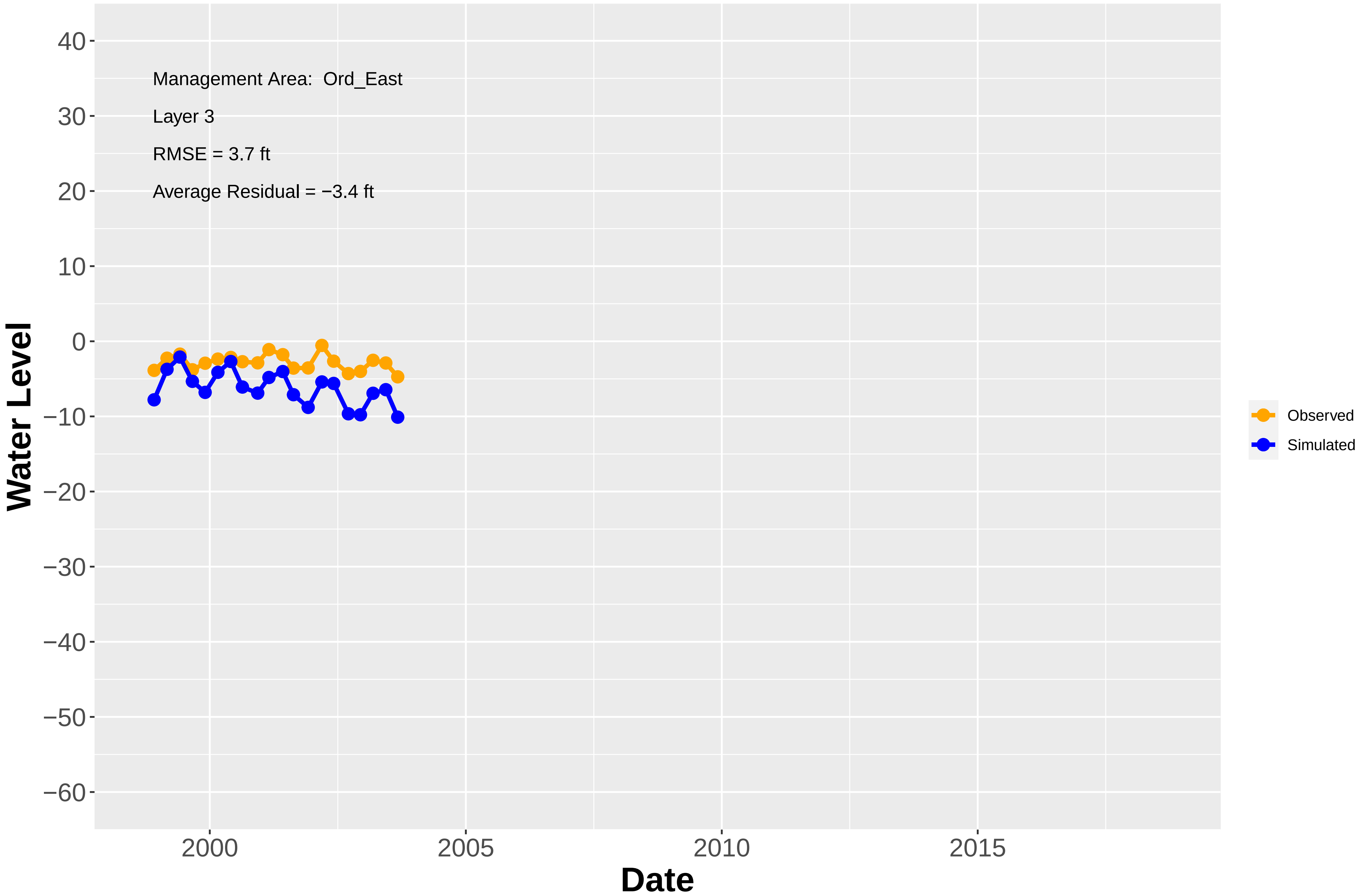
Hydrograph: MW−24−03−180
Management Area: Ord_Seaside
Layer 5
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

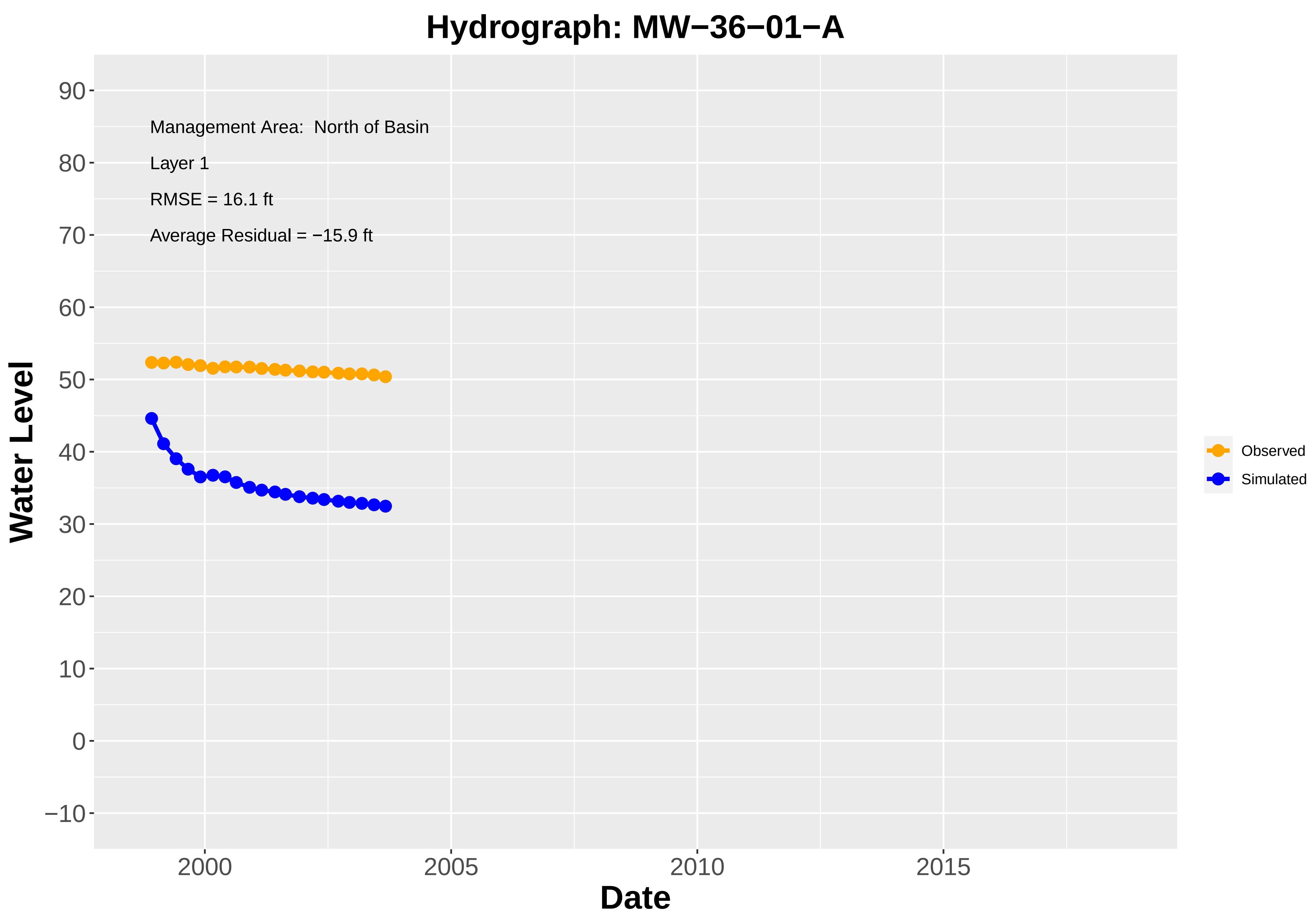

Hydrograph: MW−30−01−180
Management Area: Ord_East
Layer 3
RMSE = 7.1 ft
Average Residual = −2.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



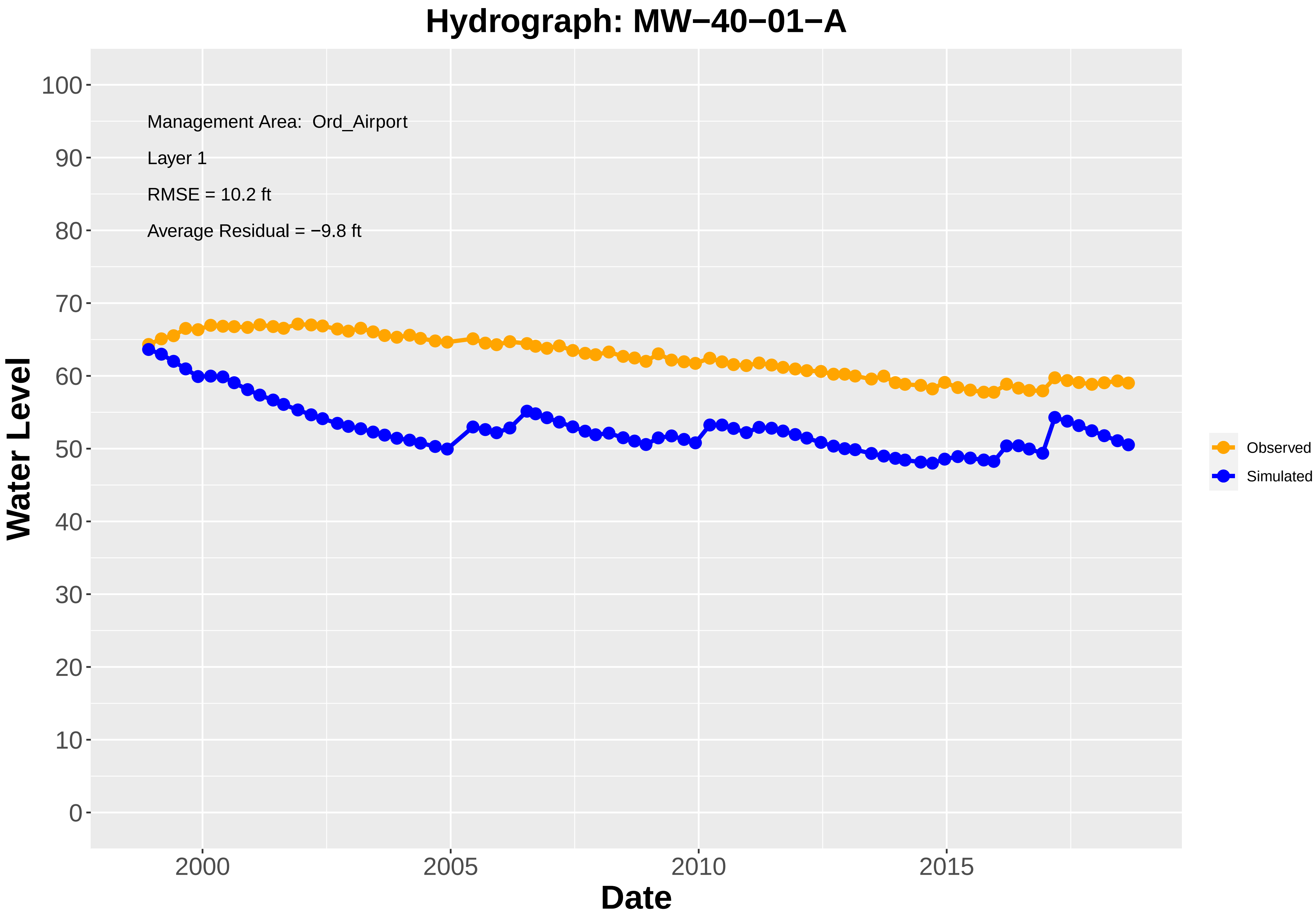
Hydrograph: MW−32−02−A
Management Area: Ord_East
Layer 3
RMSE = 7.1 ft
Average Residual = −5.0 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

Hydrograph: MW−32−03−A

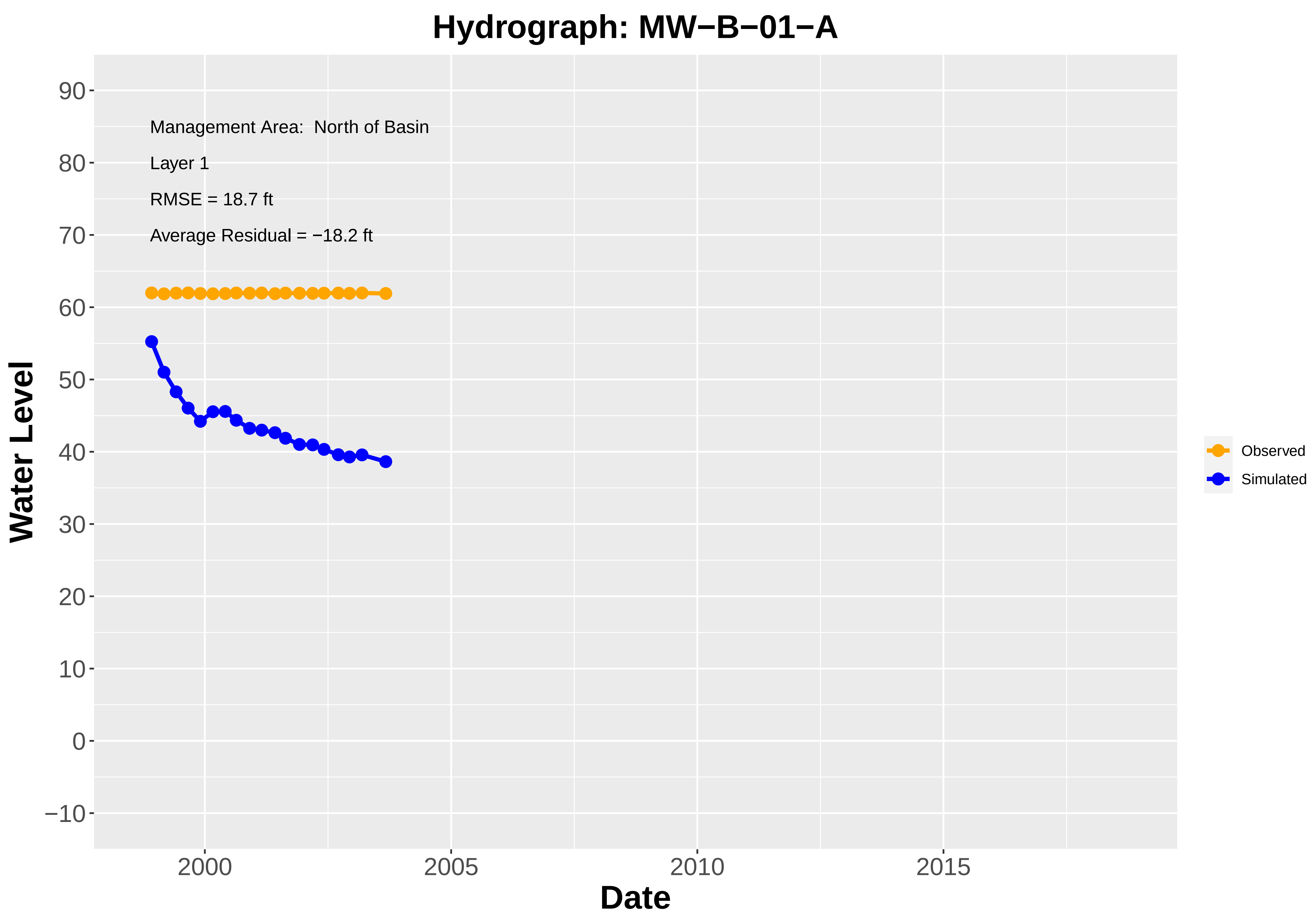




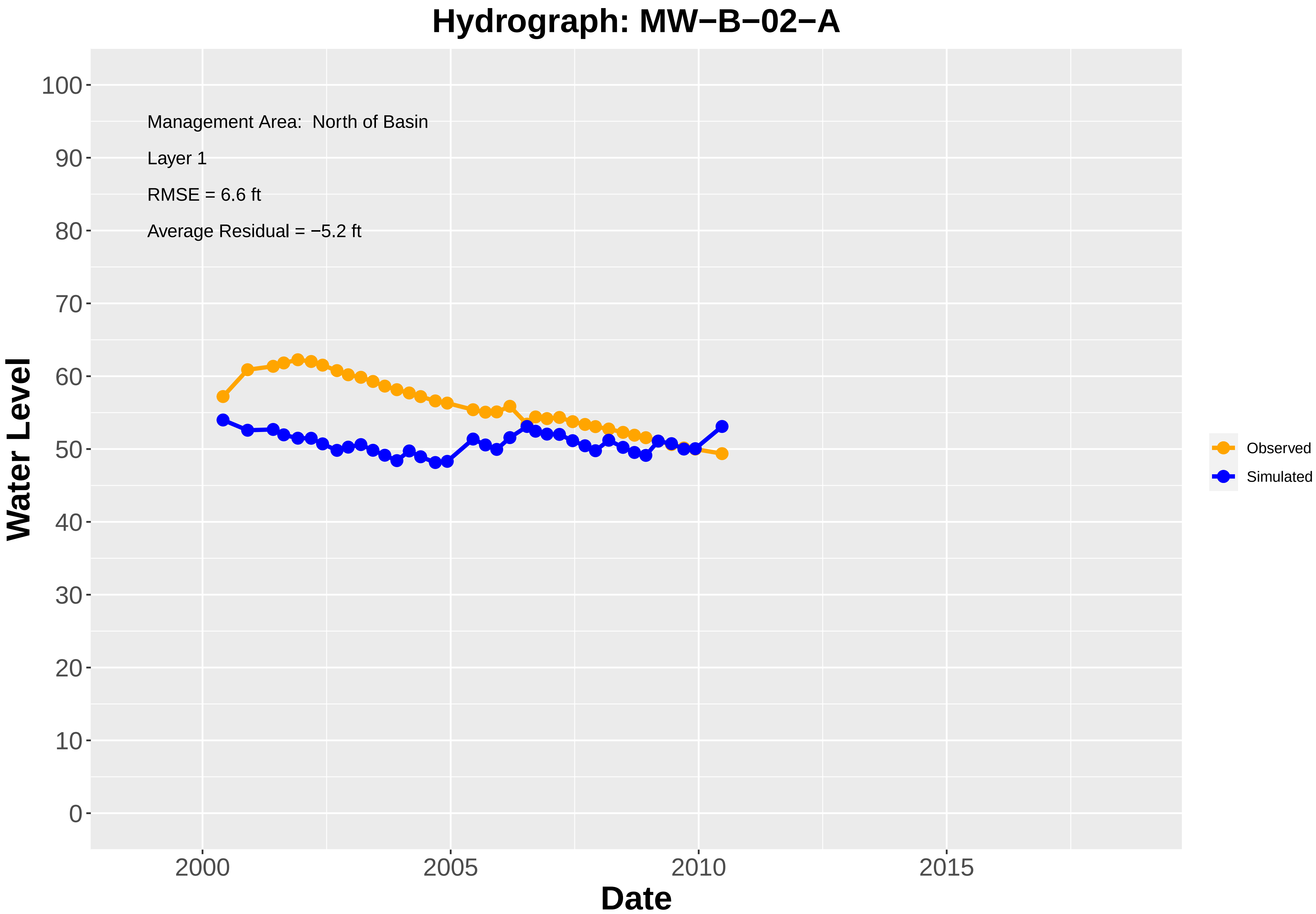
Hydrograph: MW−36−01−A
Management Area: North of Basin
Layer 1
RMSE = 16.1 ft
Average Residual = −15.9 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated



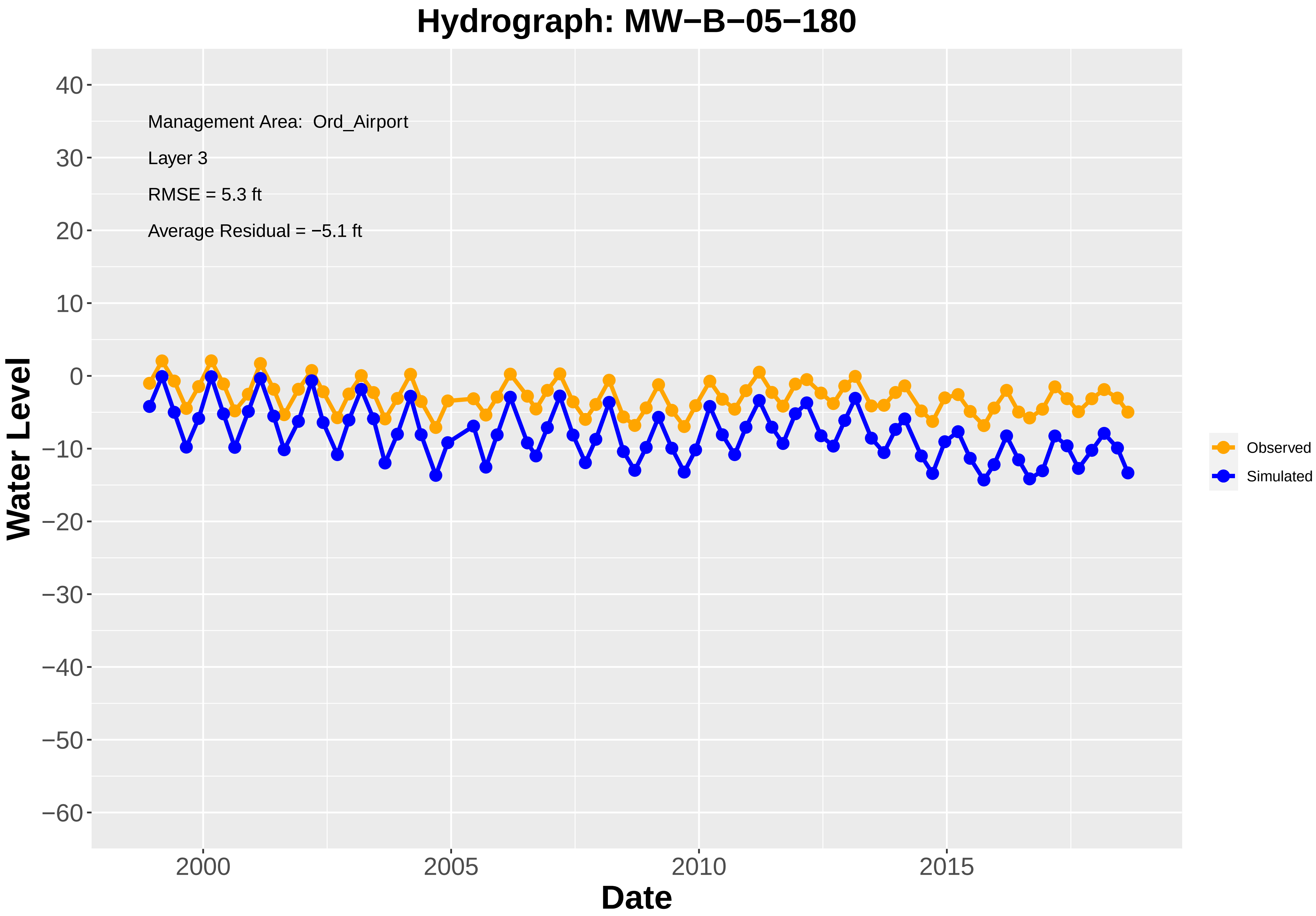
Hydrograph: MW−40−01−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.2 ft
Average Residual = −9.8 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated



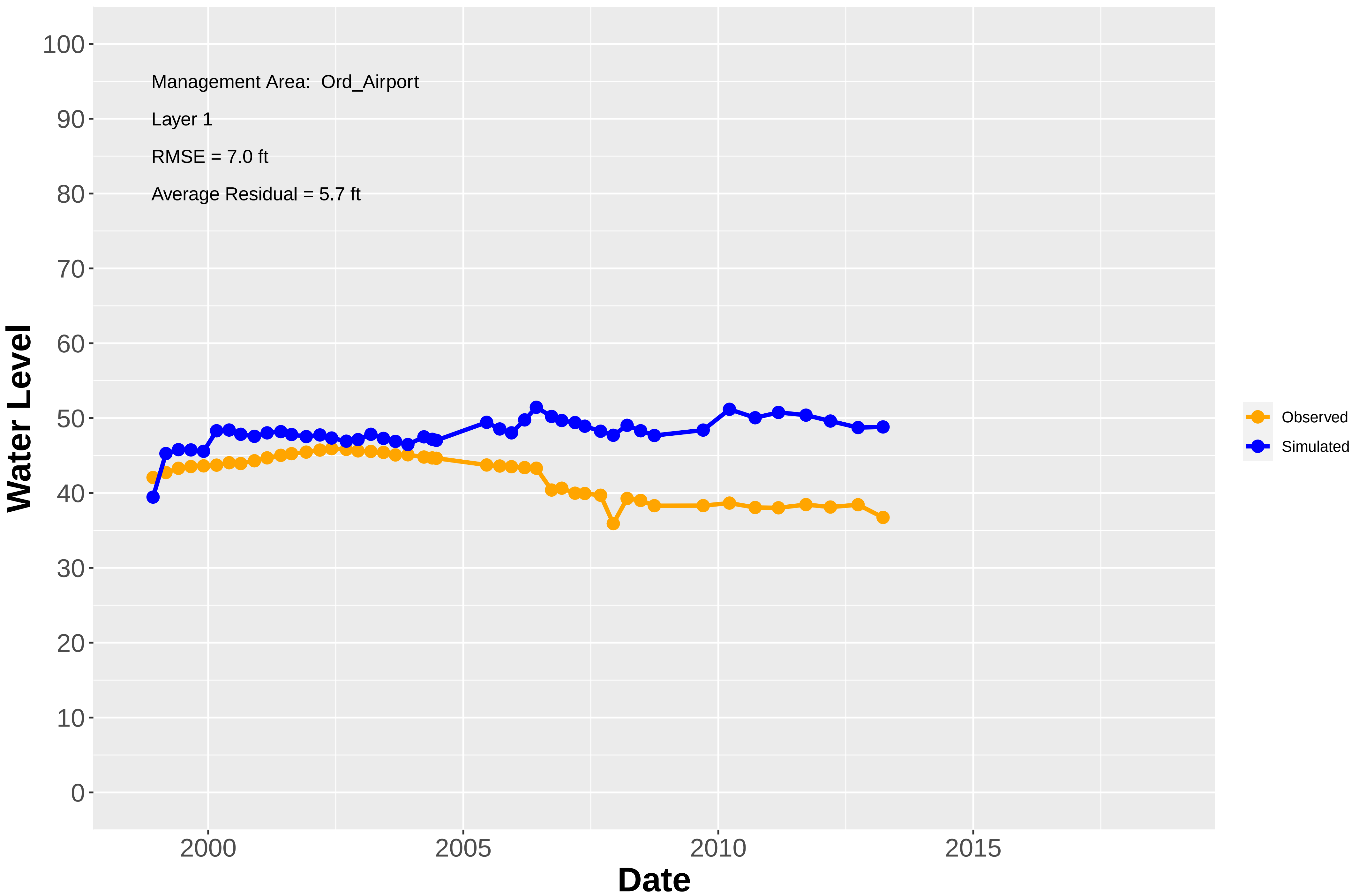
Hydrograph: MW−B−01−A
Management Area: North of Basin
Layer 1
RMSE = 18.7 ft
Average Residual = −18.2 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated

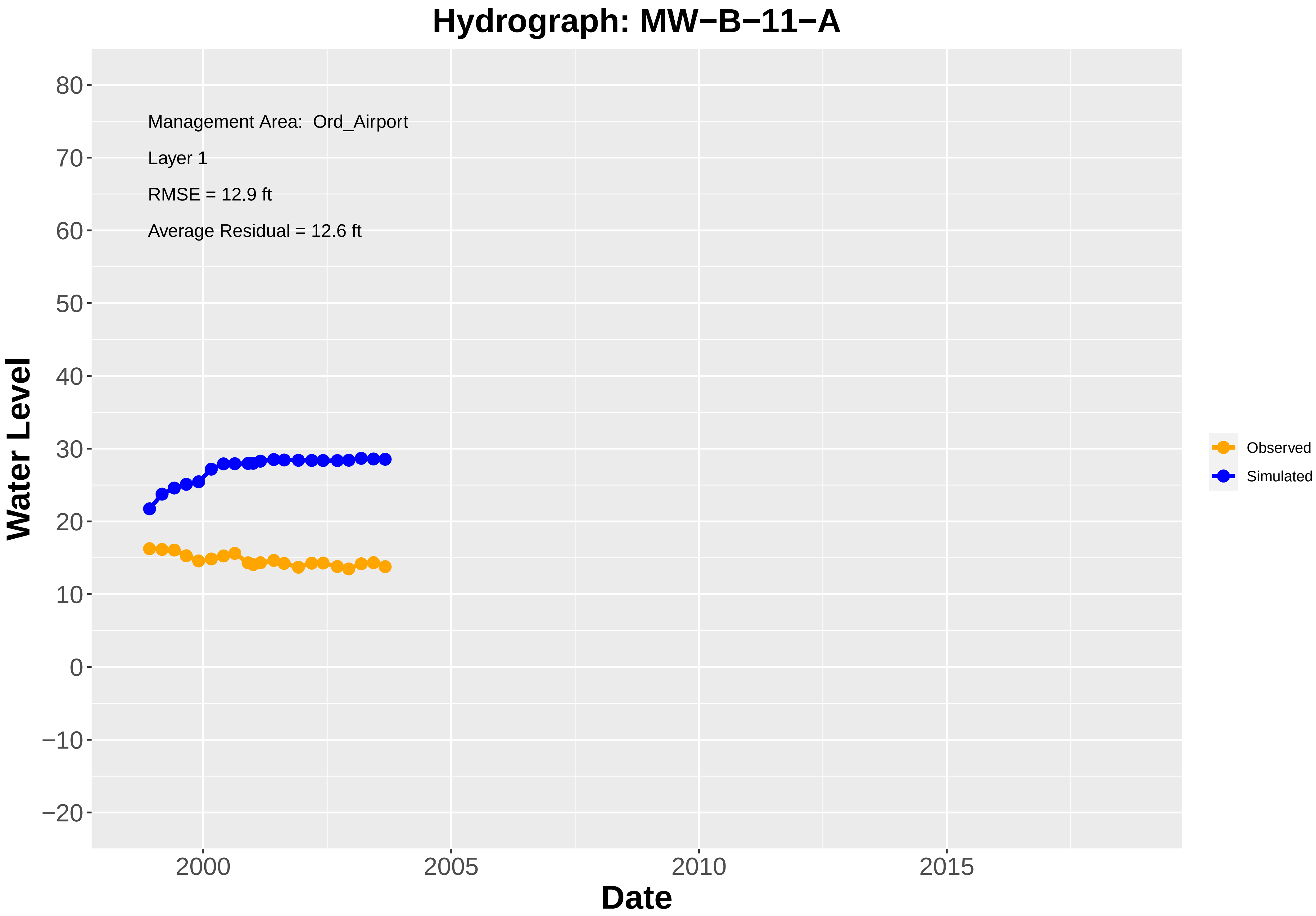


Hydrograph: MW−B−02−A
Management Area: North of Basin
Layer 1
RMSE = 6.6 ft
Average Residual = −5.2 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

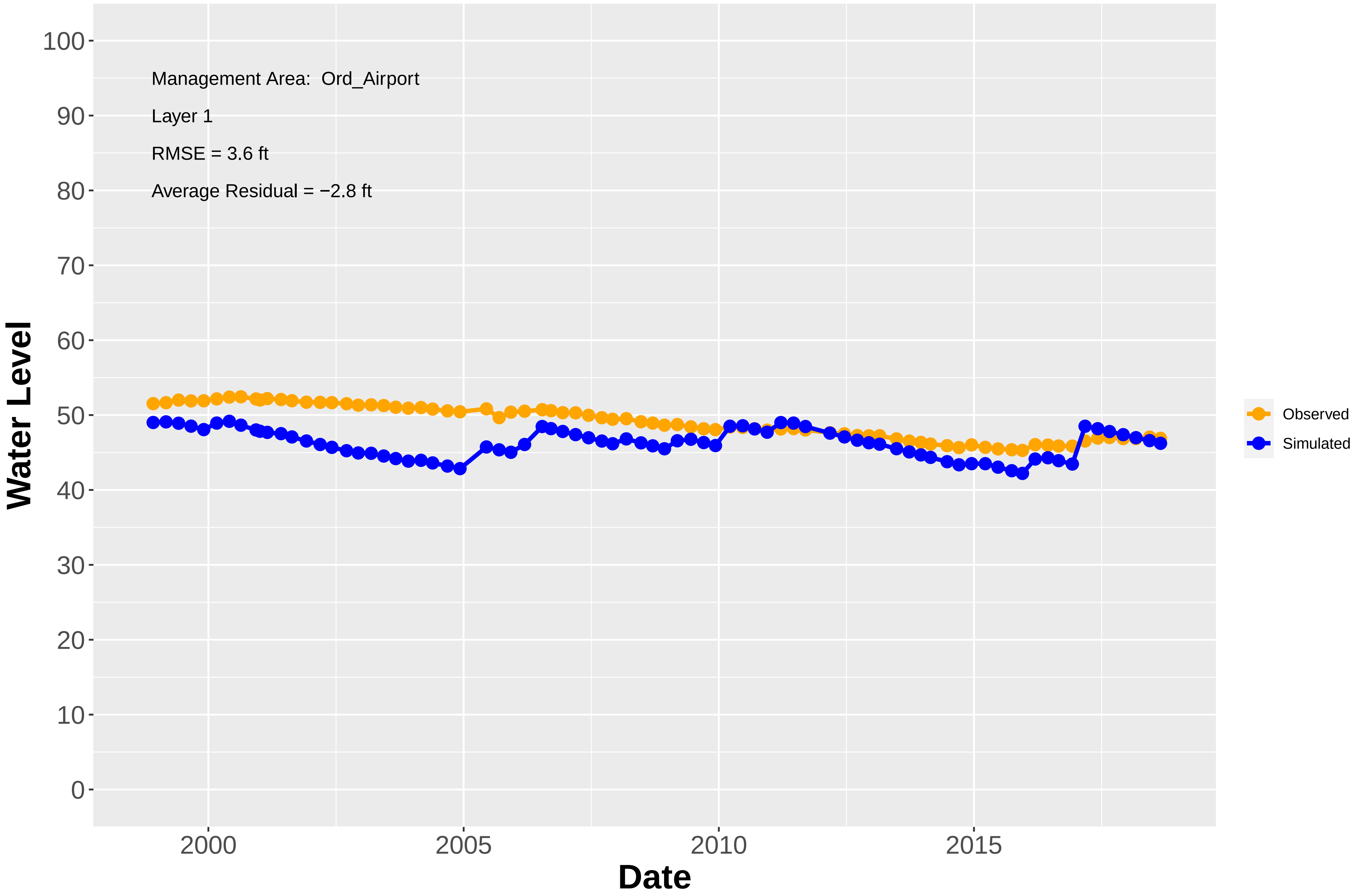

Hydrograph: MW−B−05−180
Management Area: Ord_Airport
Layer 3
RMSE = 5.3 ft
Average Residual = −5.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

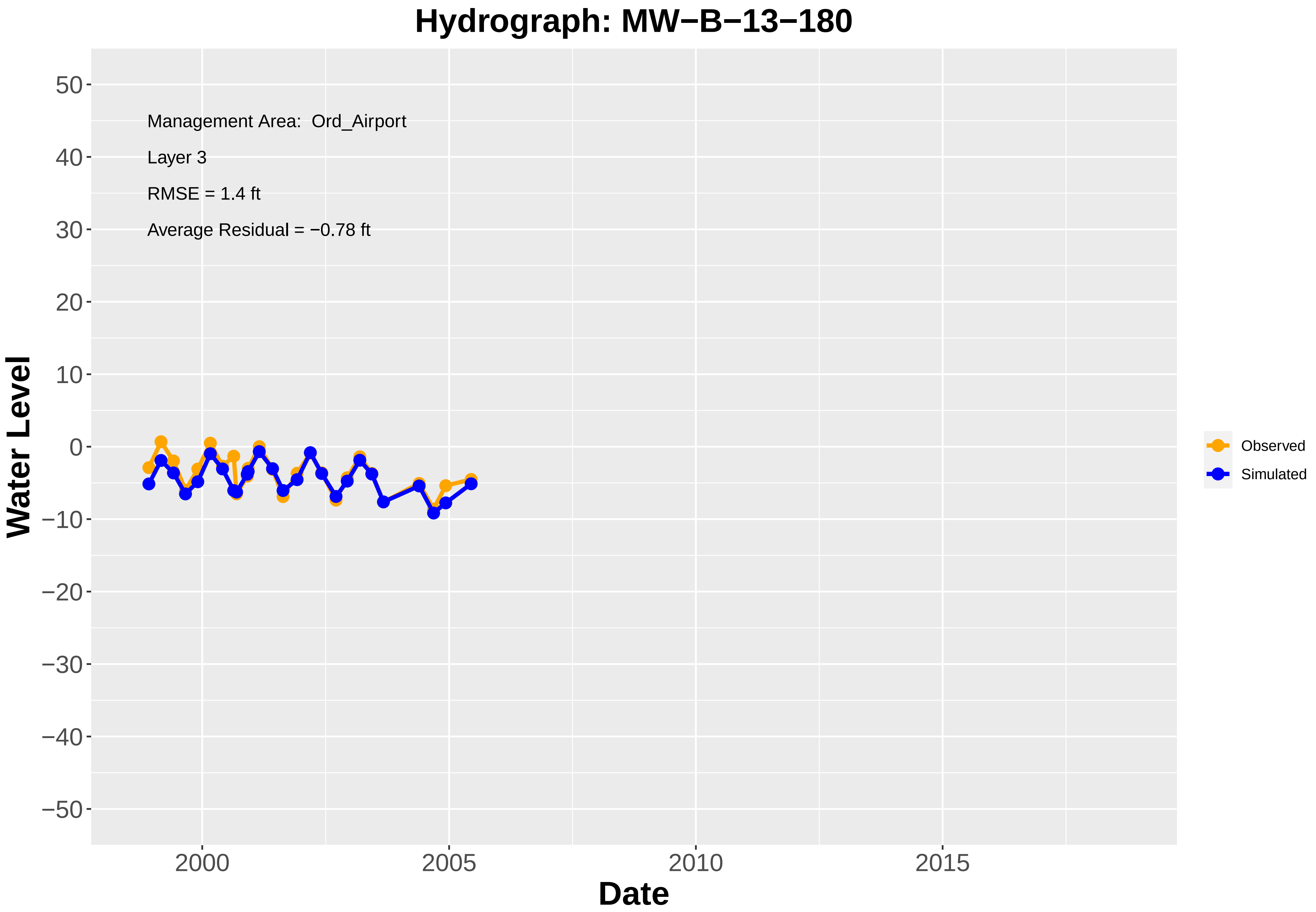
Hydrograph: MW−B−10−A

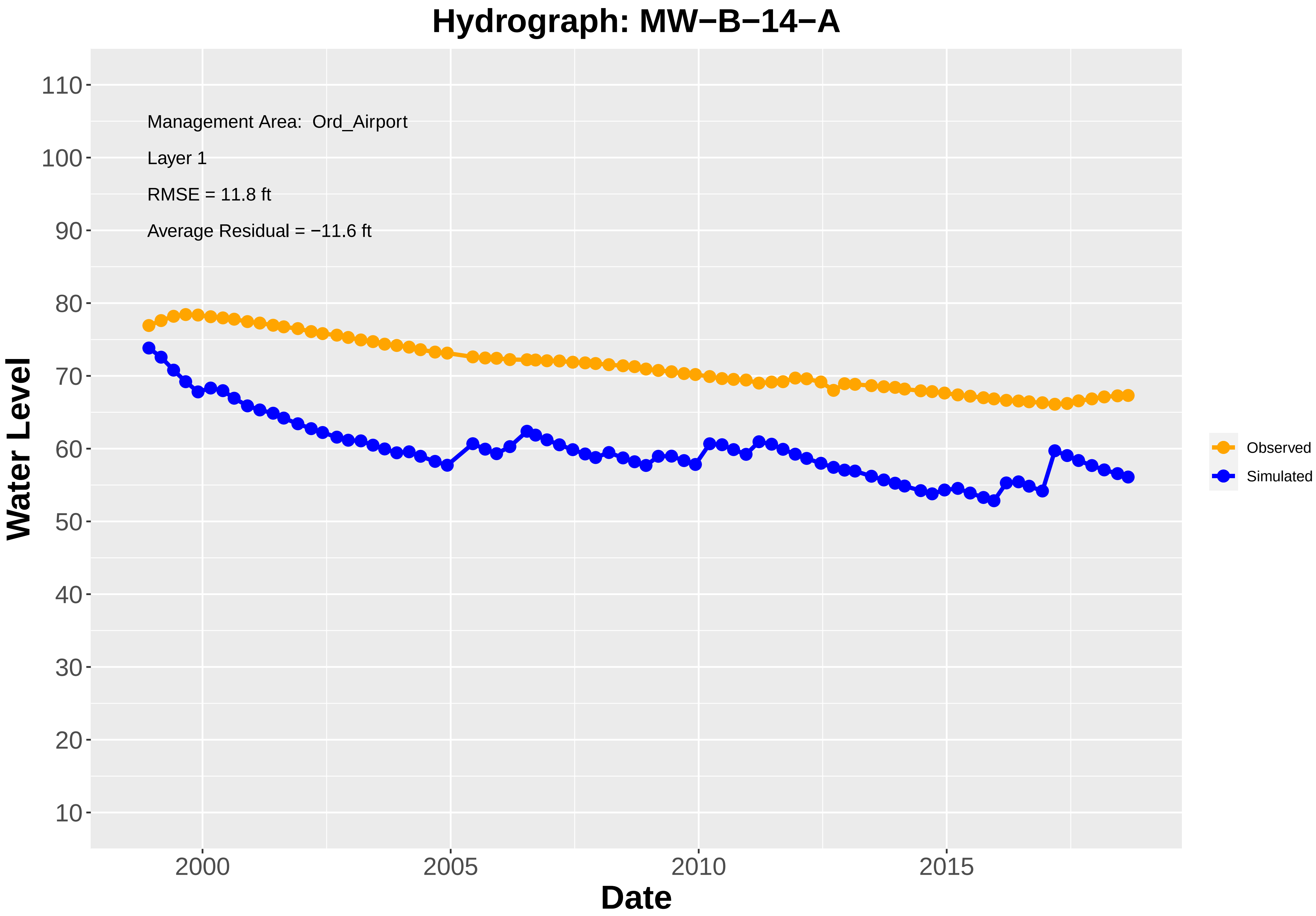



Hydrograph: MW−B−11−A
Management Area: Ord_Airport
Layer 1
RMSE = 12.9 ft
Average Residual = 12.6 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

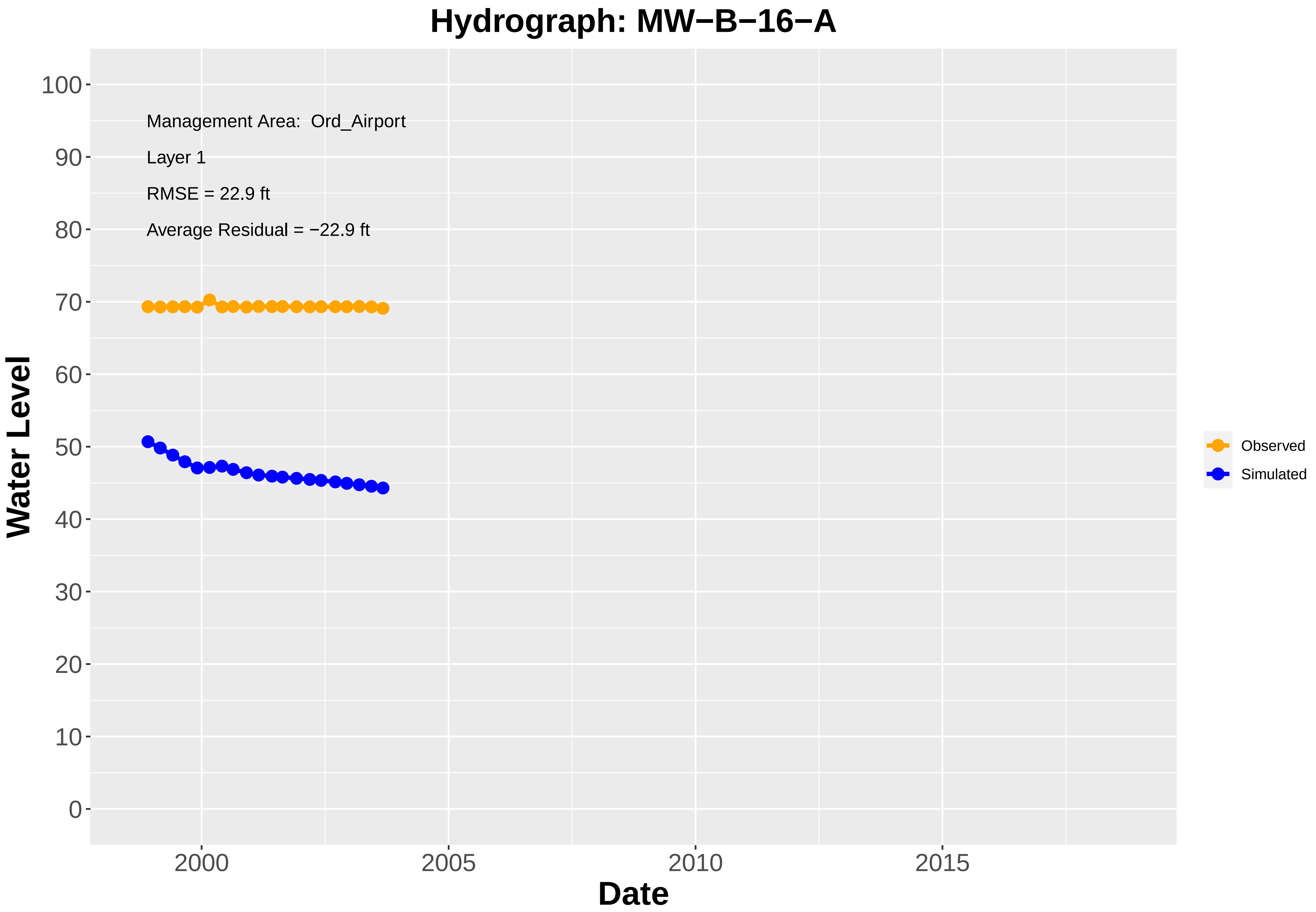
Hydrograph: MW−B−12−A



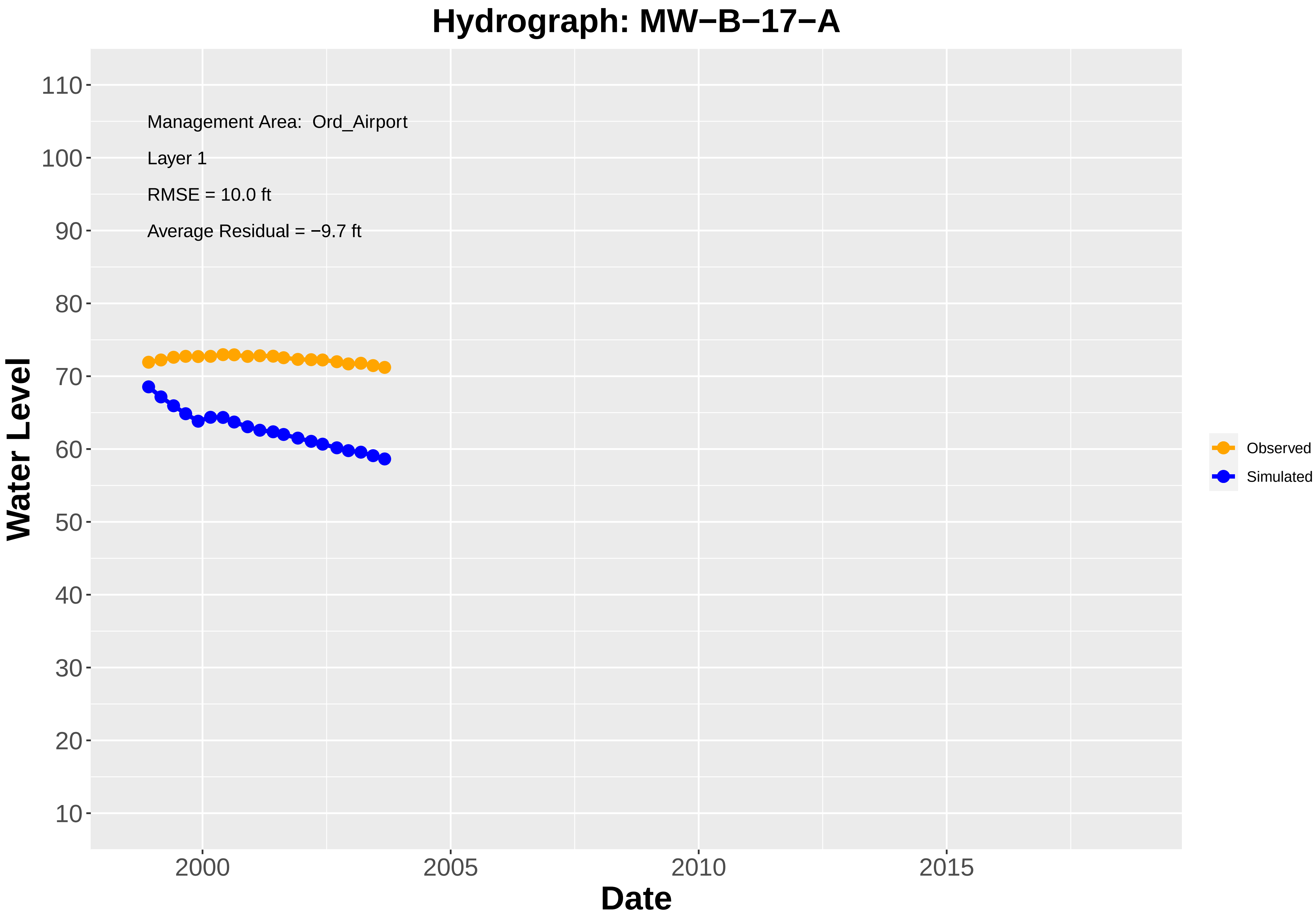

Hydrograph: MW−B−13−180
Management Area: Ord_Airport
Layer 3
RMSE = 1.4 ft
Average Residual = −0.78 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



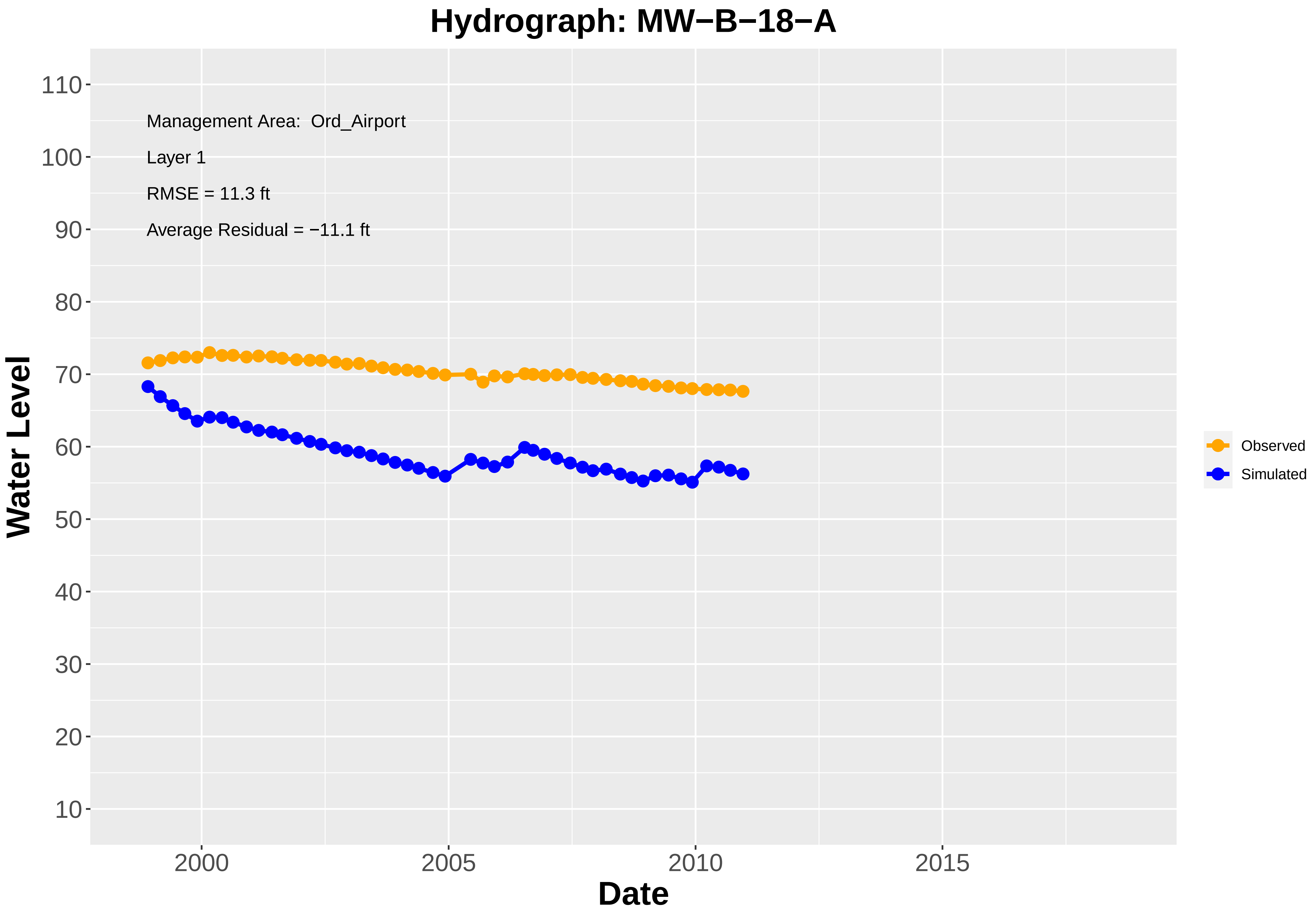
Hydrograph: MW−B−14−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.8 ft
Average Residual = −11.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



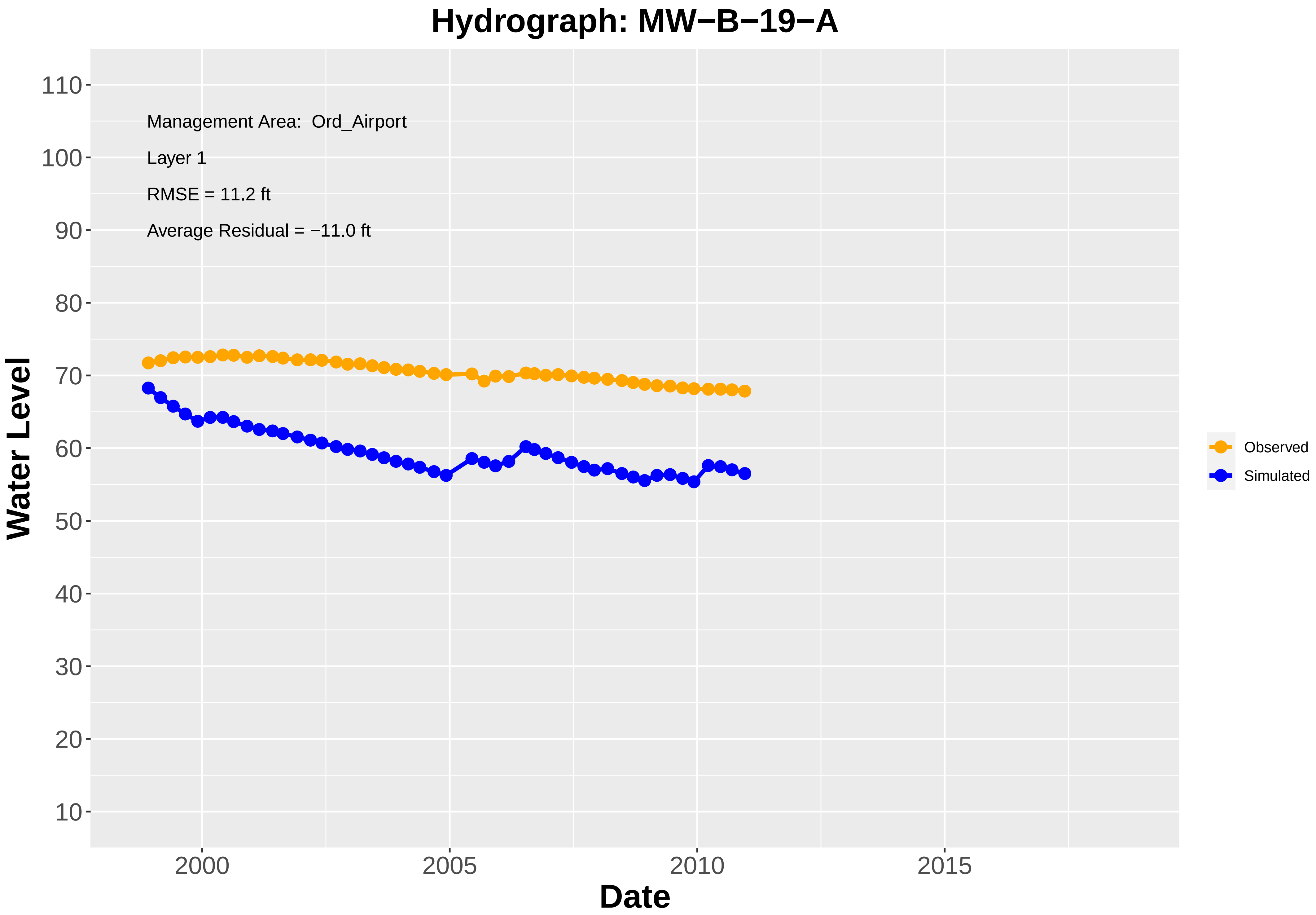
Hydrograph: MW−B−16−A
Management Area: Ord_Airport
Layer 1
RMSE = 22.9 ft
Average Residual = −22.9 ft
Water Level
Date
Observed
Simulated

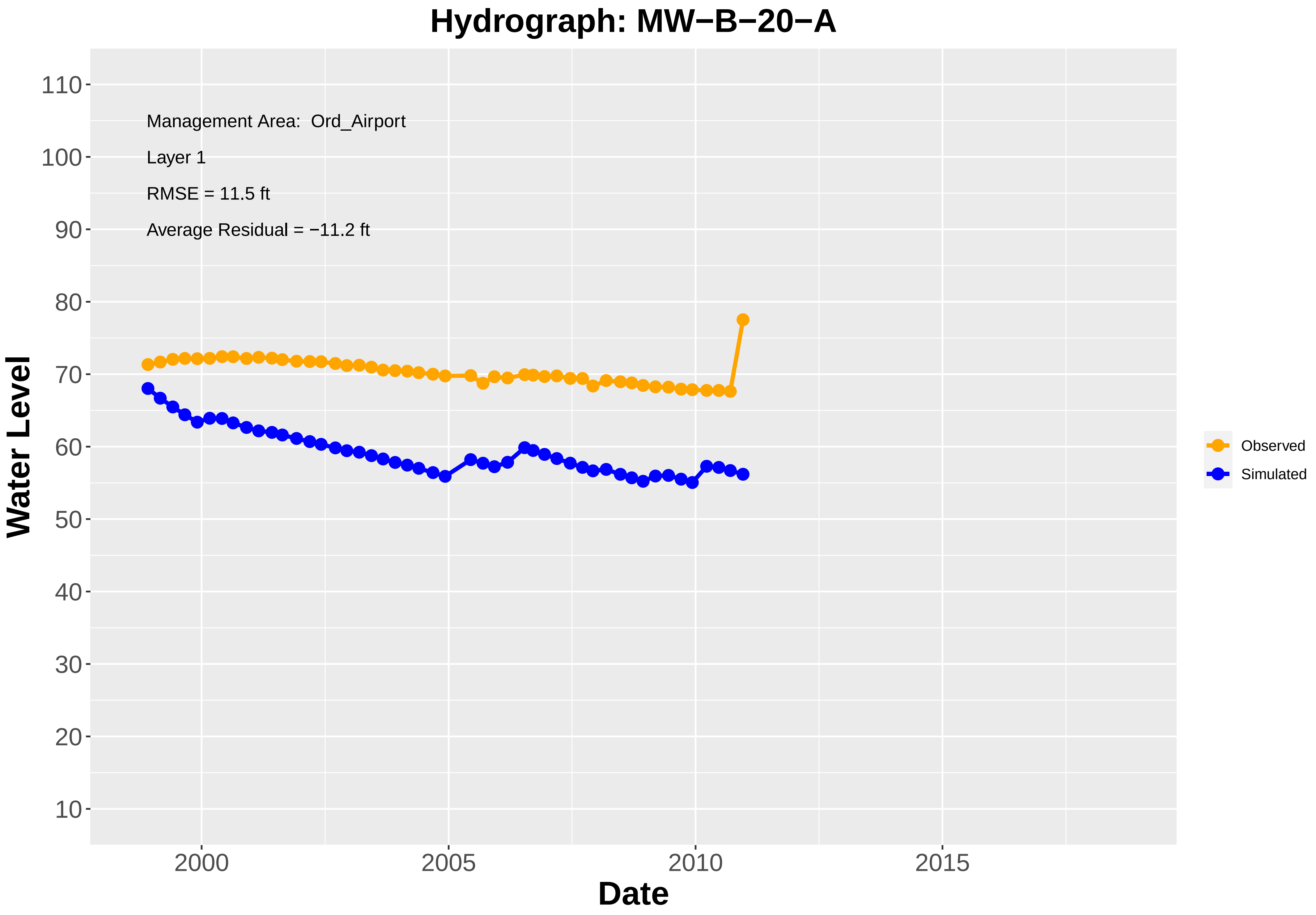


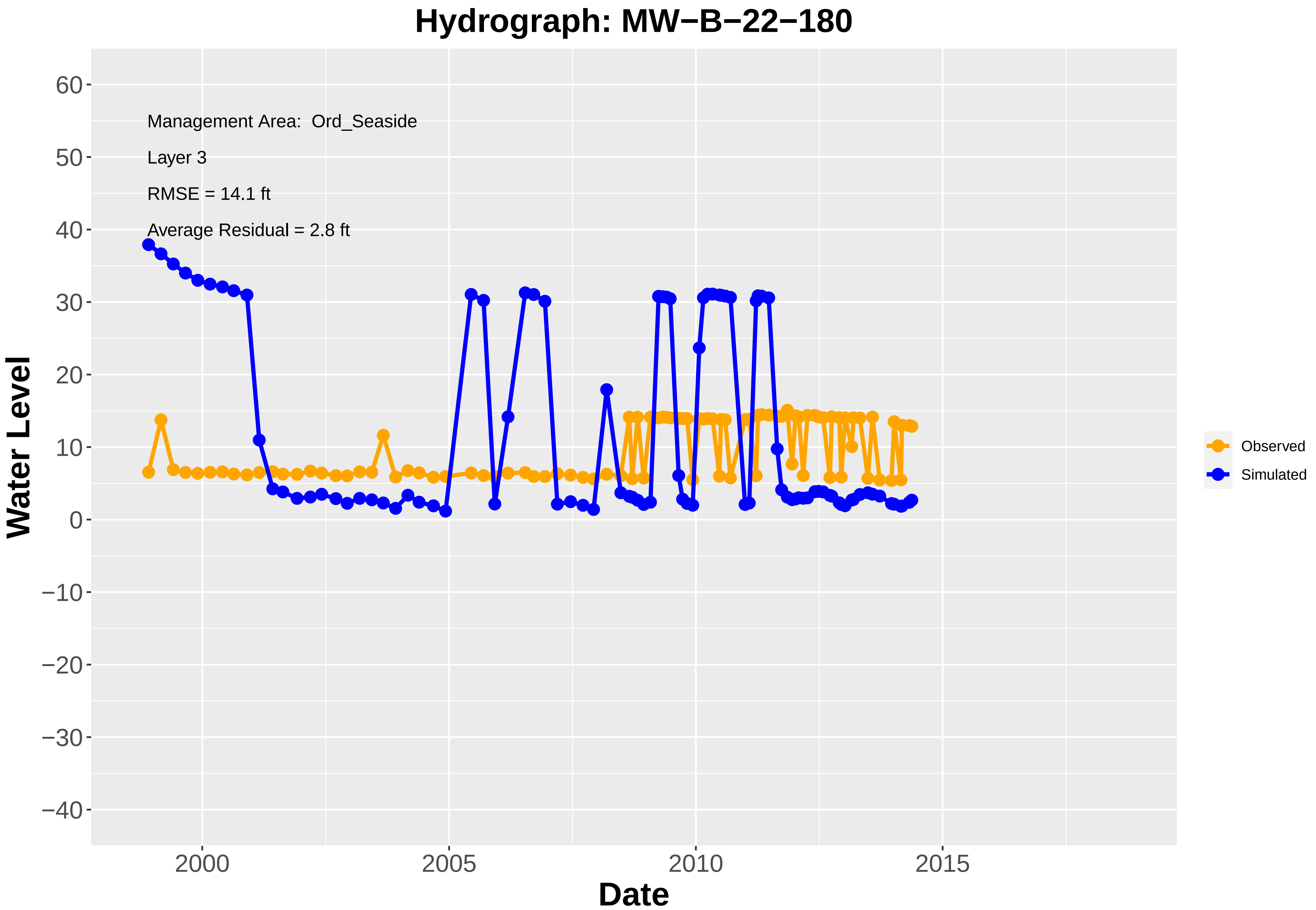
Hydrograph: MW−B−17−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.0 ft
Average Residual = −9.7 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
Date
2000
2005
2010
2015
Observed
Simulated

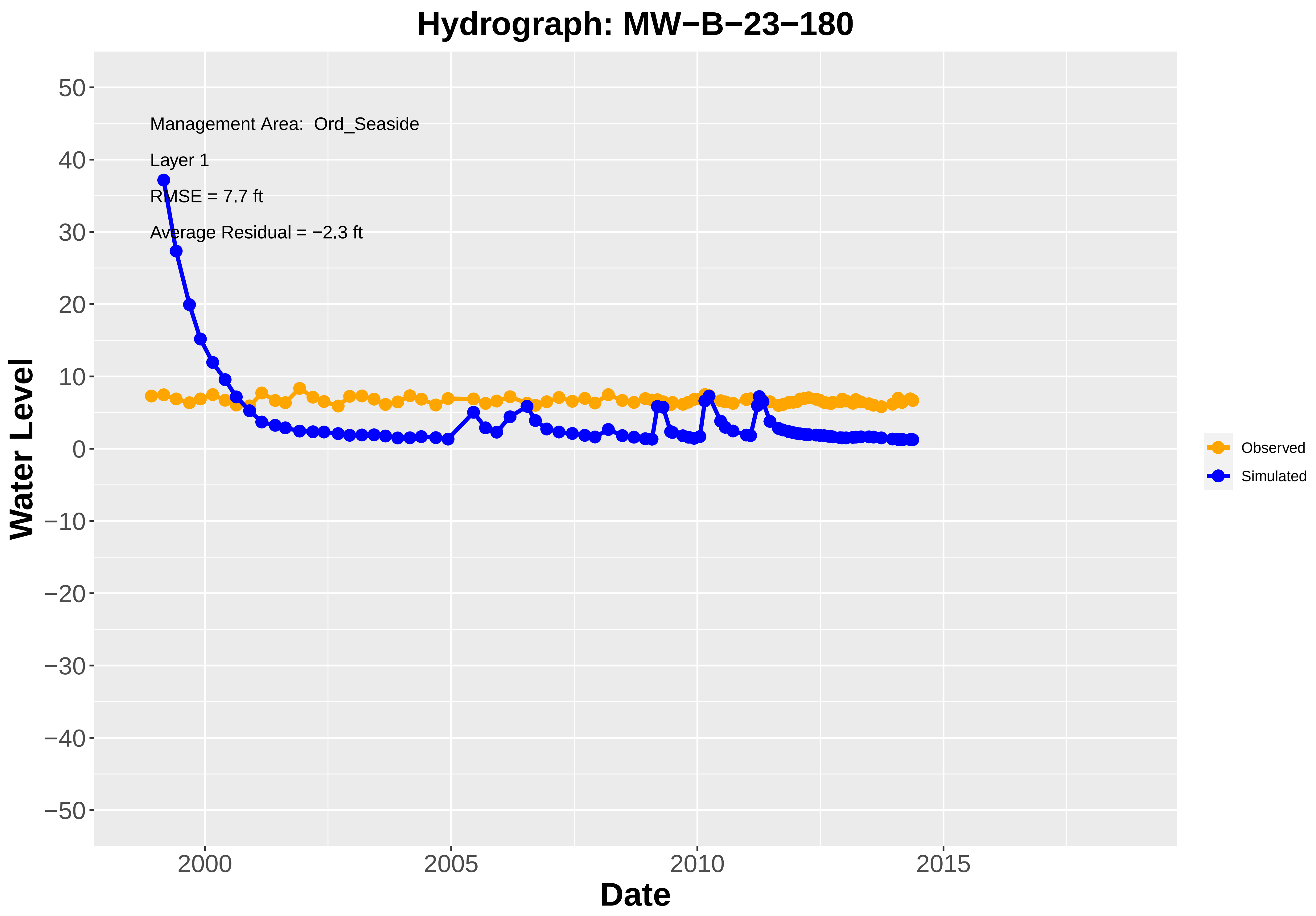


Hydrograph: MW−B−18−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.3 ft
Average Residual = −11.1 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

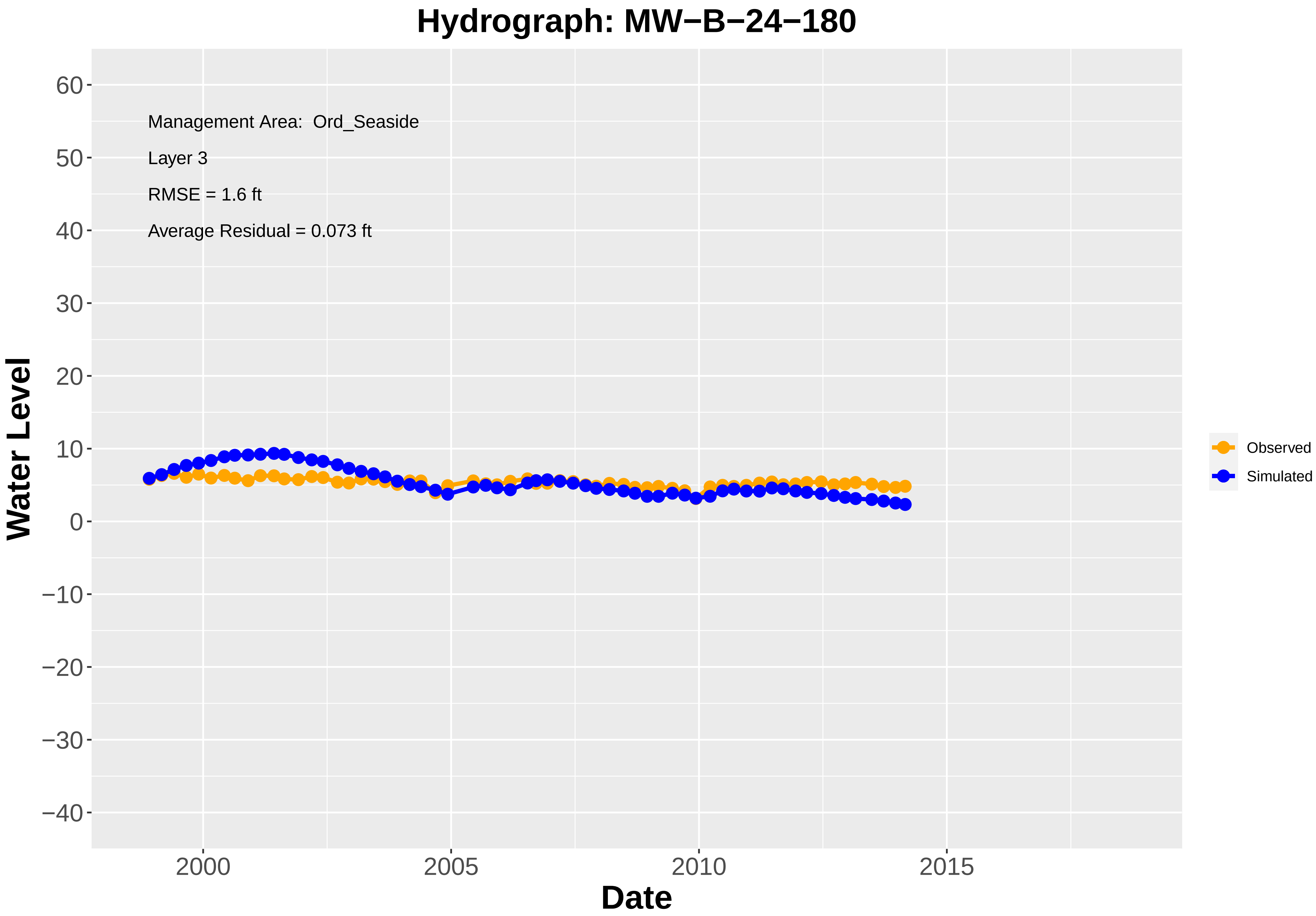

Hydrograph: MW−B−19−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.2 ft
Average Residual = −11.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

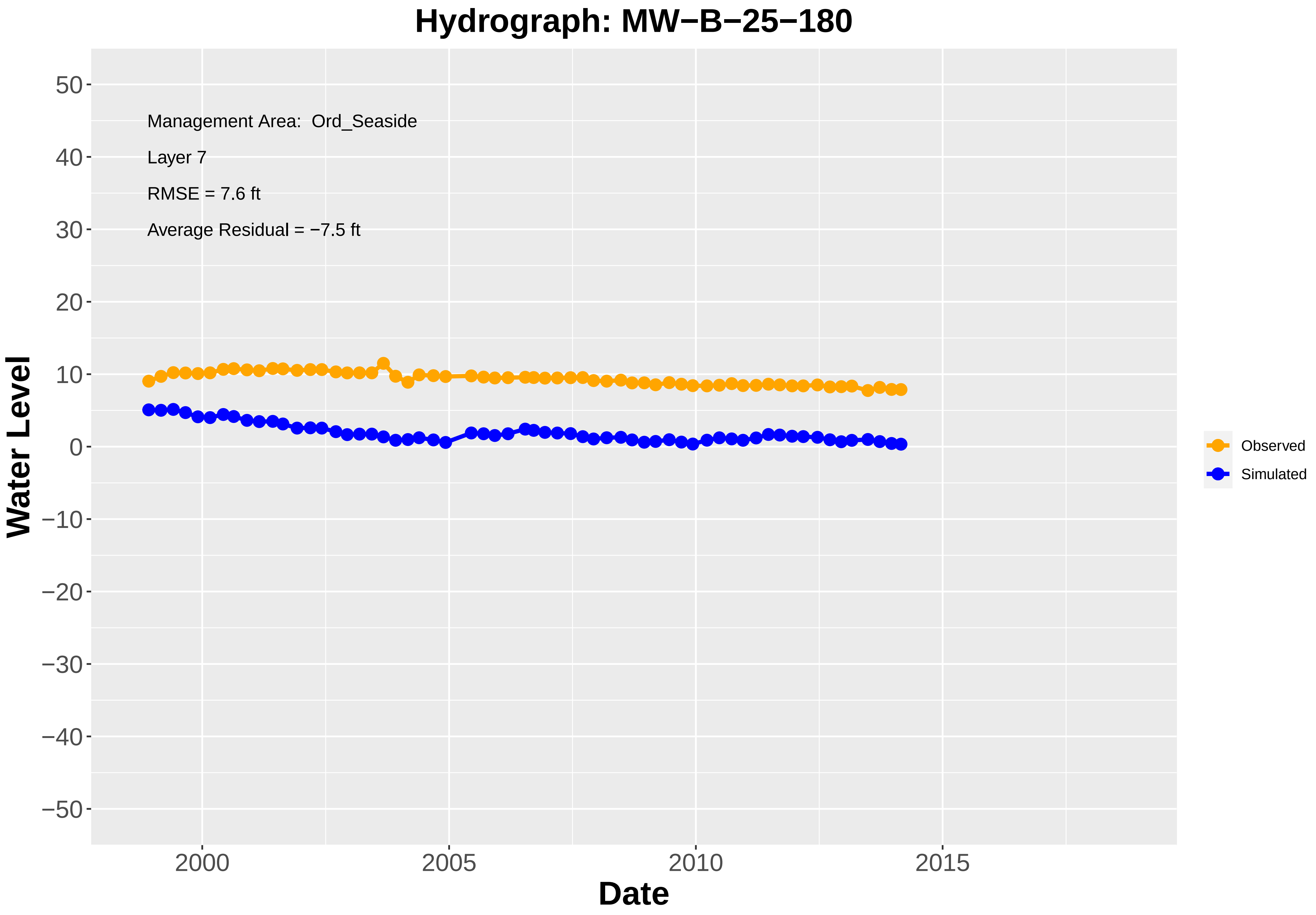

Hydrograph: MW−B−20−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.5 ft
Average Residual = −11.2 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
Date
2000
2005
2010
2015
Observed
Simulated

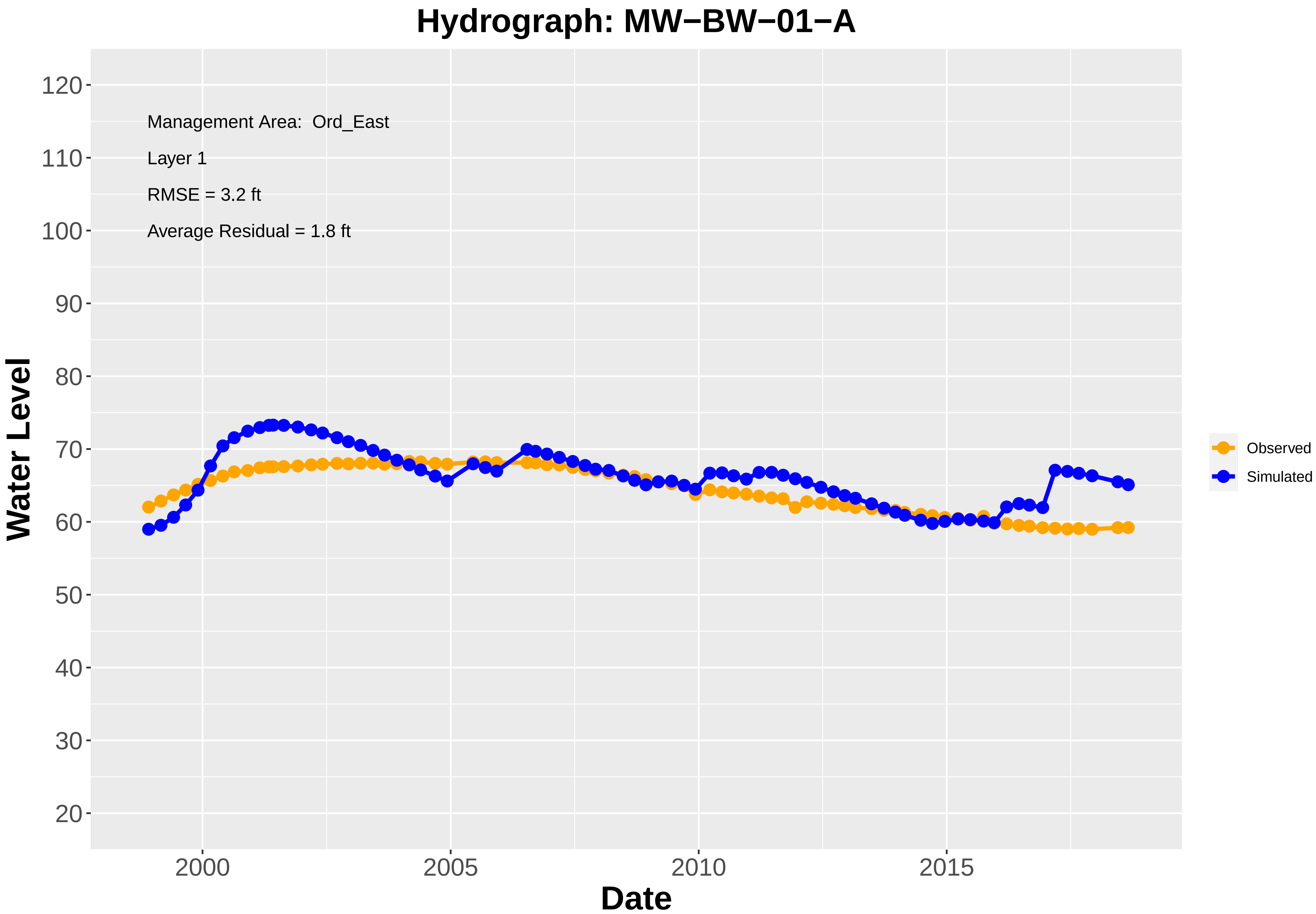

Hydrograph: MW−B−22−180
Management Area: Ord_Seaside
Layer 3
RMSE = 14.1 ft
Average Residual = 2.8 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

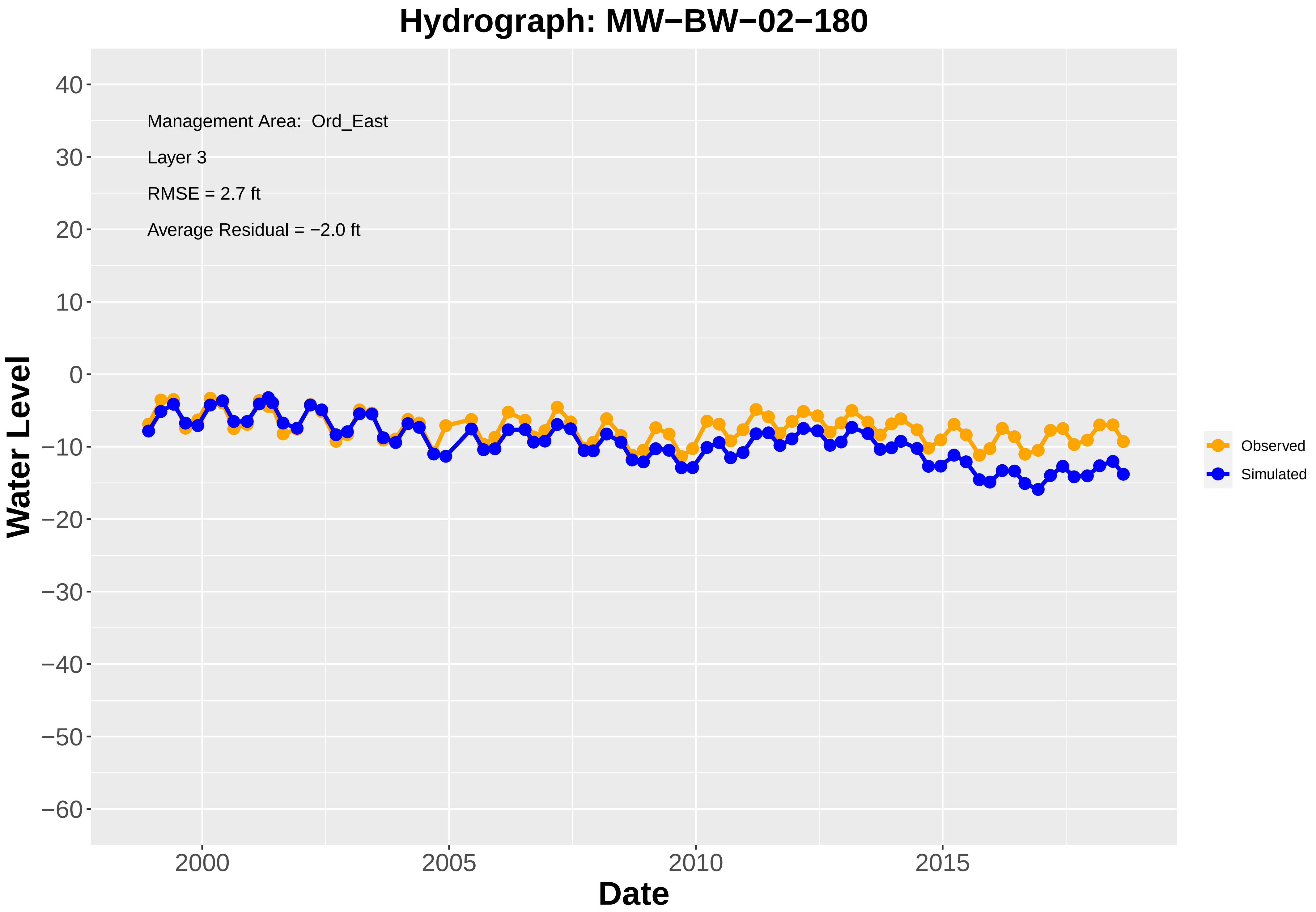


Hydrograph: MW−B−23−180
Management Area: Ord_Seaside
Layer 1
RMSE = 7.7 ft
Average Residual = −2.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

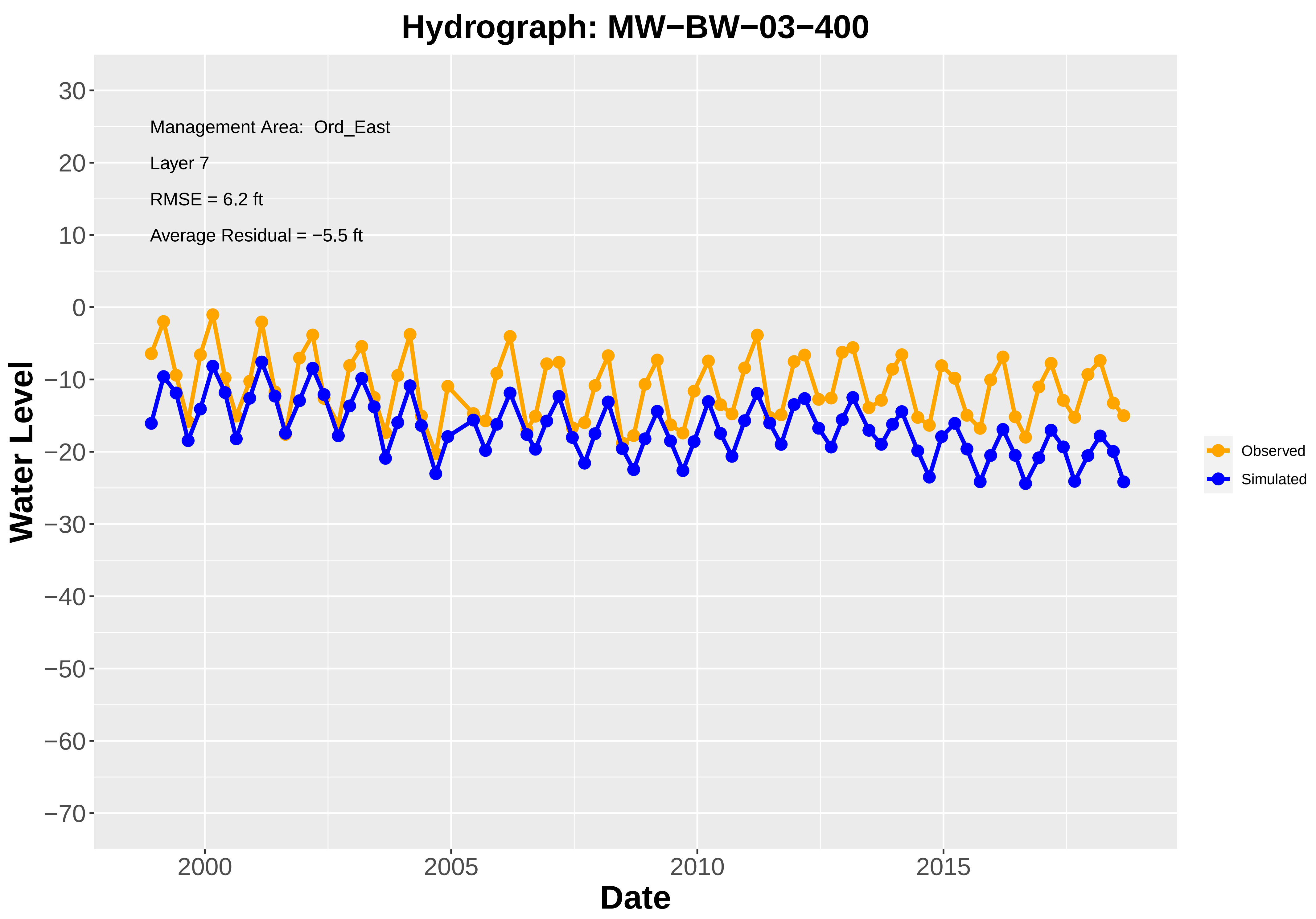

Hydrograph: MW−B−24−180
Management Area: Ord_Seaside
Layer 3
RMSE = 1.6 ft
Average Residual = 0.073 ft
Water Level
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−B−25−180
Management Area: Ord_Seaside
Layer 7
RMSE = 7.6 ft
Average Residual = −7.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

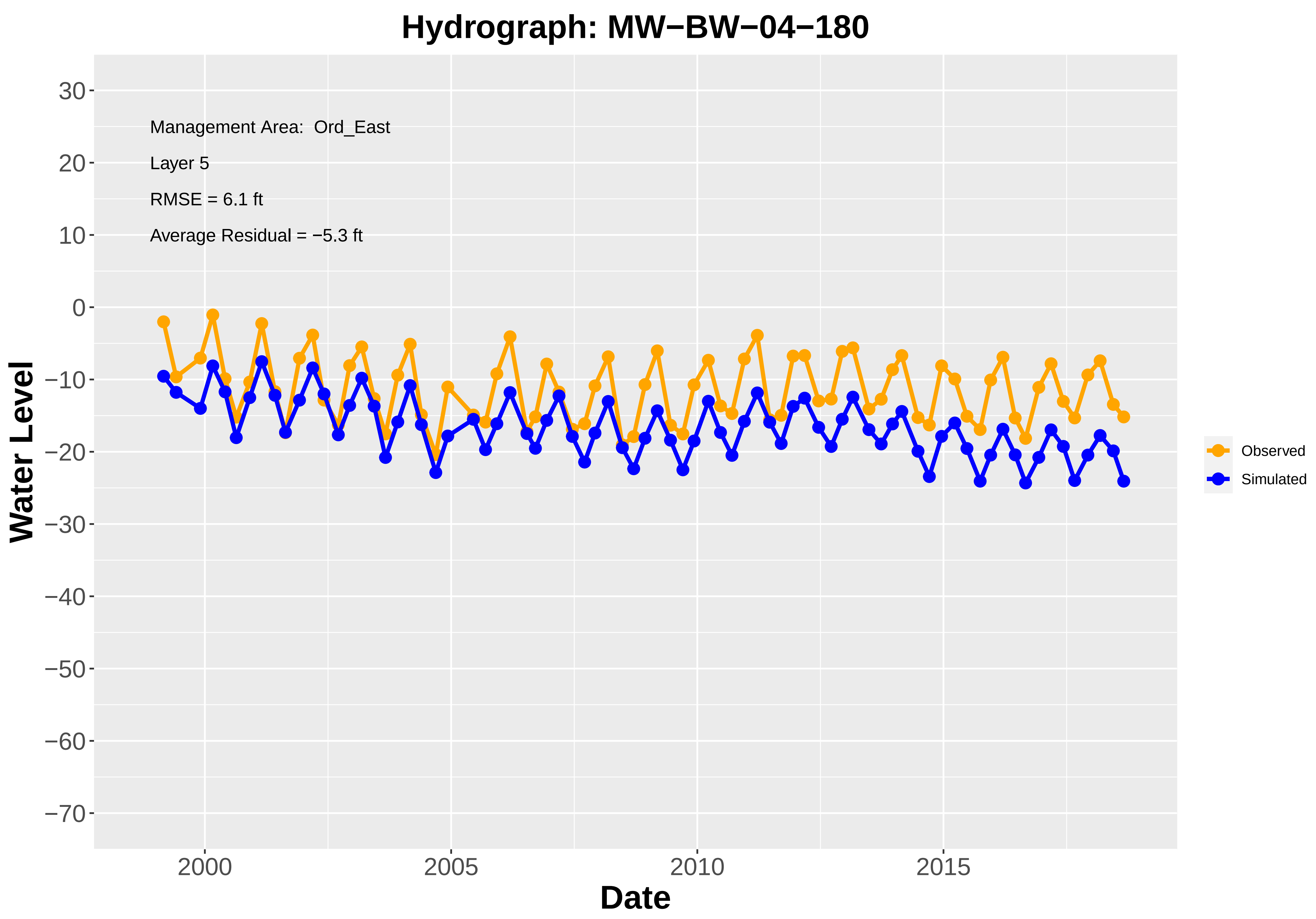

Hydrograph: MW−BW−01−A
Management Area: Ord_East
Layer 1
RMSE = 3.2 ft
Average Residual = 1.8 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated



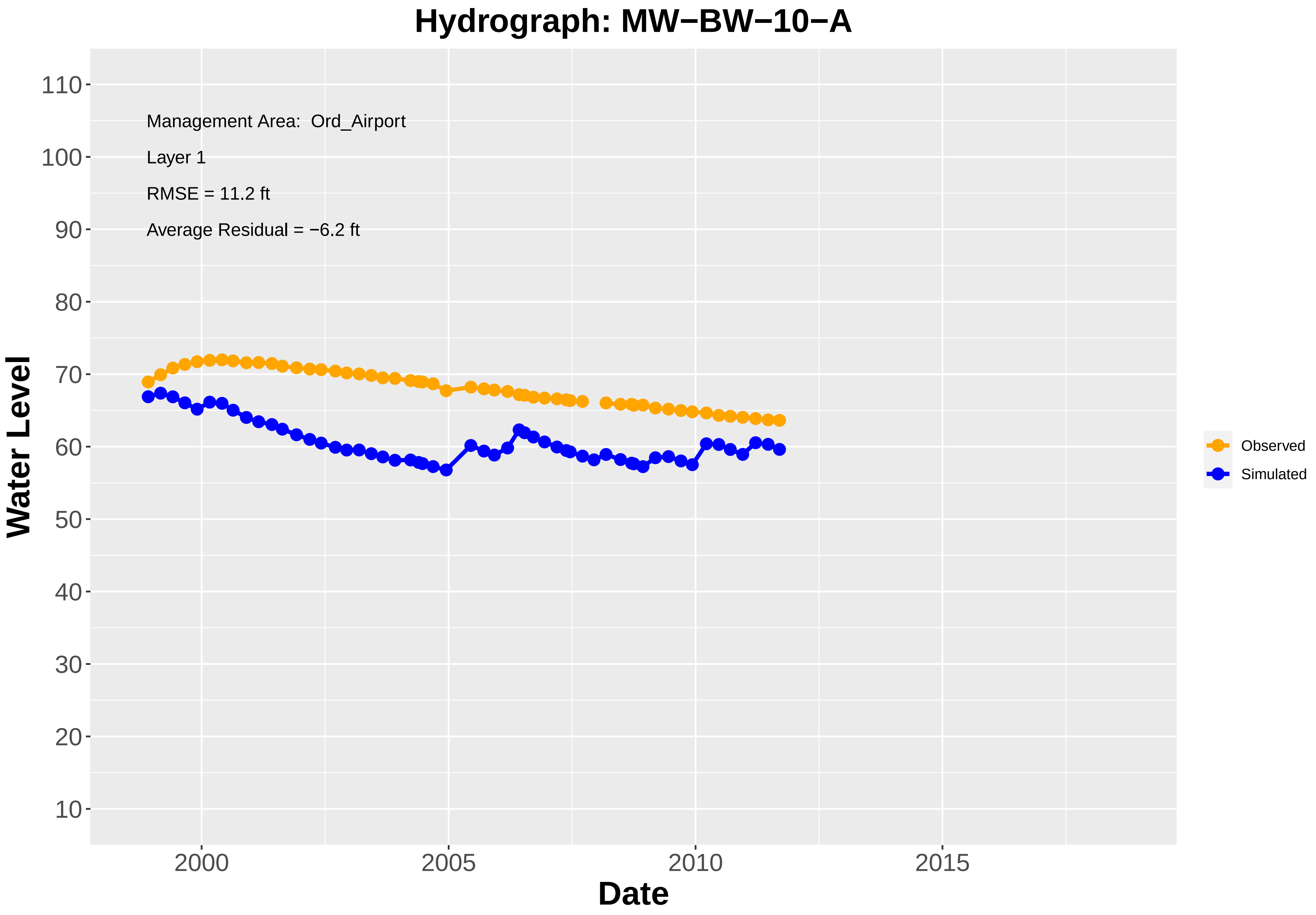
Hydrograph: MW−BW−02−180
Management Area: Ord_East
Layer 3
RMSE = 2.7 ft
Average Residual = −2.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



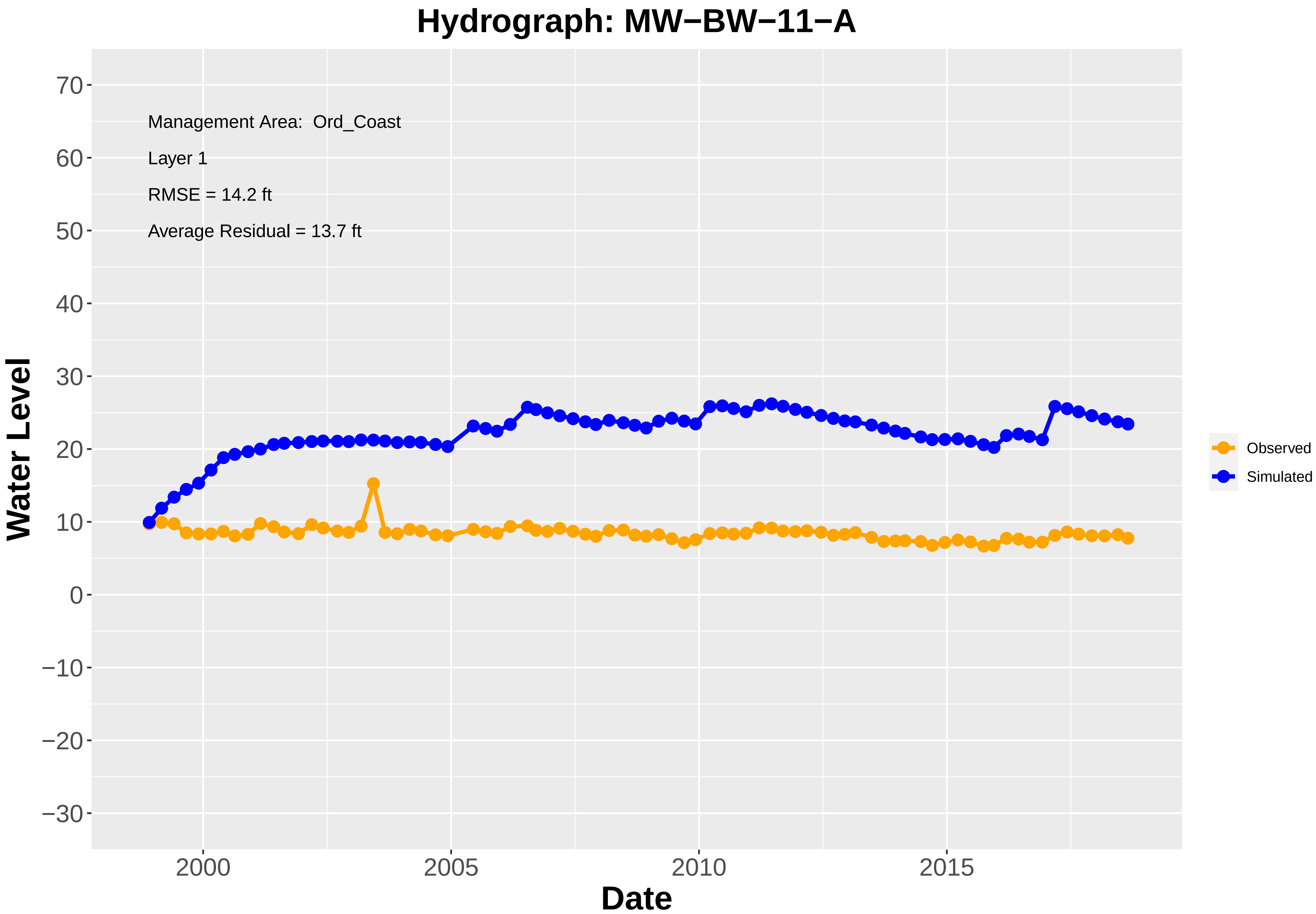
Hydrograph: MW−BW−03−400
Management Area: Ord_East
Layer 7
RMSE = 6.2 ft
Average Residual = −5.5 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



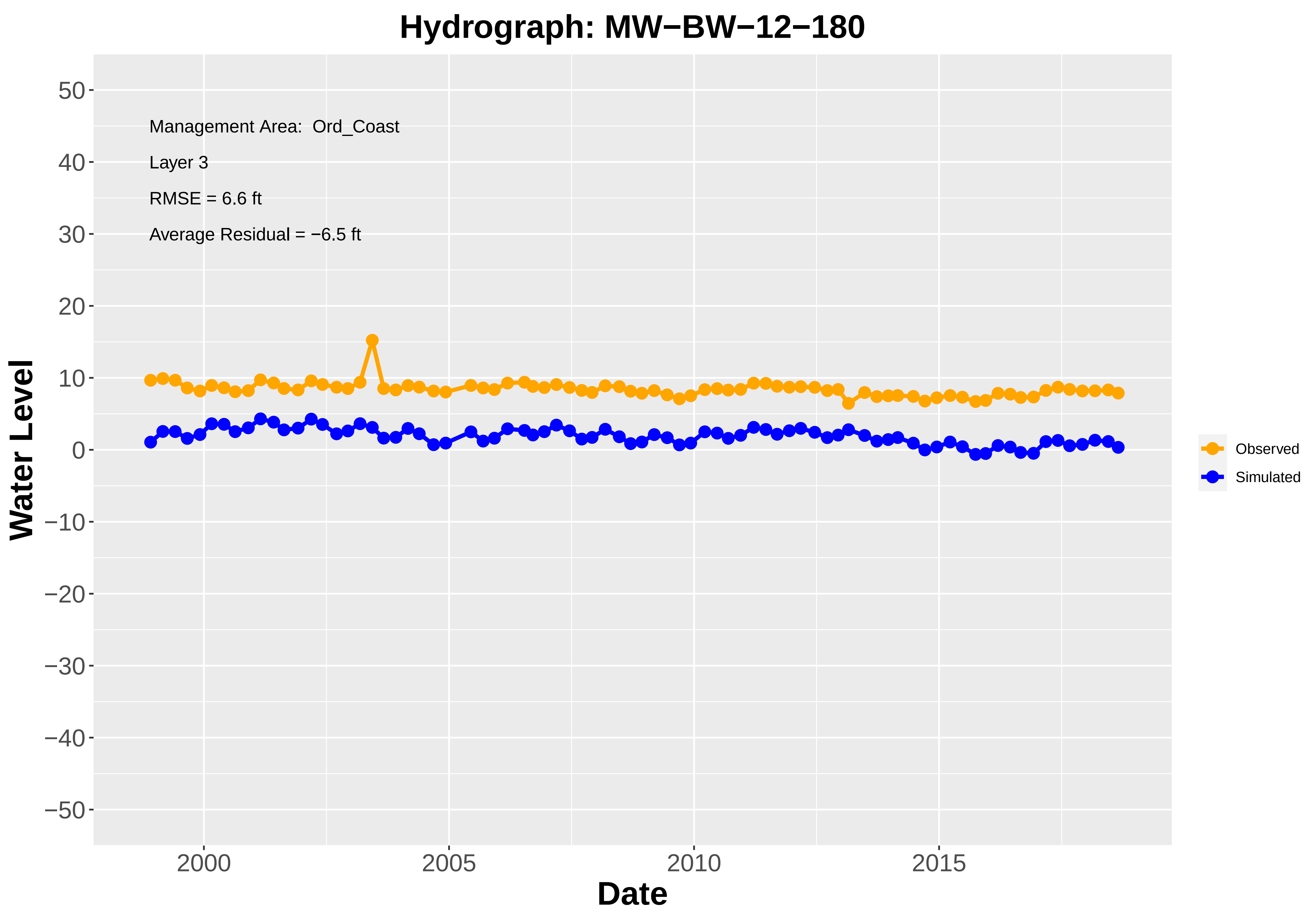
Hydrograph: MW−BW−04−180
Management Area: Ord_East
Layer 5
RMSE = 6.1 ft
Average Residual = −5.3 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated

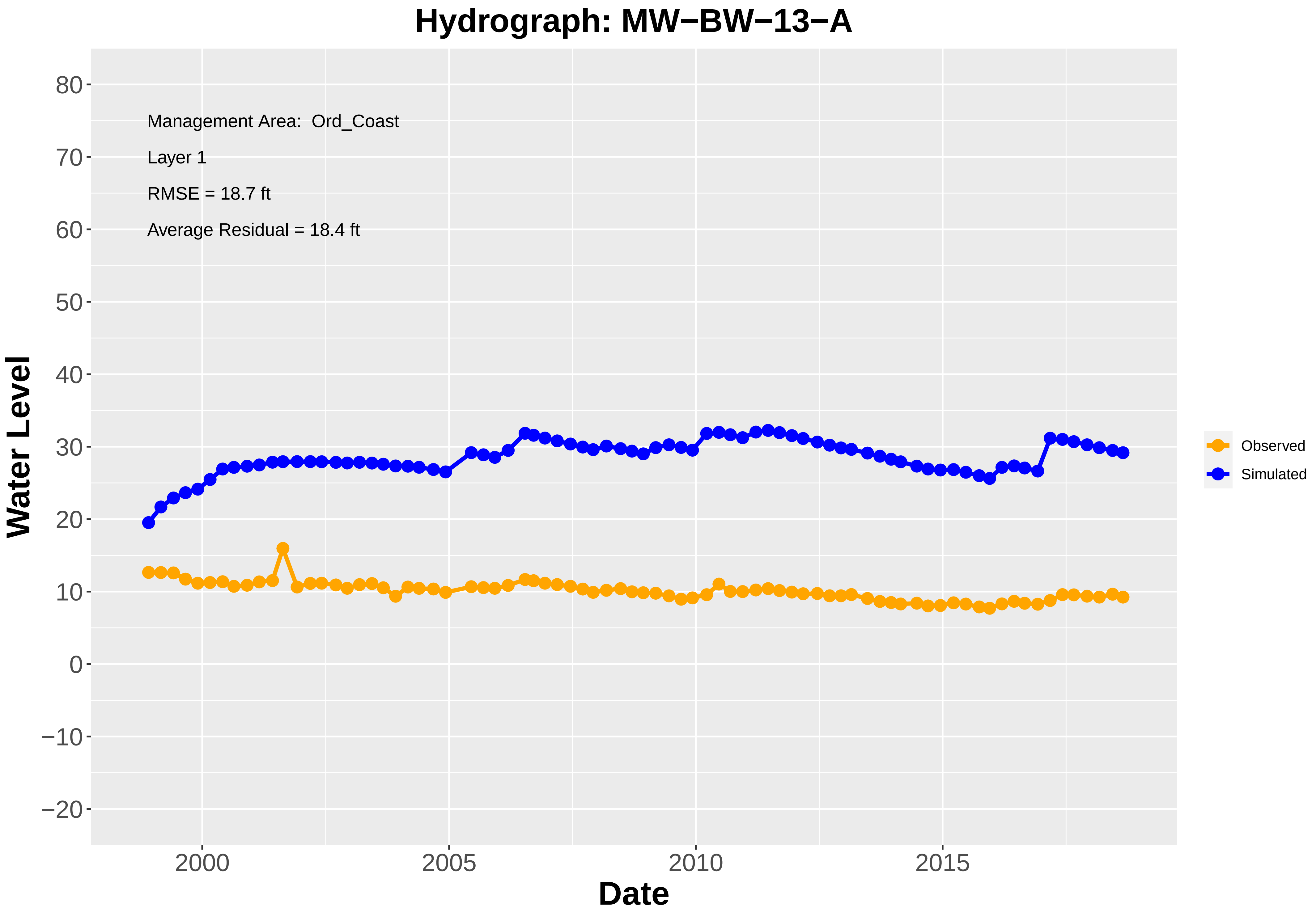


Hydrograph: MW−BW−10−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.2 ft
Average Residual = −6.2 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

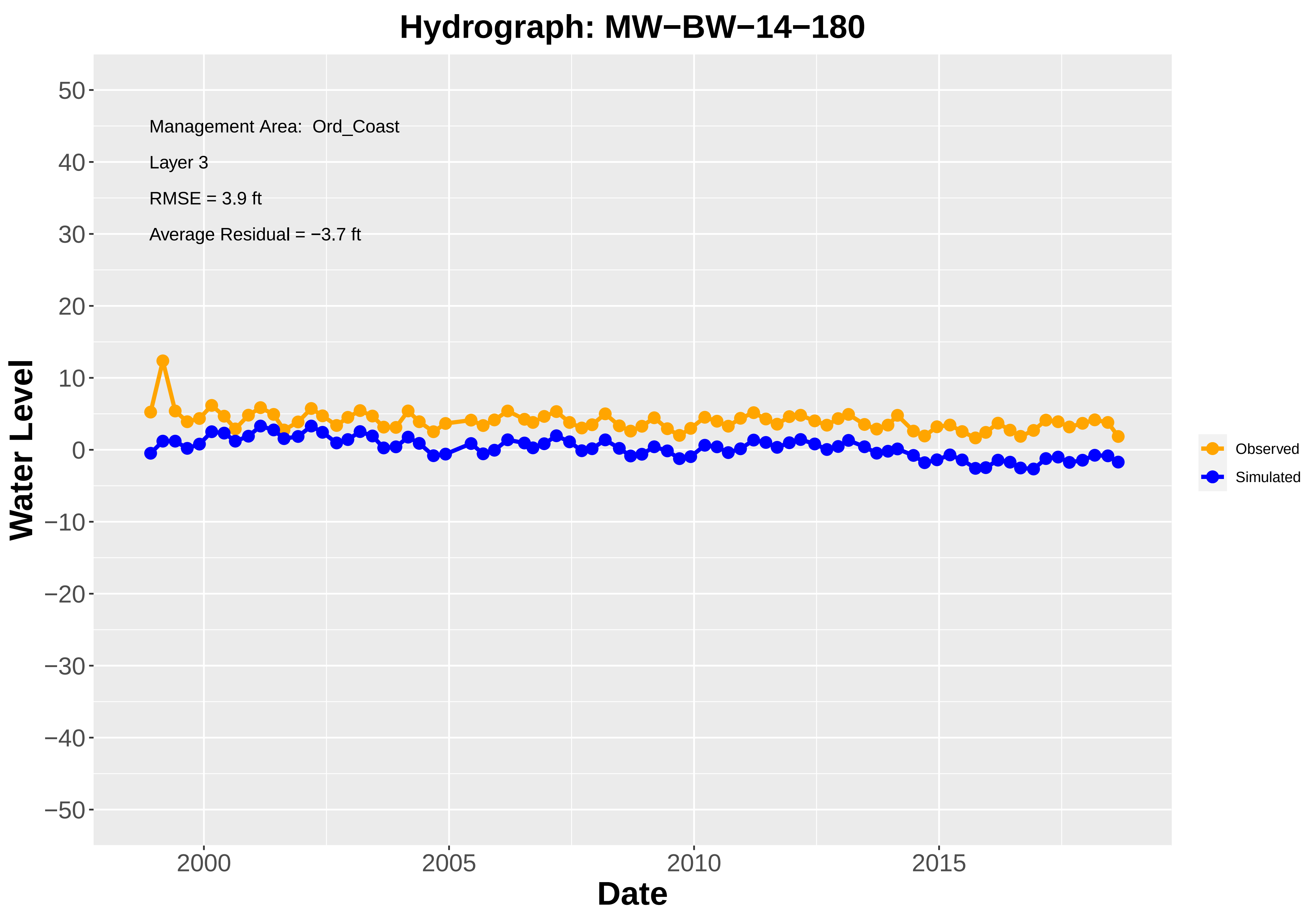


Hydrograph: MW−BW−11−A
Management Area: Ord_Coast
Layer 1
RMSE = 14.2 ft
Average Residual = 13.7 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Date
Observed
Simulated

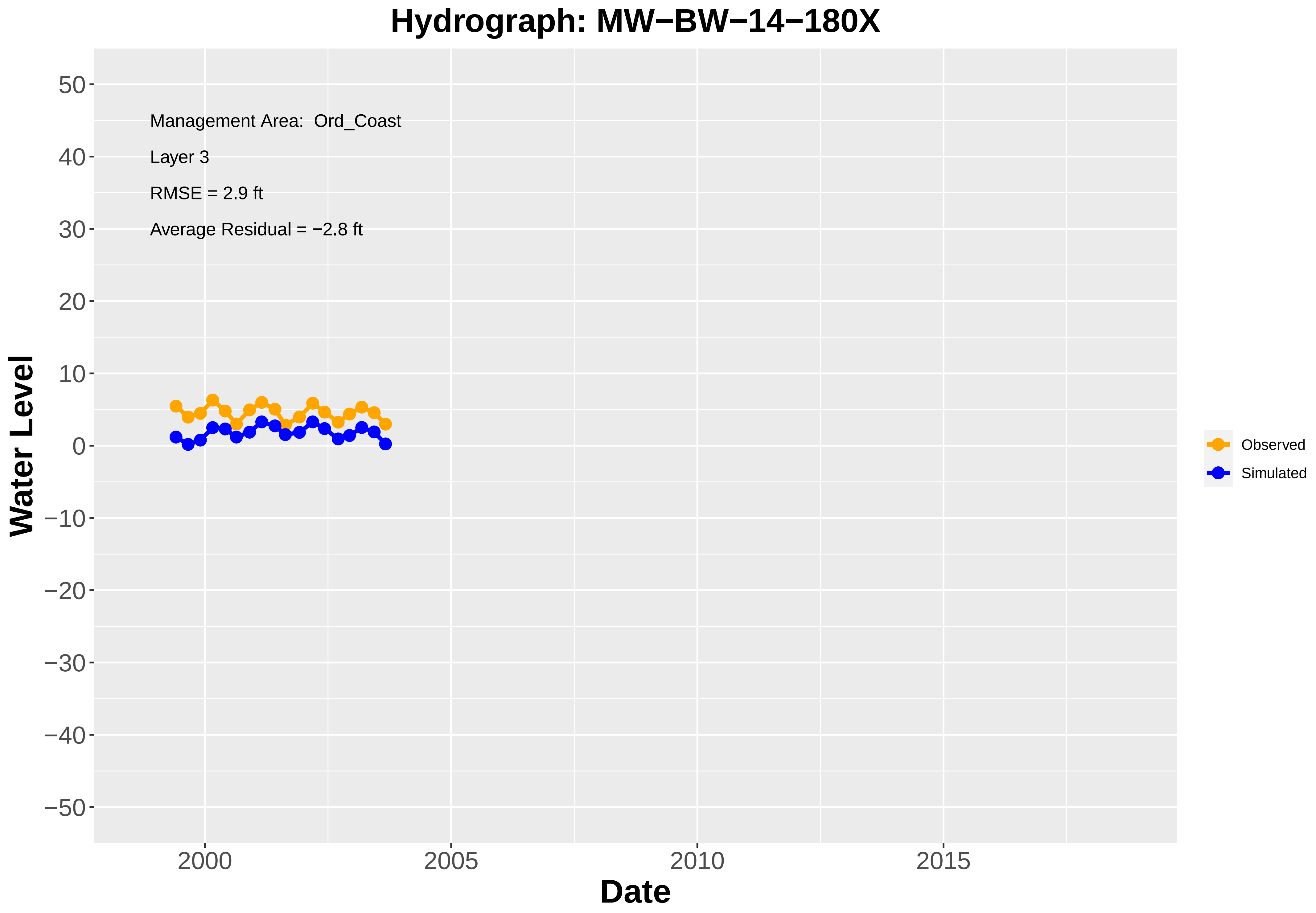

Hydrograph: MW−BW−12−180
Management Area: Ord_Coast
Layer 3
RMSE = 6.6 ft
Average Residual = −6.5 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

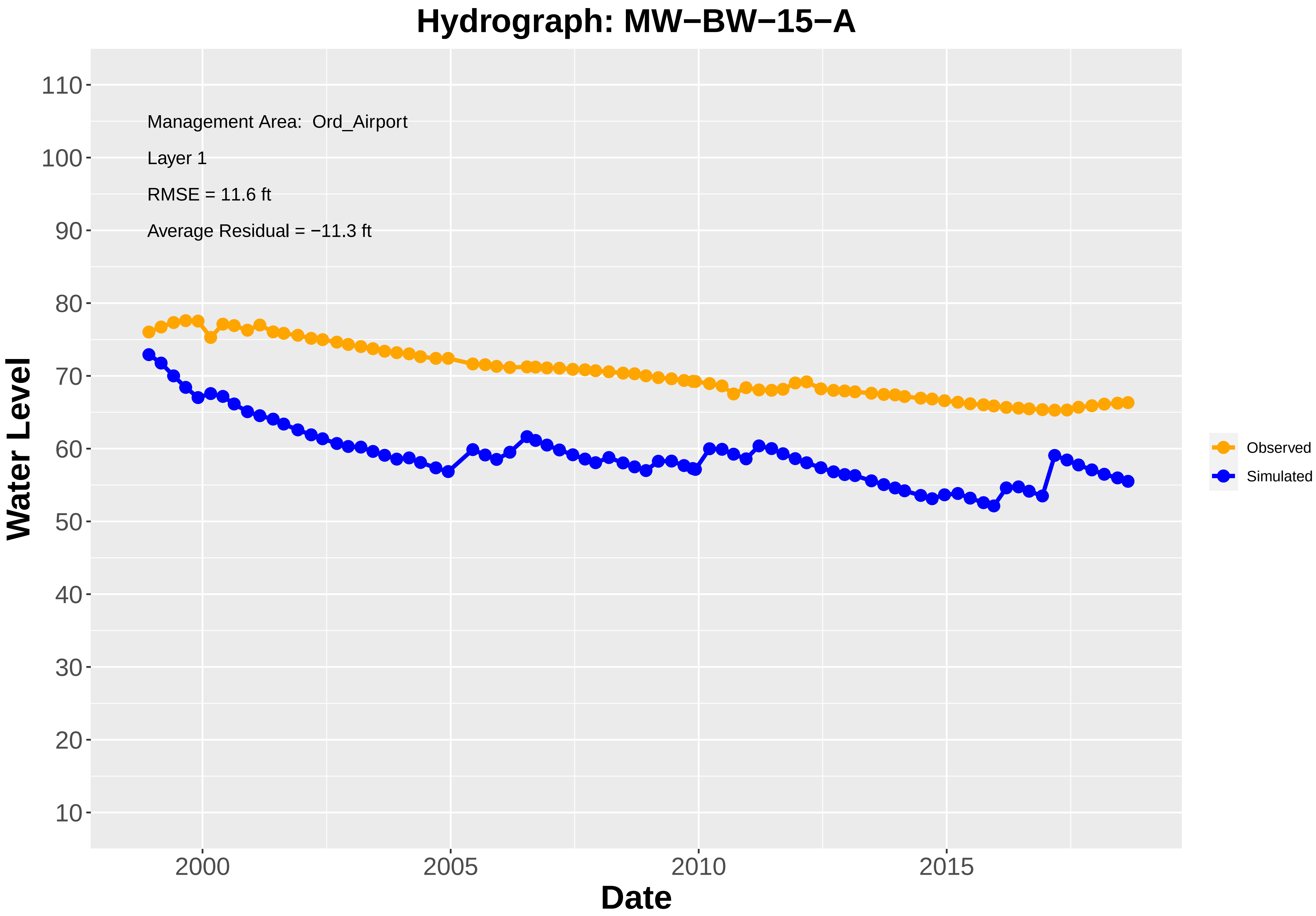


Hydrograph: MW−BW−13−A
Management Area: Ord_Coast
Layer 1
RMSE = 18.7 ft
Average Residual = 18.4 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

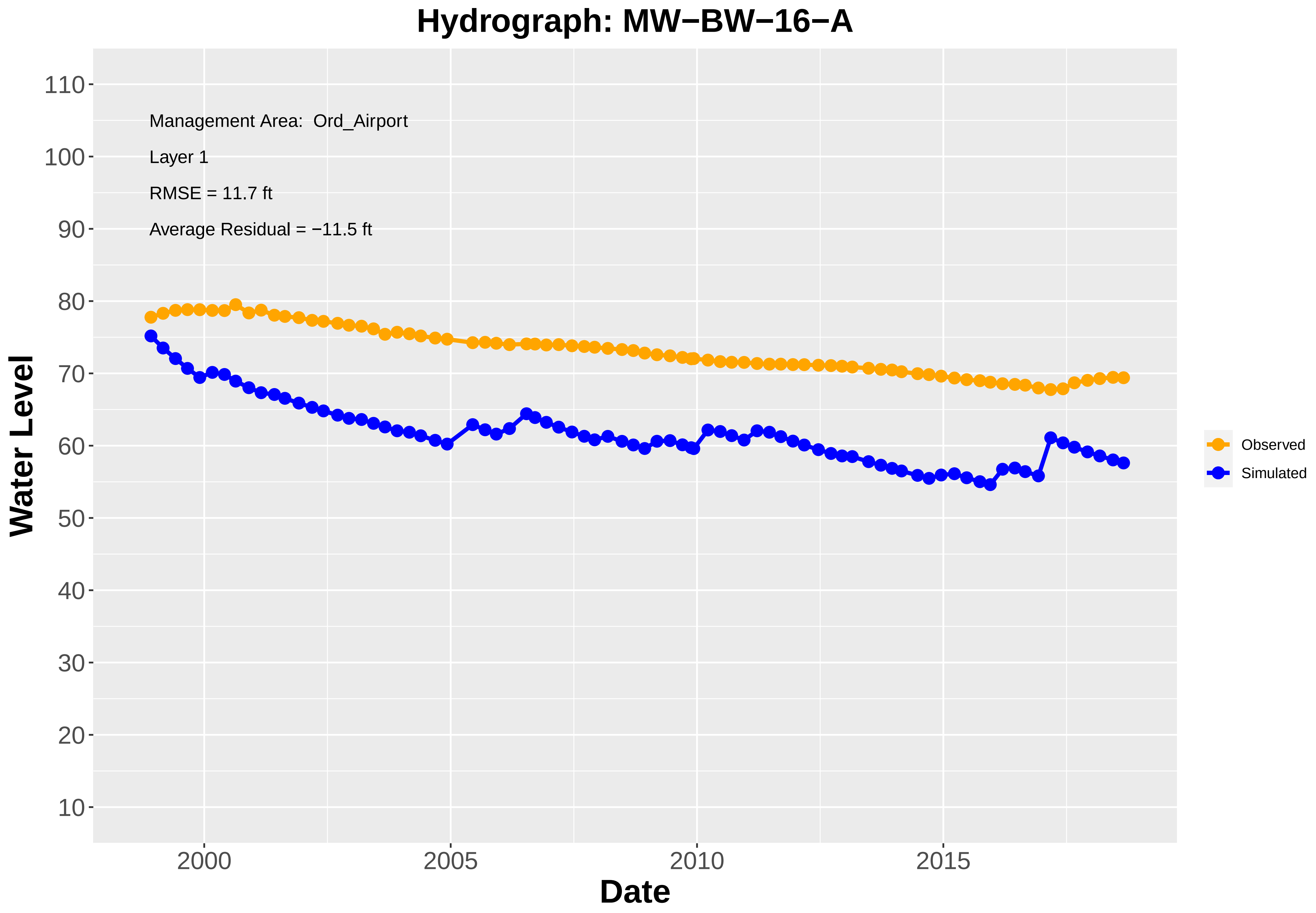


Hydrograph: MW−BW−14−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.9 ft
Average Residual = −3.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

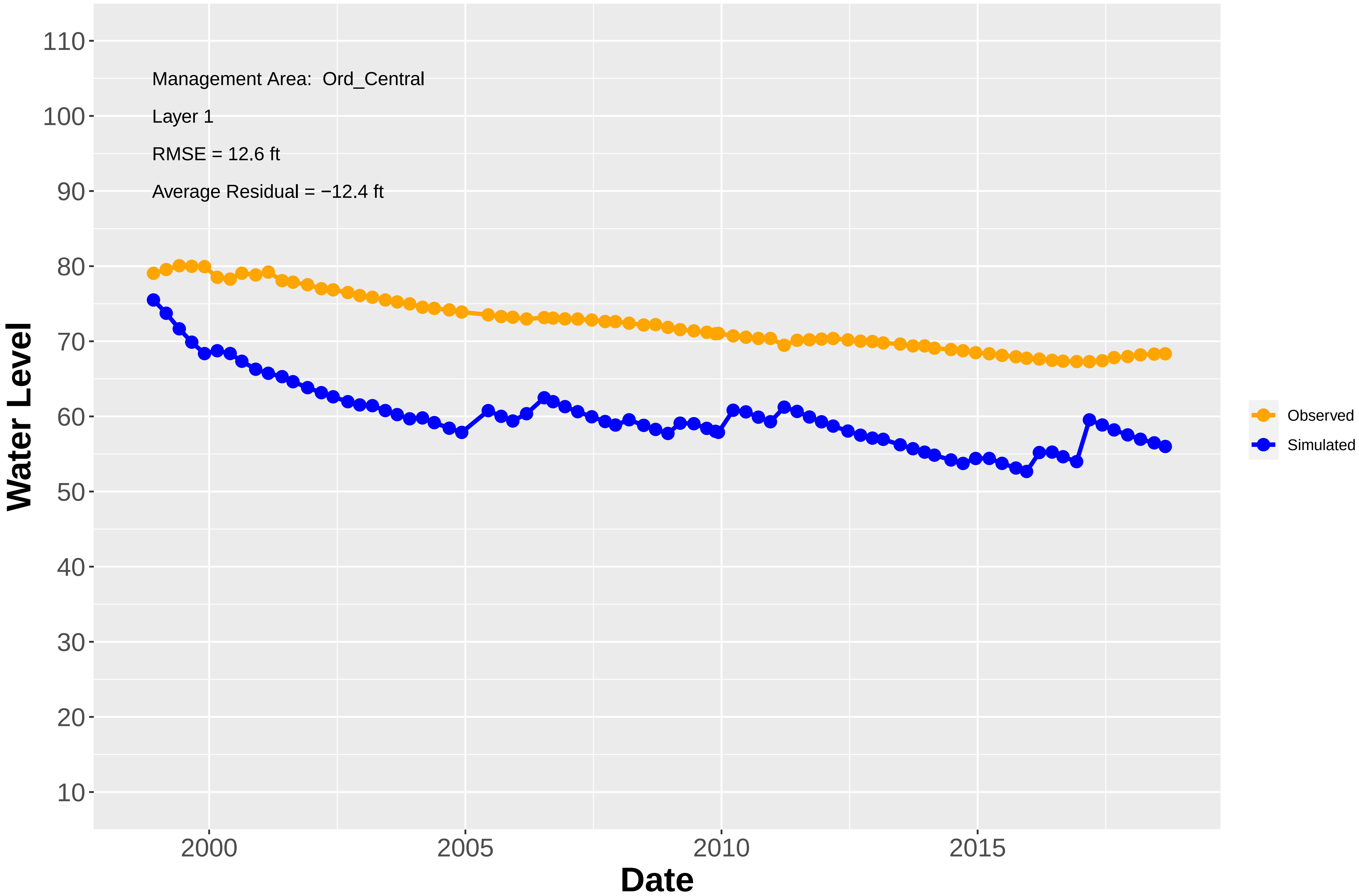

Hydrograph: MW−BW−14−180X
Management Area: Ord_Coast
Layer 3
RMSE = 2.9 ft
Average Residual = −2.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

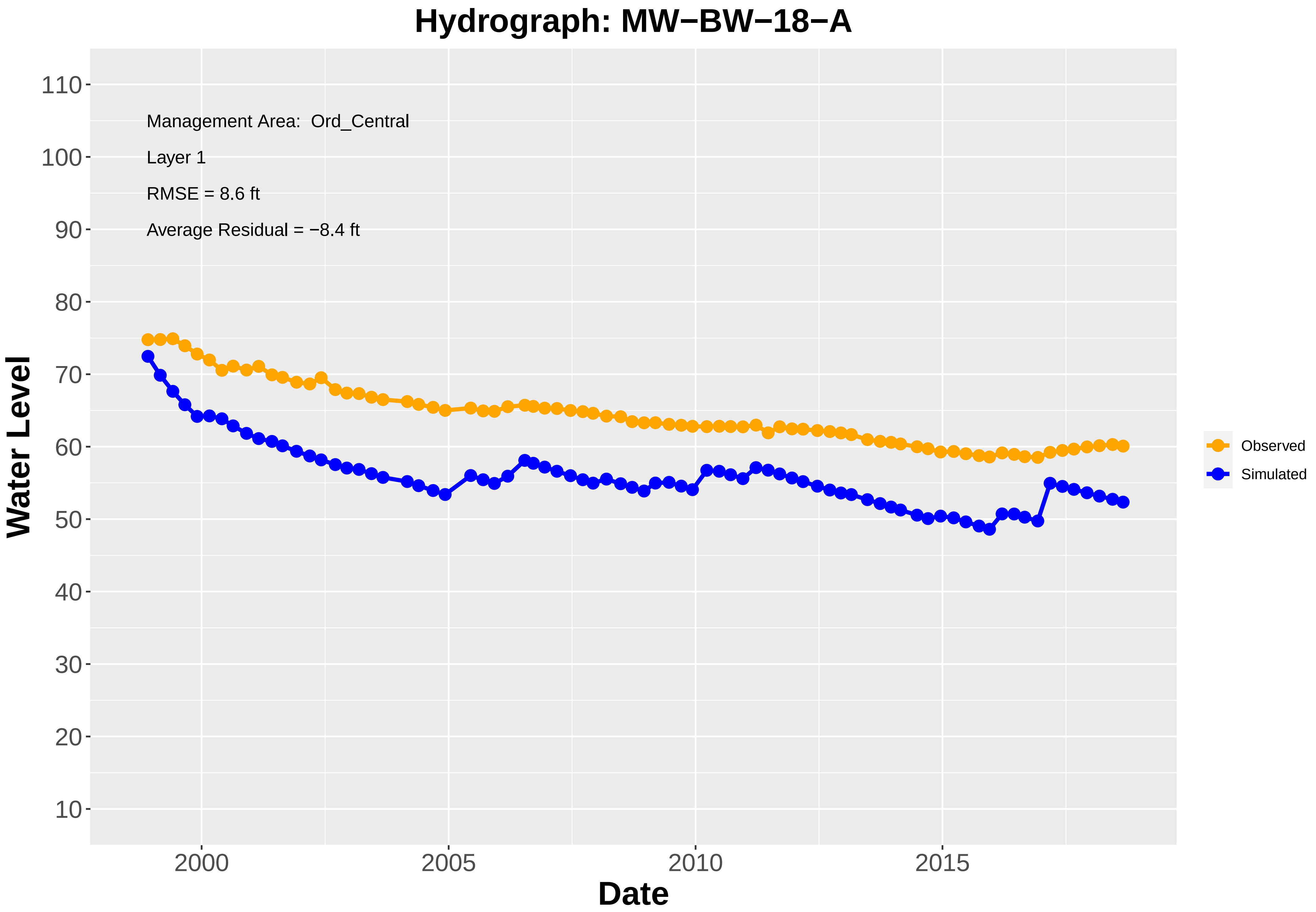


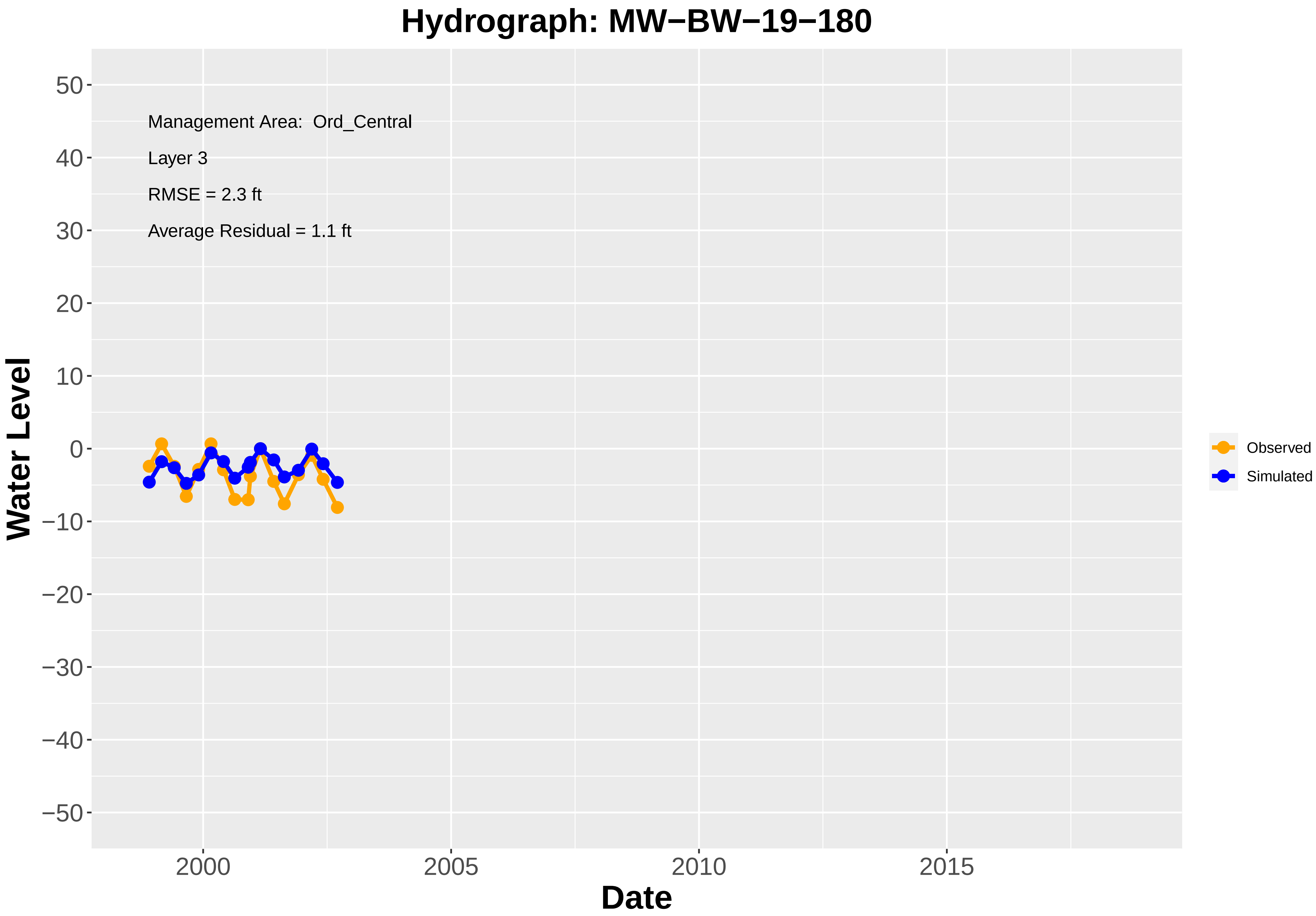
Hydrograph: MW−BW−15−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.6 ft
Average Residual = −11.3 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−16−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.7 ft
Average Residual = −11.5 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

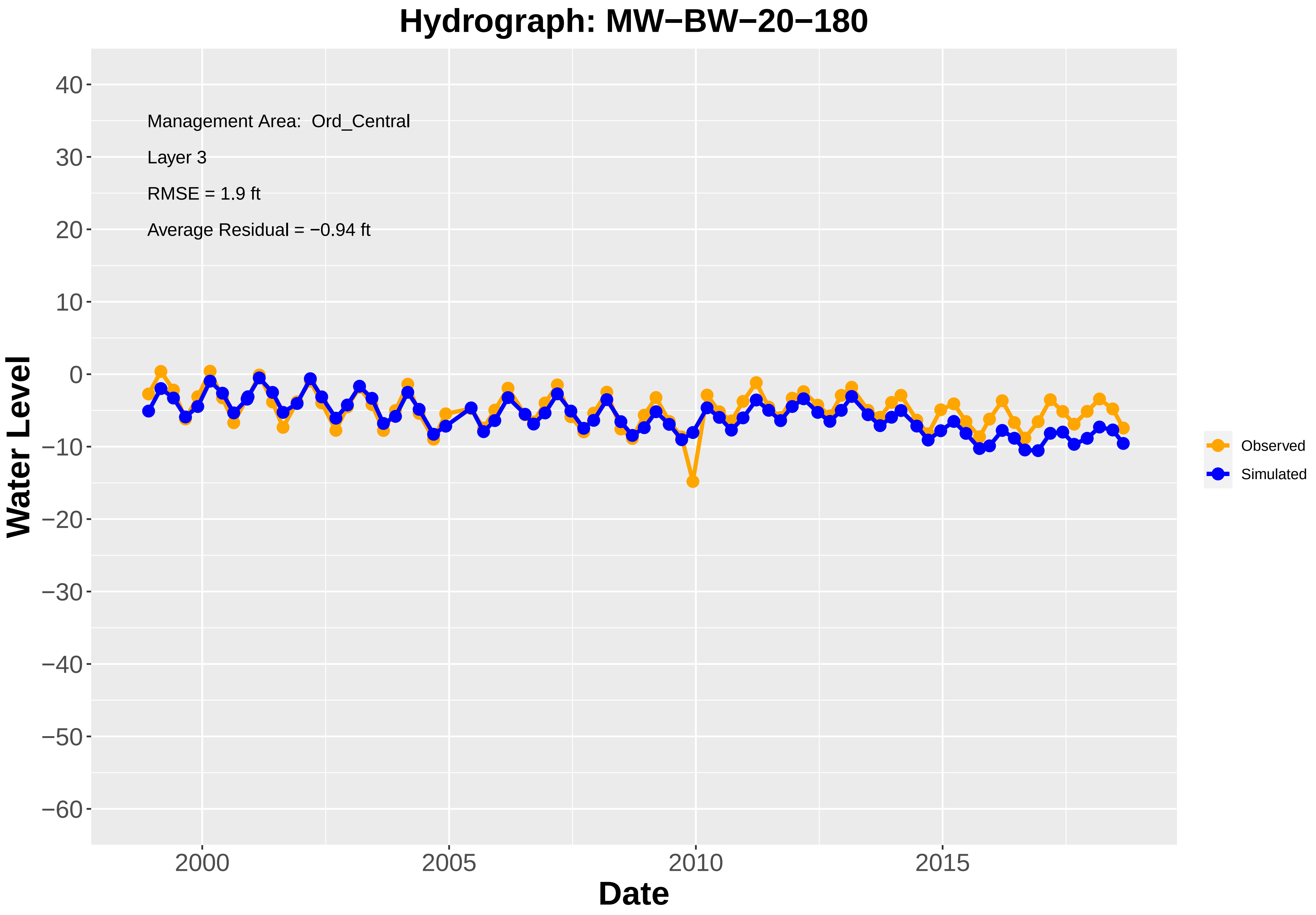
Hydrograph: MW−BW−17−A



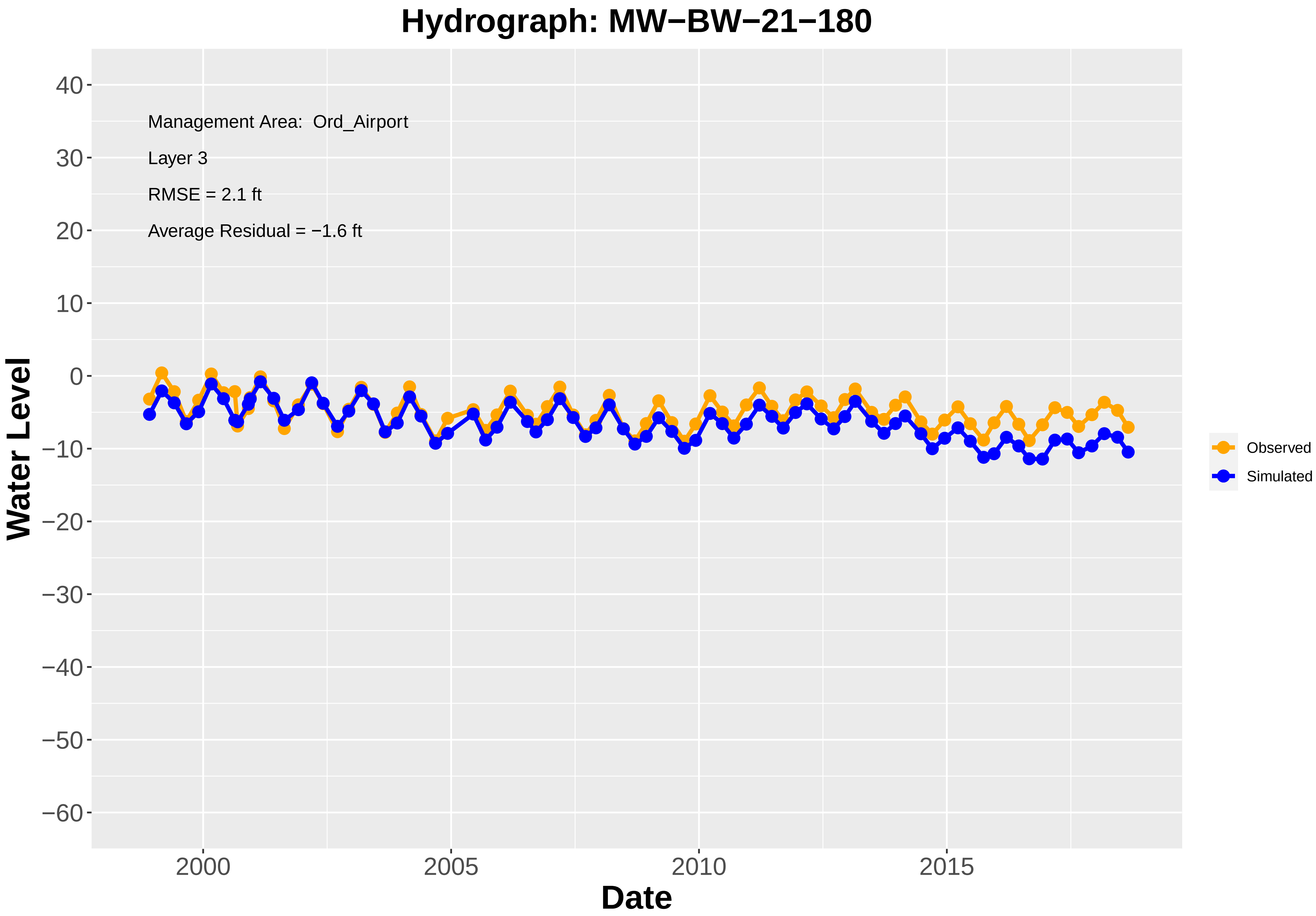

Hydrograph: MW−BW−18−A
Management Area: Ord_Central
Layer 1
RMSE = 8.6 ft
Average Residual = −8.4 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



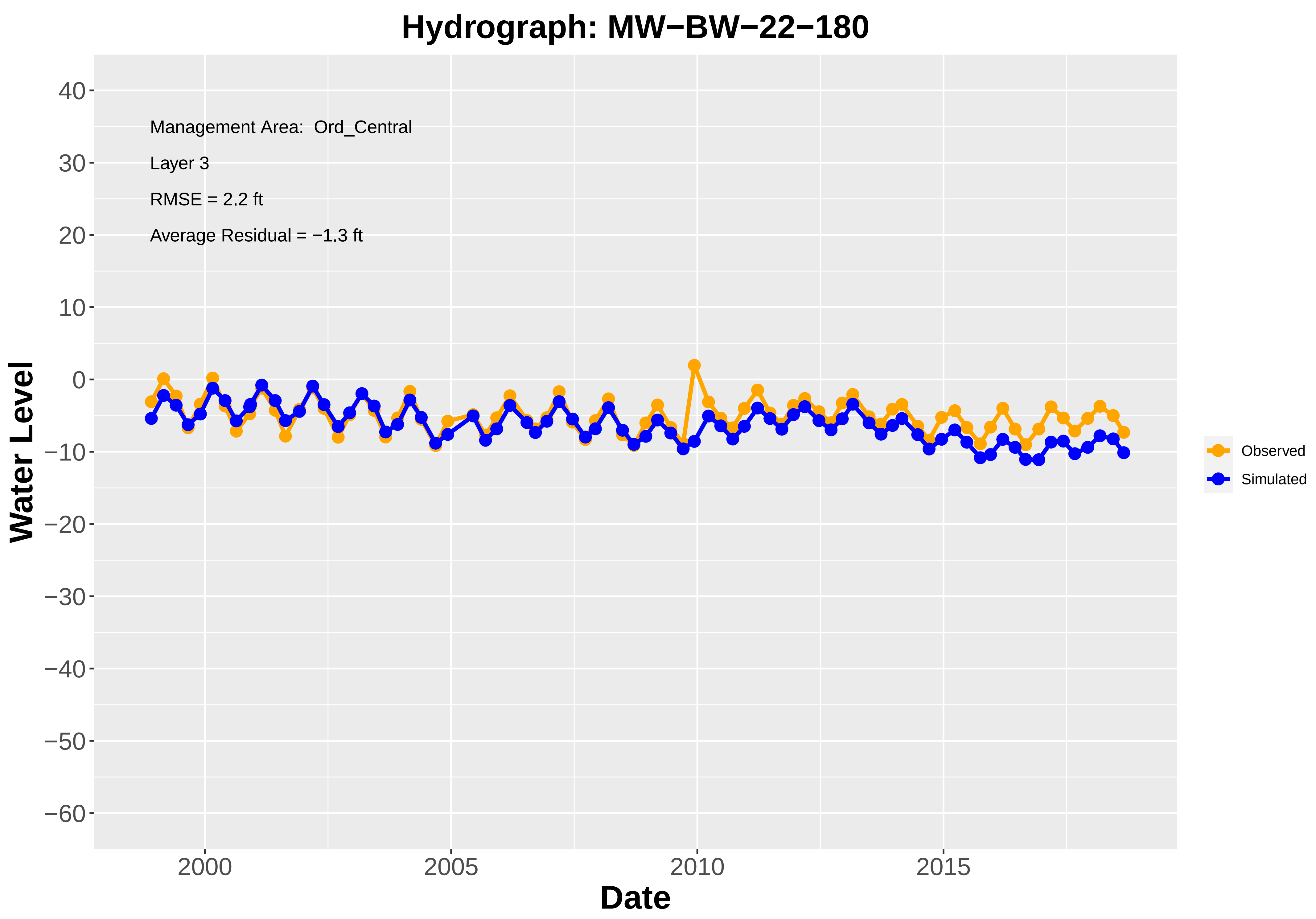
Hydrograph: MW−BW−19−180
Management Area: Ord_Central
Layer 3
RMSE = 2.3 ft
Average Residual = 1.1 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

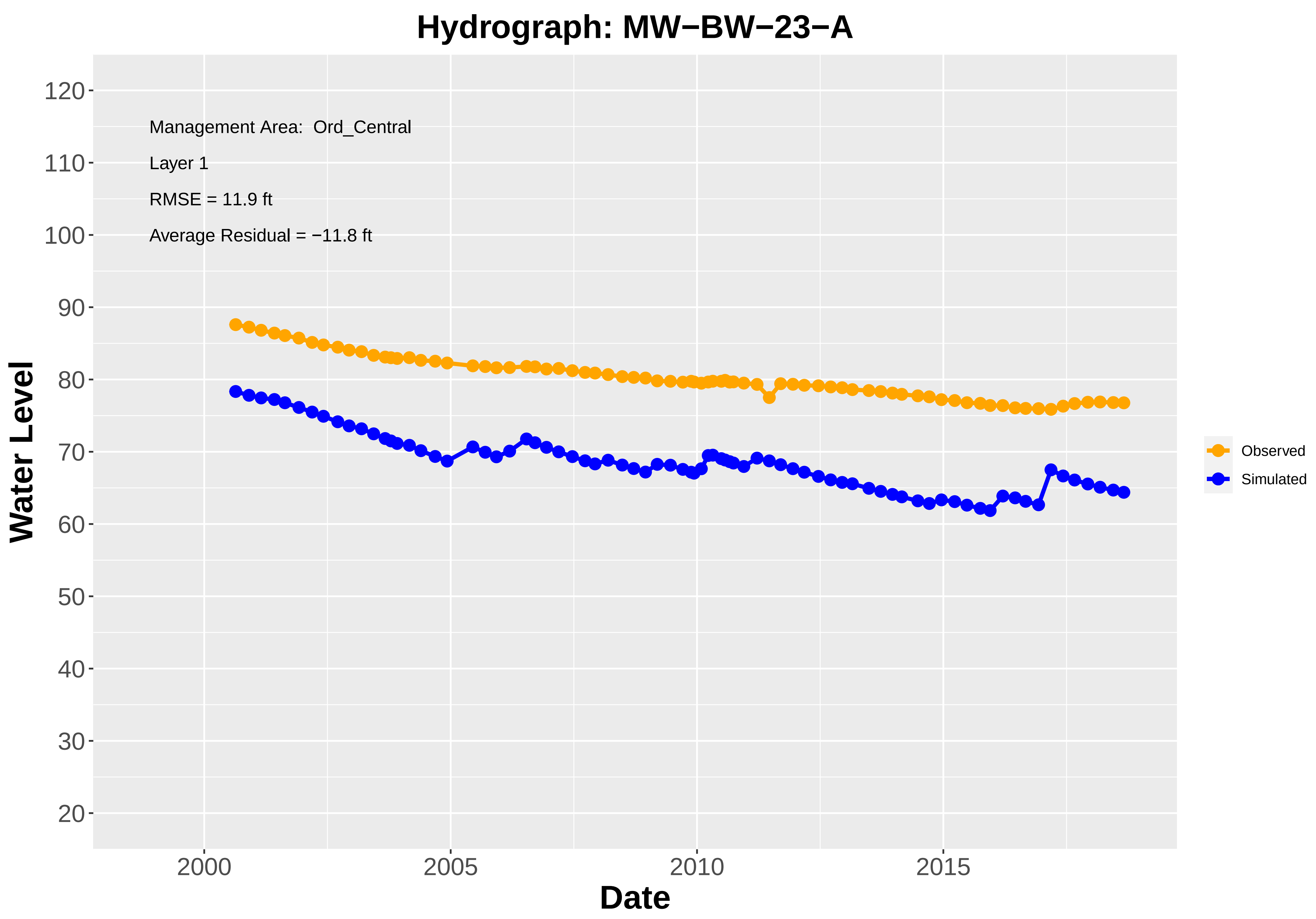


Hydrograph: MW−BW−20−180
Management Area: Ord_Central
Layer 3
RMSE = 1.9 ft
Average Residual = −0.94 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

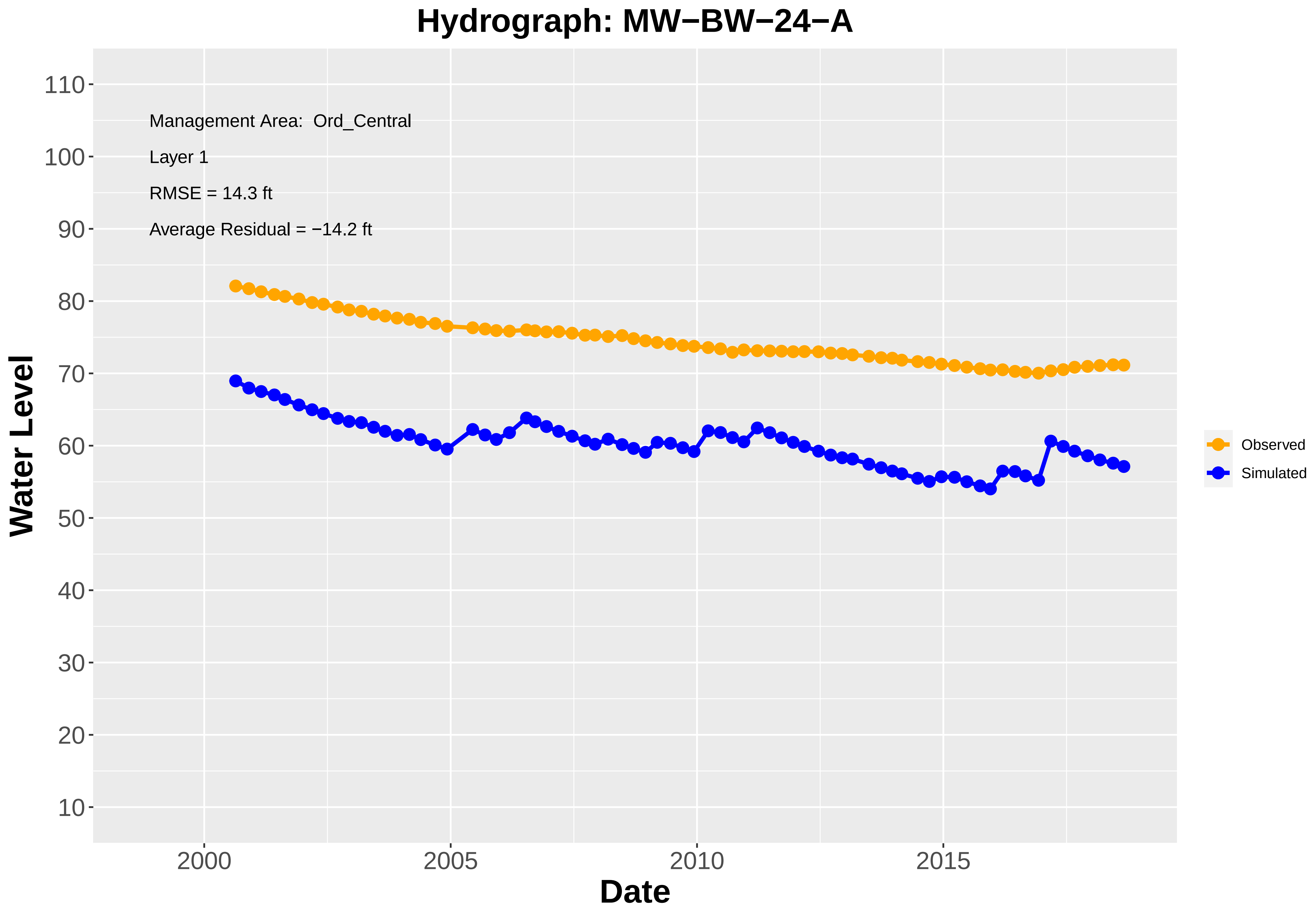


Hydrograph: MW−BW−21−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.1 ft
Average Residual = −1.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

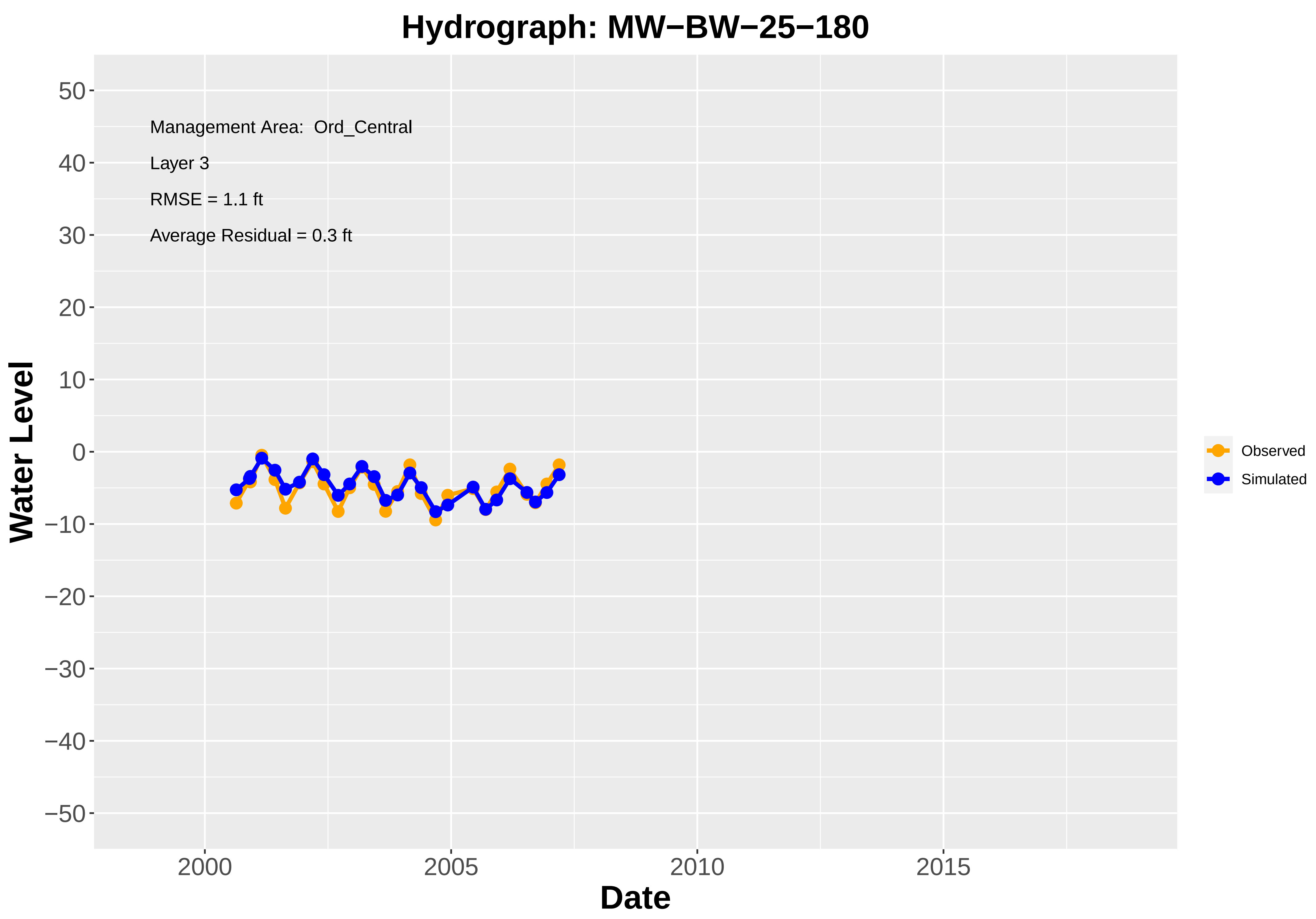

Hydrograph: MW−BW−22−180
Management Area: Ord_Central
Layer 3
RMSE = 2.2 ft
Average Residual = −1.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated



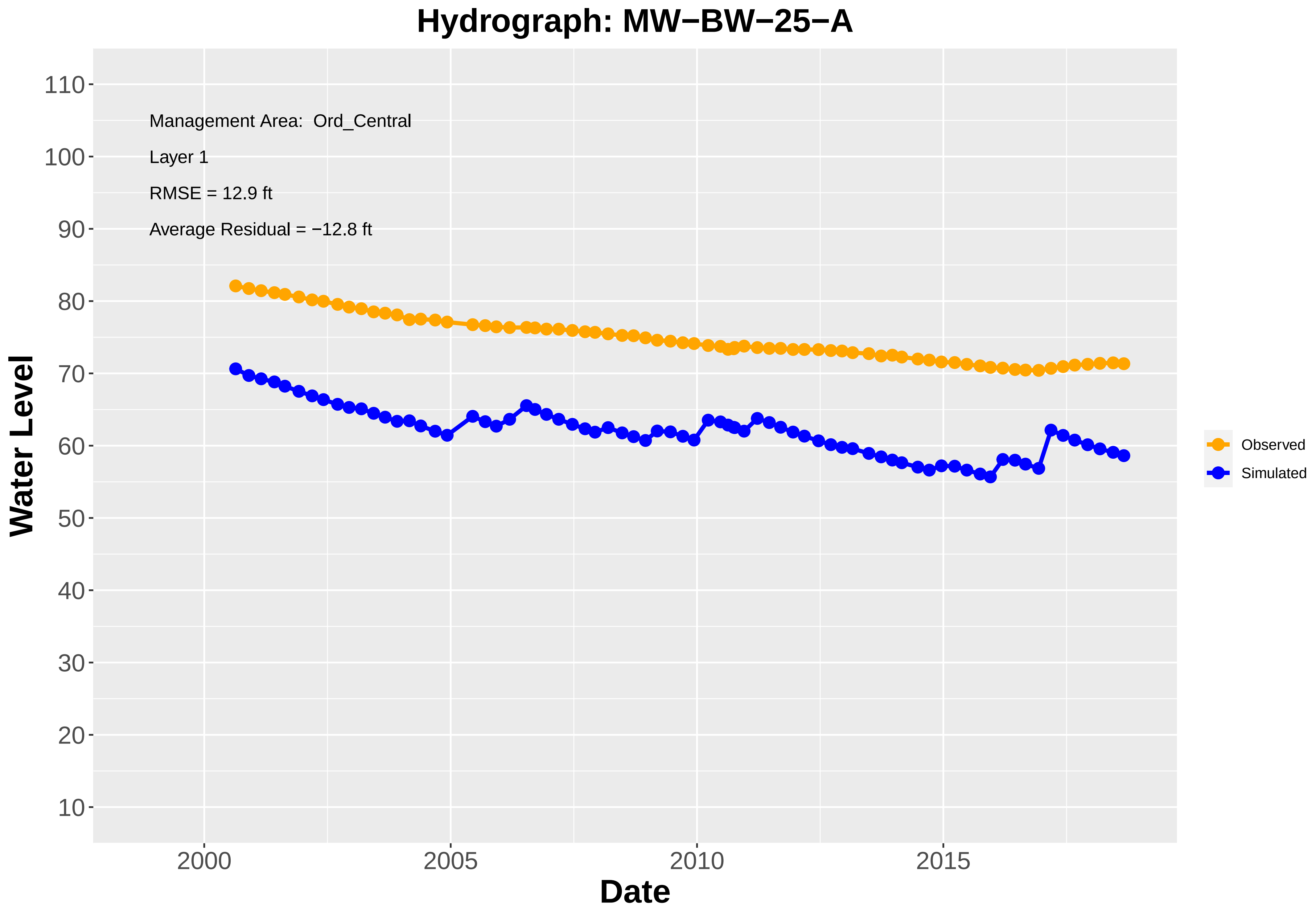
Hydrograph: MW−BW−23−A
Management Area: Ord_Central
Layer 1
RMSE = 11.9 ft
Average Residual = −11.8 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

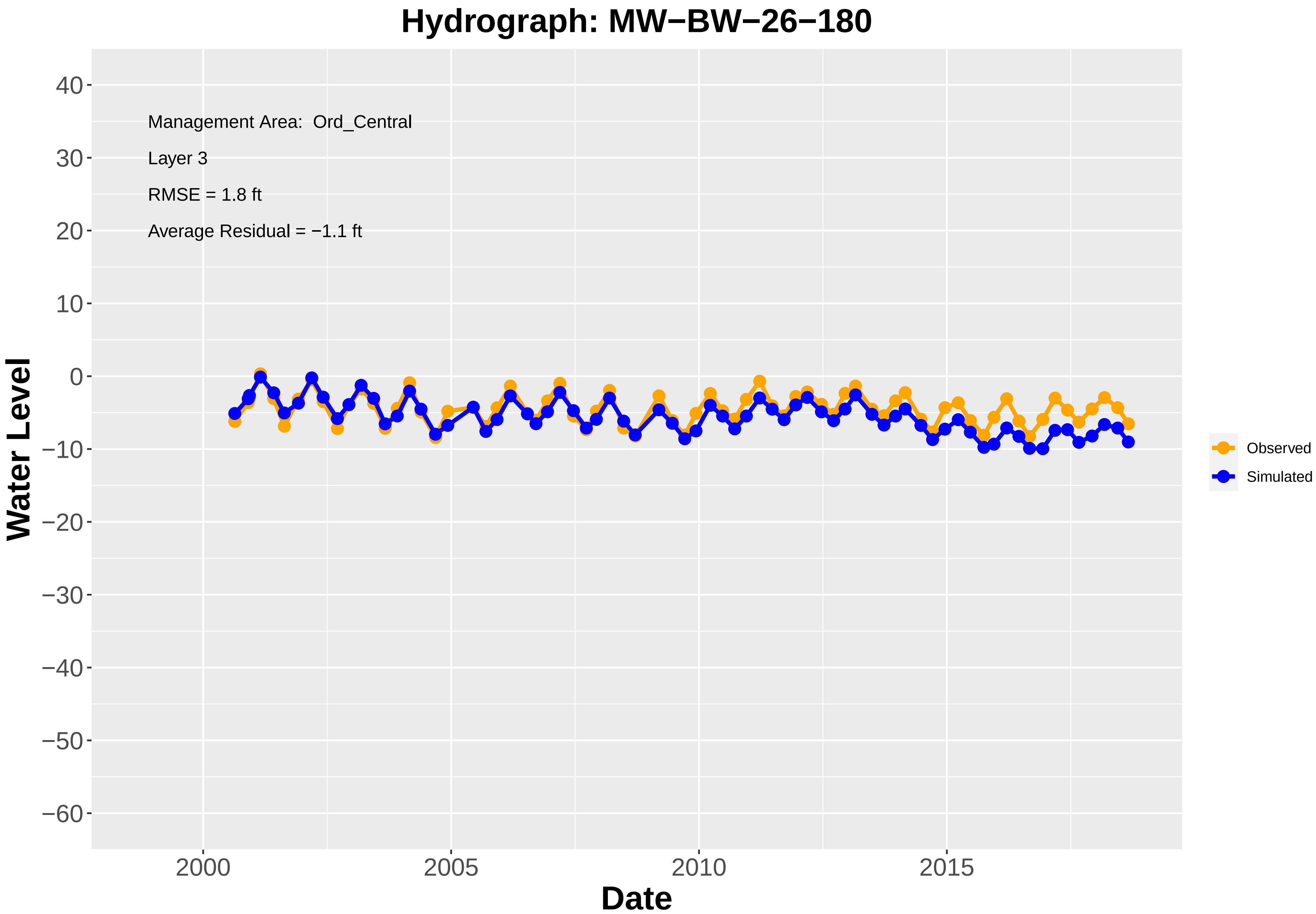


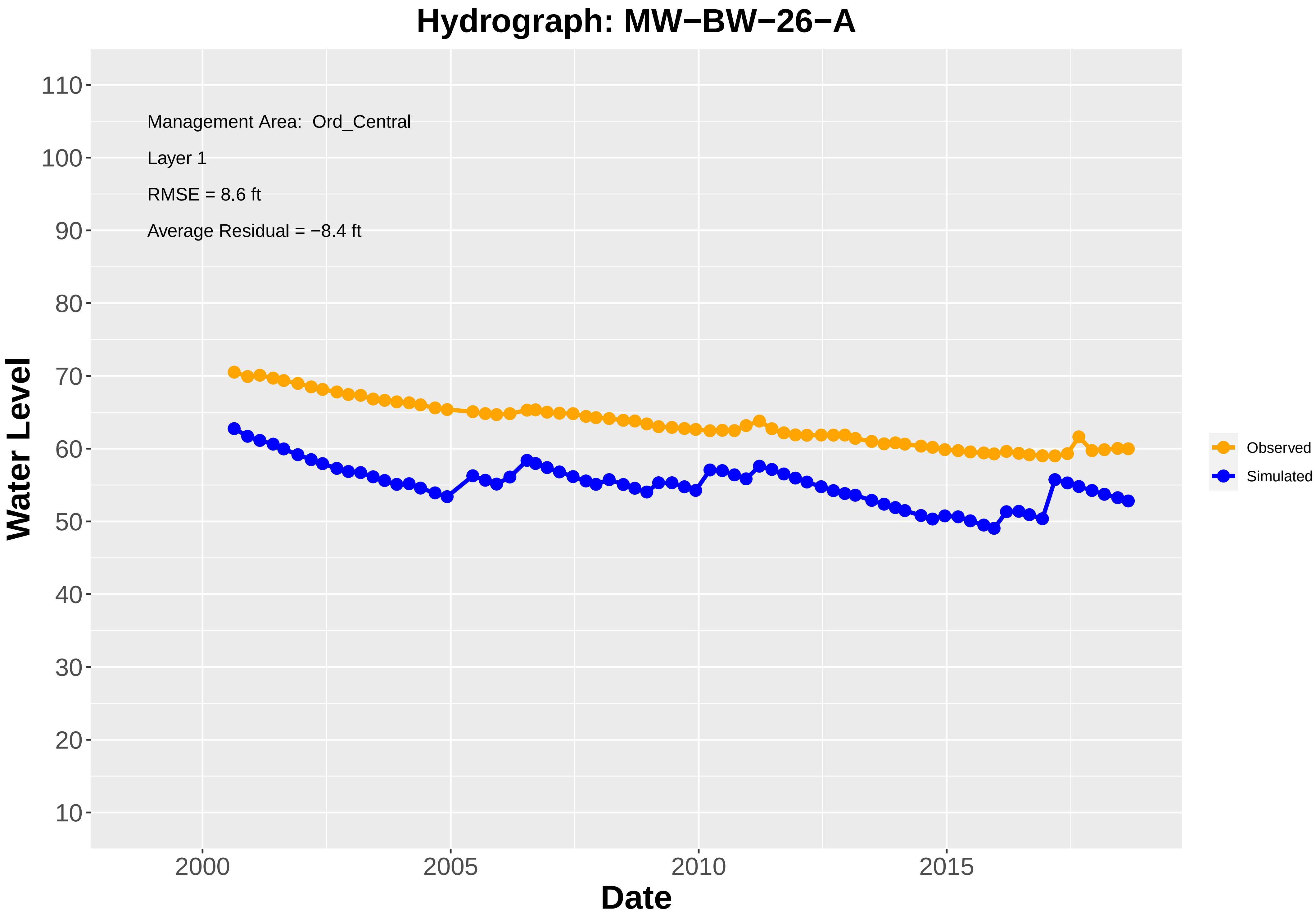
Hydrograph: MW−BW−24−A
Management Area: Ord_Central
Layer 1
RMSE = 14.3 ft
Average Residual = −14.2 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



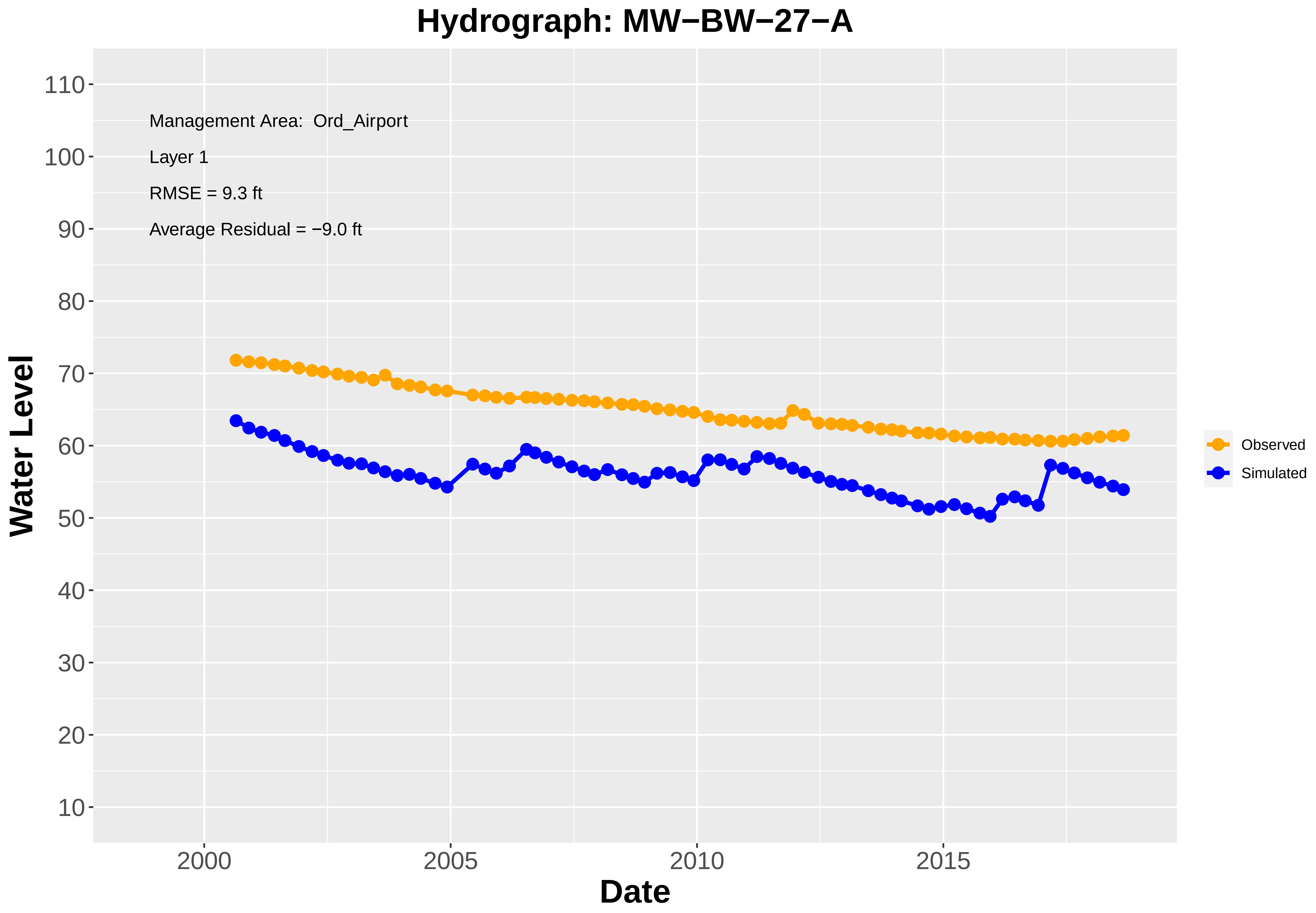
Hydrograph: MW−BW−25−180
Management Area: Ord_Central
Layer 3
RMSE = 1.1 ft
Average Residual = 0.3 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−25−A
Management Area: Ord_Central
Layer 1
RMSE = 12.9 ft
Average Residual = −12.8 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

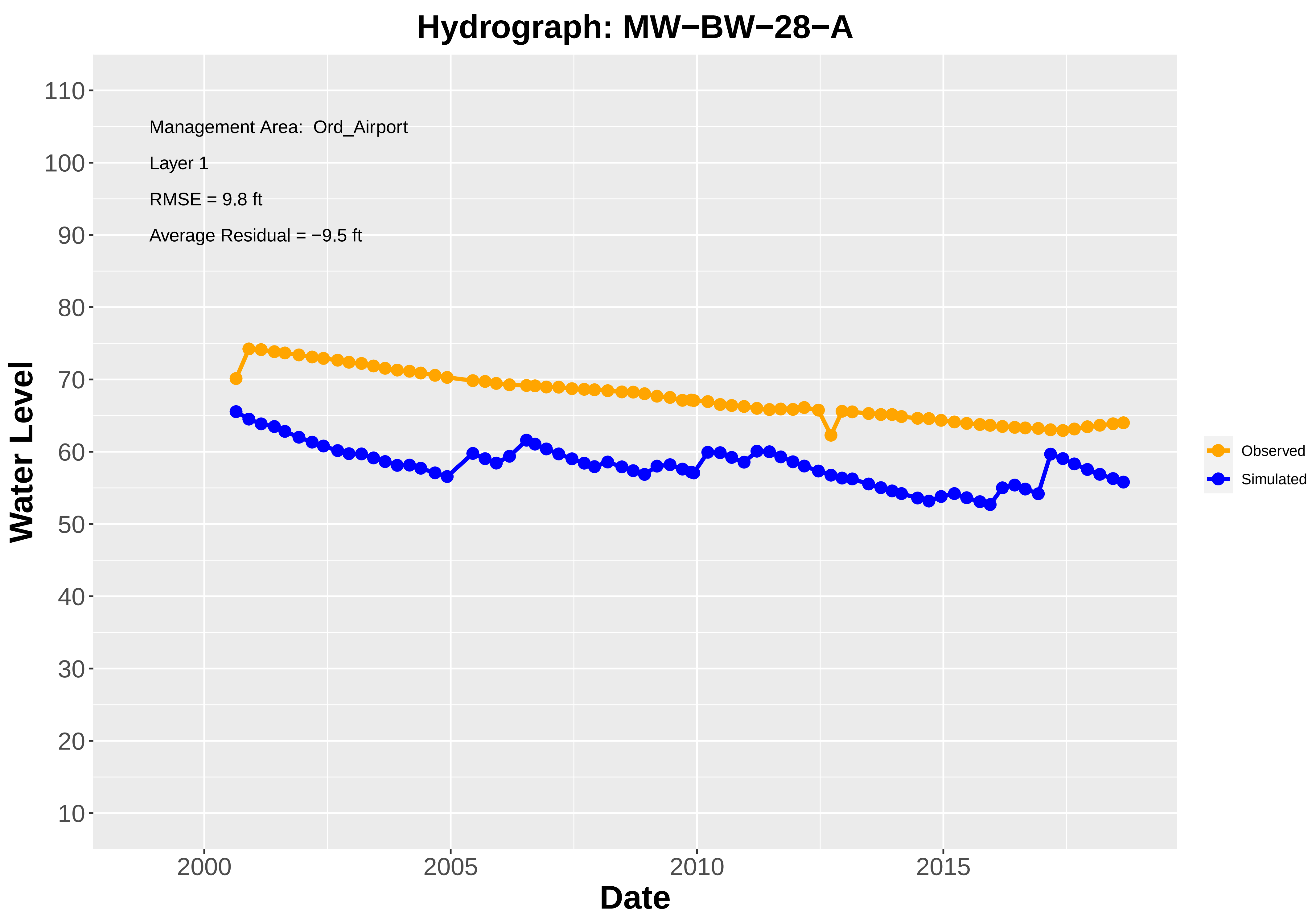

Hydrograph: MW−BW−26−180
Management Area: Ord_Central
Layer 3
RMSE = 1.8 ft
Average Residual = −1.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



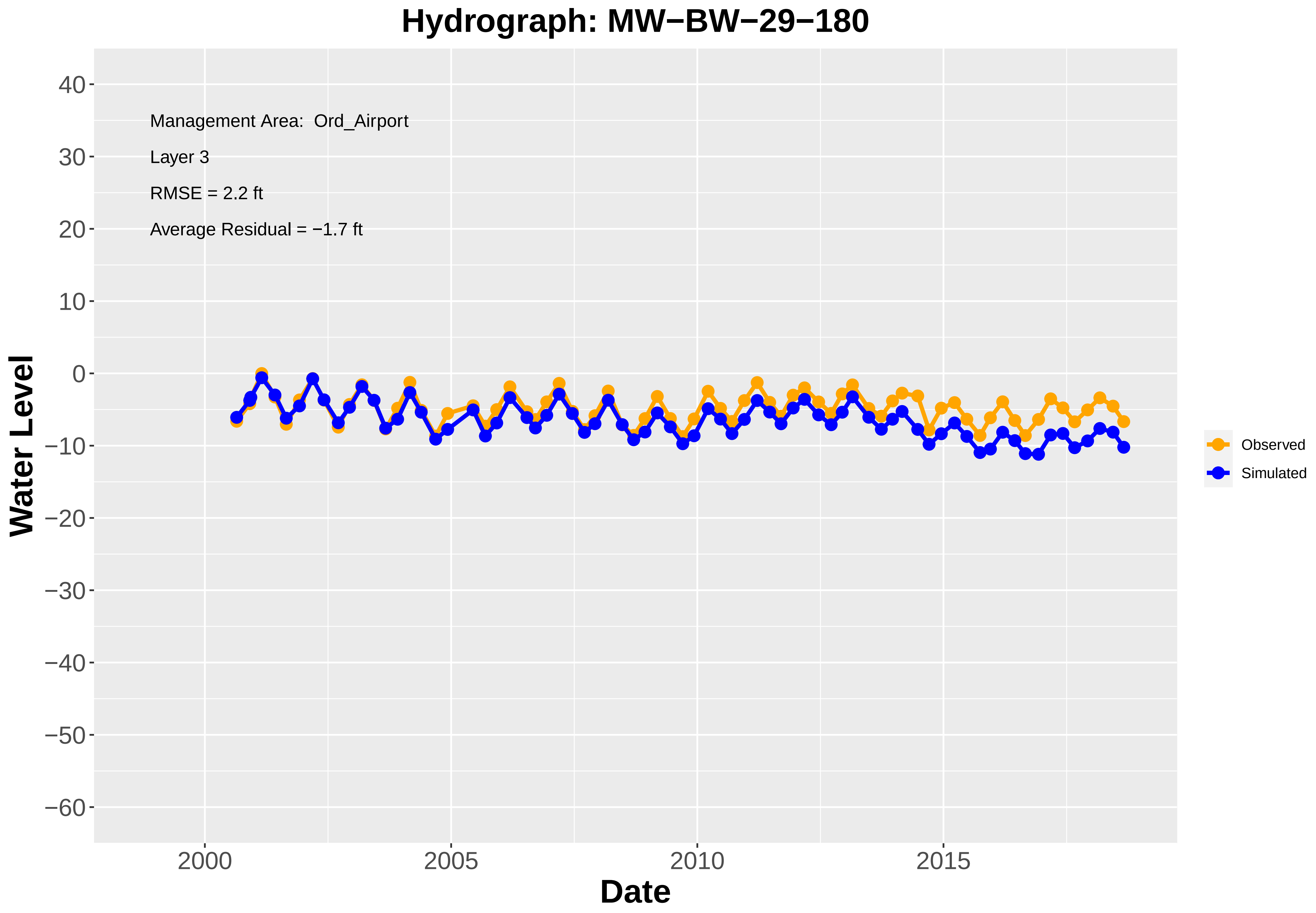
Hydrograph: MW−BW−26−A
Management Area: Ord_Central
Layer 1
RMSE = 8.6 ft
Average Residual = −8.4 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



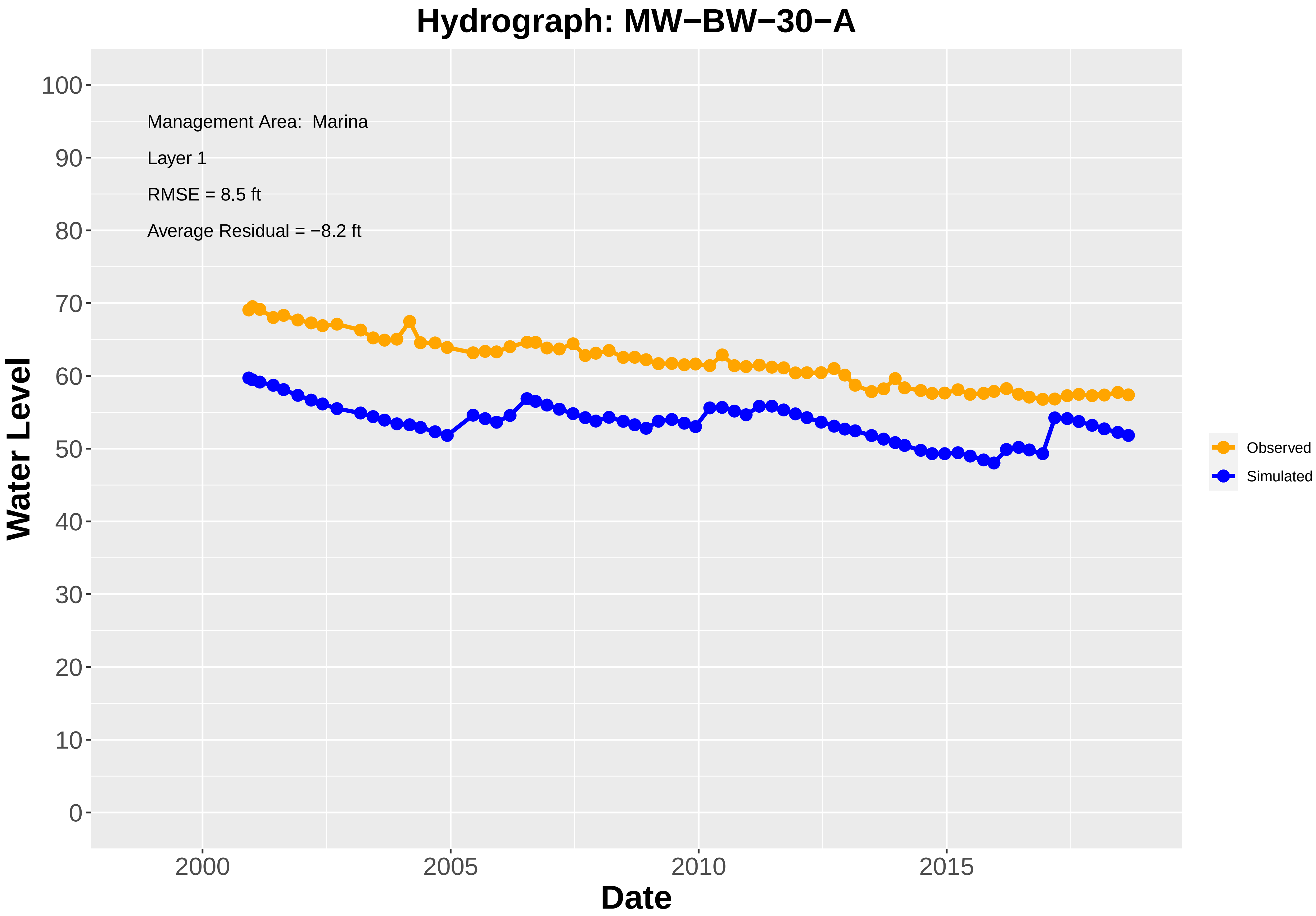
Hydrograph: MW−BW−27−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.3 ft
Average Residual = −9.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



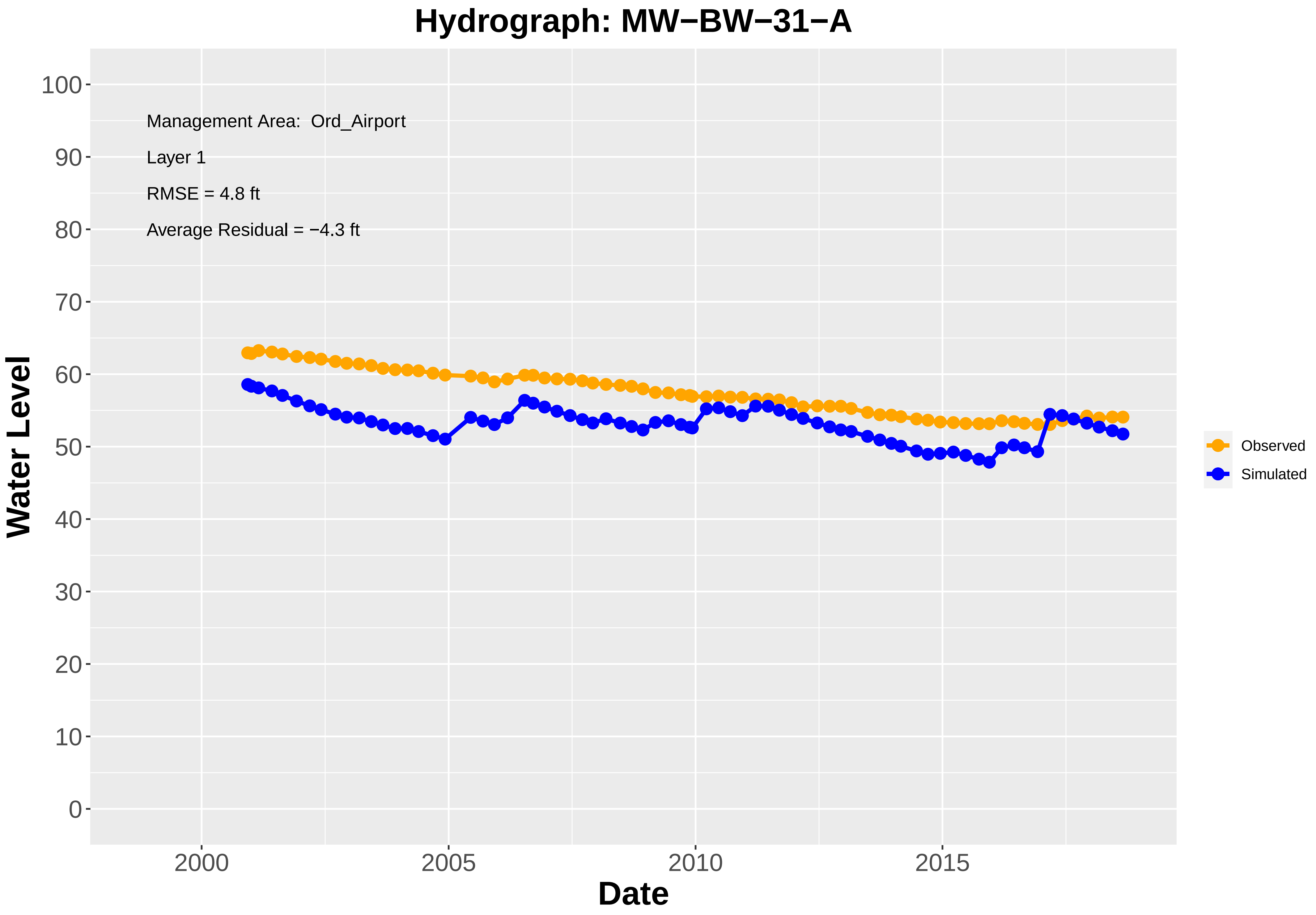
Hydrograph: MW−BW−28−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.8 ft
Average Residual = −9.5 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

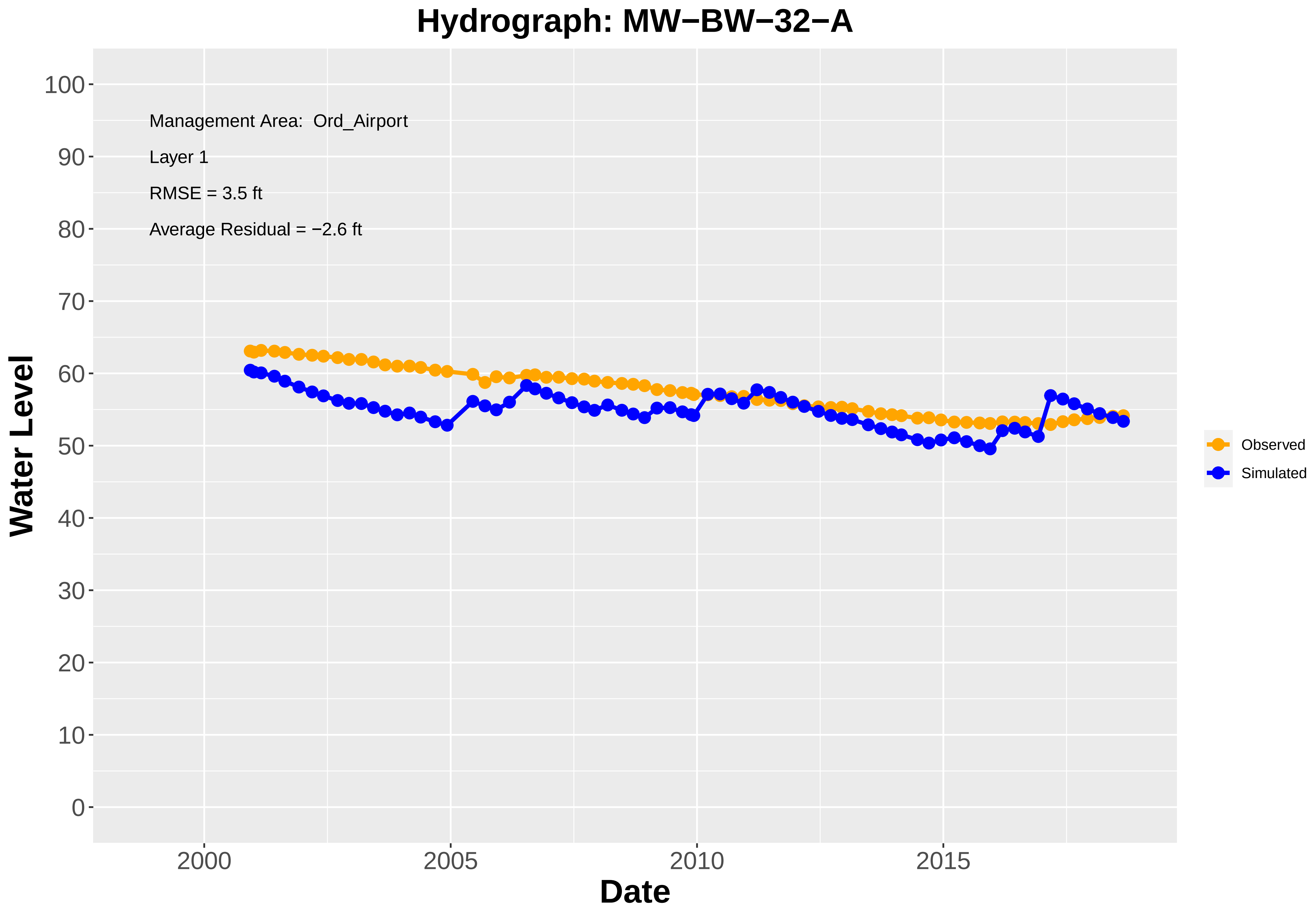


Hydrograph: MW−BW−29−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.2 ft
Average Residual = −1.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

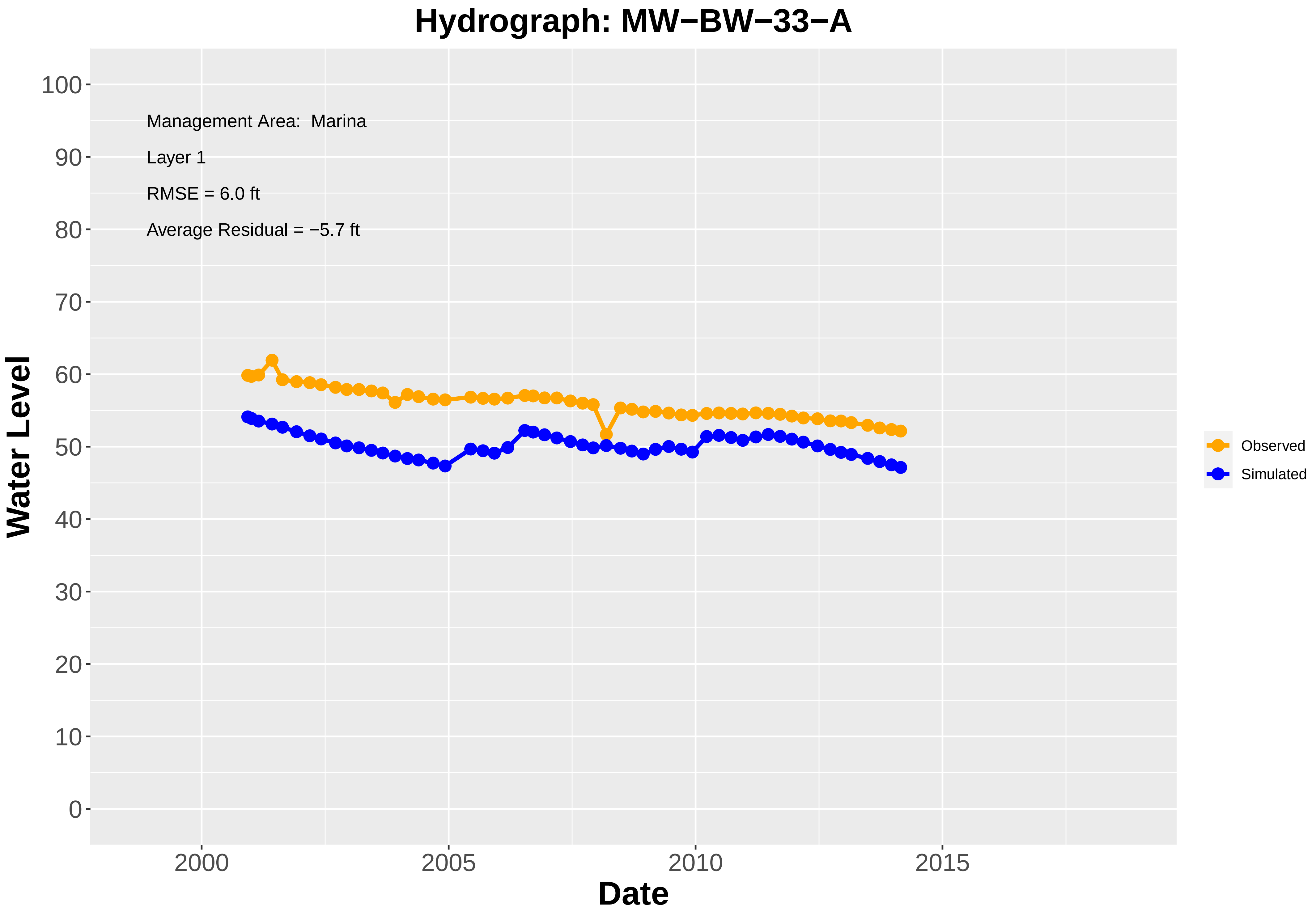


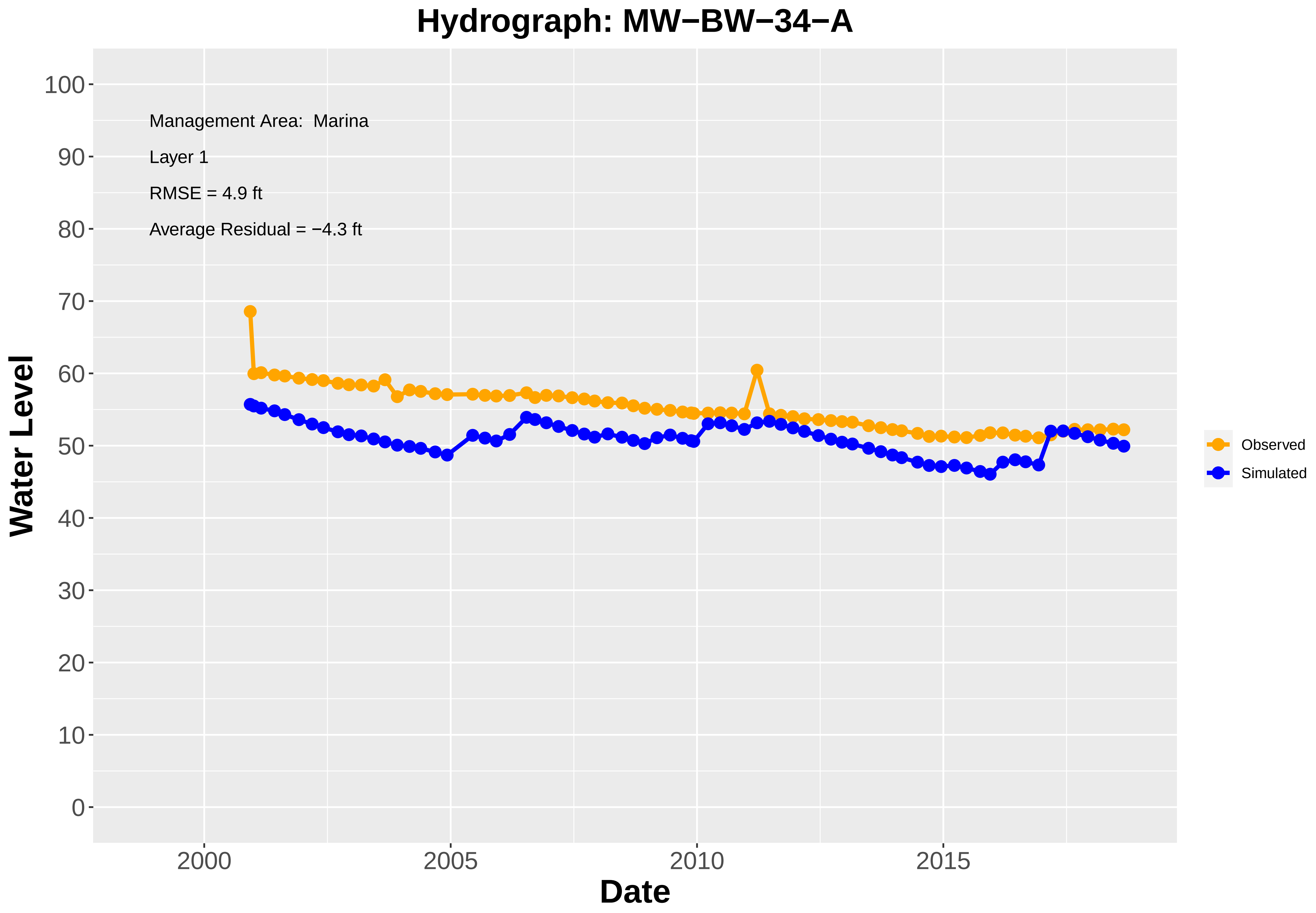
Hydrograph: MW−BW−30−A
Management Area: Marina
Layer 1
RMSE = 8.5 ft
Average Residual = −8.2 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−31−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.8 ft
Average Residual = −4.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

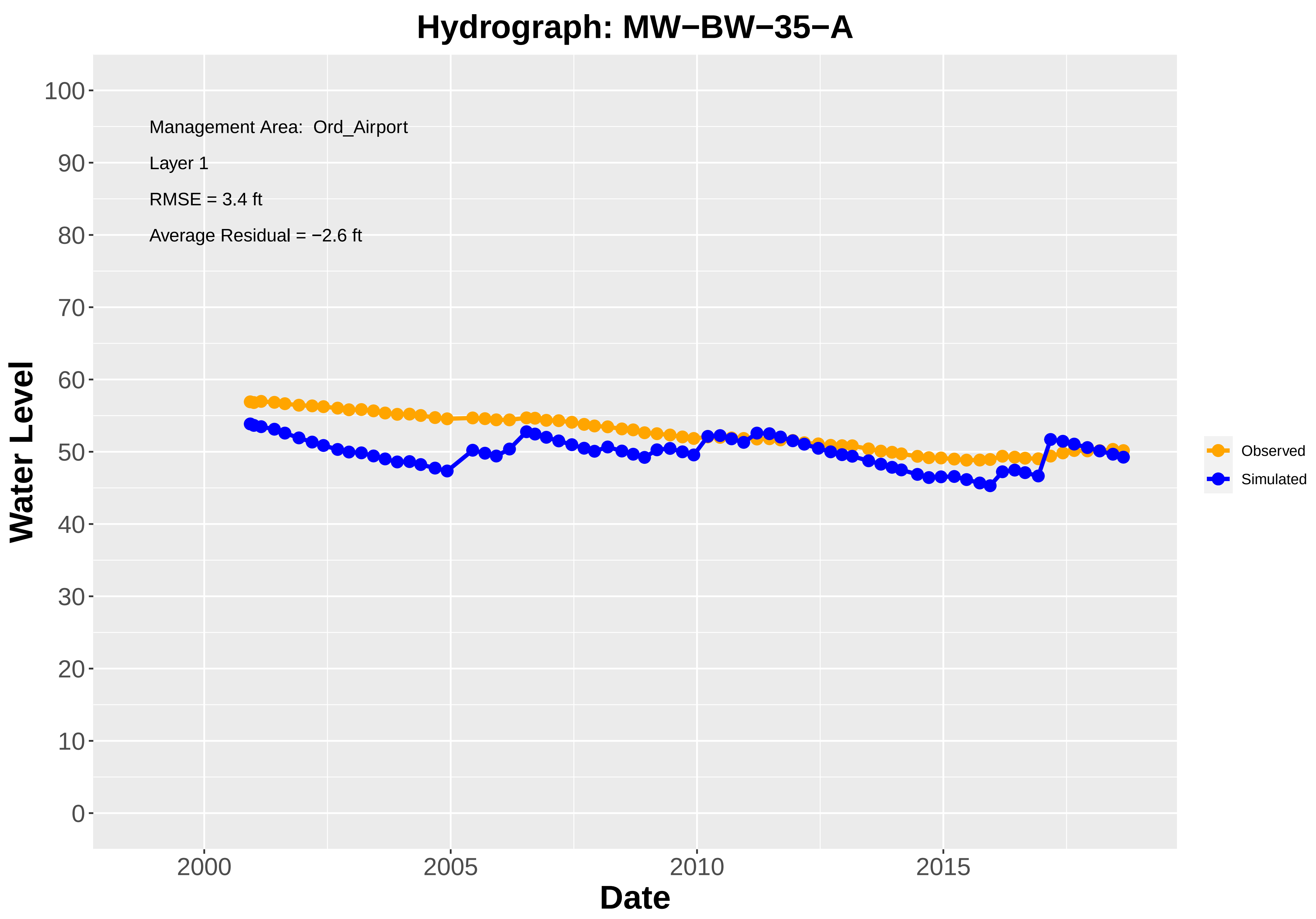


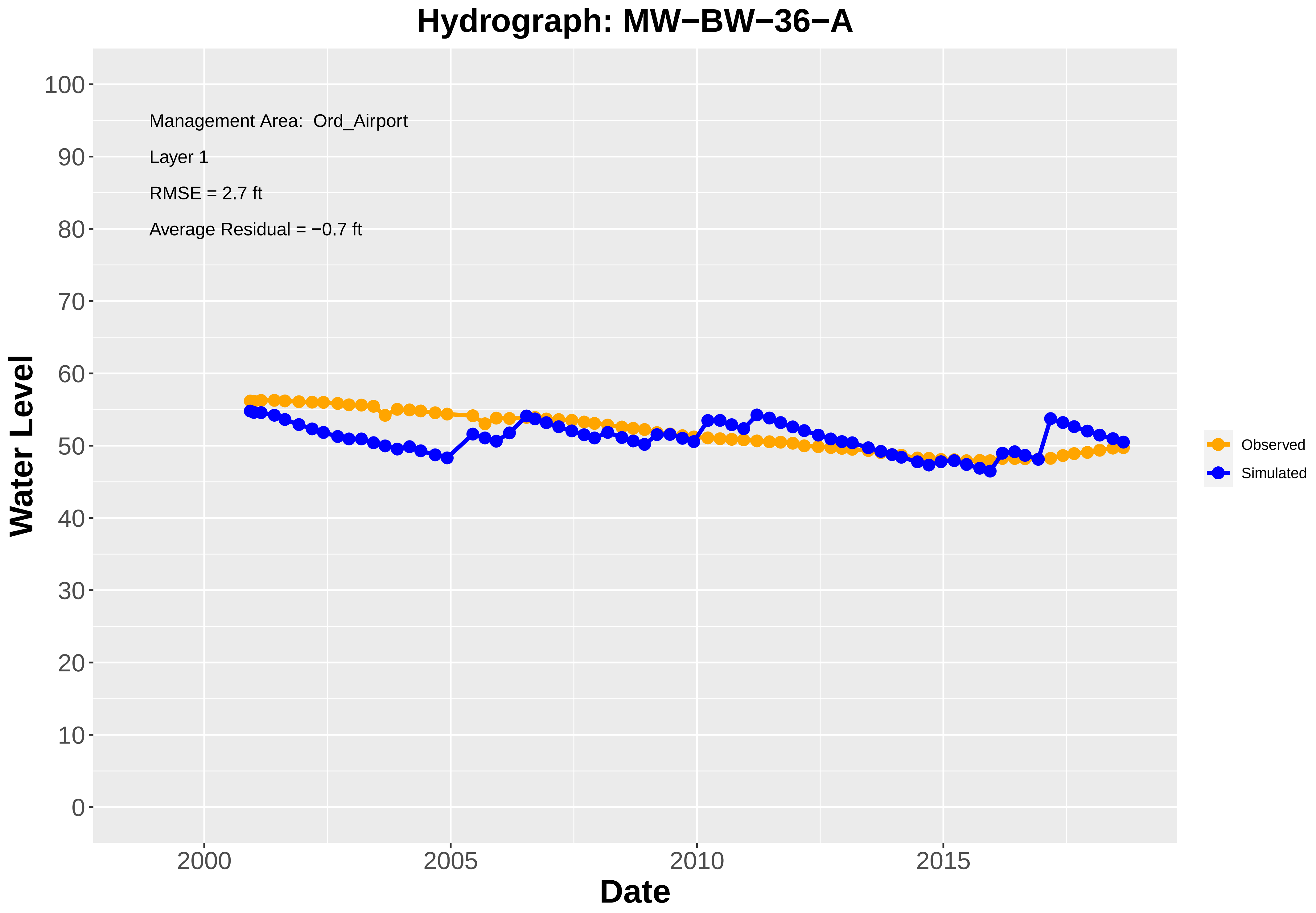
Hydrograph: MW−BW−32−A
Management Area: Ord_Airport
Layer 1
RMSE = 3.5 ft
Average Residual = −2.6 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−33−A
Management Area: Marina
Layer 1
RMSE = 6.0 ft
Average Residual = −5.7 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

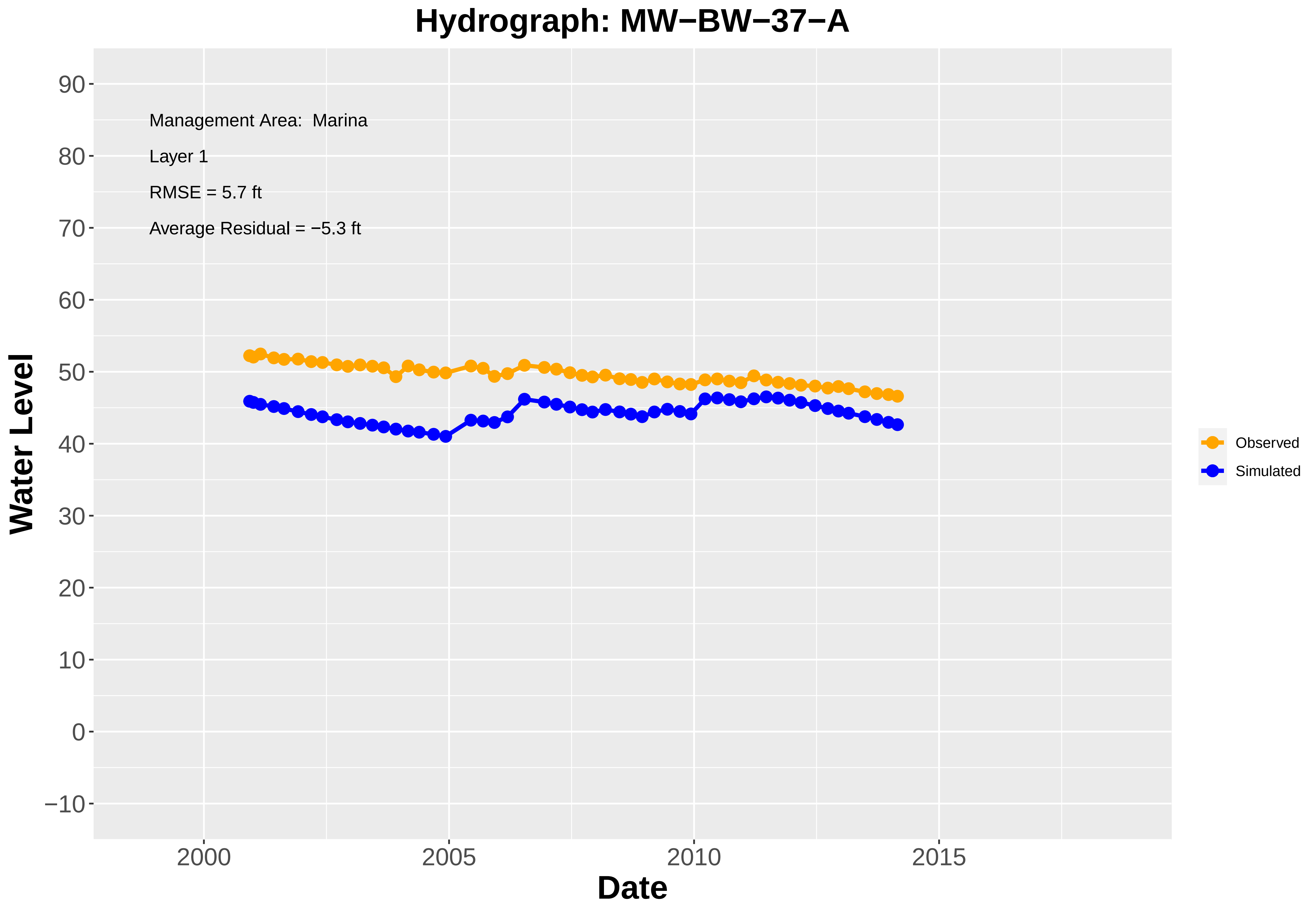


Hydrograph: MW−BW−34−A
Management Area: Marina
Layer 1
RMSE = 4.9 ft
Average Residual = −4.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

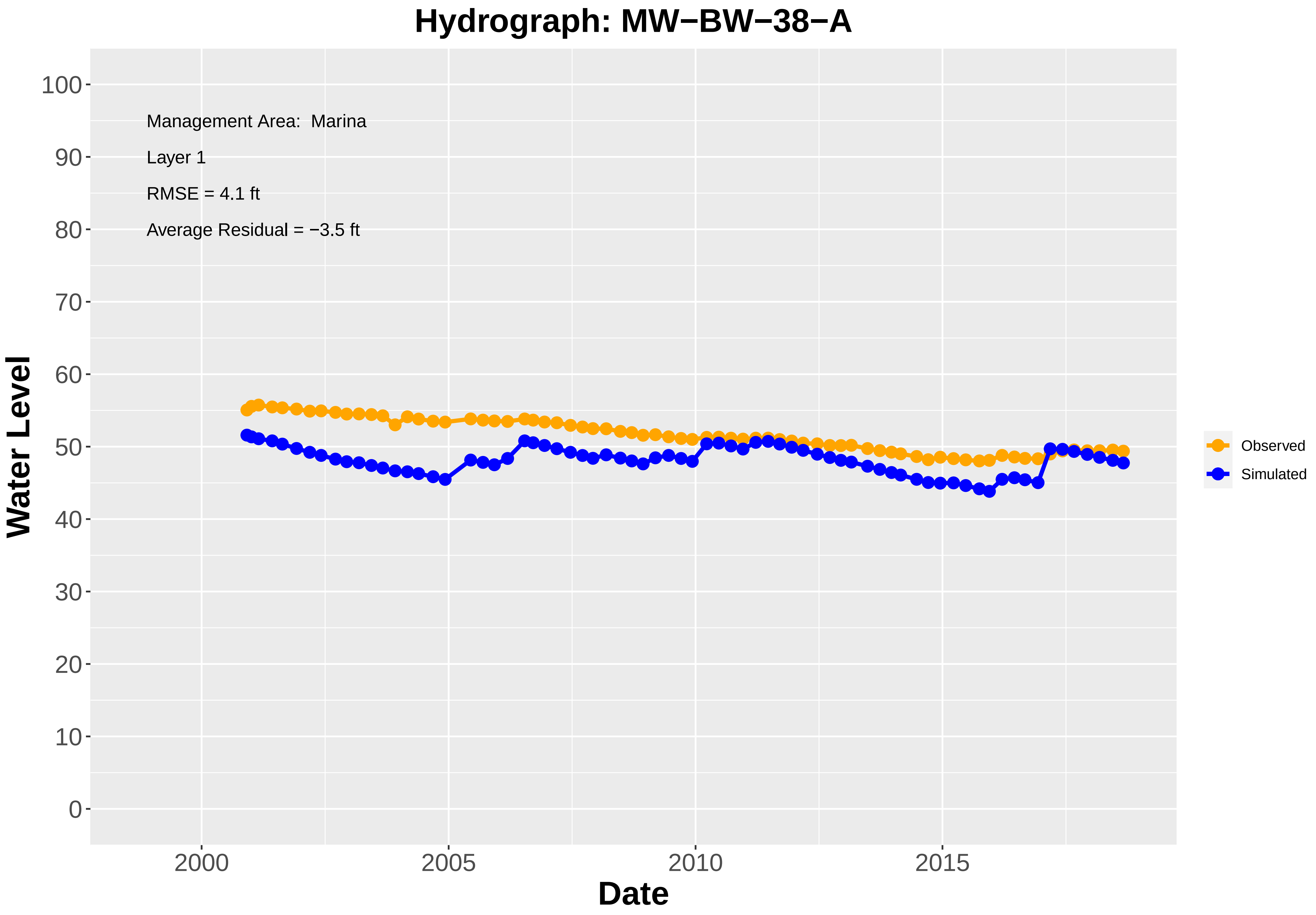

Hydrograph: MW−BW−35−A
Management Area: Ord_Airport
Layer 1
RMSE = 3.4 ft
Average Residual = −2.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

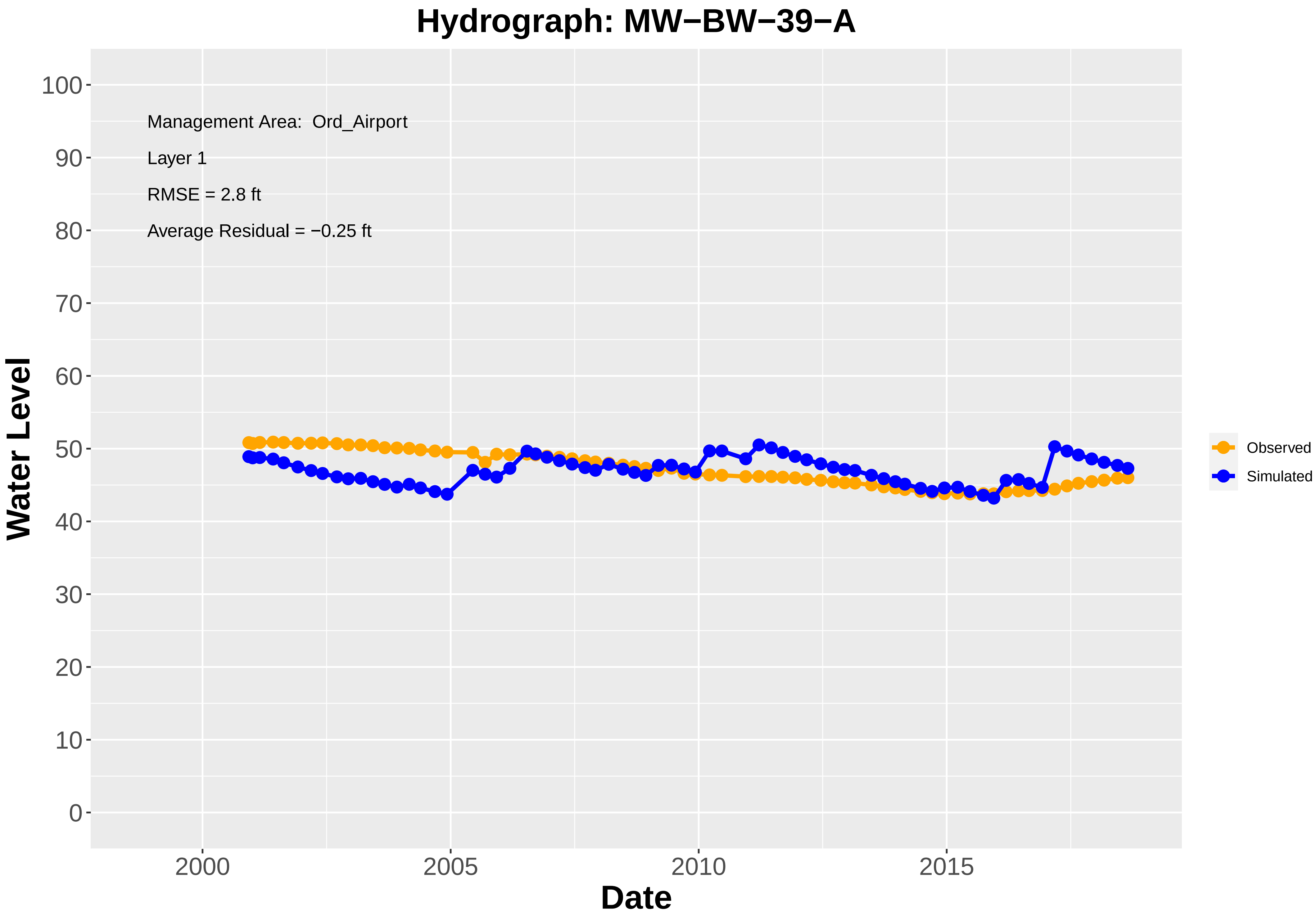


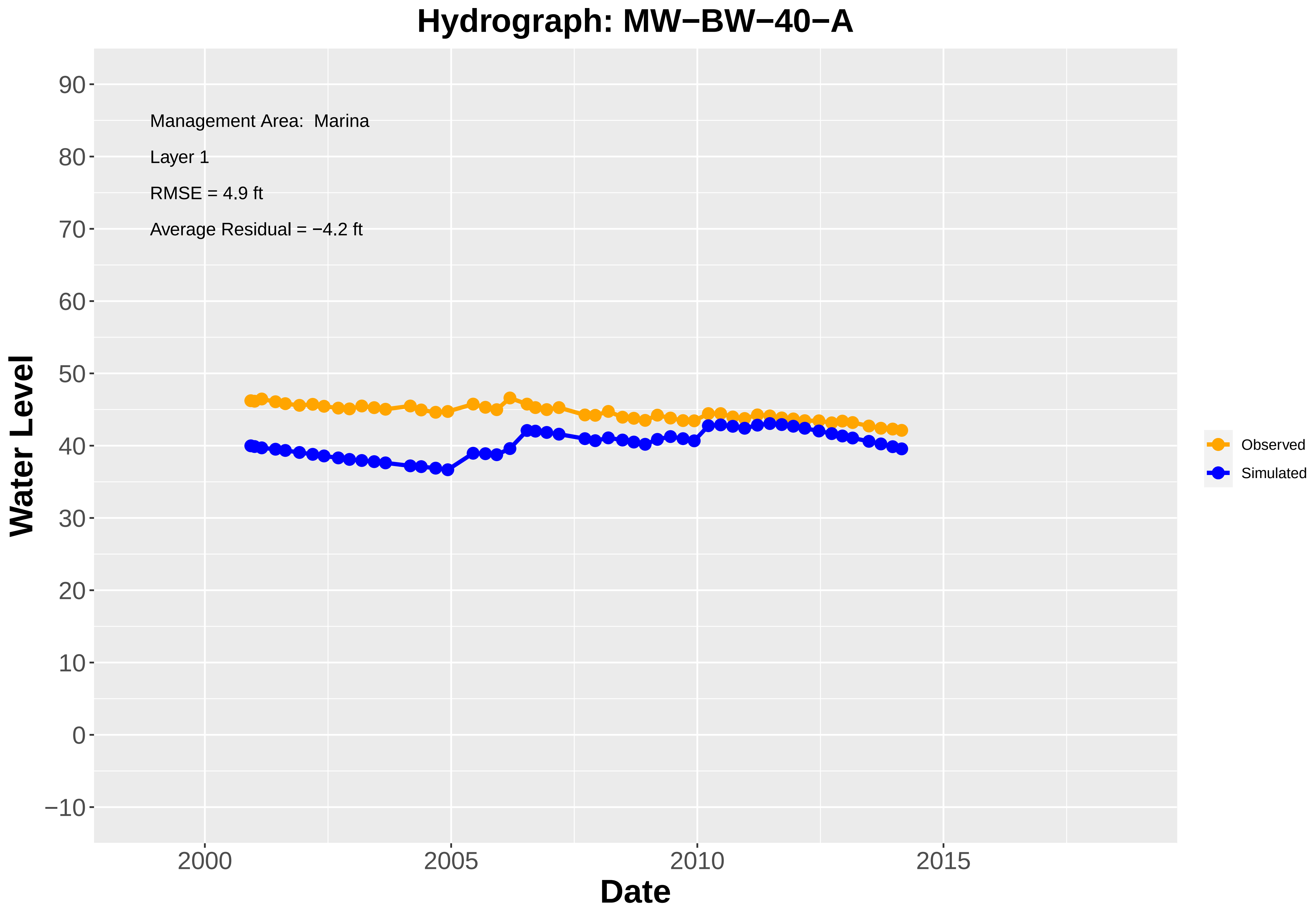
Hydrograph: MW−BW−36−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.7 ft
Average Residual = −0.7 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



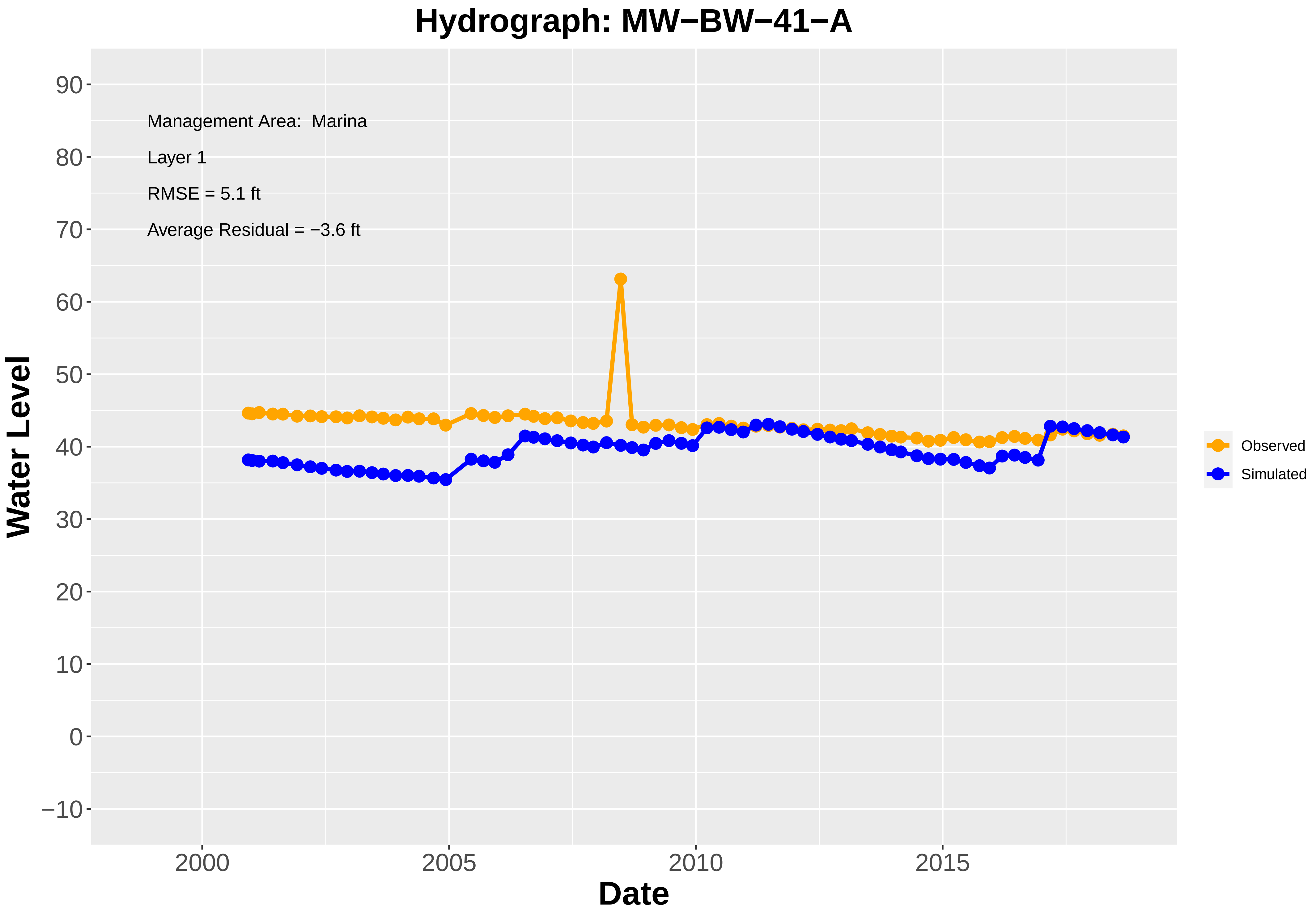
Hydrograph: MW−BW−37−A
Management Area: Marina
Layer 1
RMSE = 5.7 ft
Average Residual = −5.3 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

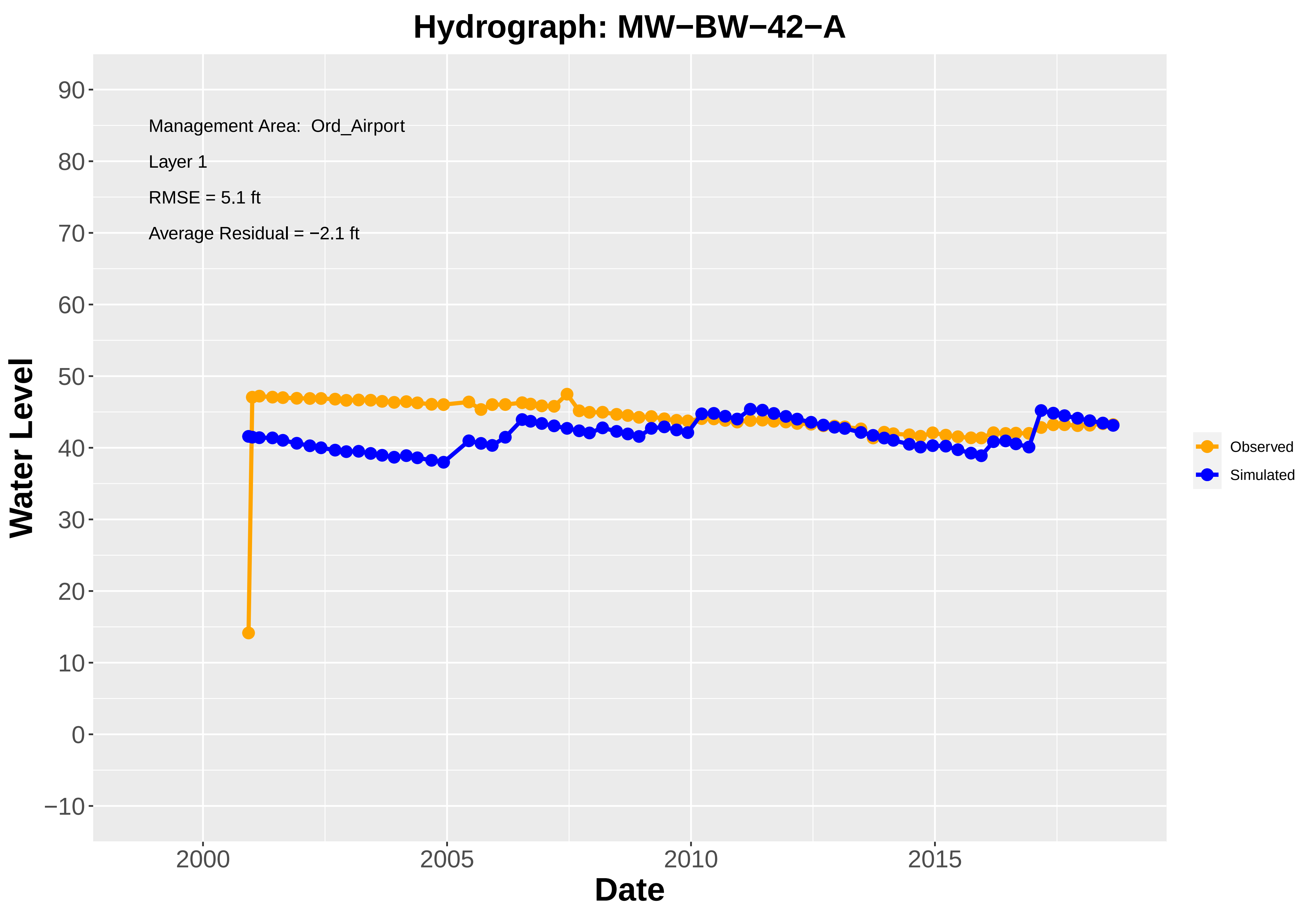

Hydrograph: MW−BW−38−A
Management Area: Marina
Layer 1
RMSE = 4.1 ft
Average Residual = −3.5 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−39−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.8 ft
Average Residual = −0.25 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

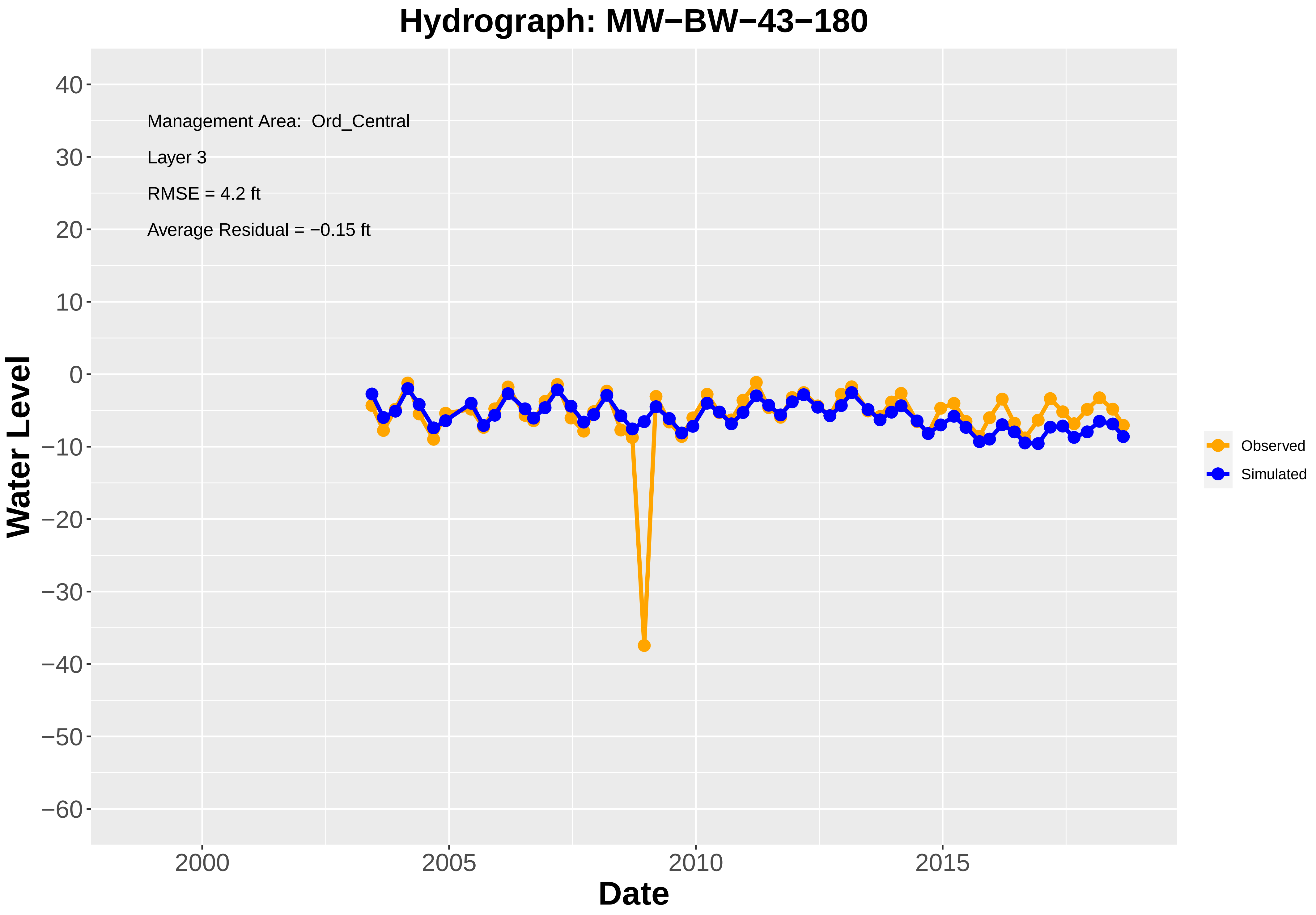


Hydrograph: MW−BW−40−A
Management Area: Marina
Layer 1
RMSE = 4.9 ft
Average Residual = −4.2 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

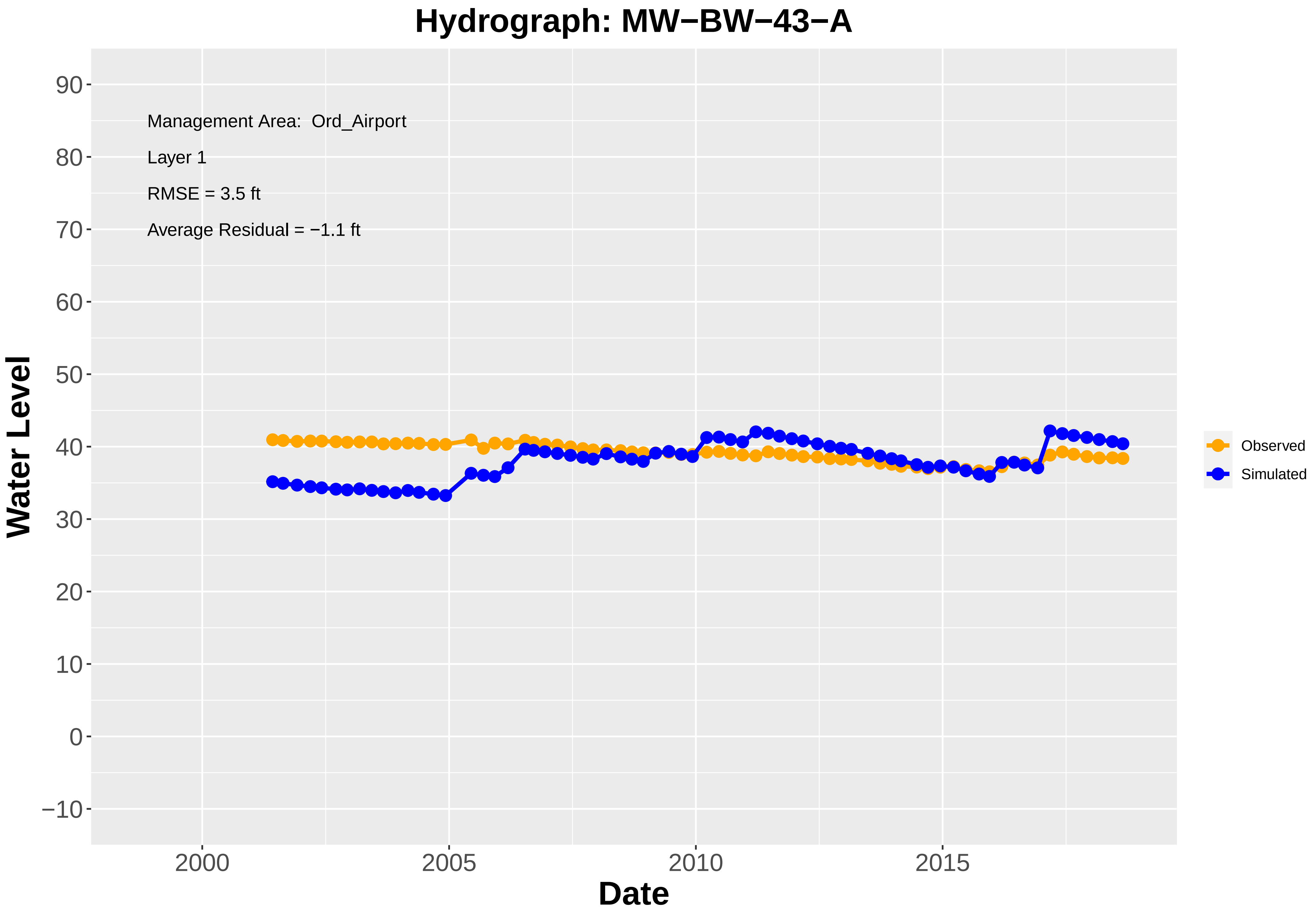

Hydrograph: MW−BW−41−A
Management Area: Marina
Layer 1
RMSE = 5.1 ft
Average Residual = −3.6 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

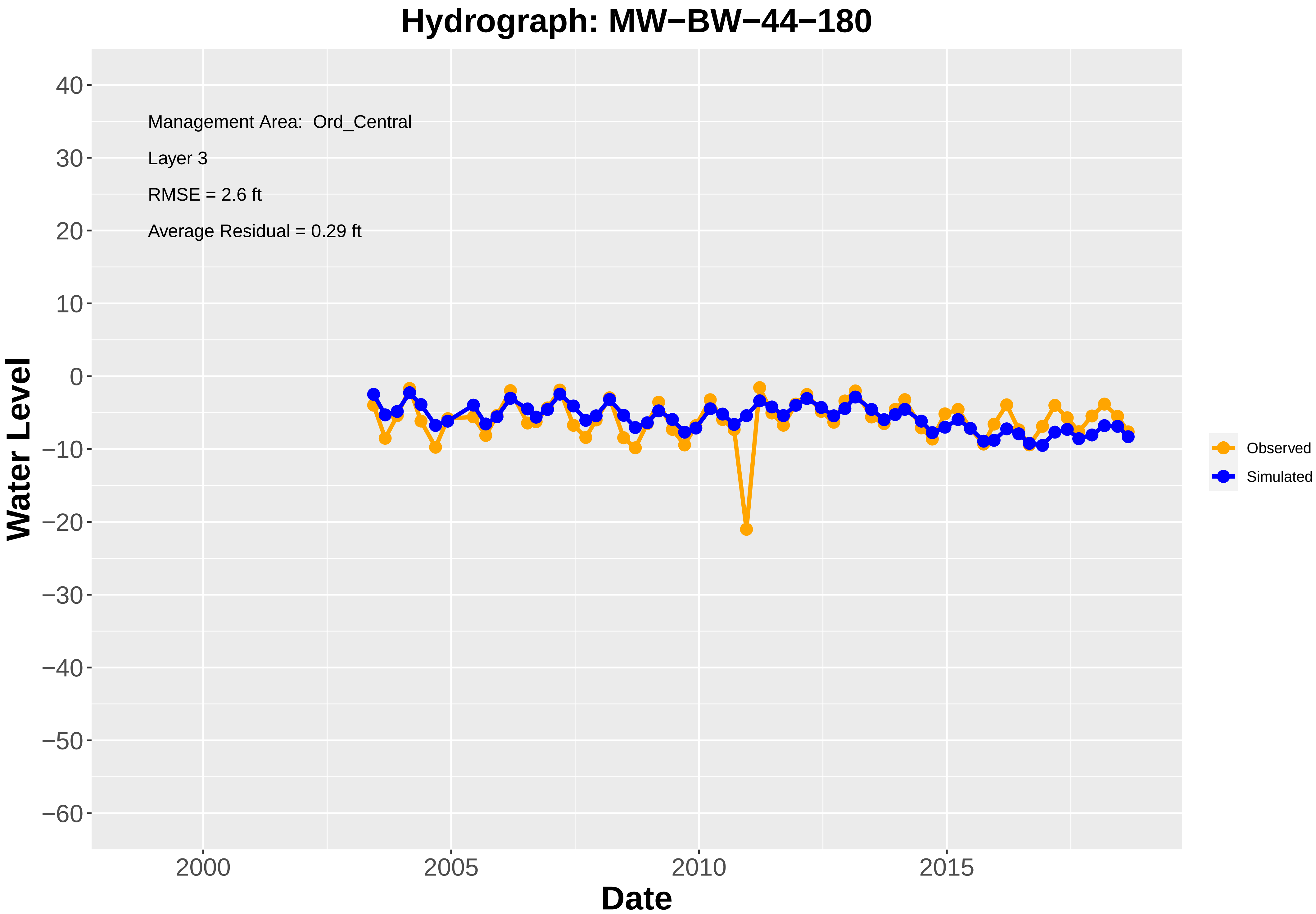


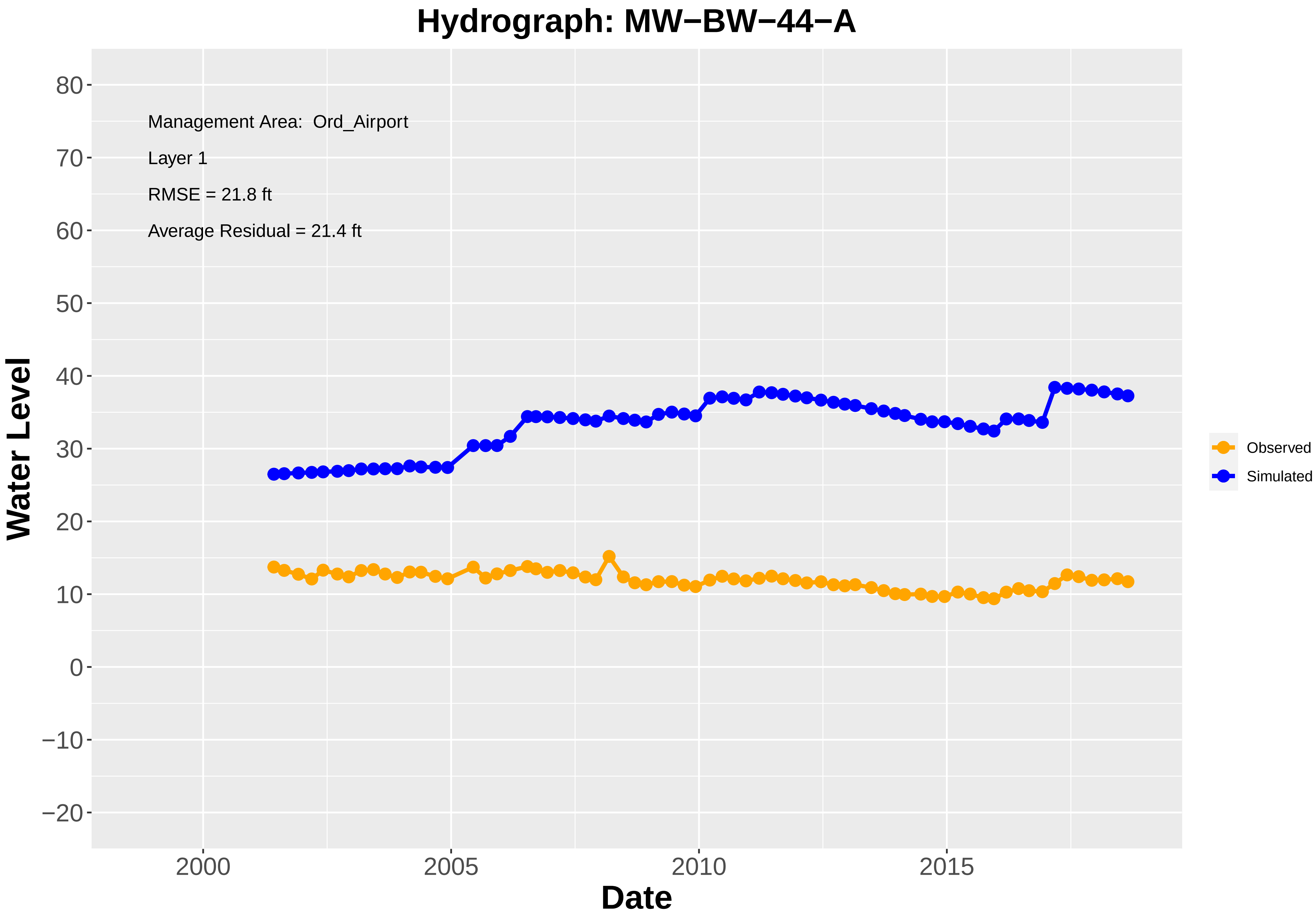
Hydrograph: MW−BW−42−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.1 ft
Average Residual = −2.1 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

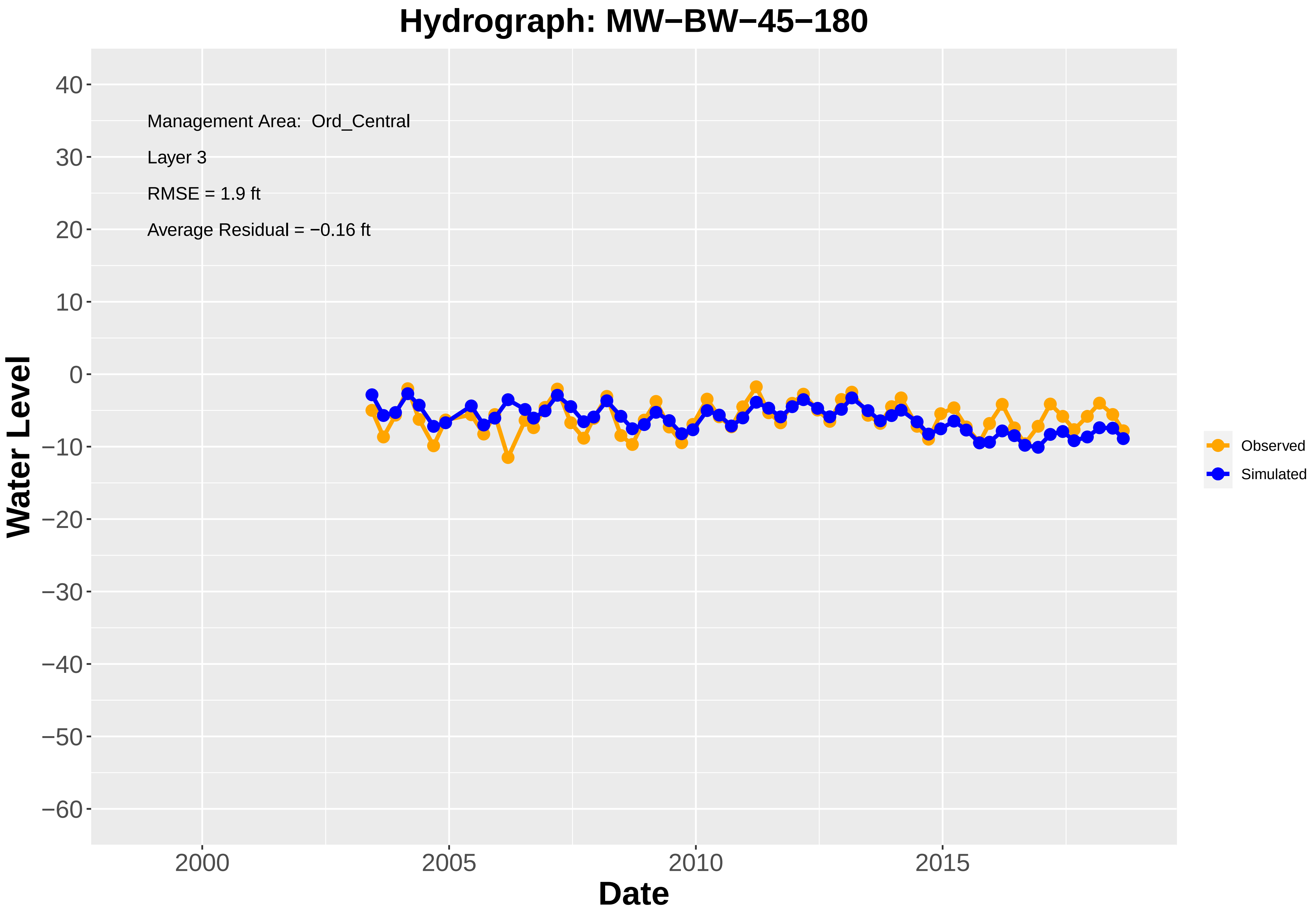


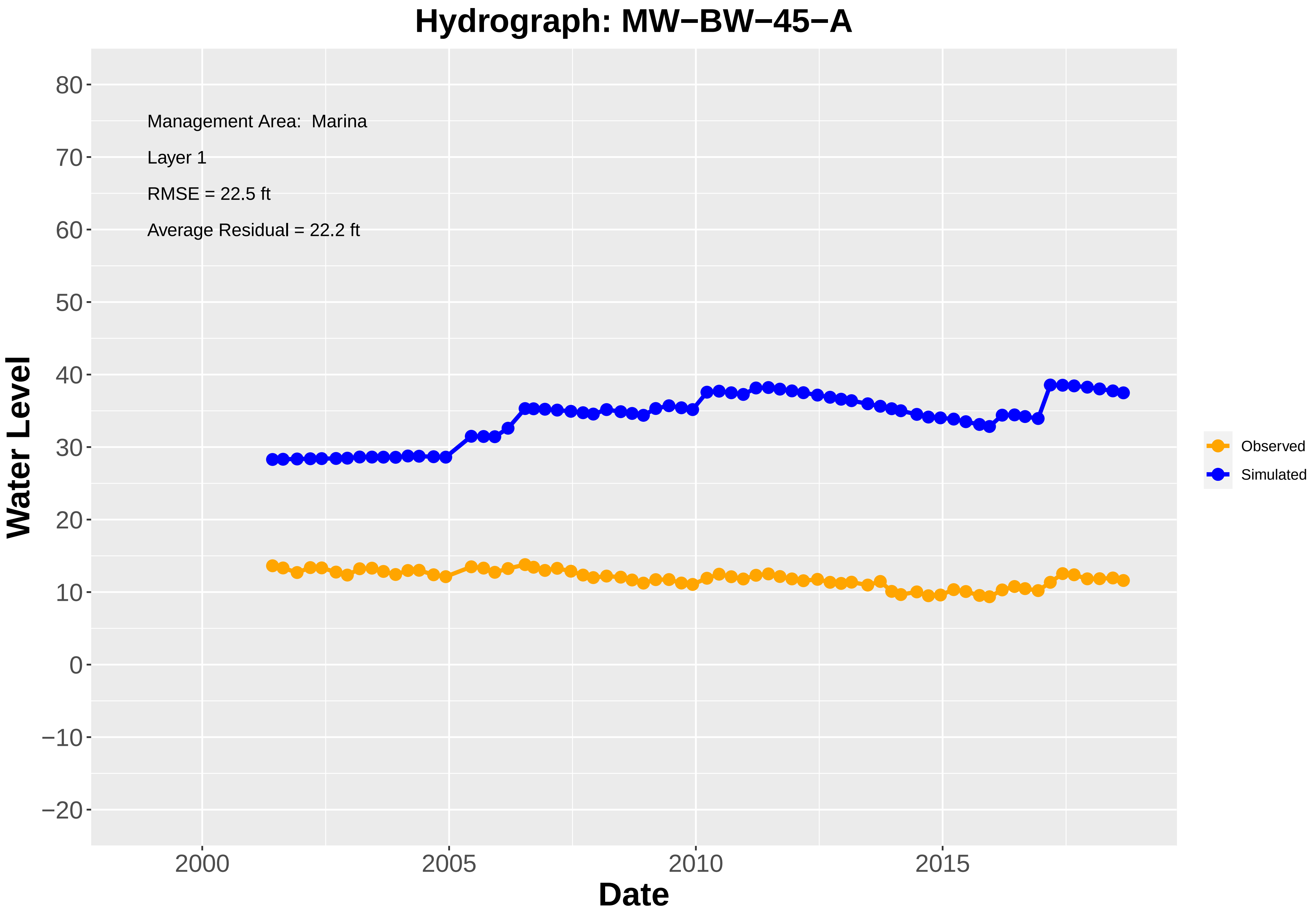
Hydrograph: MW−BW−43−180
Management Area: Ord_Central
Layer 3
RMSE = 4.2 ft
Average Residual = −0.15 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

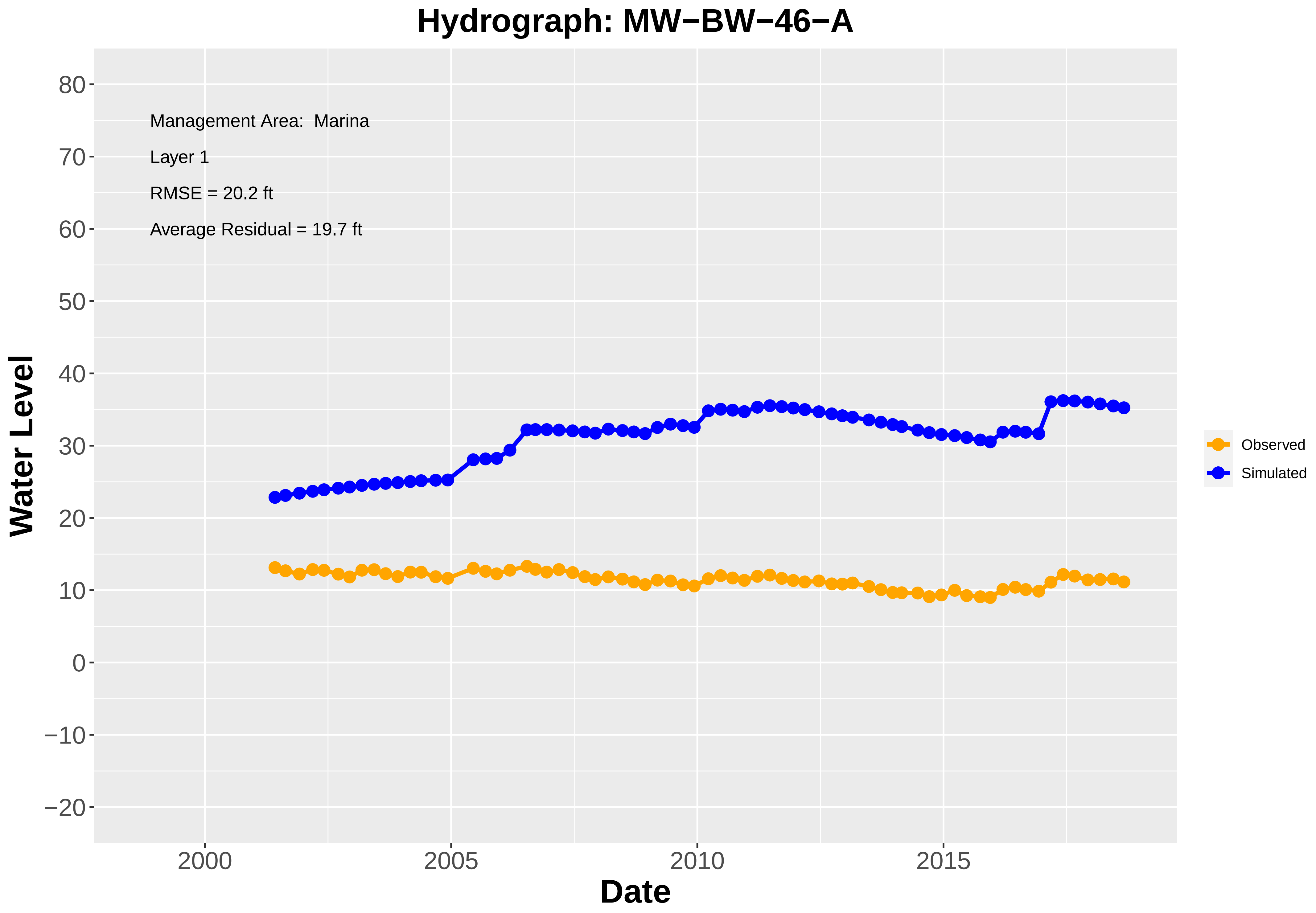

Hydrograph: MW−BW−43−A
Management Area: Ord_Airport
Layer 1
RMSE = 3.5 ft
Average Residual = −1.1 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−44−180
Management Area: Ord_Central
Layer 3
RMSE = 2.6 ft
Average Residual = 0.29 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

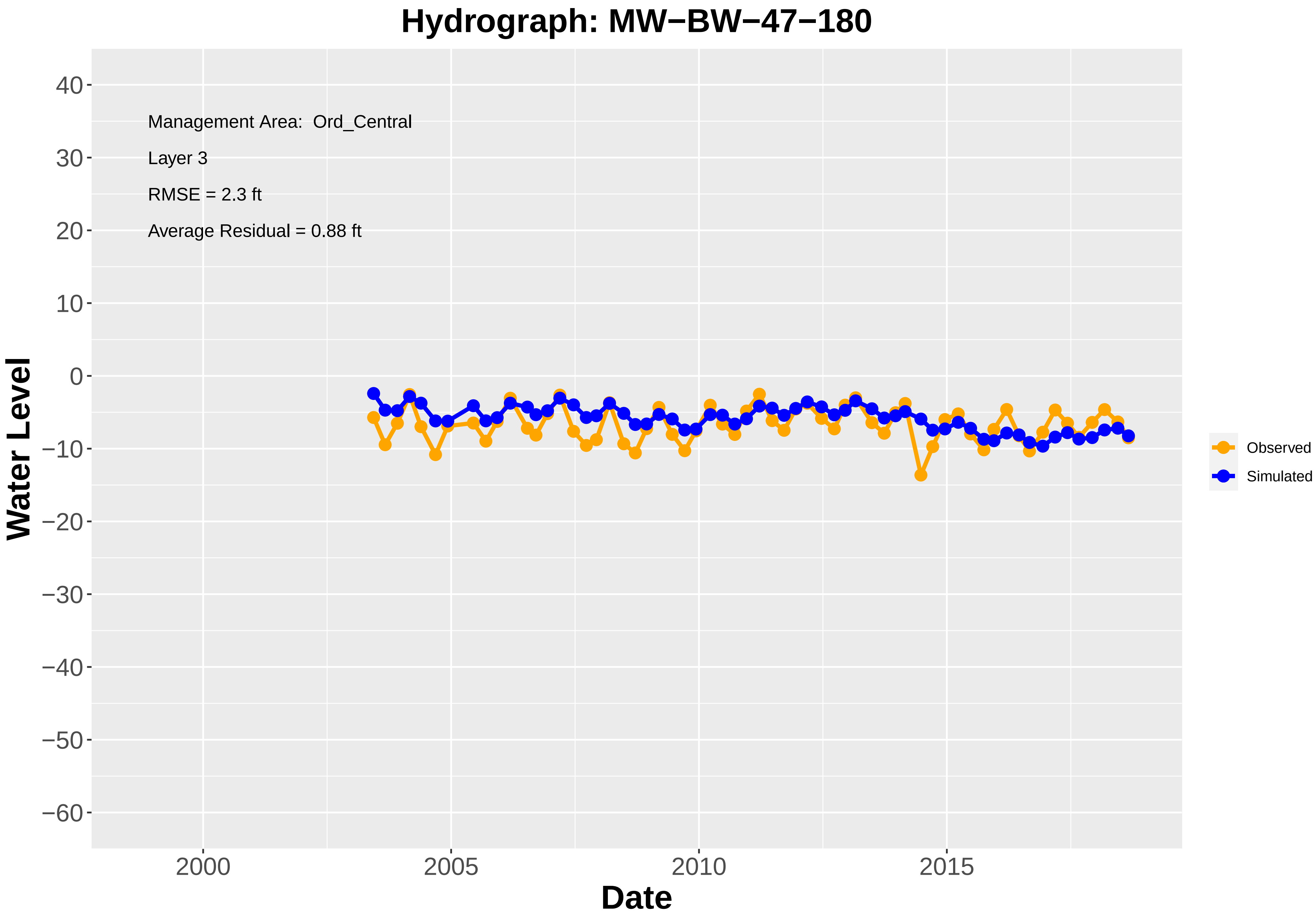

Hydrograph: MW−BW−44−A
Management Area: Ord_Airport
Layer 1
RMSE = 21.8 ft
Average Residual = 21.4 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−45−180
Management Area: Ord_Central
Layer 3
RMSE = 1.9 ft
Average Residual = −0.16 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

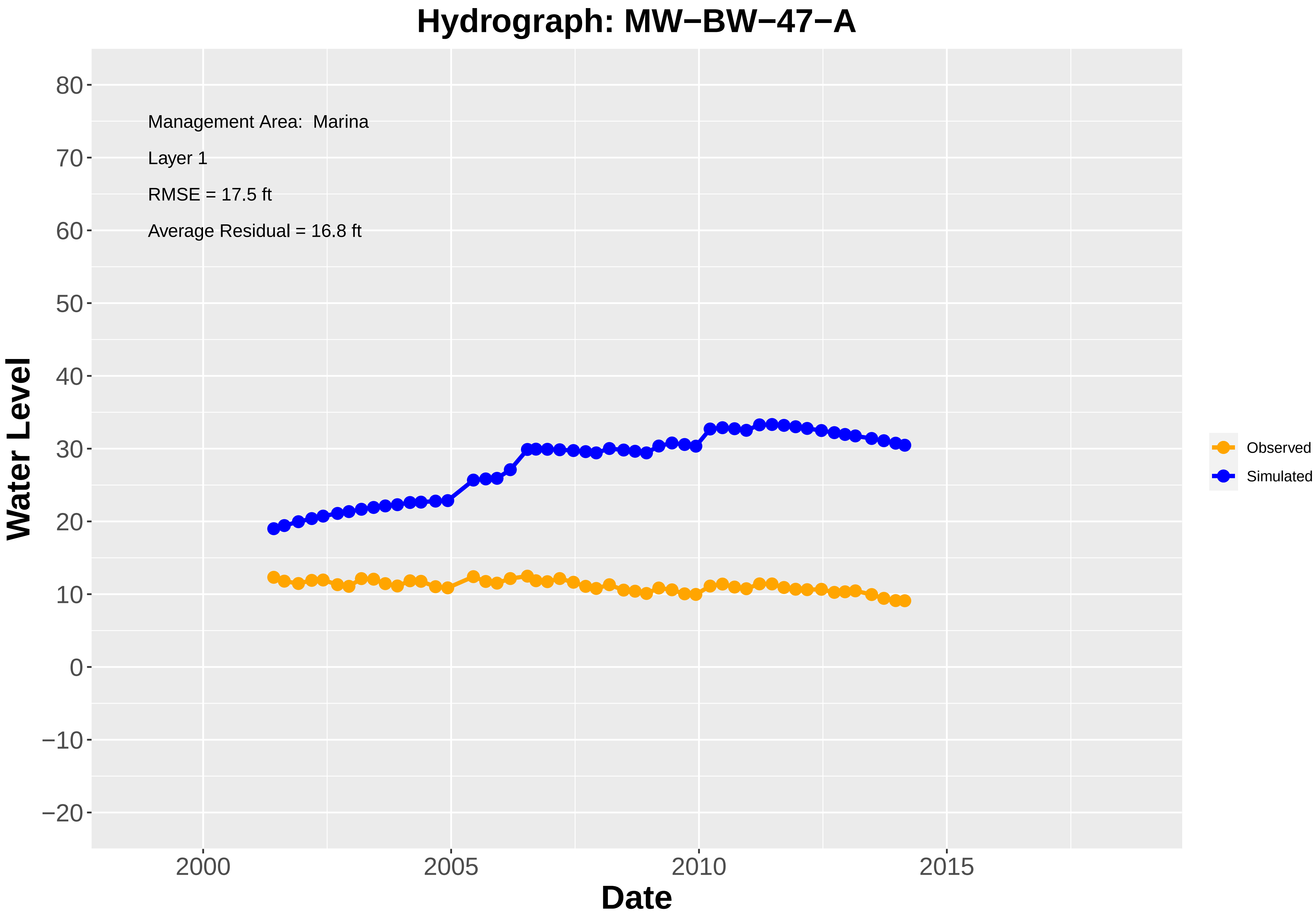

Hydrograph: MW−BW−45−A
Management Area: Marina
Layer 1
RMSE = 22.5 ft
Average Residual = 22.2 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



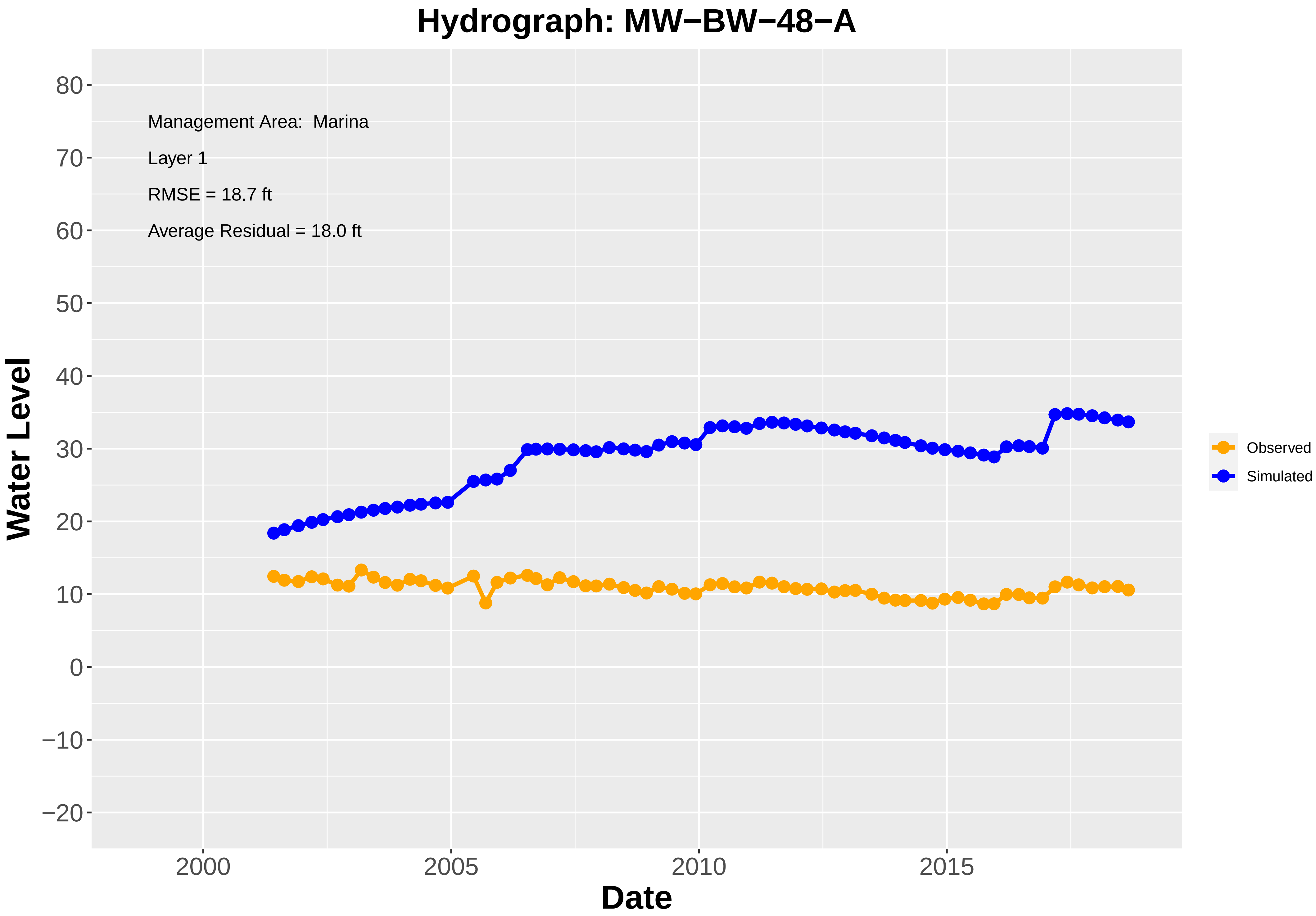
Hydrograph: MW−BW−46−A
Management Area: Marina
Layer 1
RMSE = 20.2 ft
Average Residual = 19.7 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



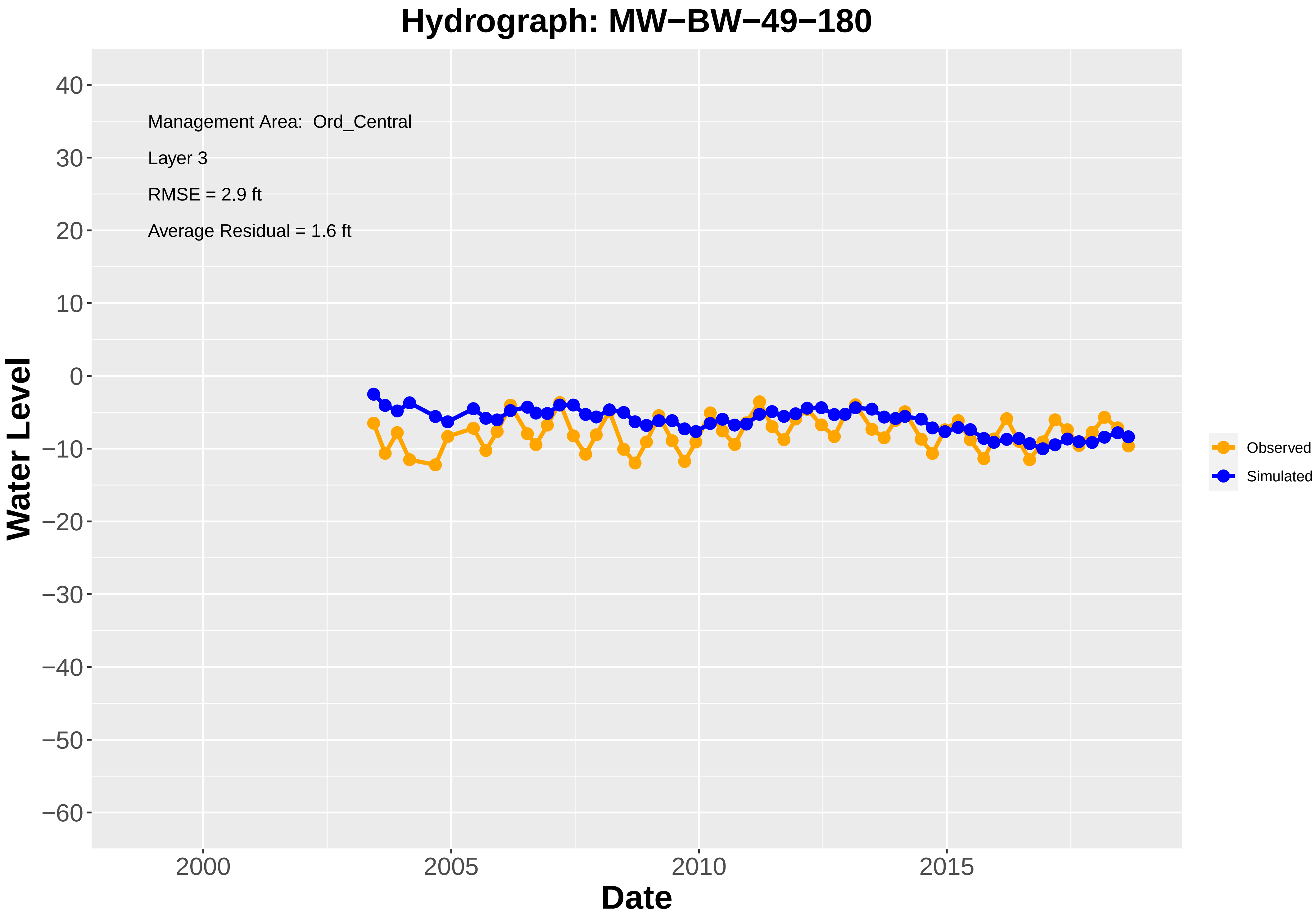
Hydrograph: MW−BW−47−180
Management Area: Ord_Central
Layer 3
RMSE = 2.3 ft
Average Residual = 0.88 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated



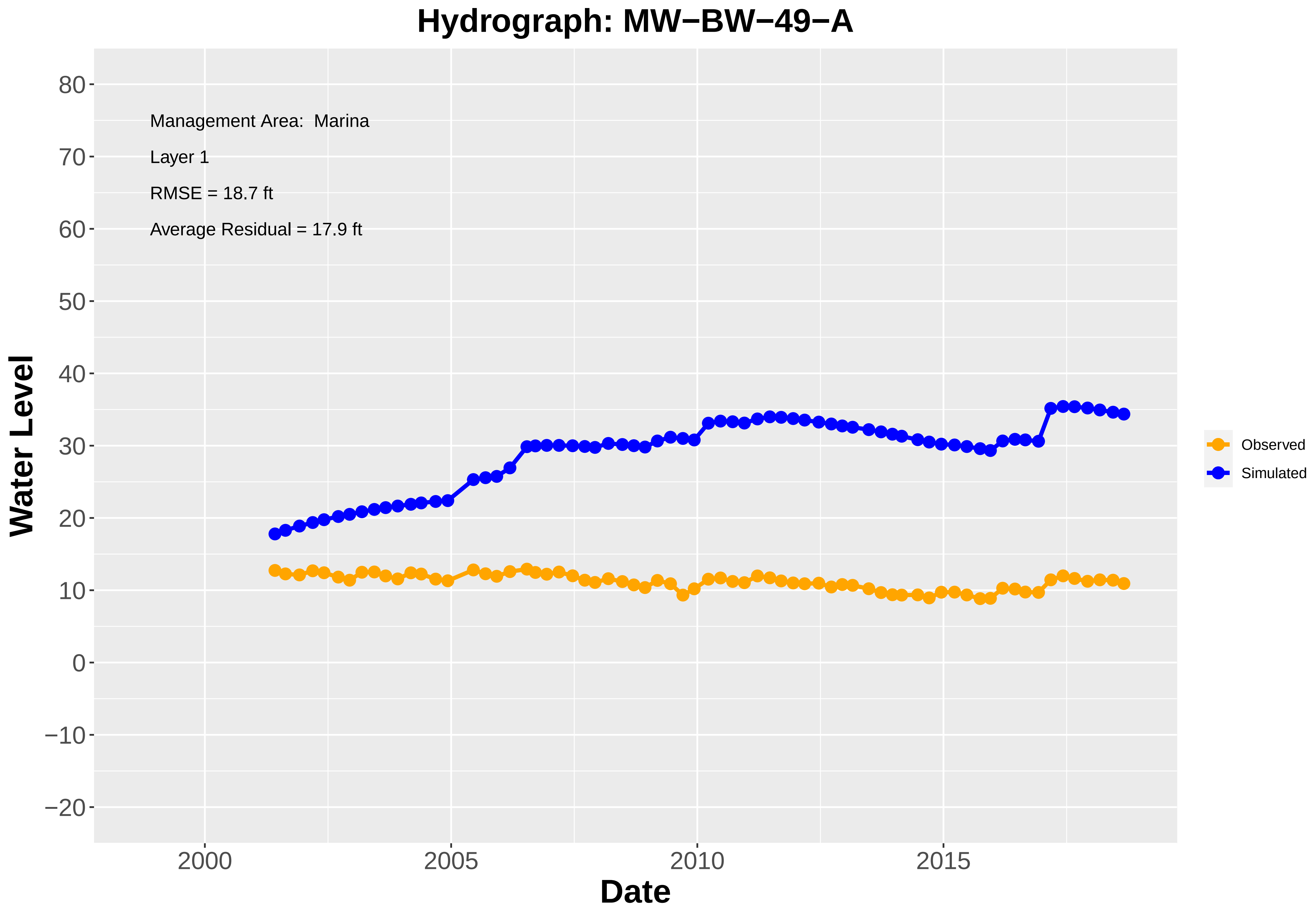
Hydrograph: MW−BW−47−A
Management Area: Marina
Layer 1
RMSE = 17.5 ft
Average Residual = 16.8 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



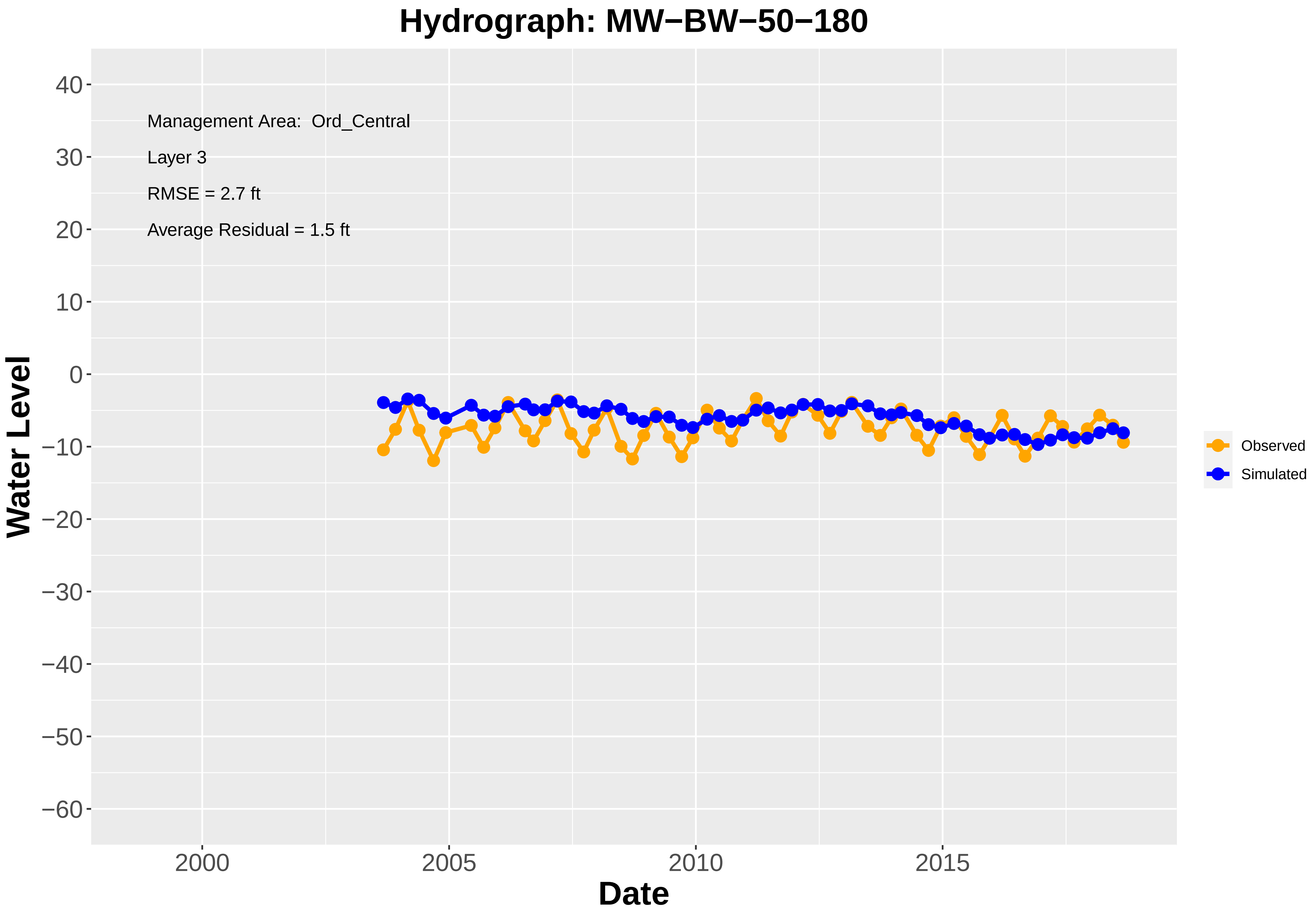
Hydrograph: MW−BW−48−A
Management Area: Marina
Layer 1
RMSE = 18.7 ft
Average Residual = 18.0 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



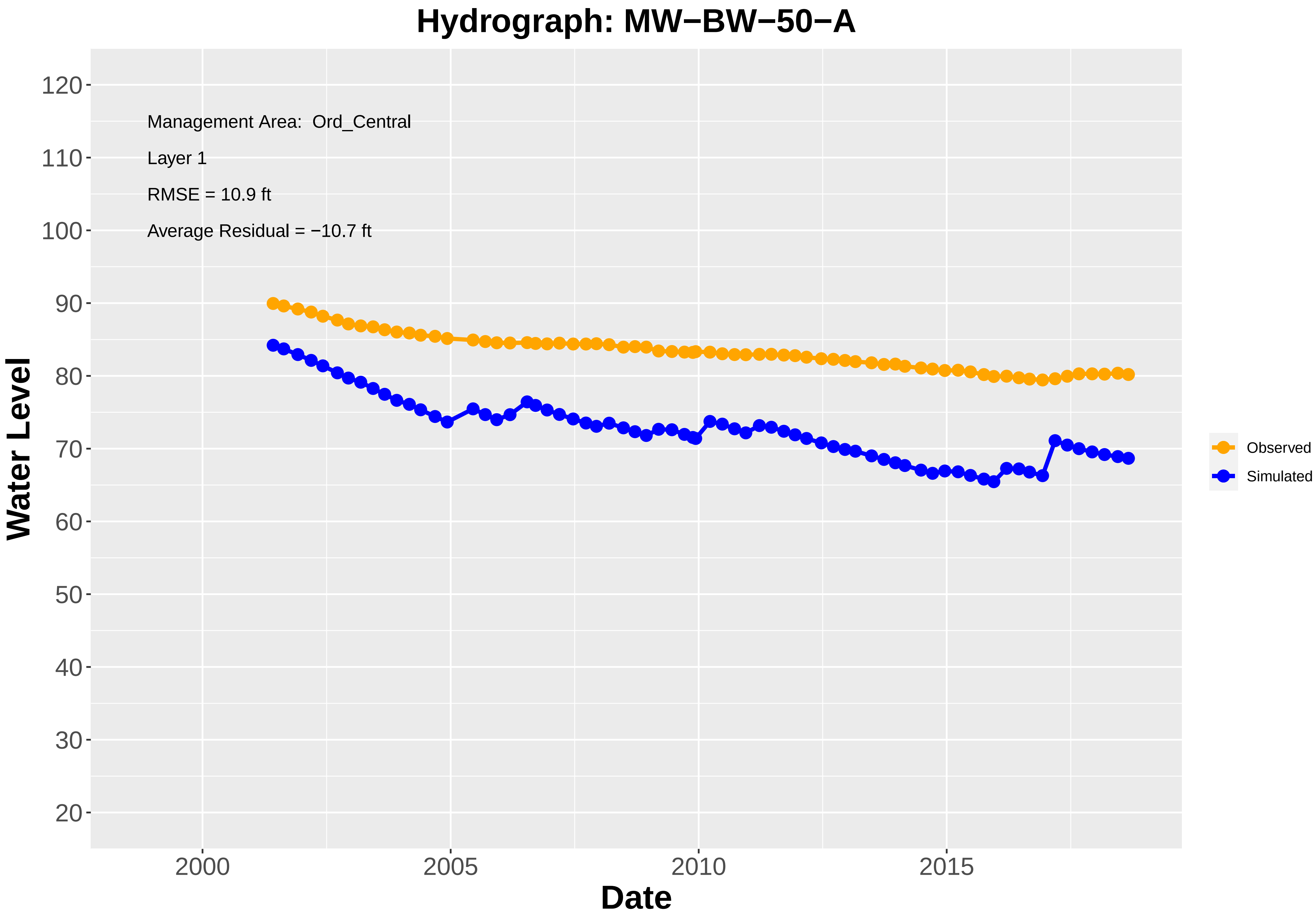
Hydrograph: MW−BW−49−180
Management Area: Ord_Central
Layer 3
RMSE = 2.9 ft
Average Residual = 1.6 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

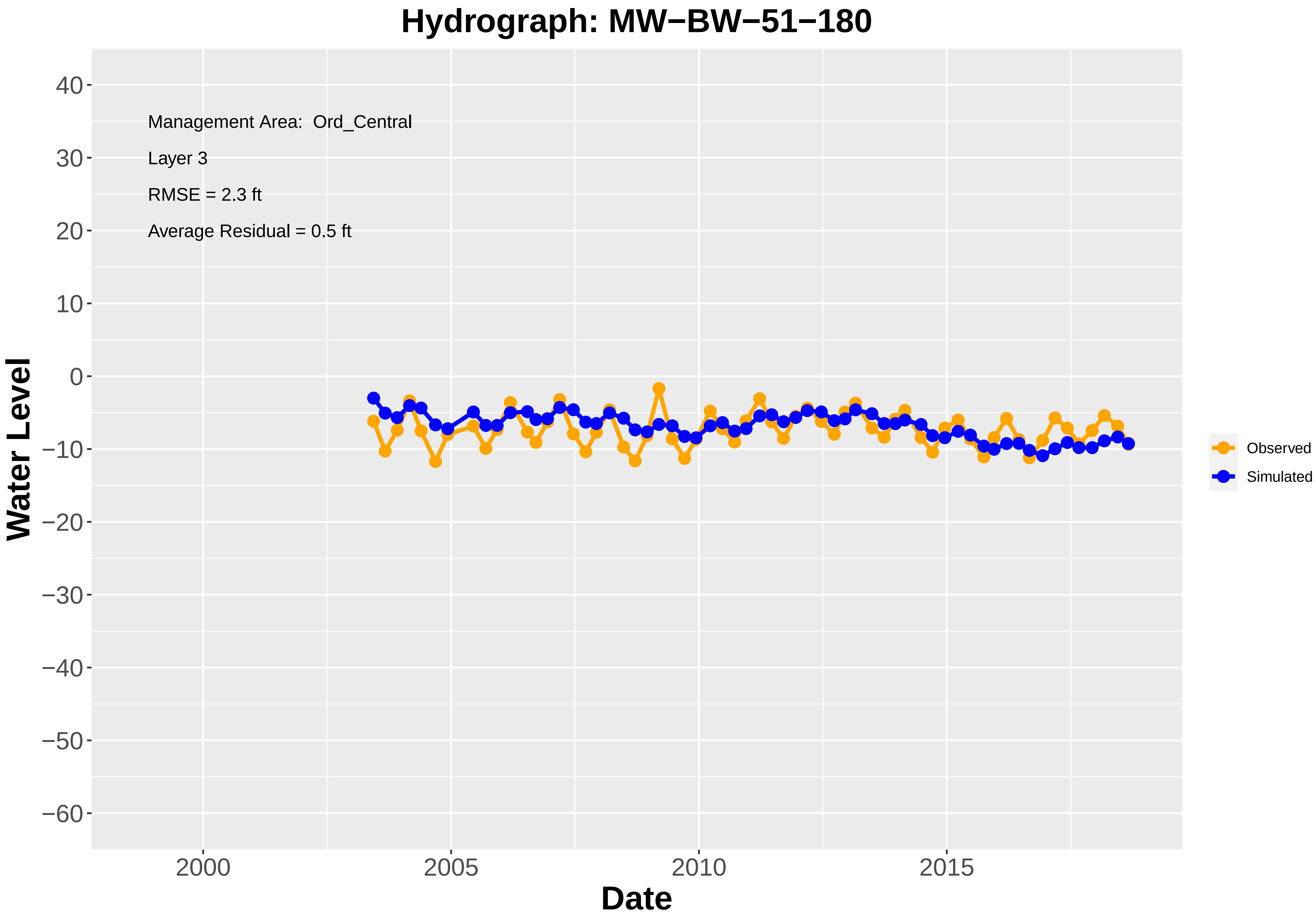


Hydrograph: MW−BW−49−A
Management Area: Marina
Layer 1
RMSE = 18.7 ft
Average Residual = 17.9 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

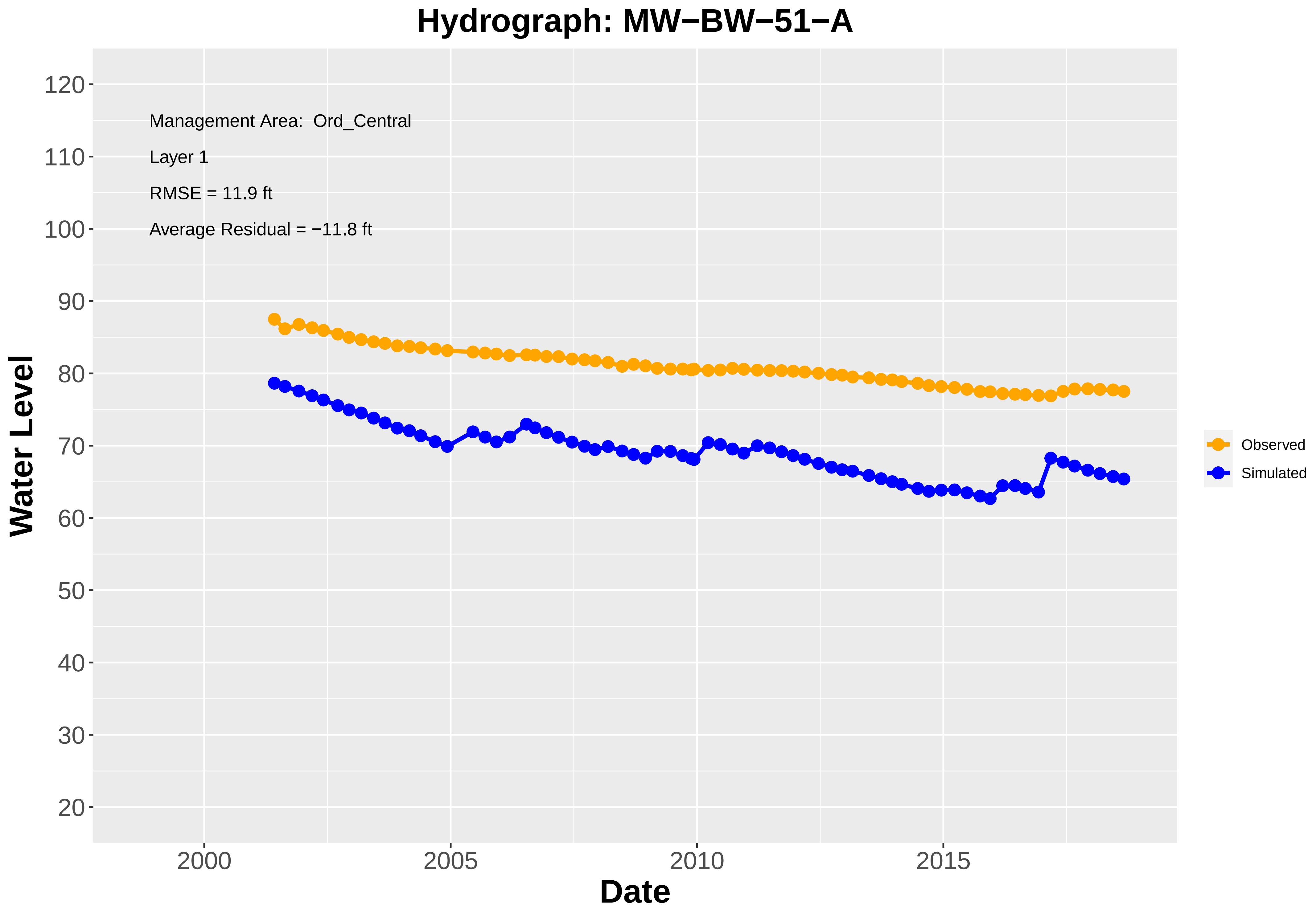


Hydrograph: MW−BW−50−180
Management Area: Ord_Central
Layer 3
RMSE = 2.7 ft
Average Residual = 1.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

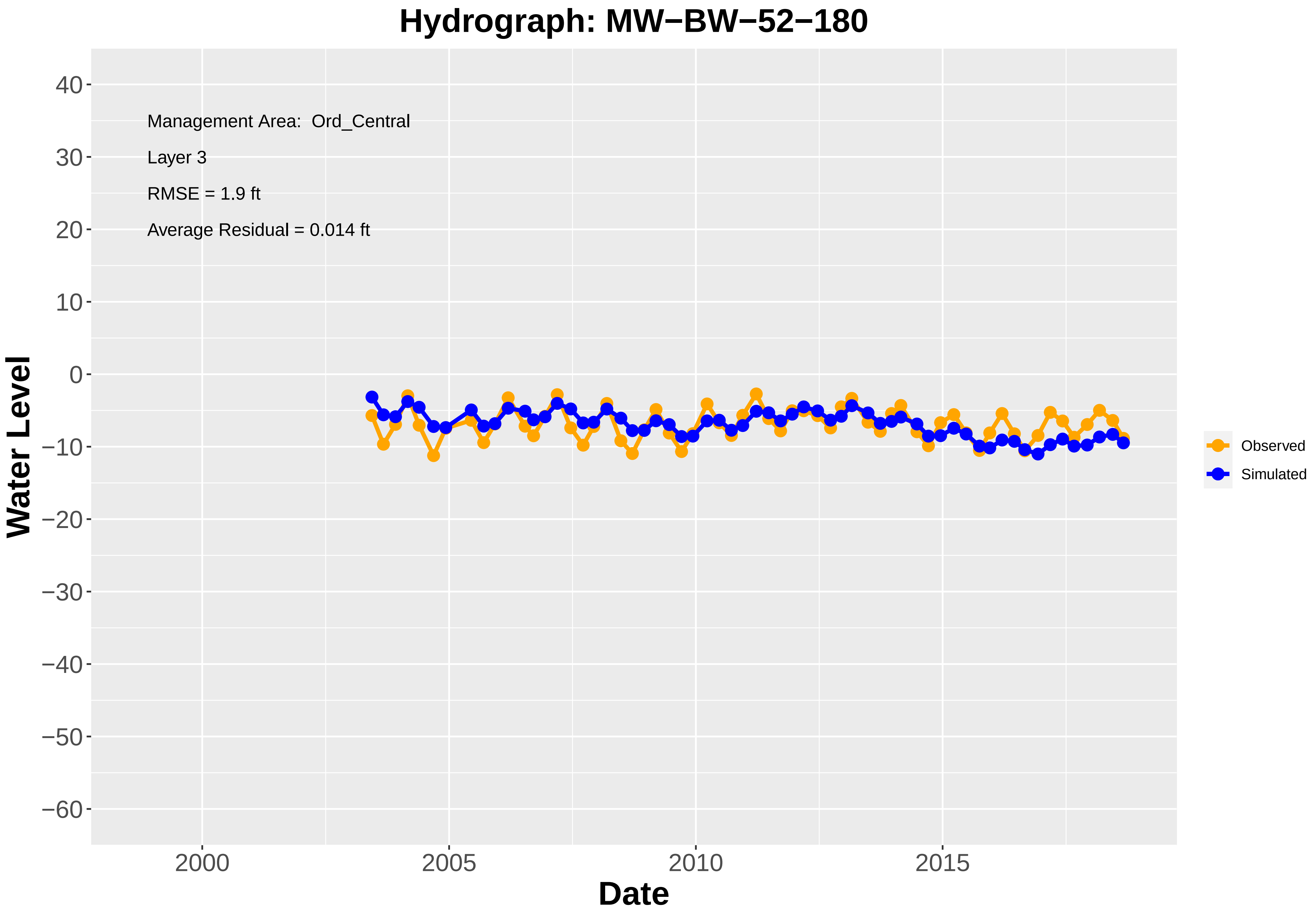

Hydrograph: MW−BW−50−A
Management Area: Ord_Central
Layer 1
RMSE = 10.9 ft
Average Residual = −10.7 ft
Water Level
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Date
Observed
Simulated



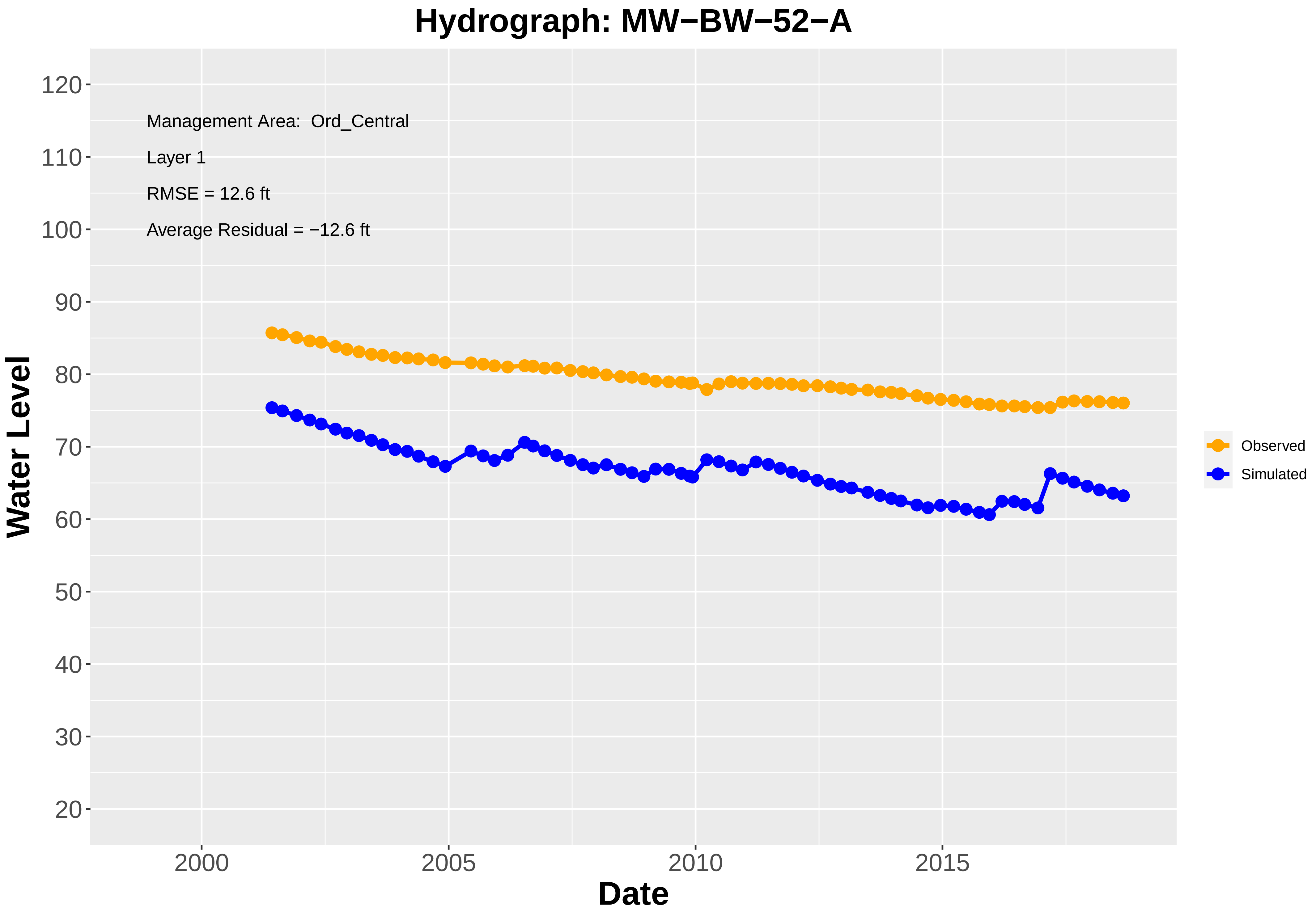
Hydrograph: MW−BW−51−180
Management Area: Ord_Central
Layer 3
RMSE = 2.3 ft
Average Residual = 0.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



Hydrograph: MW−BW−51−A
Management Area: Ord_Central
Layer 1
RMSE = 11.9 ft
Average Residual = −11.8 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

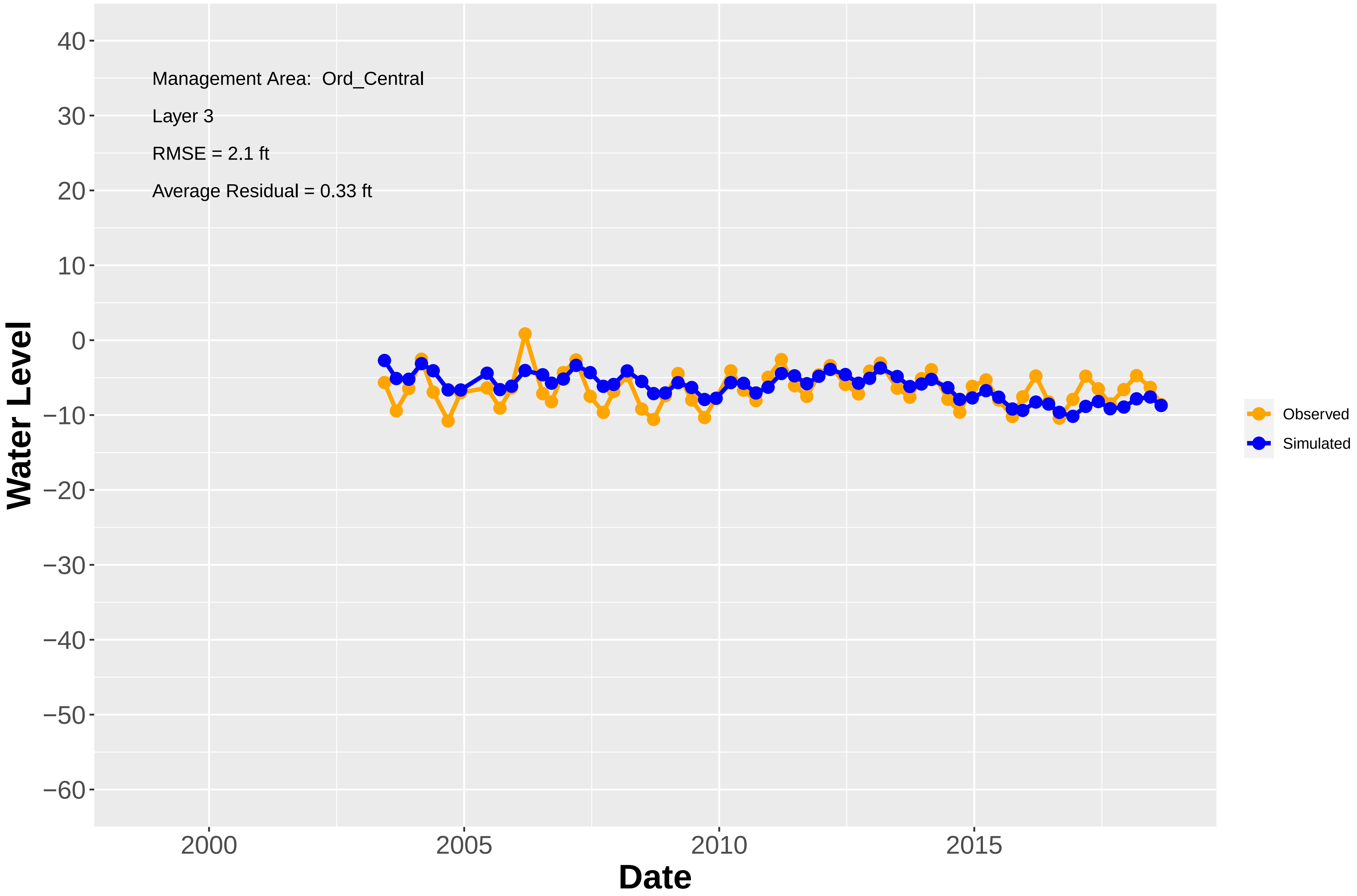


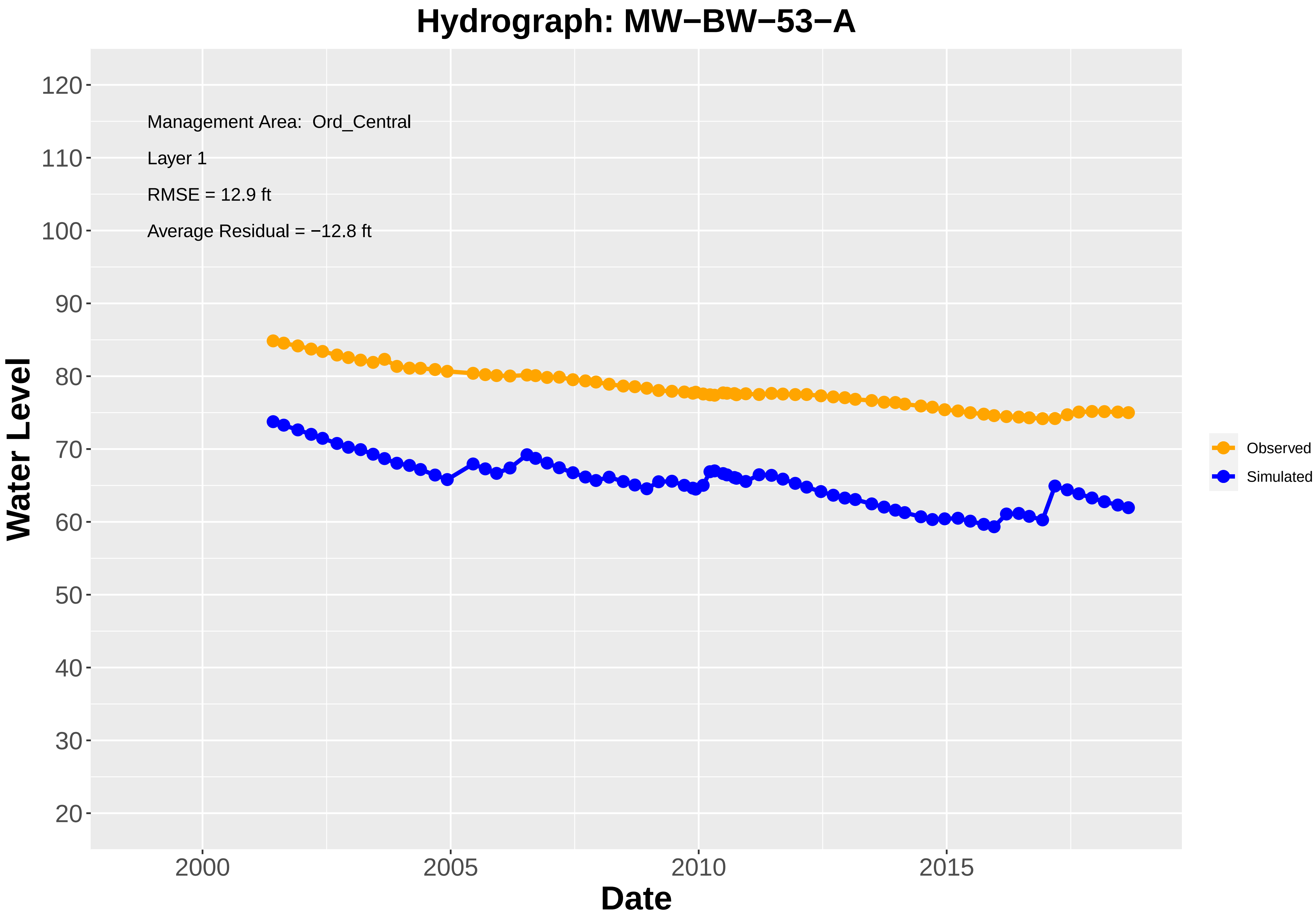
Hydrograph: MW−BW−52−180
Management Area: Ord_Central
Layer 3
RMSE = 1.9 ft
Average Residual = 0.014 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



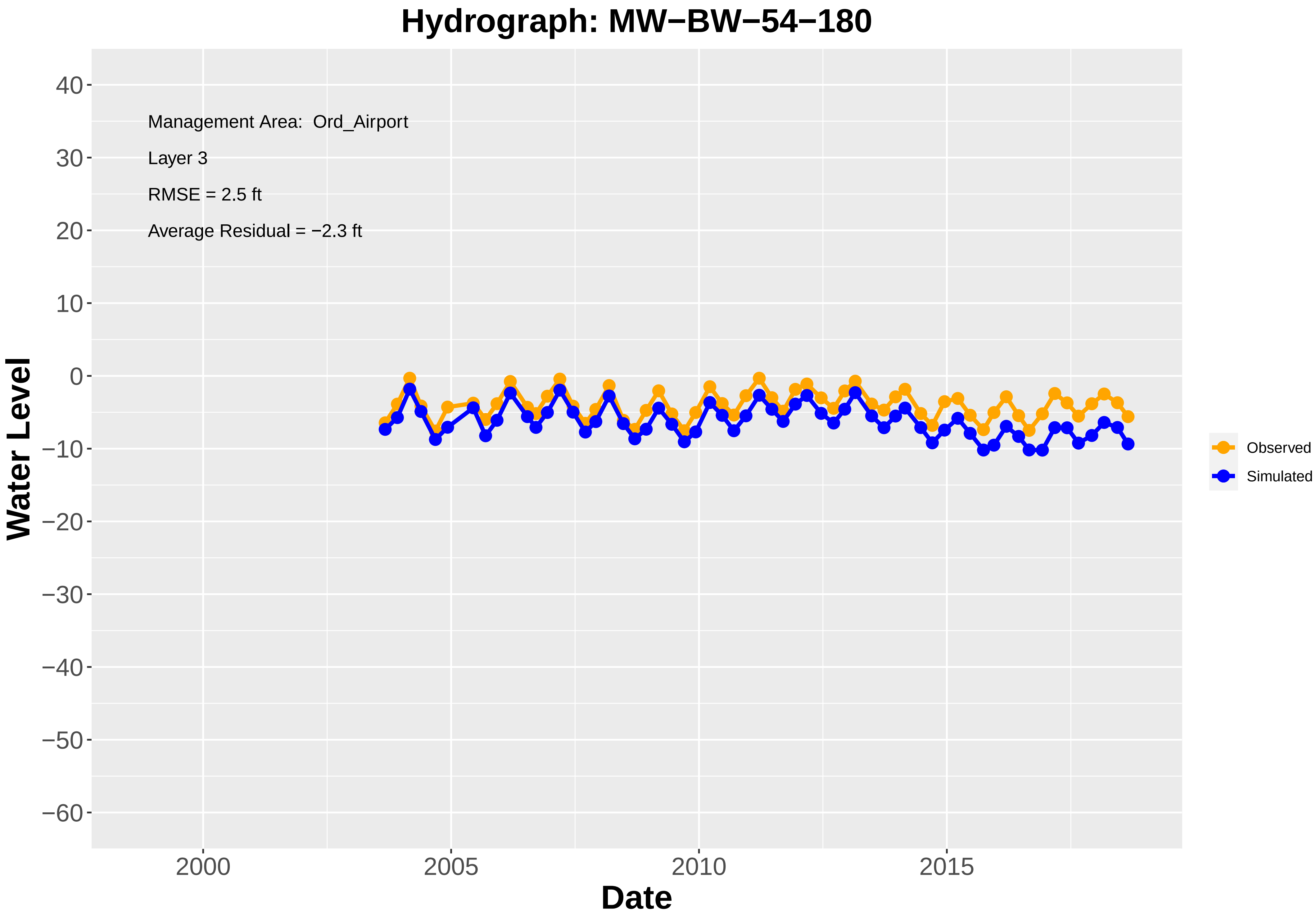
Hydrograph: MW−BW−52−A
Management Area: Ord_Central
Layer 1
RMSE = 12.6 ft
Average Residual = −12.6 ft
Water Level
Date
Observed
Simulated
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015

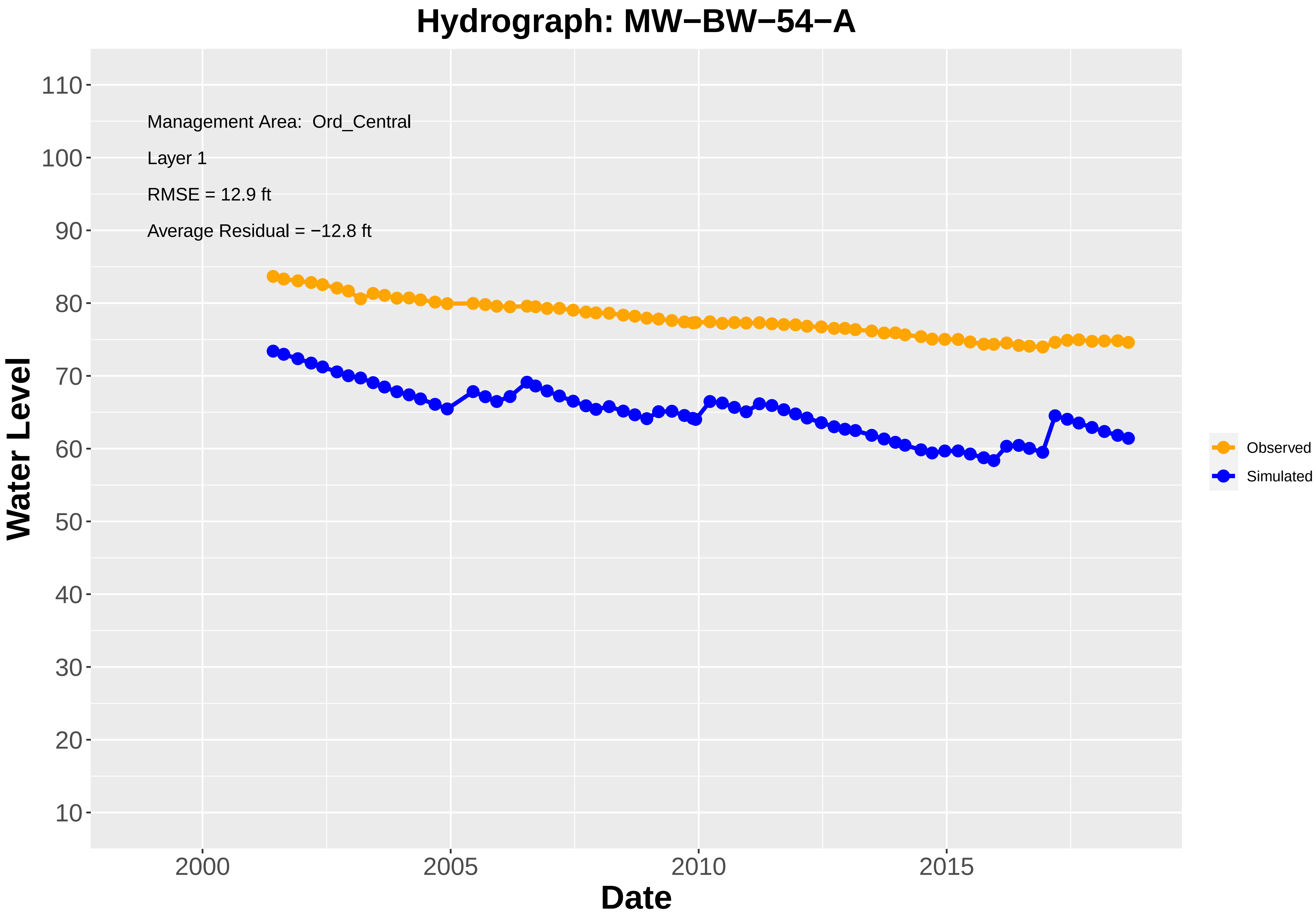
Hydrograph: MW−BW−53−180



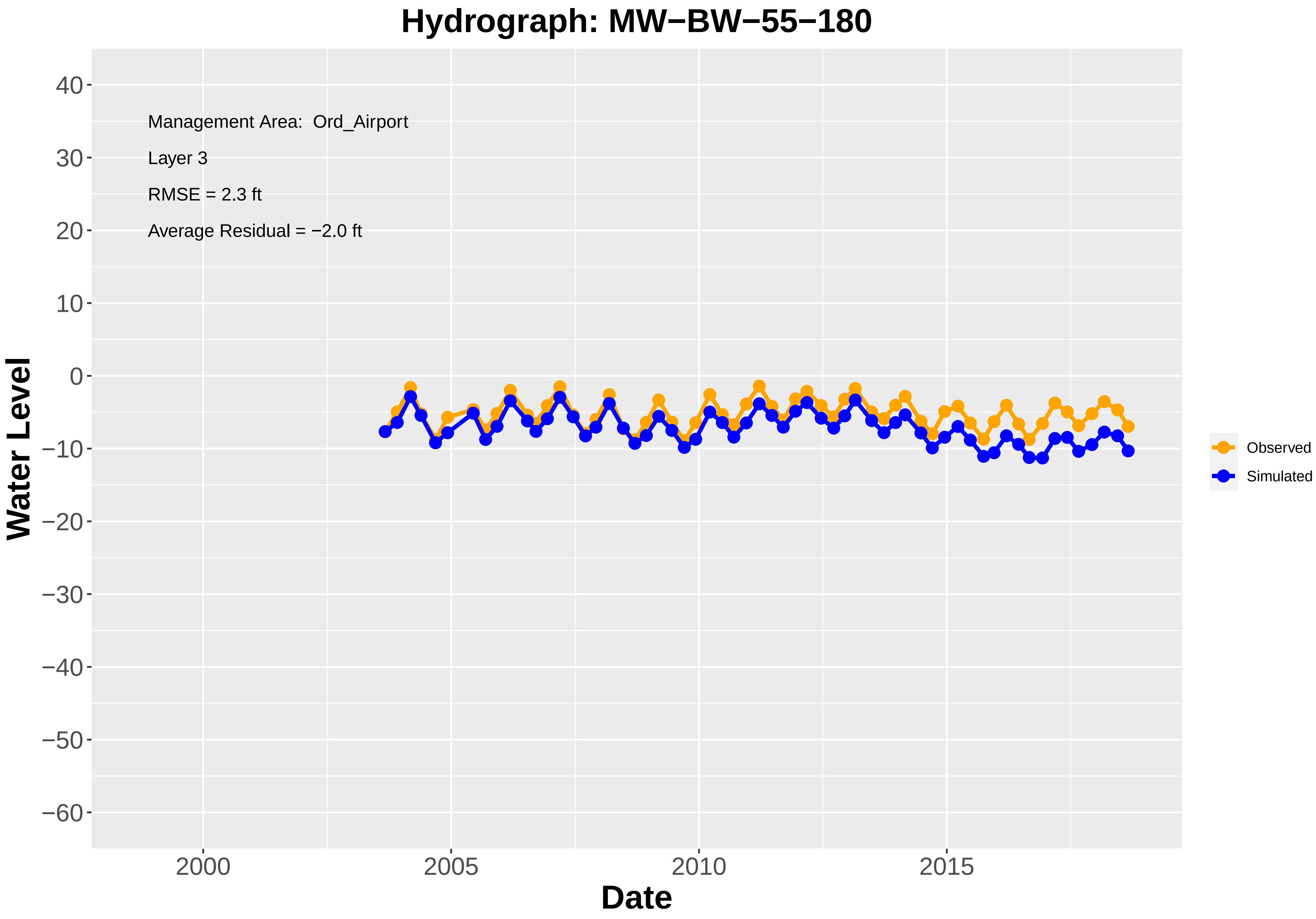


Hydrograph: MW−BW−53−A
Management Area: Ord_Central
Layer 1
RMSE = 12.9 ft
Average Residual = −12.8 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

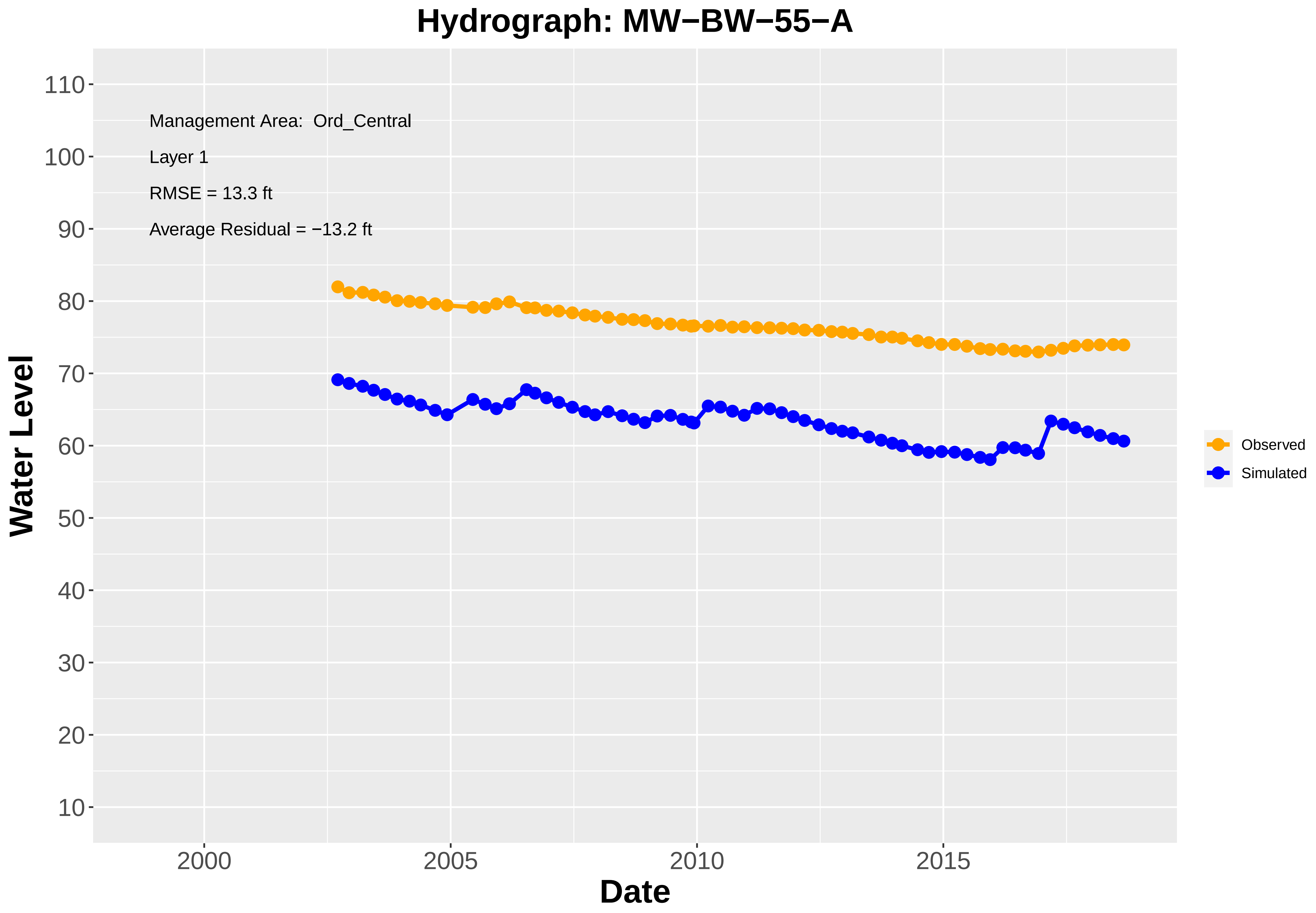

Hydrograph: MW−BW−54−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.5 ft
Average Residual = −2.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

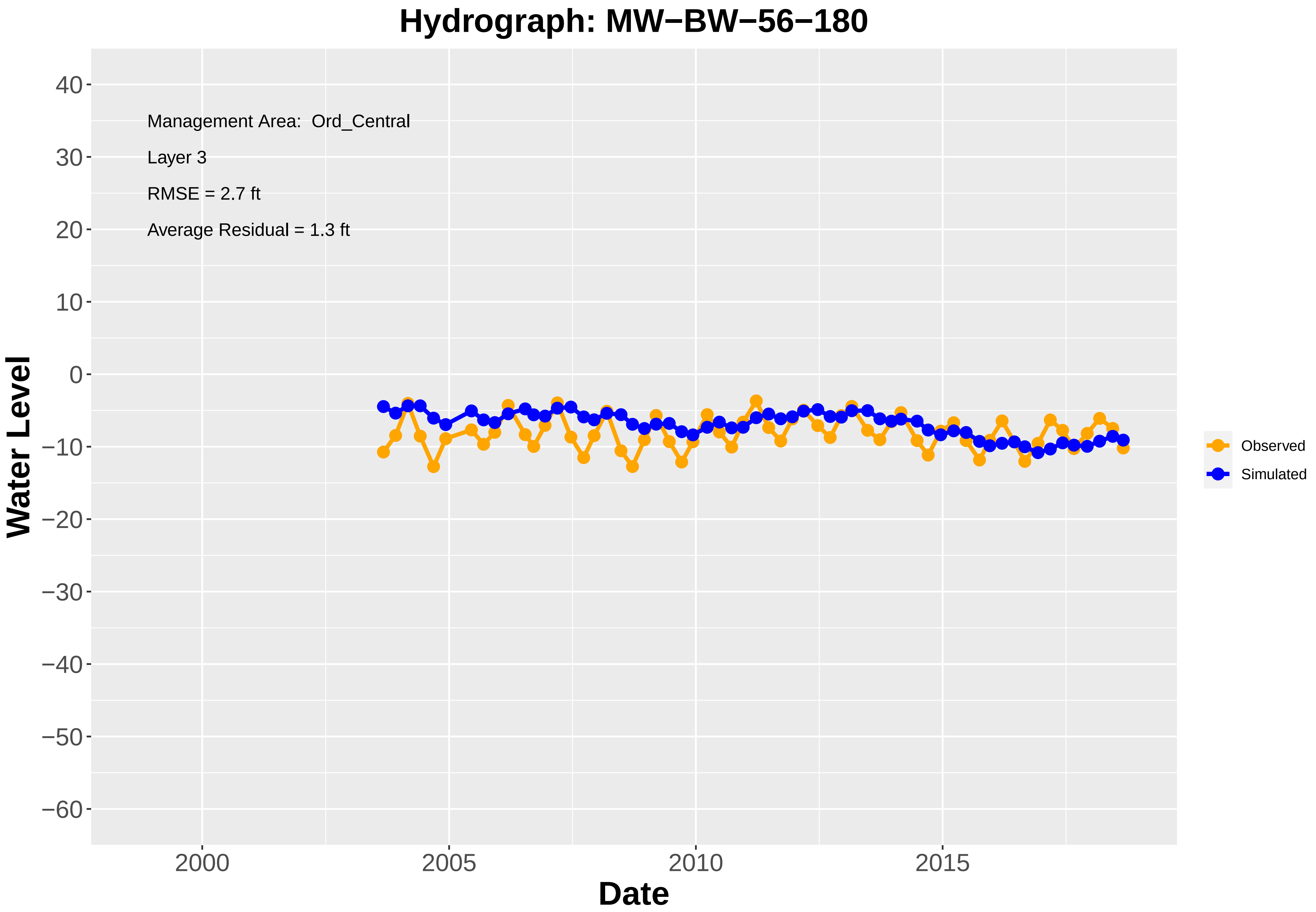


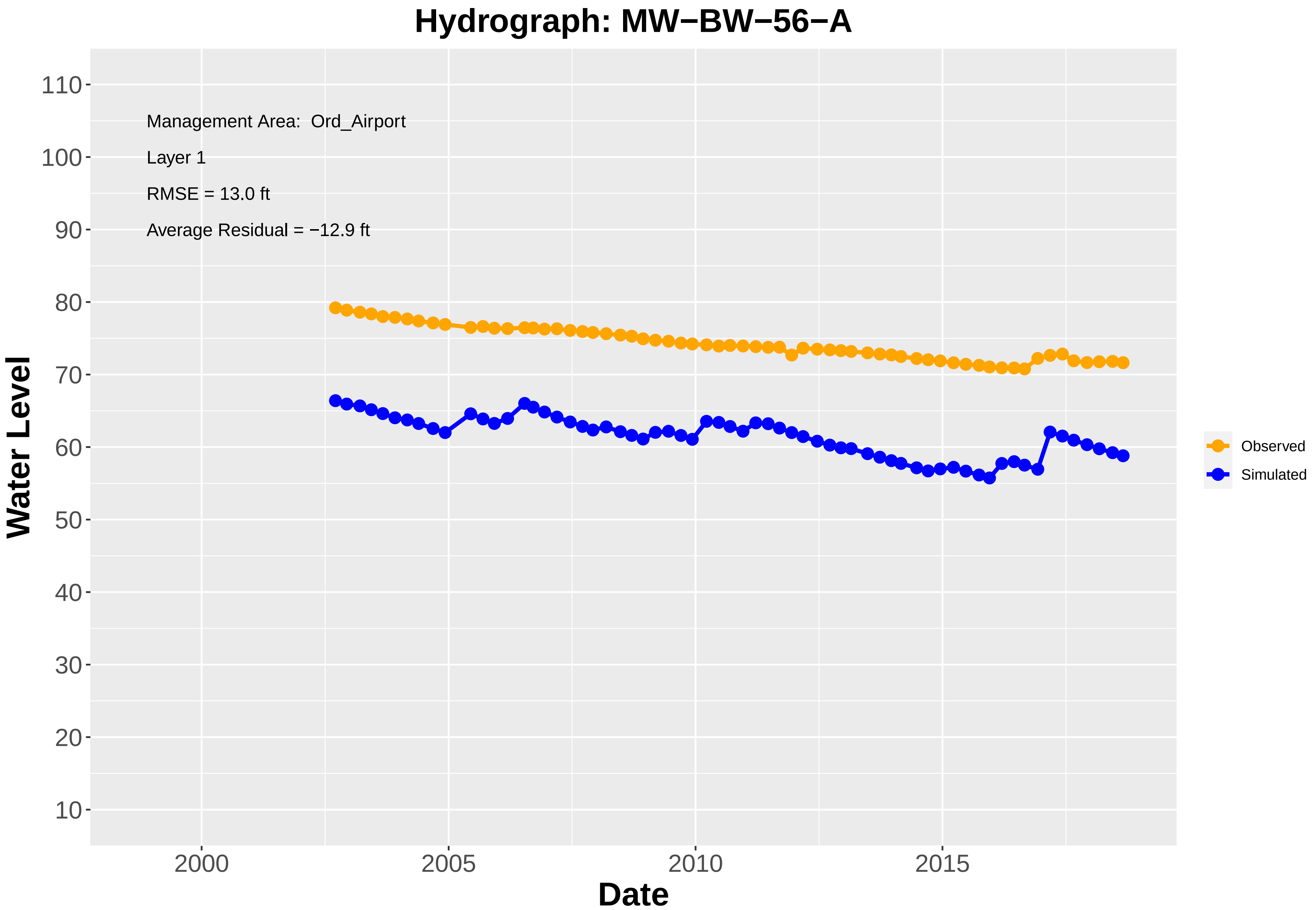
Hydrograph: MW−BW−54−A
Management Area: Ord_Central
Layer 1
RMSE = 12.9 ft
Average Residual = −12.8 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

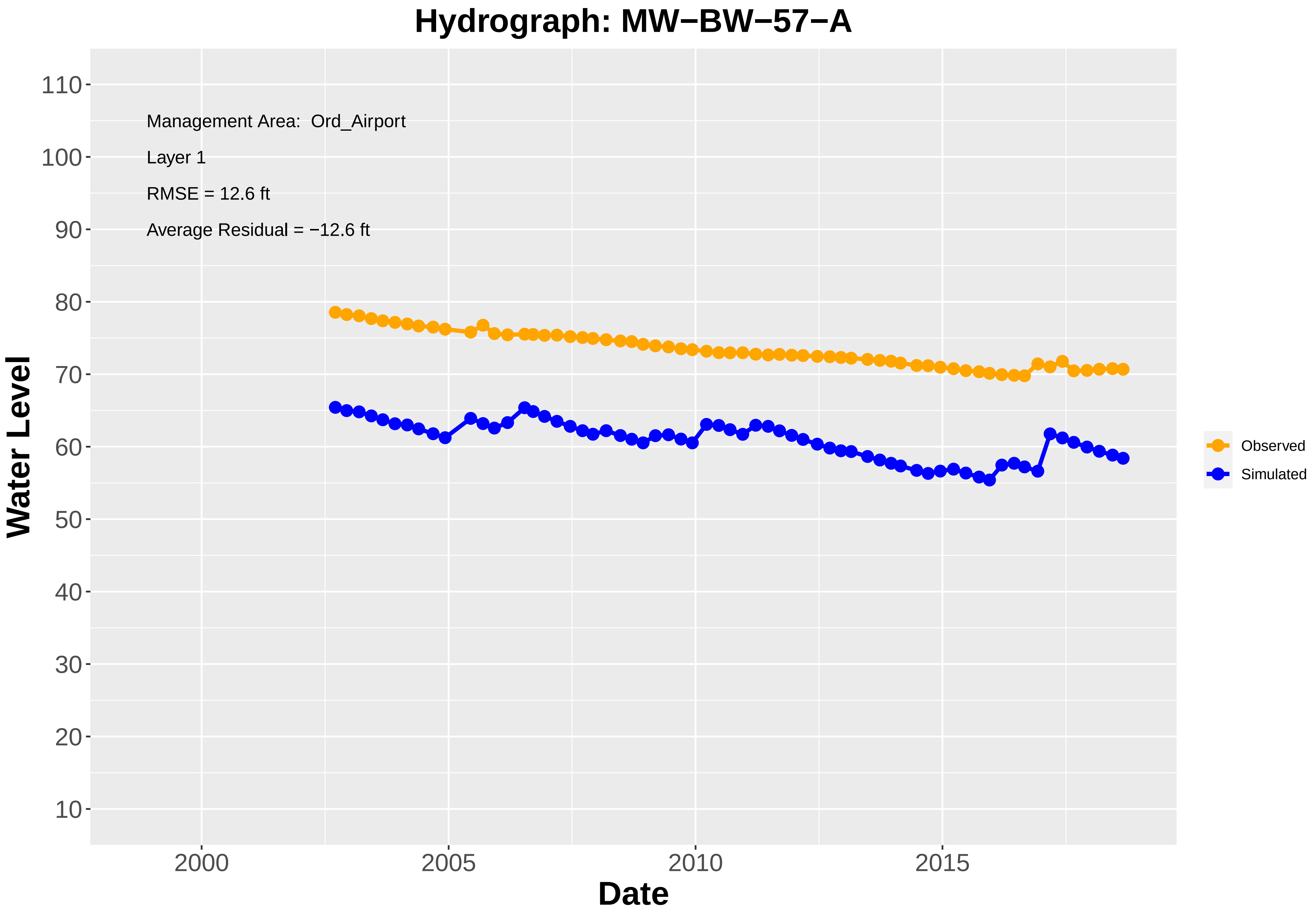


Hydrograph: MW−BW−55−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.3 ft
Average Residual = −2.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

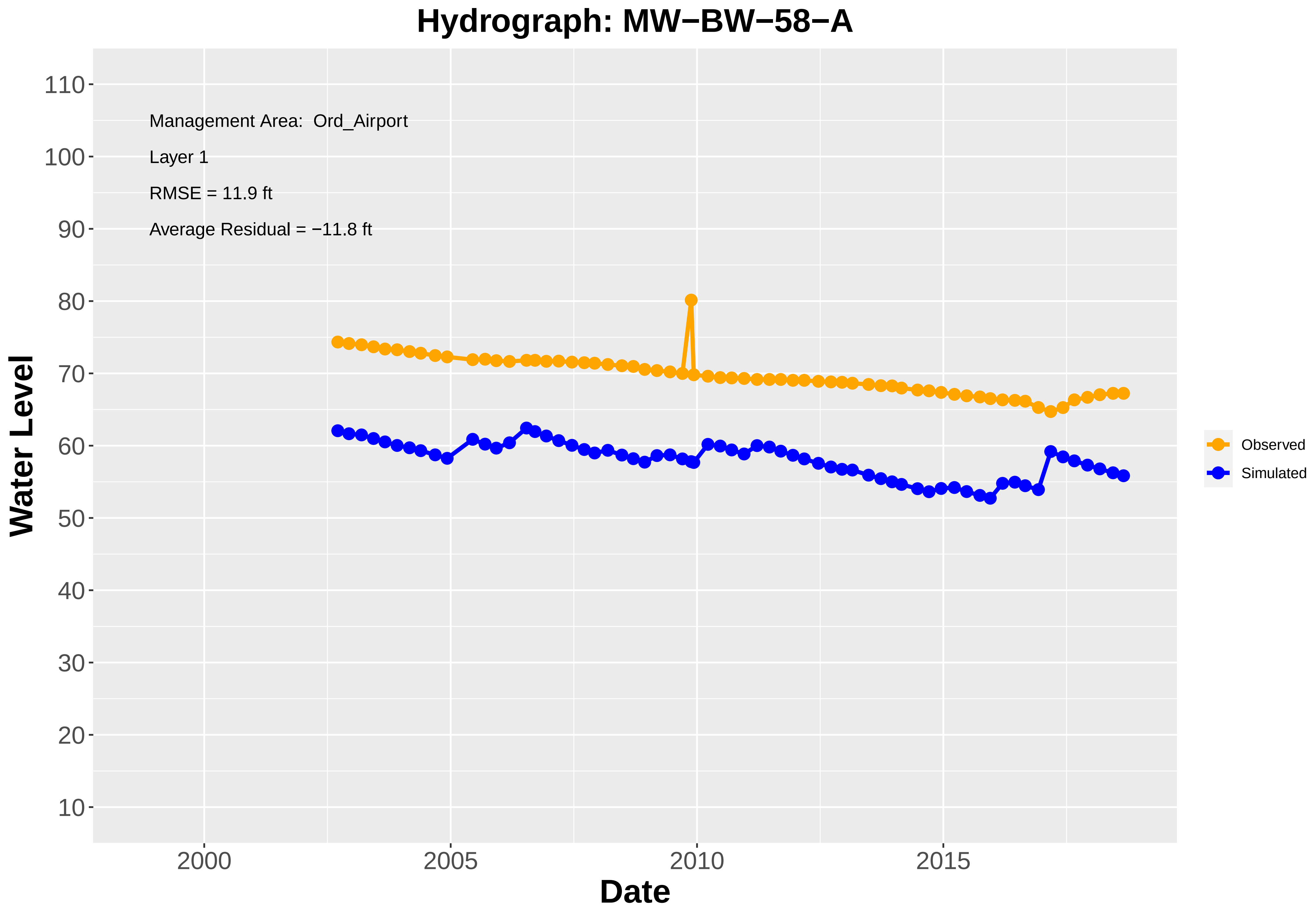

Hydrograph: MW−BW−55−A
Management Area: Ord_Central
Layer 1
RMSE = 13.3 ft
Average Residual = −13.2 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−56−180
Management Area: Ord_Central
Layer 3
RMSE = 2.7 ft
Average Residual = 1.3 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

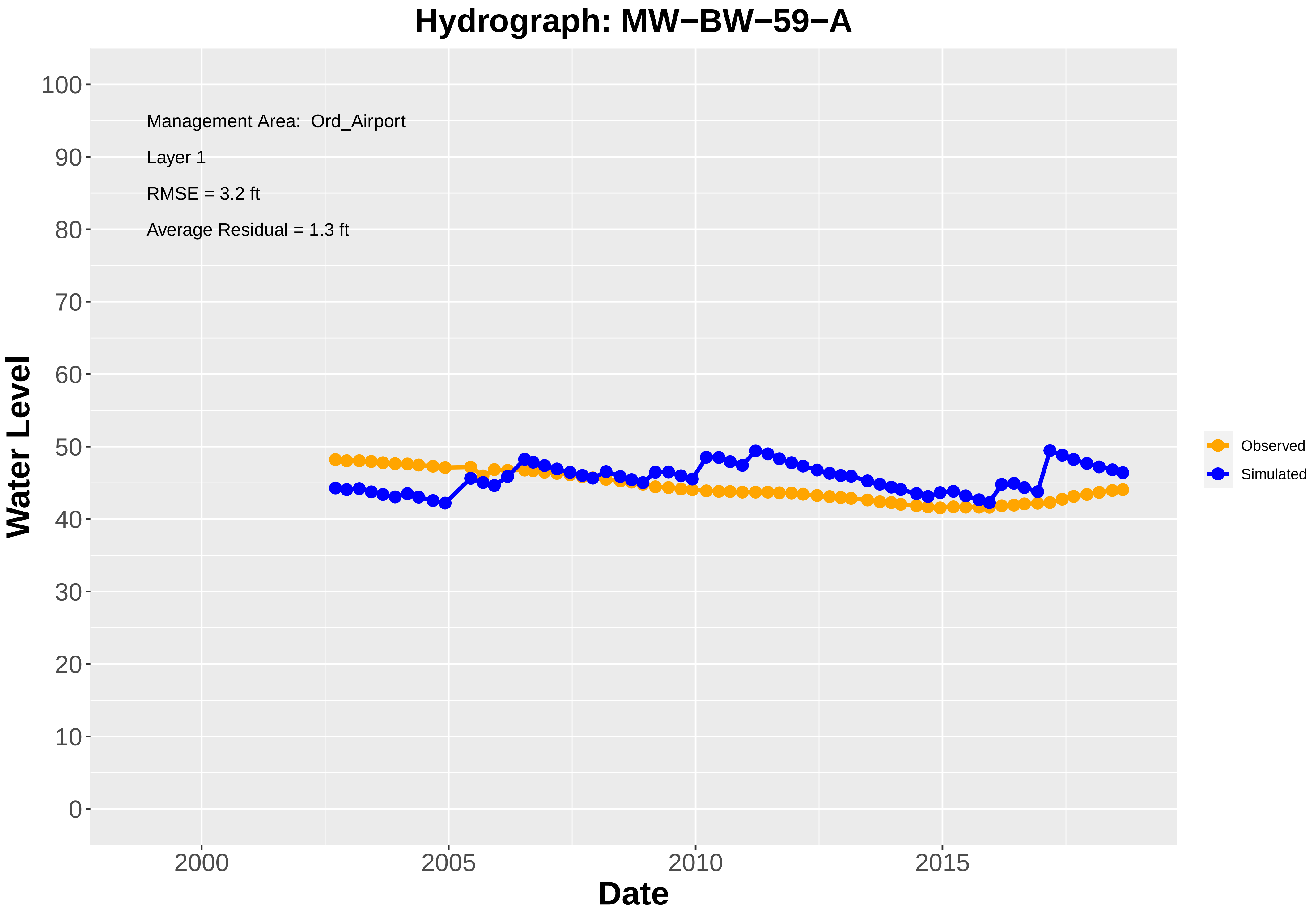

Hydrograph: MW−BW−56−A
Management Area: Ord_Airport
Layer 1
RMSE = 13.0 ft
Average Residual = −12.9 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



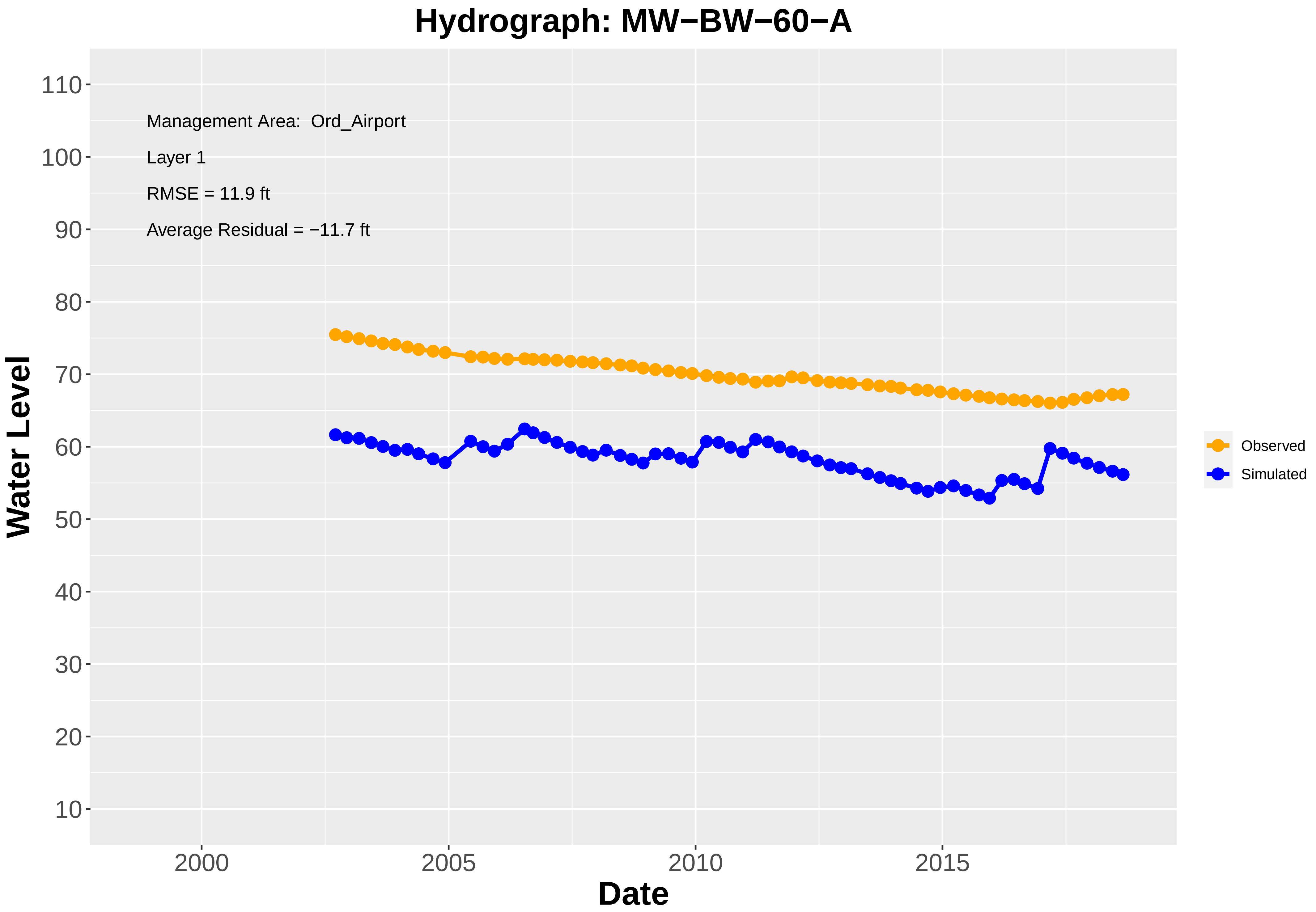
Hydrograph: MW−BW−57−A
Management Area: Ord_Airport
Layer 1
RMSE = 12.6 ft
Average Residual = −12.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



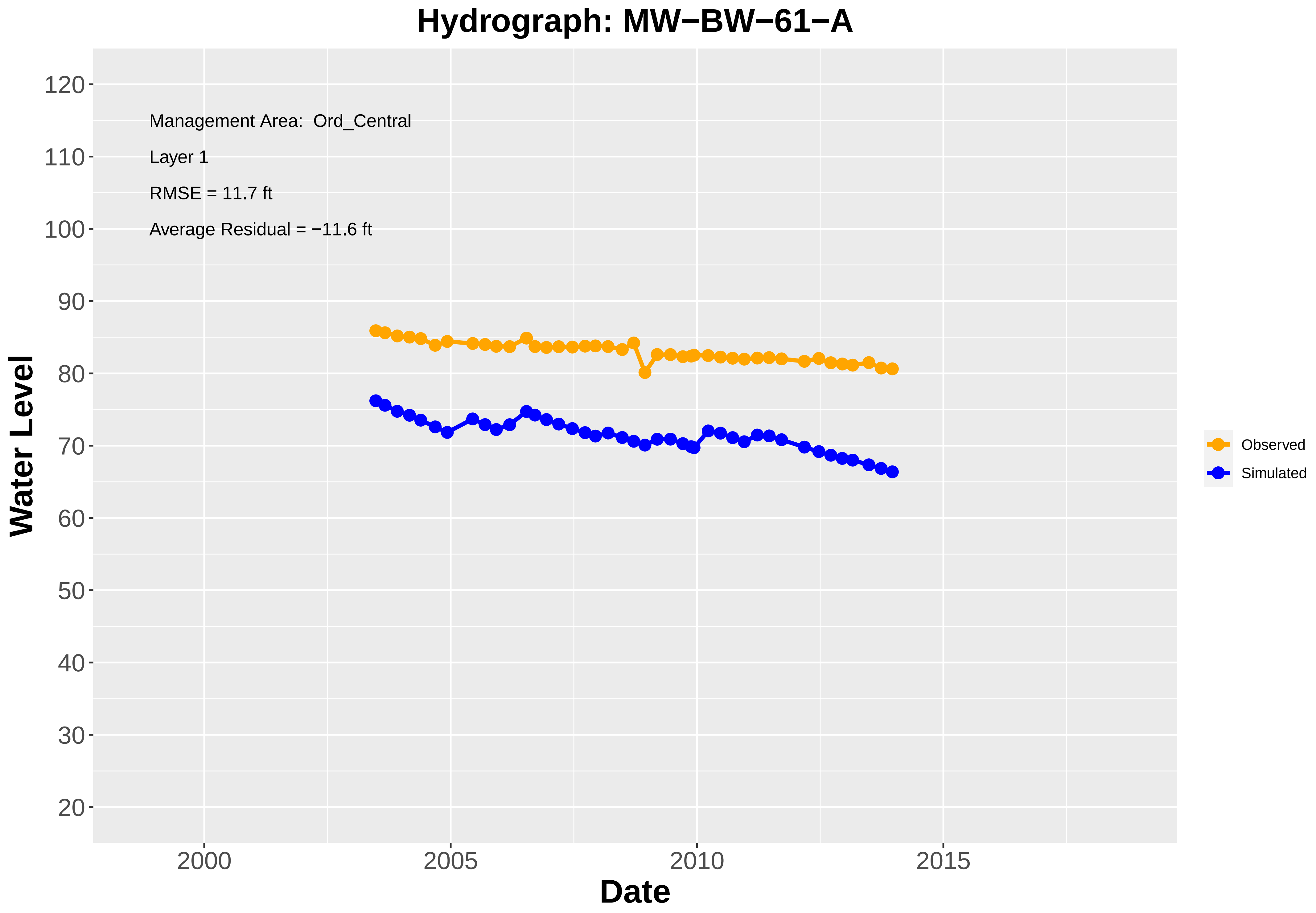
Hydrograph: MW−BW−58−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.9 ft
Average Residual = −11.8 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

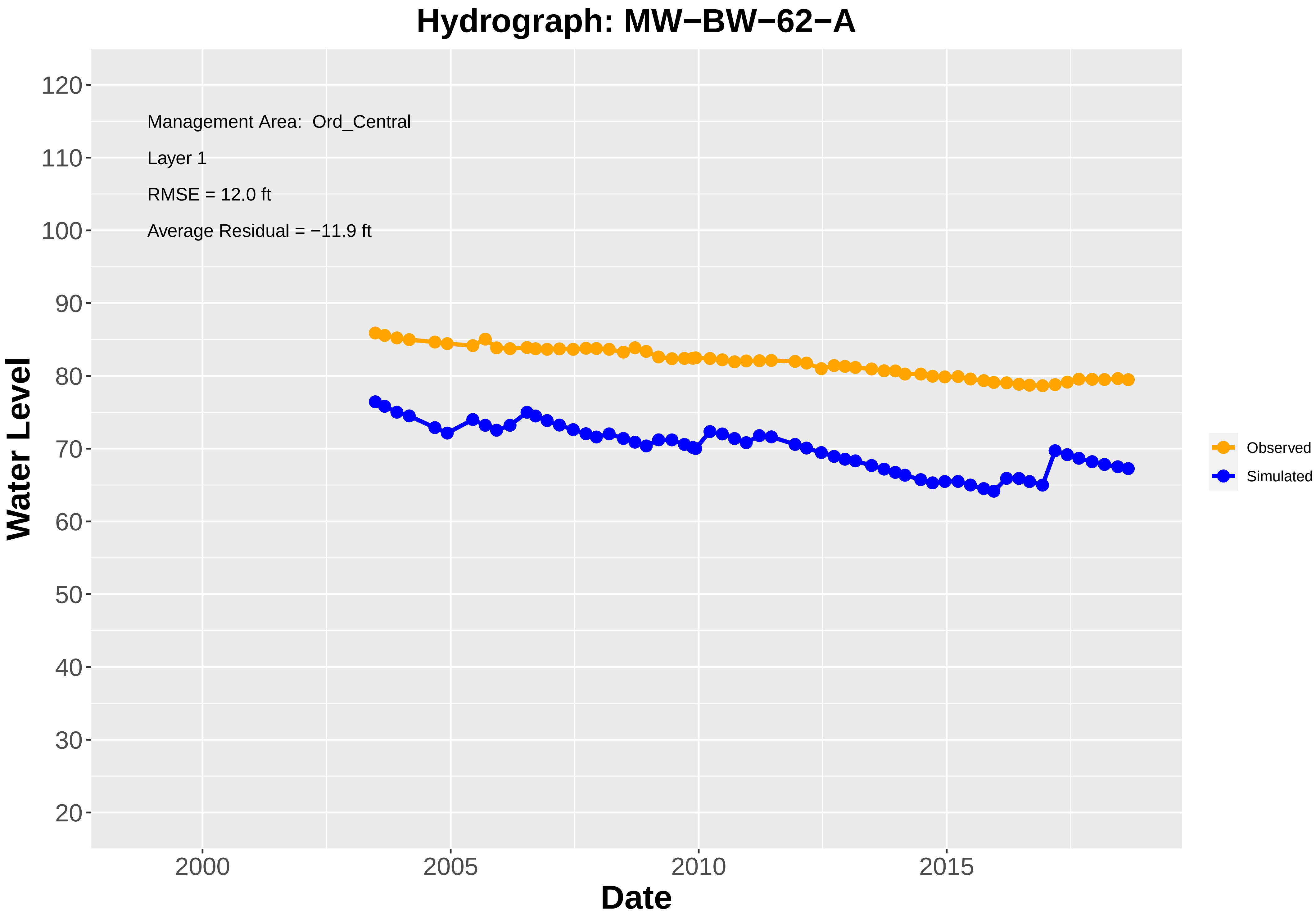


Hydrograph: MW−BW−59−A
Management Area: Ord_Airport
Layer 1
RMSE = 3.2 ft
Average Residual = 1.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

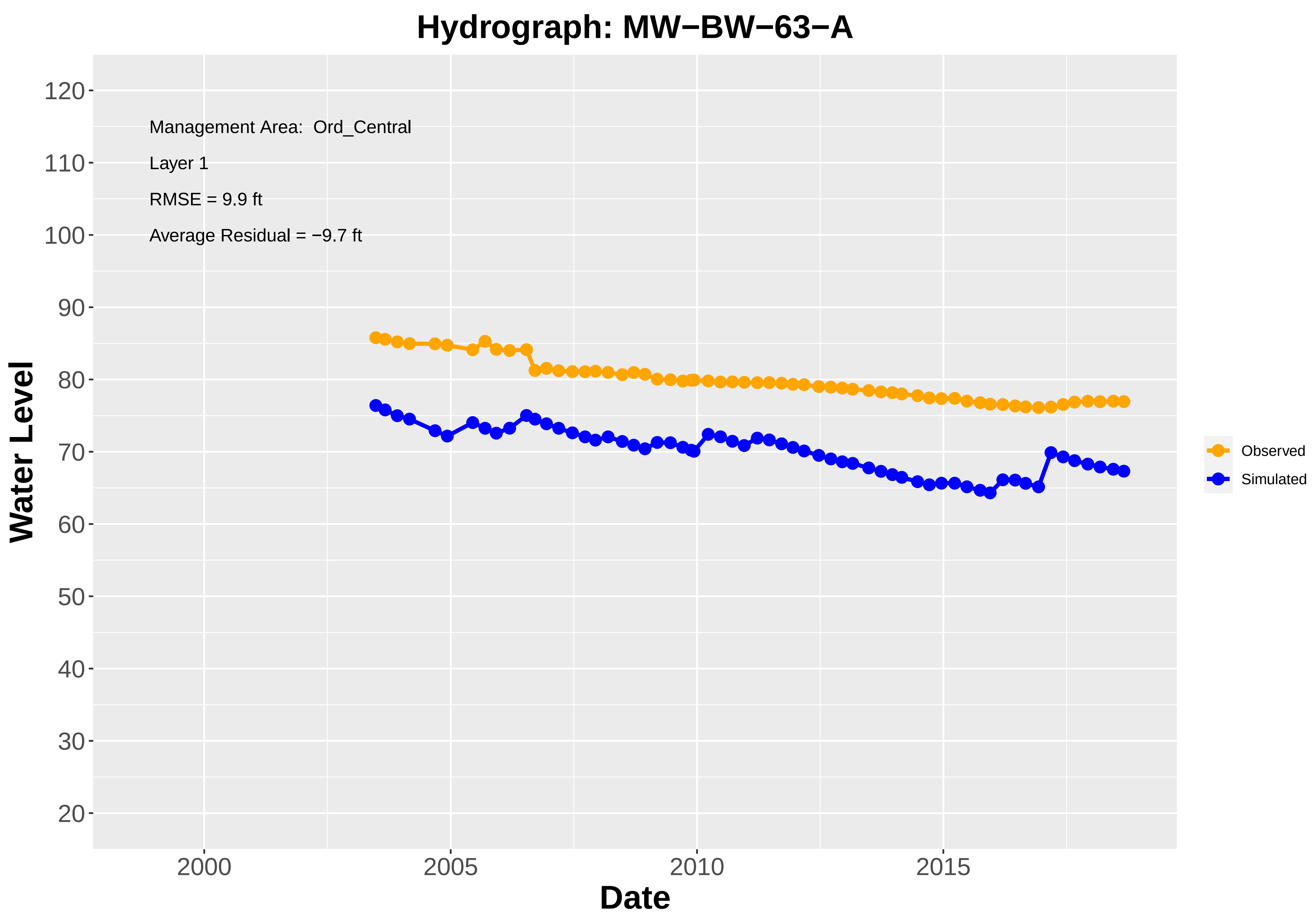


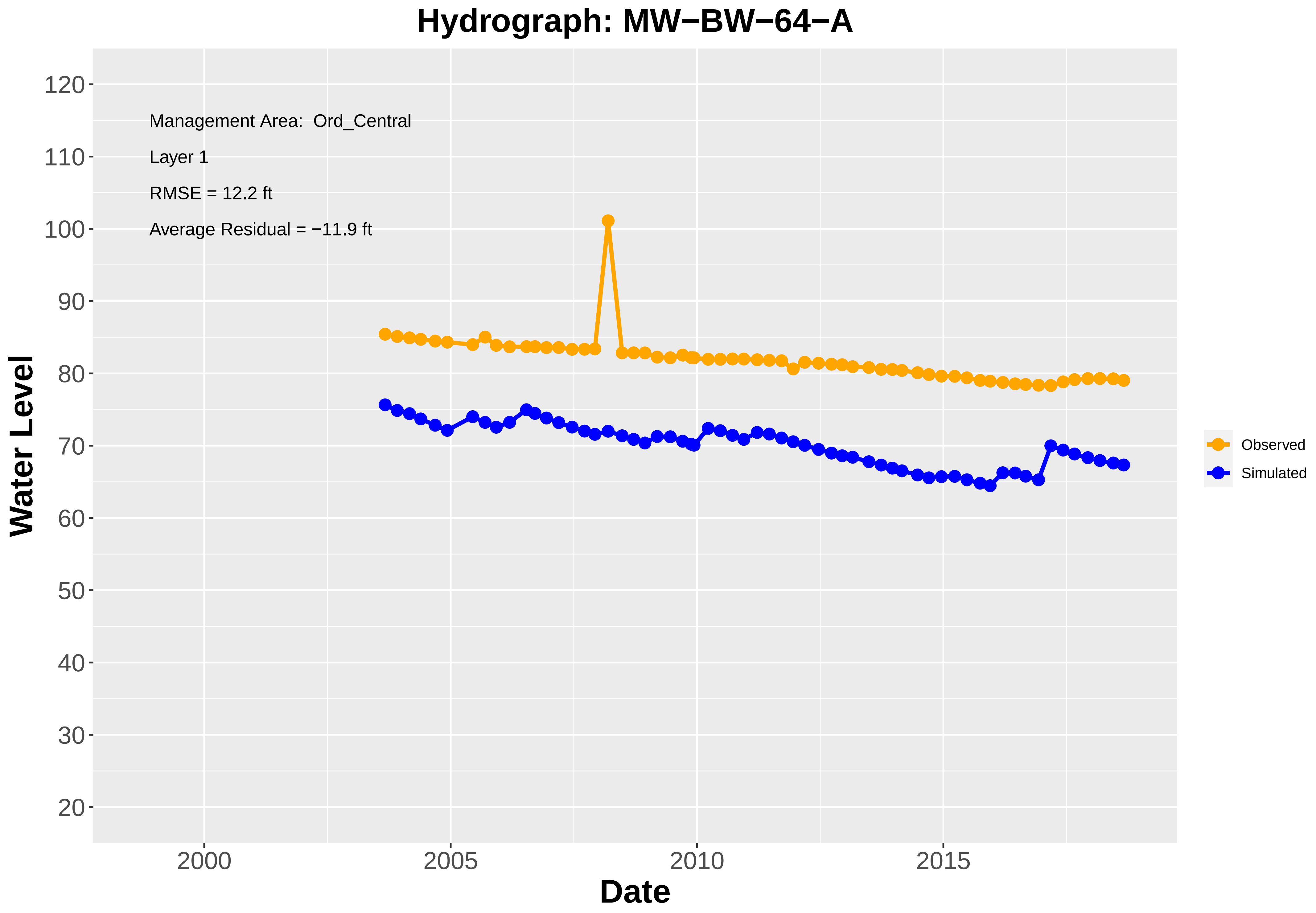
Hydrograph: MW−BW−60−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.9 ft
Average Residual = −11.7 ft
Water Level
Date
Observed
Simulated
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015

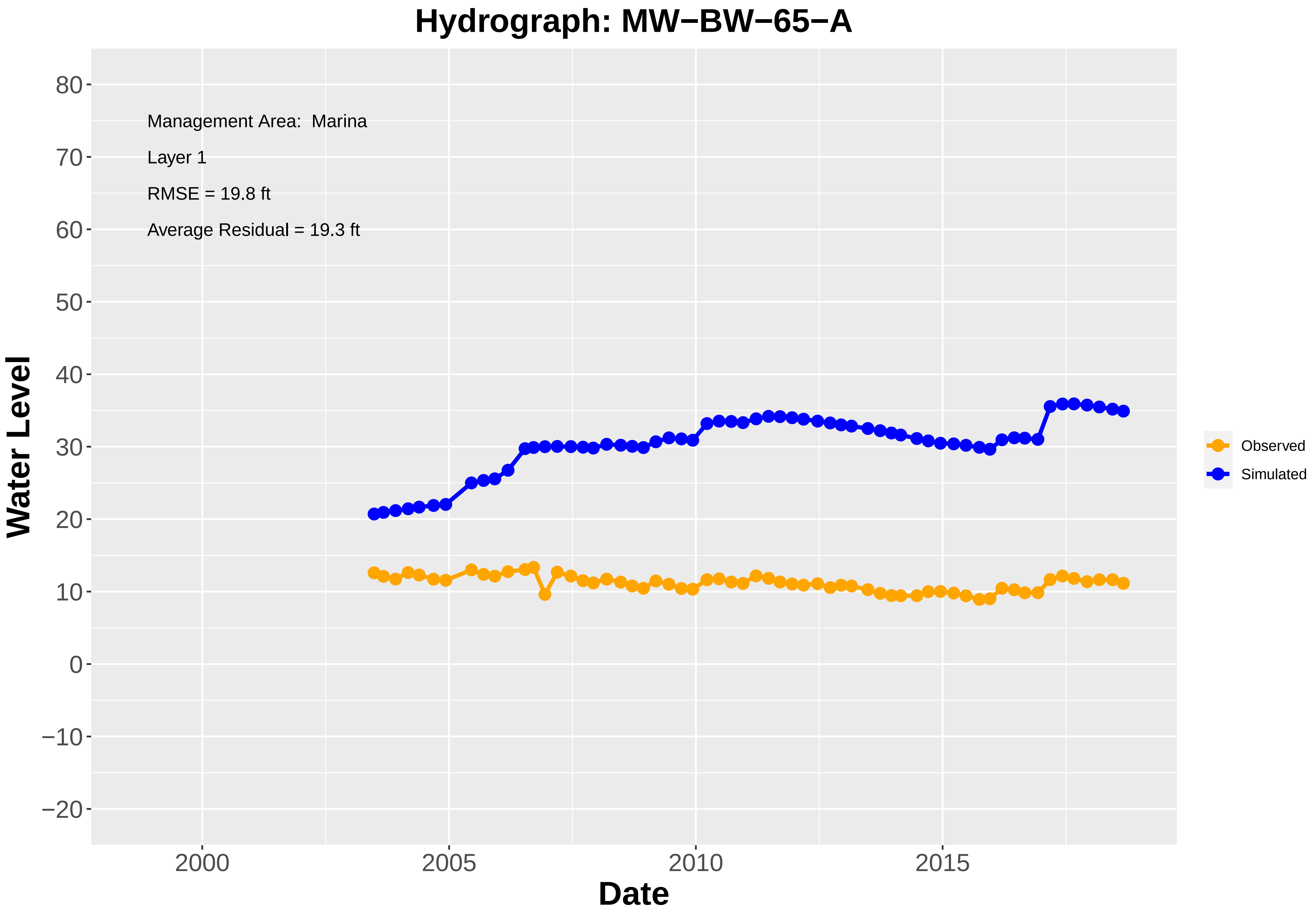

Hydrograph: MW−BW−61−A
Management Area: Ord_Central
Layer 1
RMSE = 11.7 ft
Average Residual = −11.6 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated



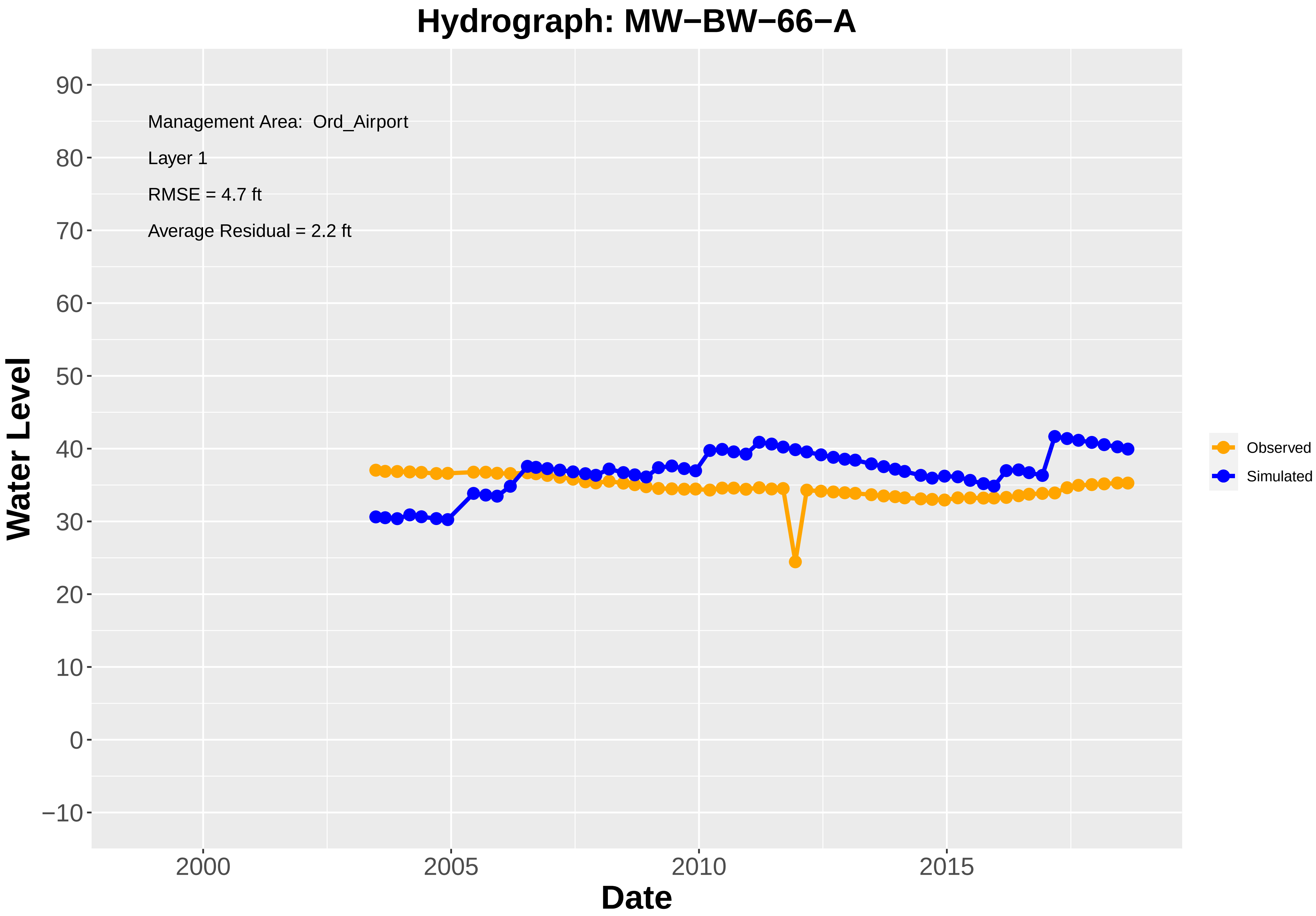
Hydrograph: MW−BW−62−A
Management Area: Ord_Central
Layer 1
RMSE = 12.0 ft
Average Residual = −11.9 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−63−A
Management Area: Ord_Central
Layer 1
RMSE = 9.9 ft
Average Residual = −9.7 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

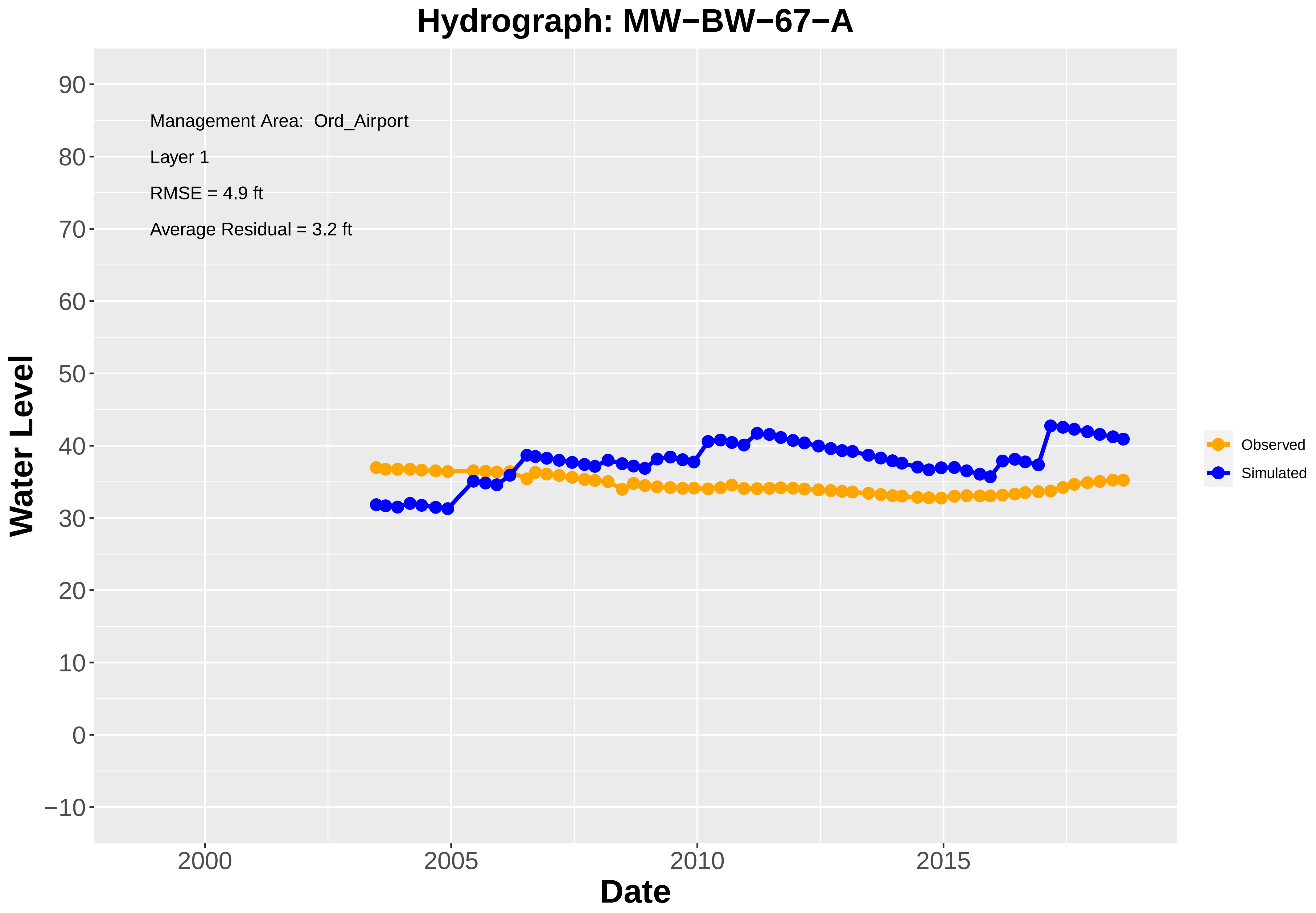

Hydrograph: MW−BW−64−A
Management Area: Ord_Central
Layer 1
RMSE = 12.2 ft
Average Residual = −11.9 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

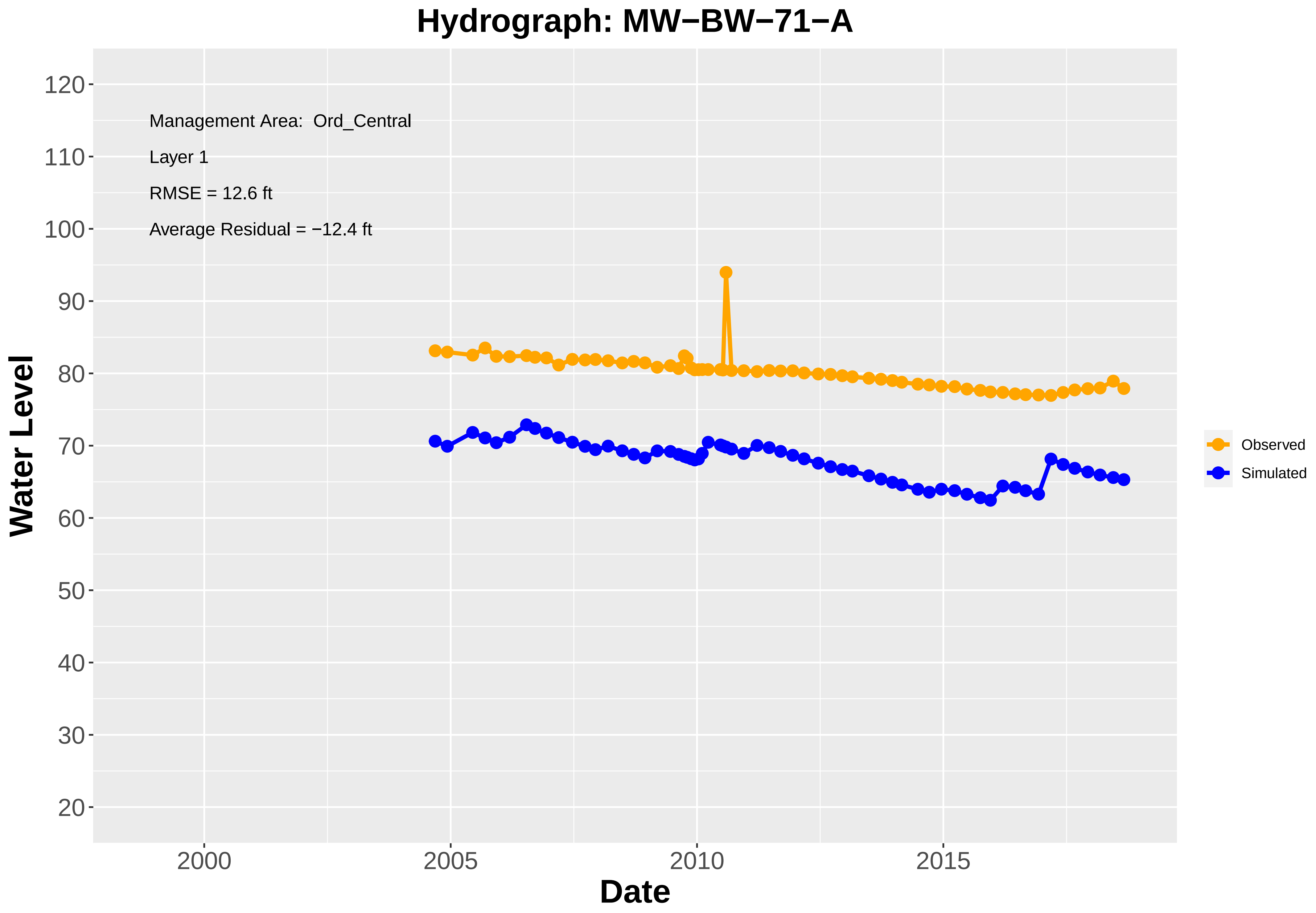


Hydrograph: MW−BW−65−A
Management Area: Marina
Layer 1
RMSE = 19.8 ft
Average Residual = 19.3 ft
Water Level
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Date
Observed
Simulated

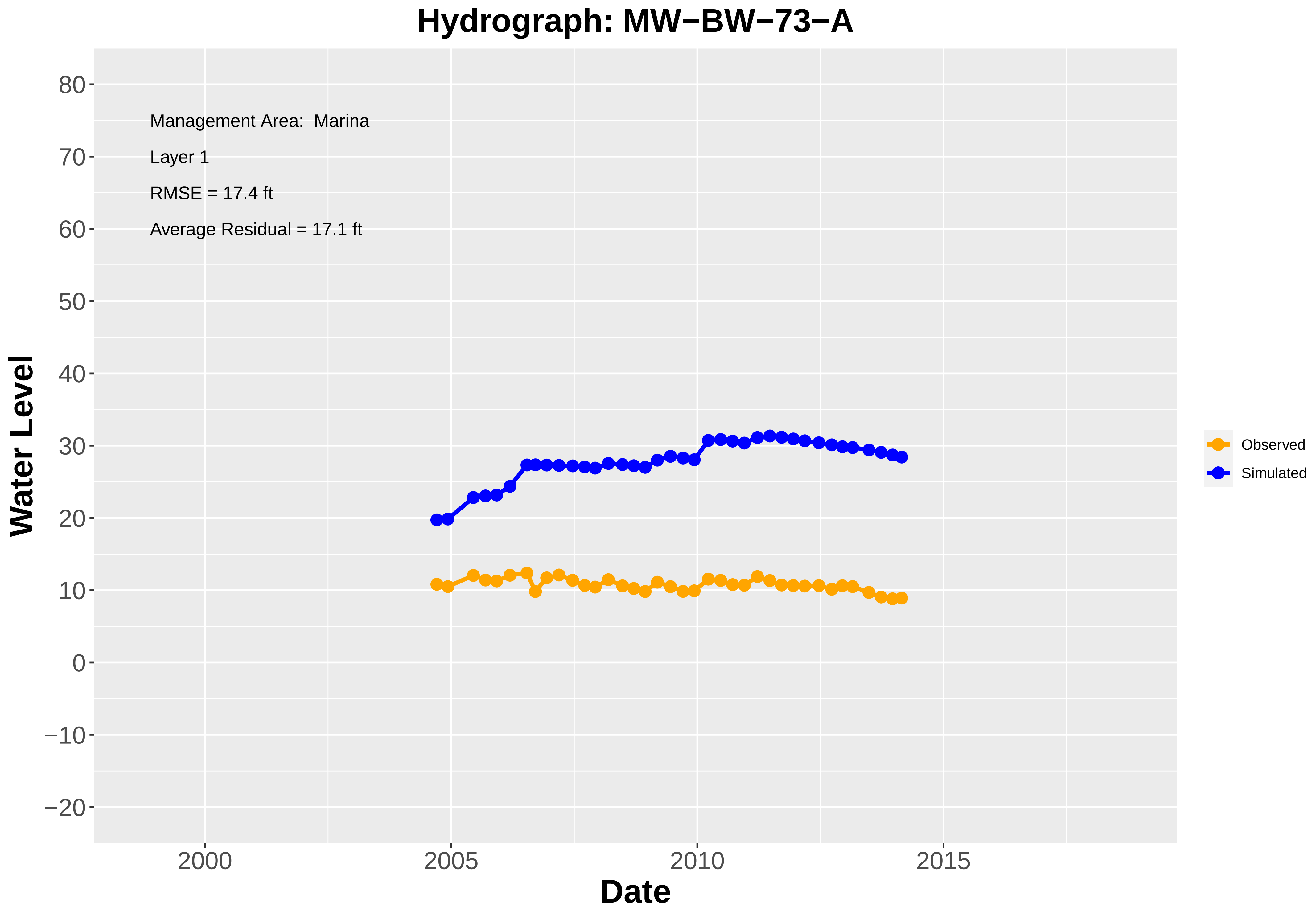


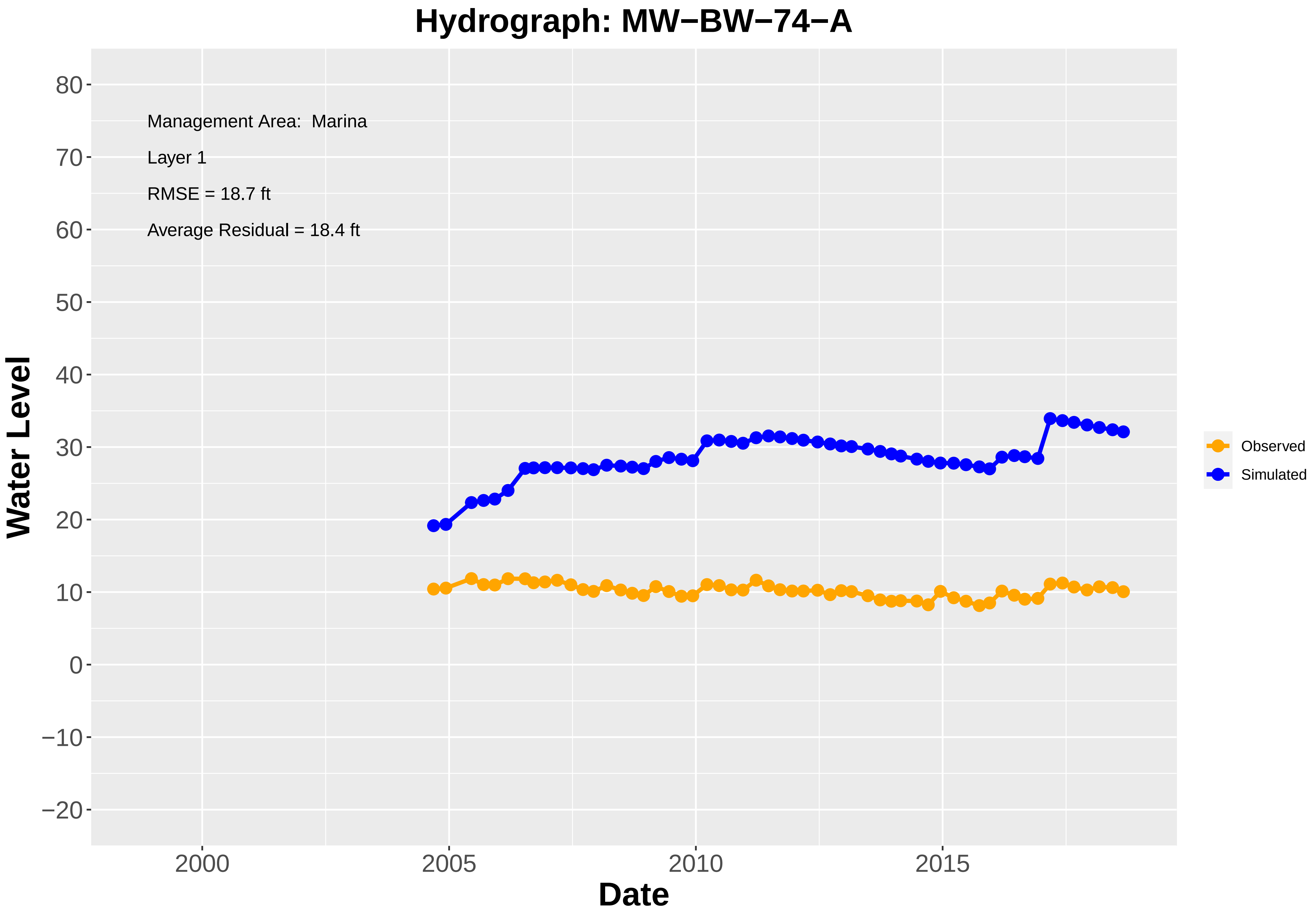
Hydrograph: MW−BW−66−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.7 ft
Average Residual = 2.2 ft
Water Level
Date
Observed
Simulated
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015

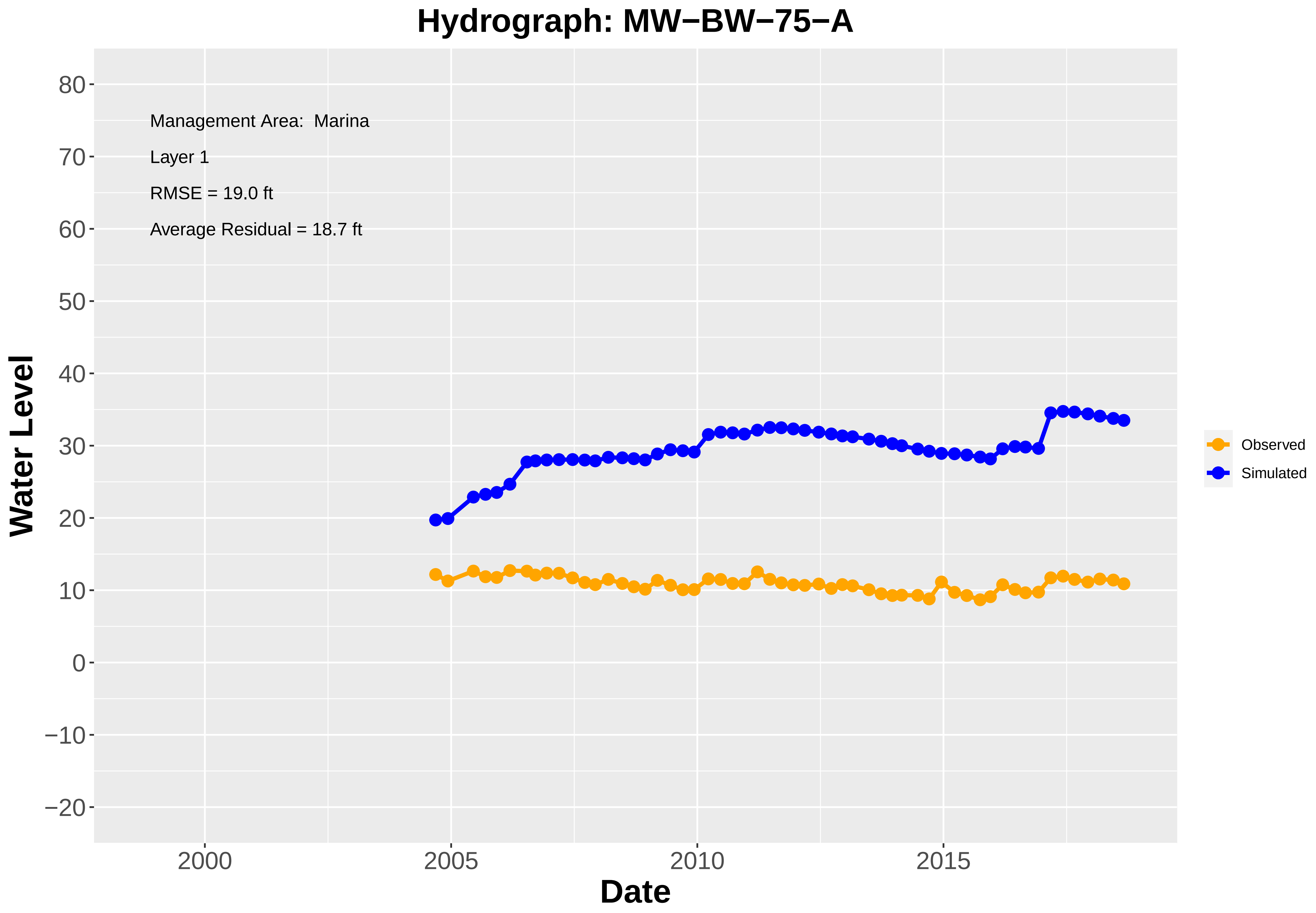

Hydrograph: MW−BW−67−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.9 ft
Average Residual = 3.2 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



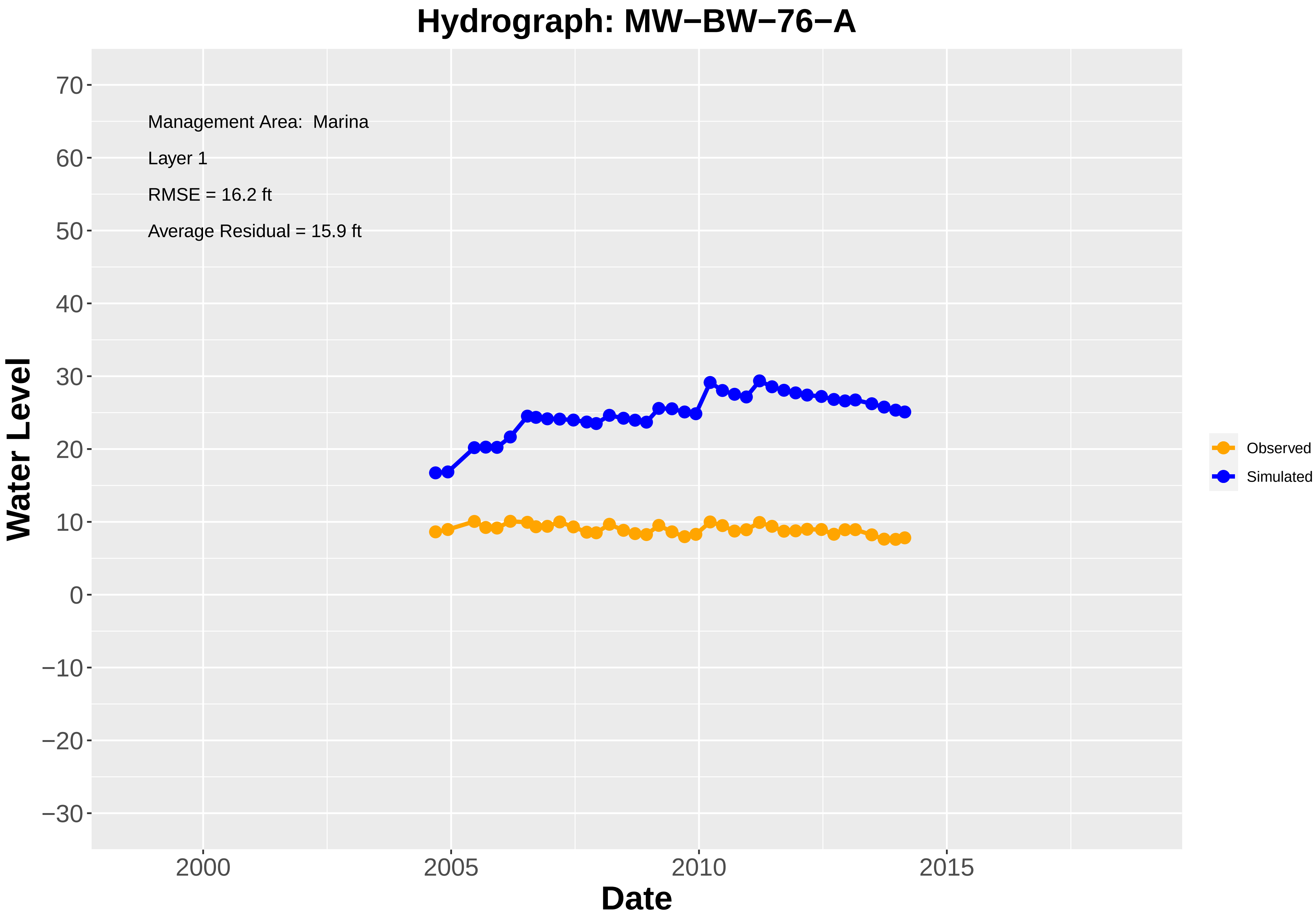
Hydrograph: MW−BW−71−A
Management Area: Ord_Central
Layer 1
RMSE = 12.6 ft
Average Residual = −12.4 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−73−A
Management Area: Marina
Layer 1
RMSE = 17.4 ft
Average Residual = 17.1 ft
Water Level
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Date
Observed
Simulated

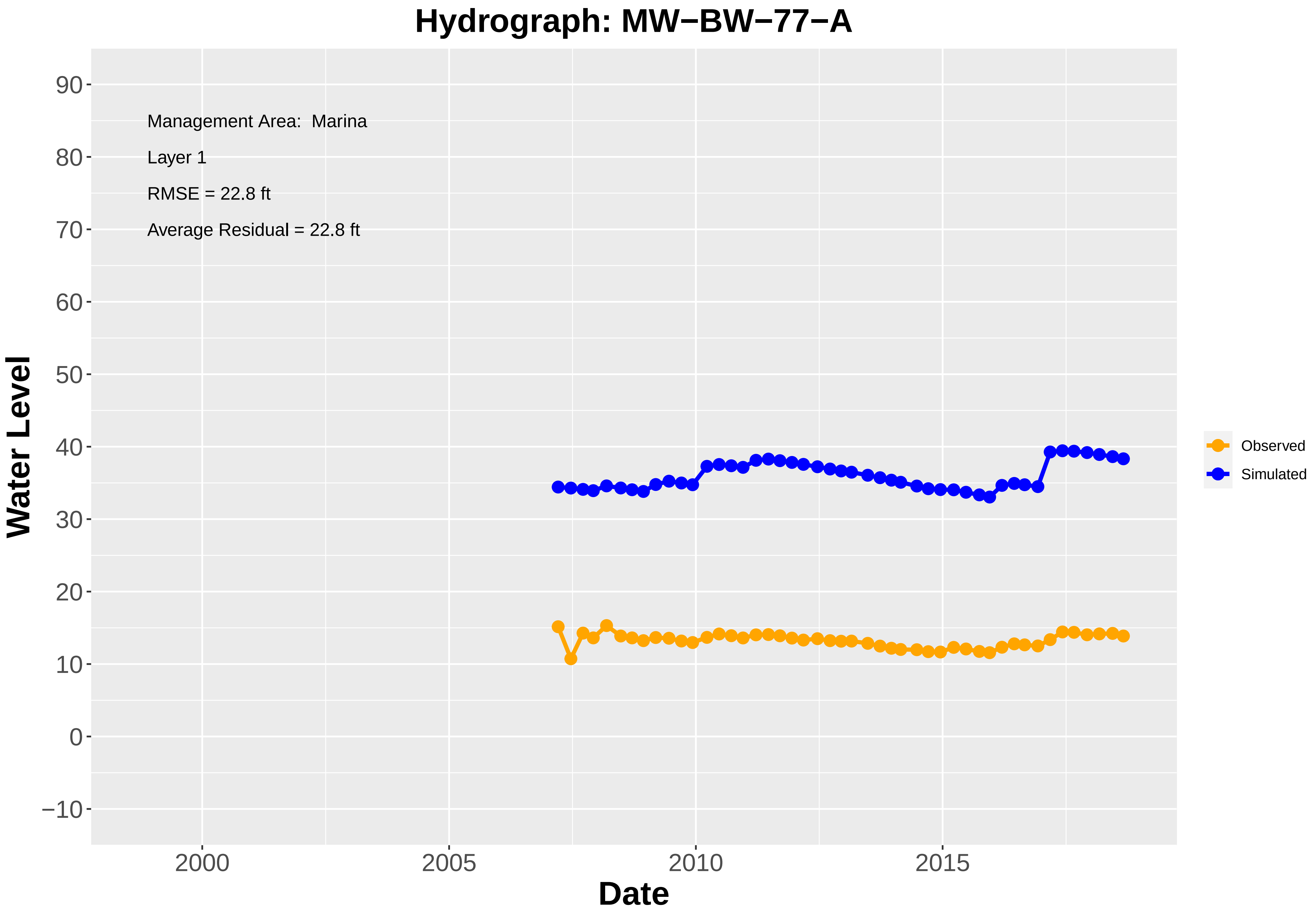

Hydrograph: MW−BW−74−A
Management Area: Marina
Layer 1
RMSE = 18.7 ft
Average Residual = 18.4 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



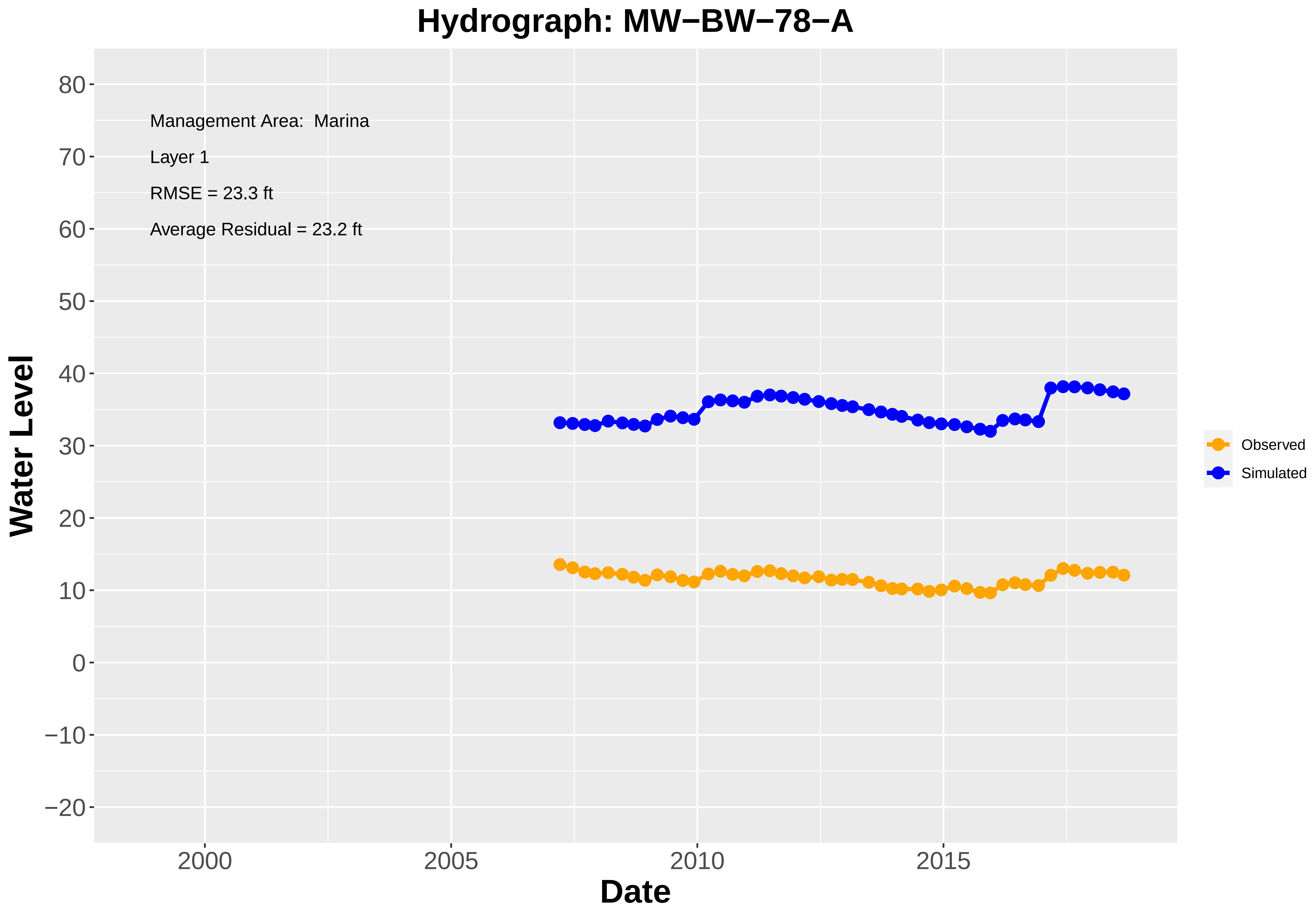
Hydrograph: MW−BW−75−A
Management Area: Marina
Layer 1
RMSE = 19.0 ft
Average Residual = 18.7 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated



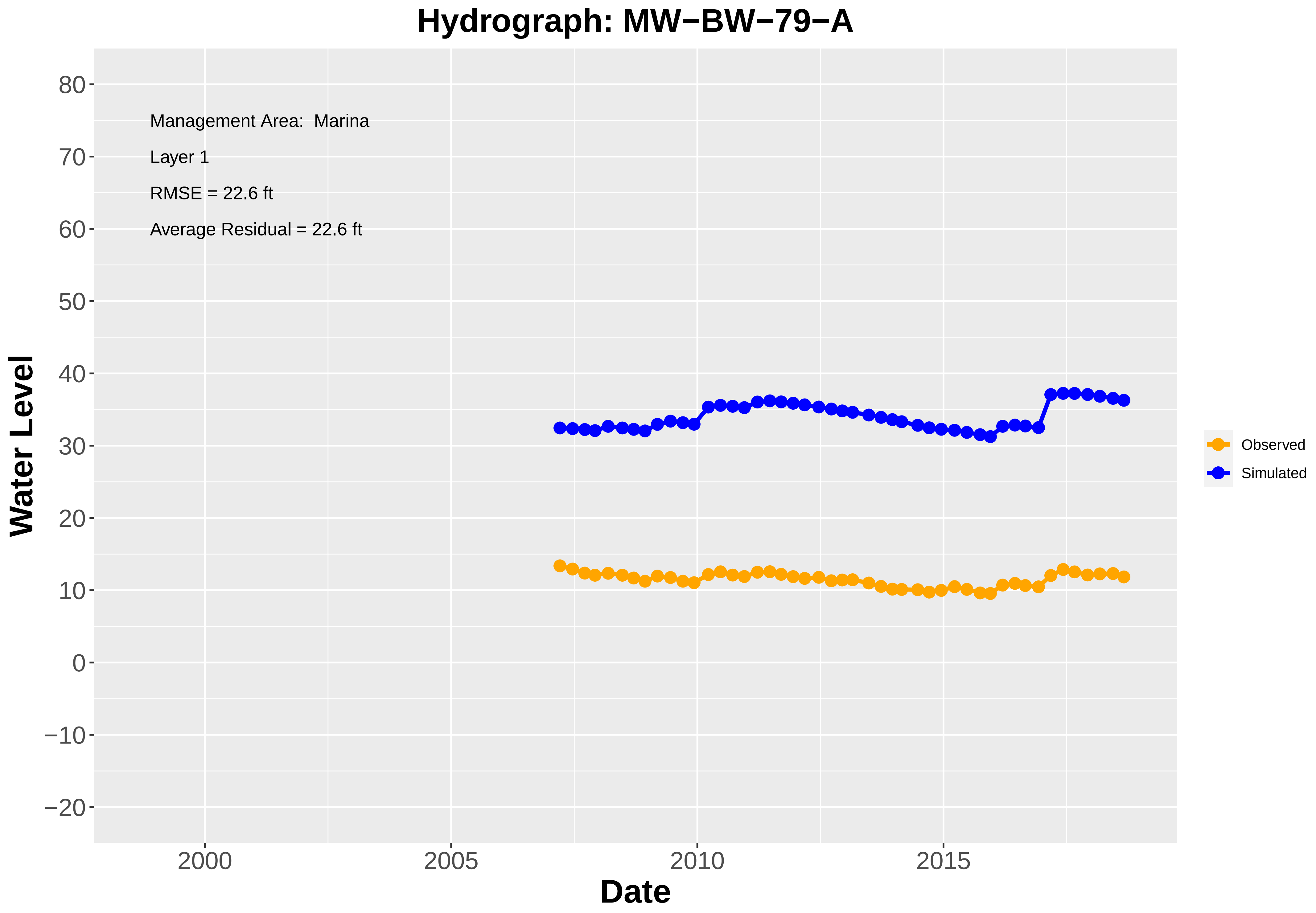
Hydrograph: MW−BW−76−A
Management Area: Marina
Layer 1
RMSE = 16.2 ft
Average Residual = 15.9 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Date
Observed
Simulated



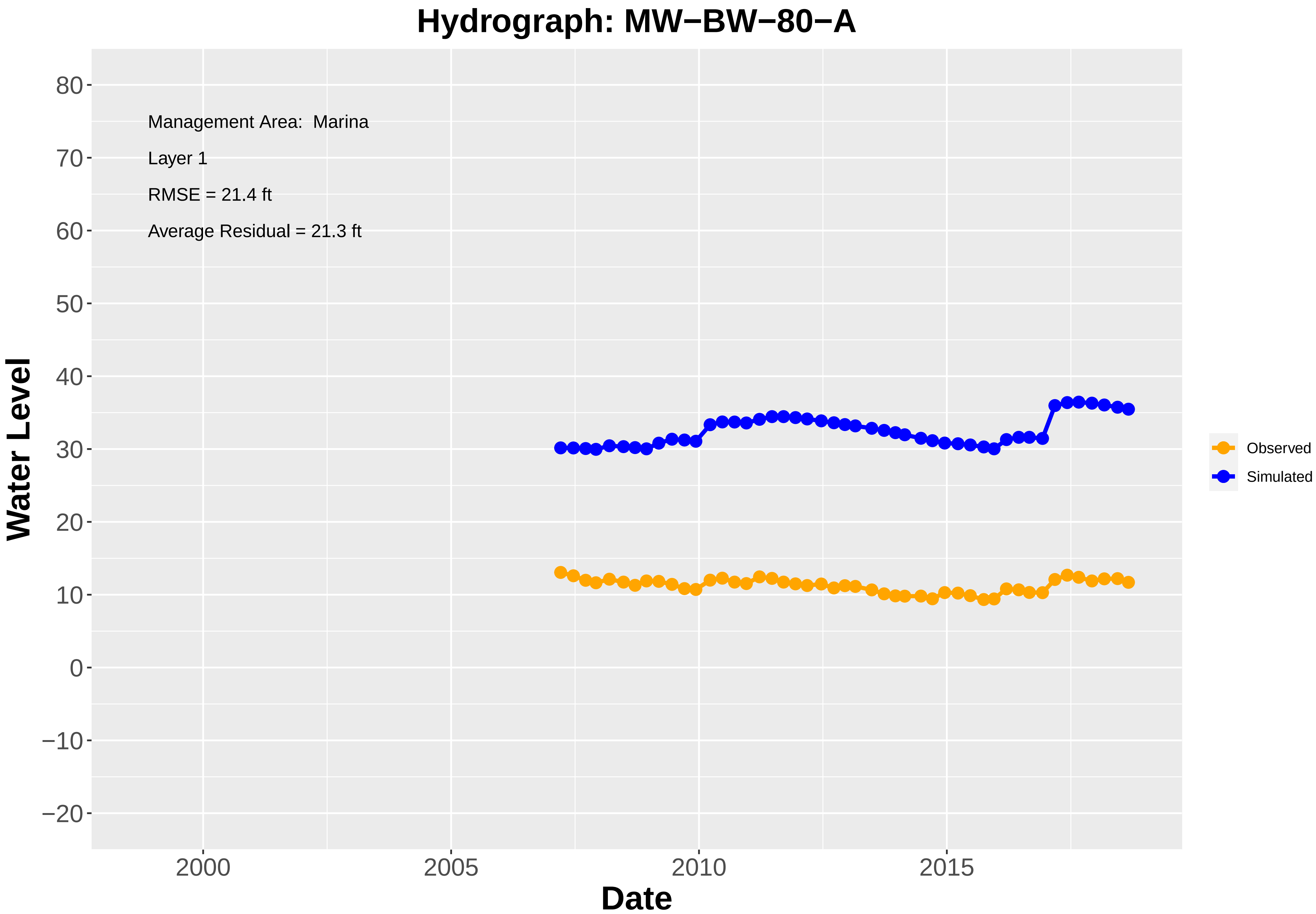
Hydrograph: MW−BW−77−A
Management Area: Marina
Layer 1
RMSE = 22.8 ft
Average Residual = 22.8 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



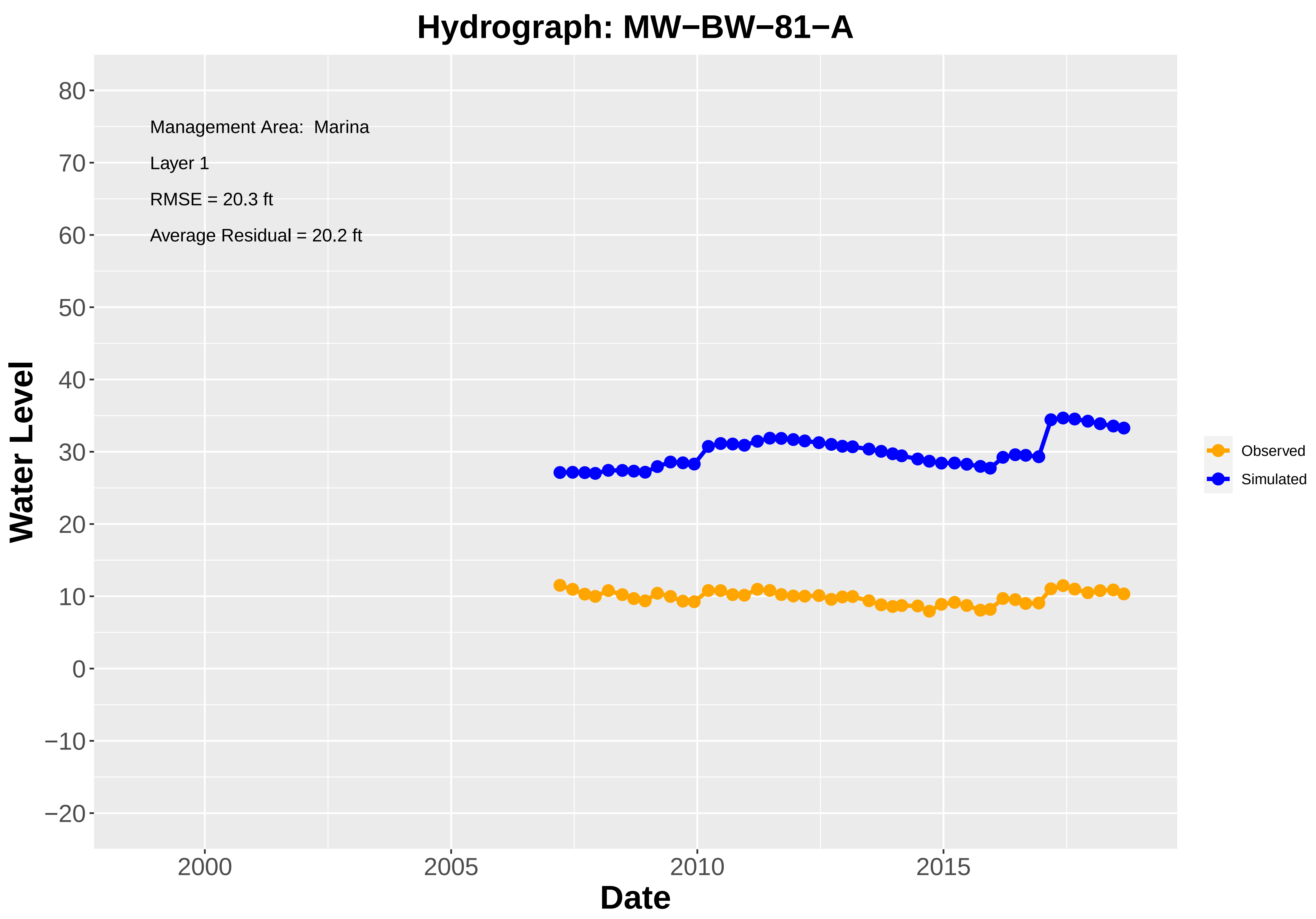
Hydrograph: MW−BW−78−A
Management Area: Marina
Layer 1
RMSE = 23.3 ft
Average Residual = 23.2 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

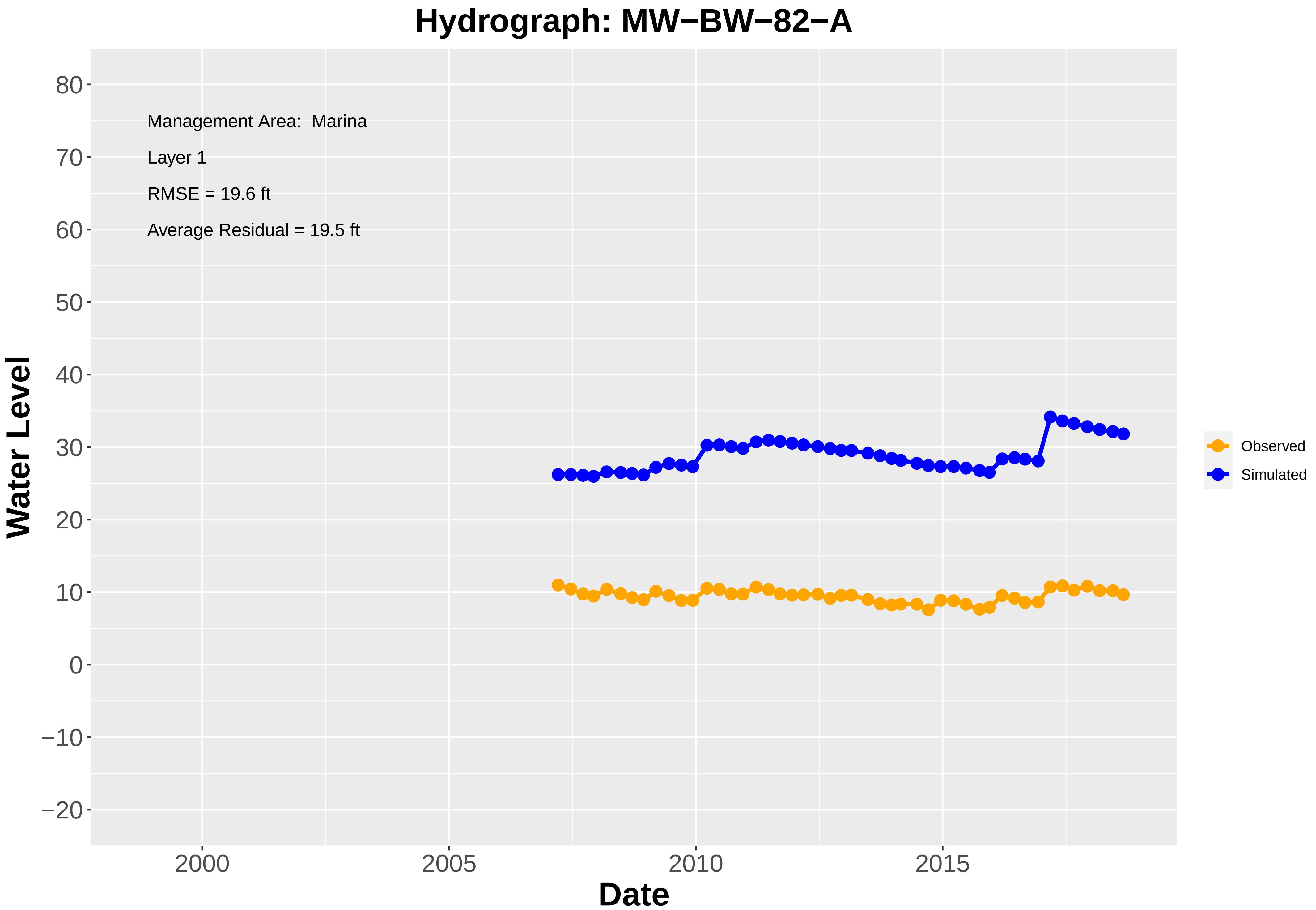


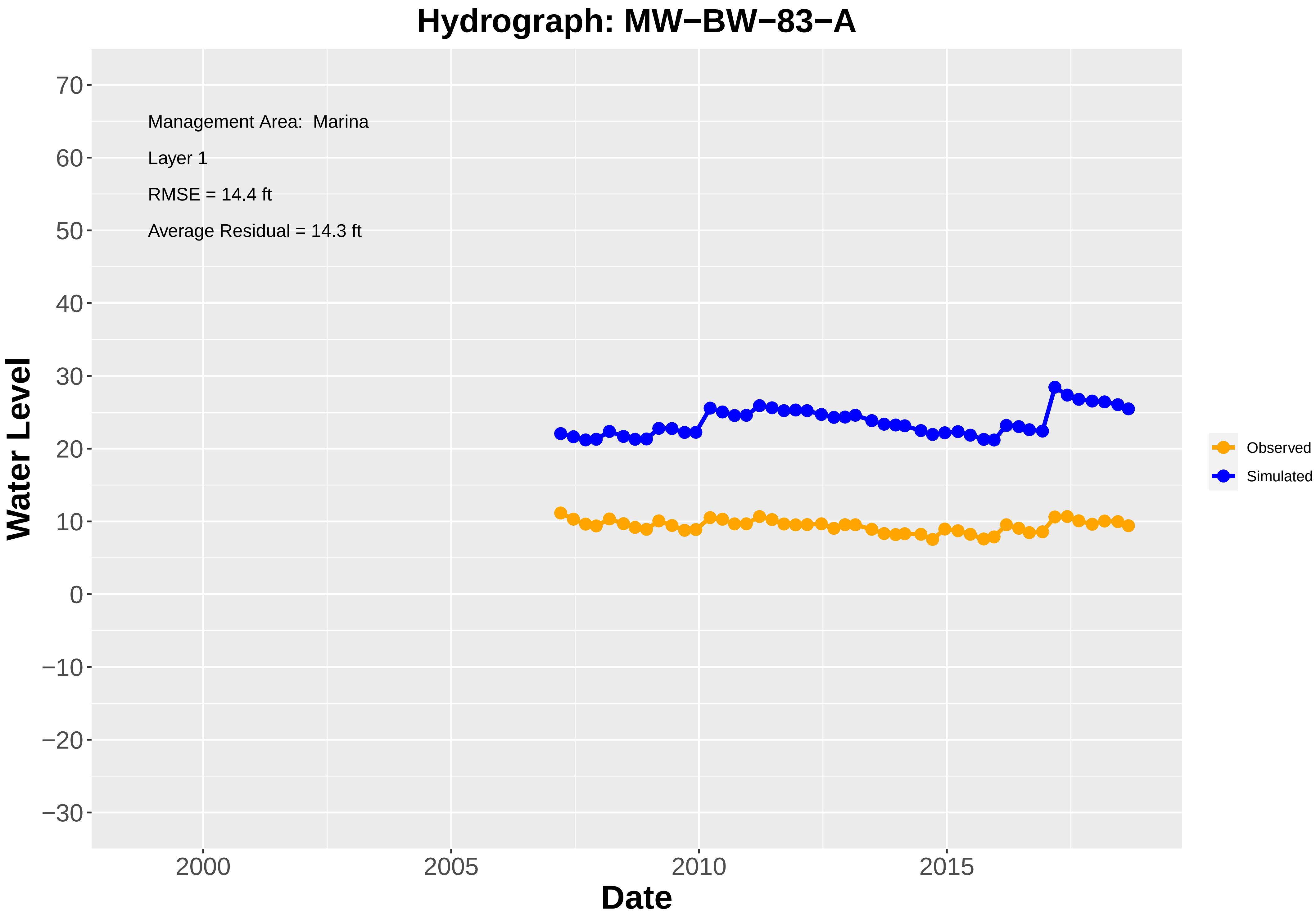
Hydrograph: MW−BW−79−A
Management Area: Marina
Layer 1
RMSE = 22.6 ft
Average Residual = 22.6 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

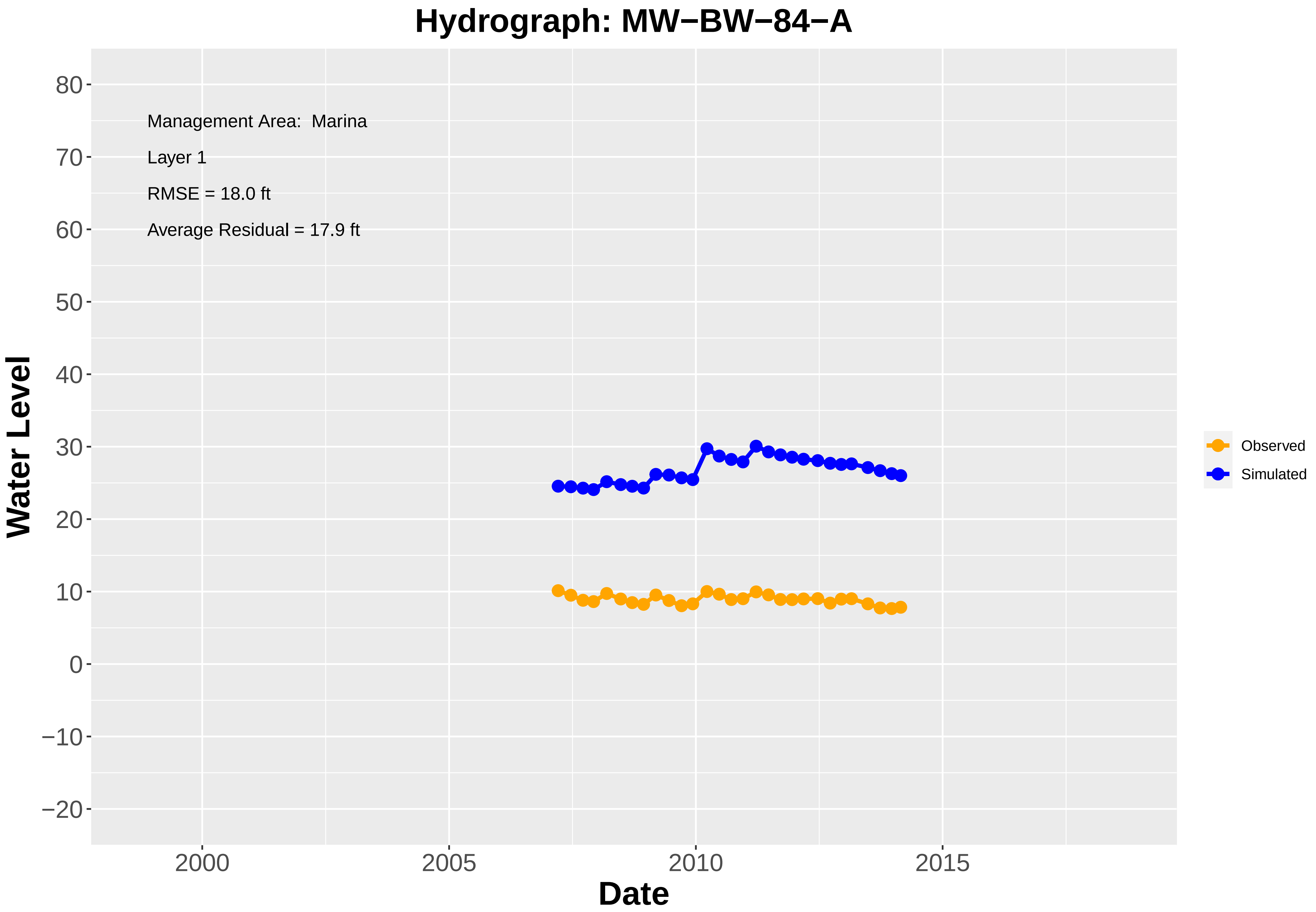


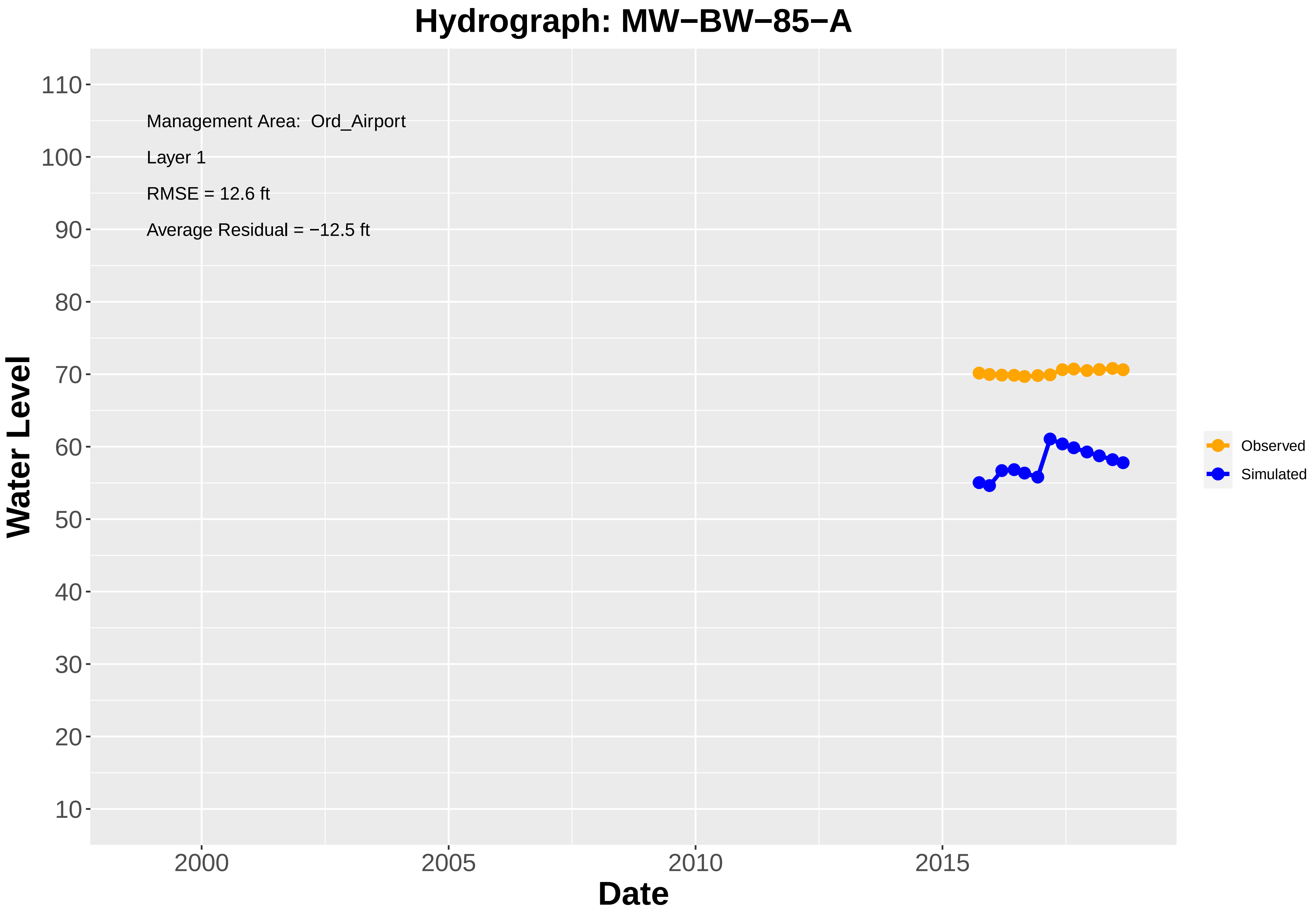
Hydrograph: MW−BW−80−A
Management Area: Marina
Layer 1
RMSE = 21.4 ft
Average Residual = 21.3 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

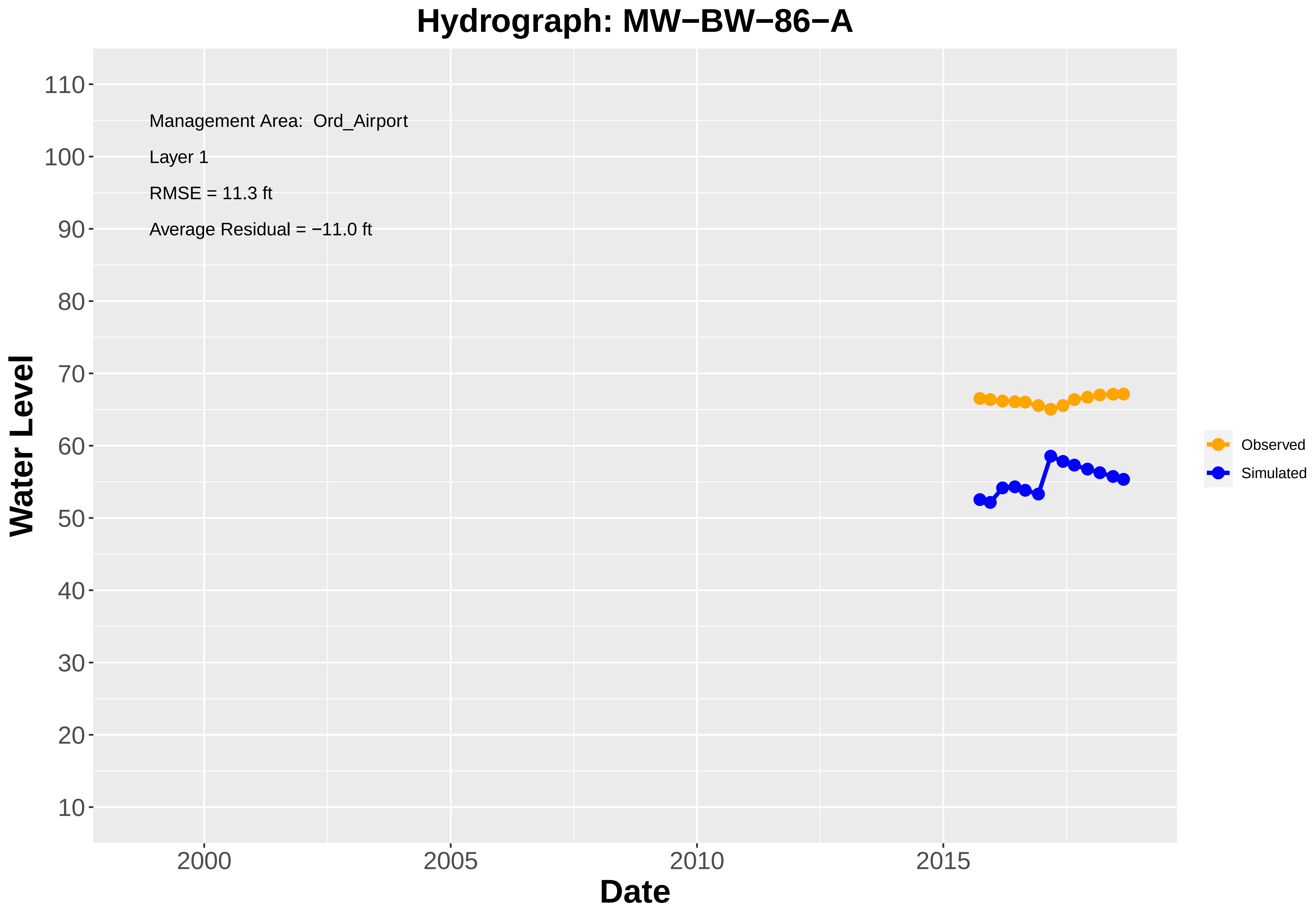

Hydrograph: MW−BW−81−A
Management Area: Marina
Layer 1
RMSE = 20.3 ft
Average Residual = 20.2 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

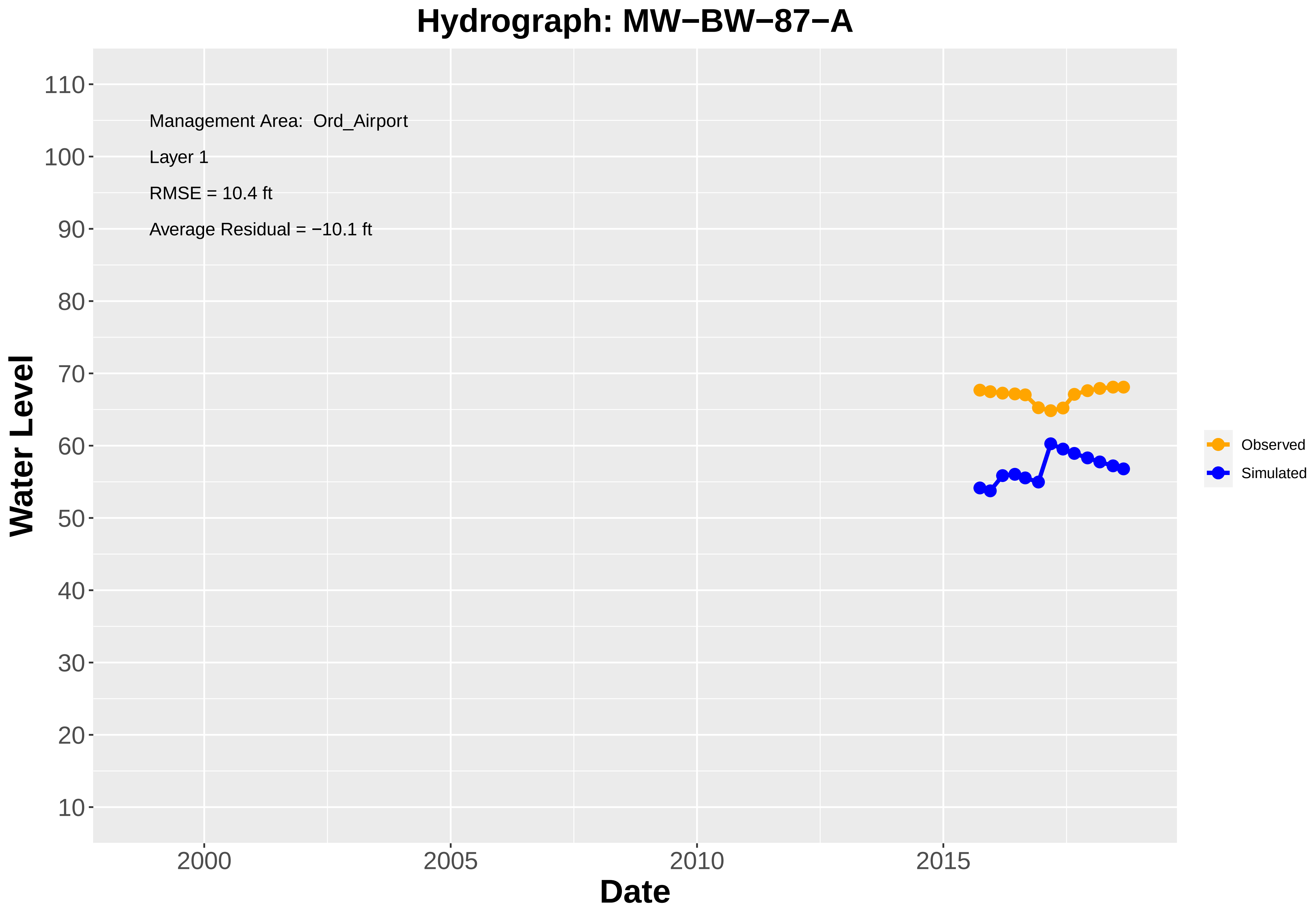

Hydrograph: MW−BW−82−A
Management Area: Marina
Layer 1
RMSE = 19.6 ft
Average Residual = 19.5 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−83−A
Management Area: Marina
Layer 1
RMSE = 14.4 ft
Average Residual = 14.3 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Date
Observed
Simulated

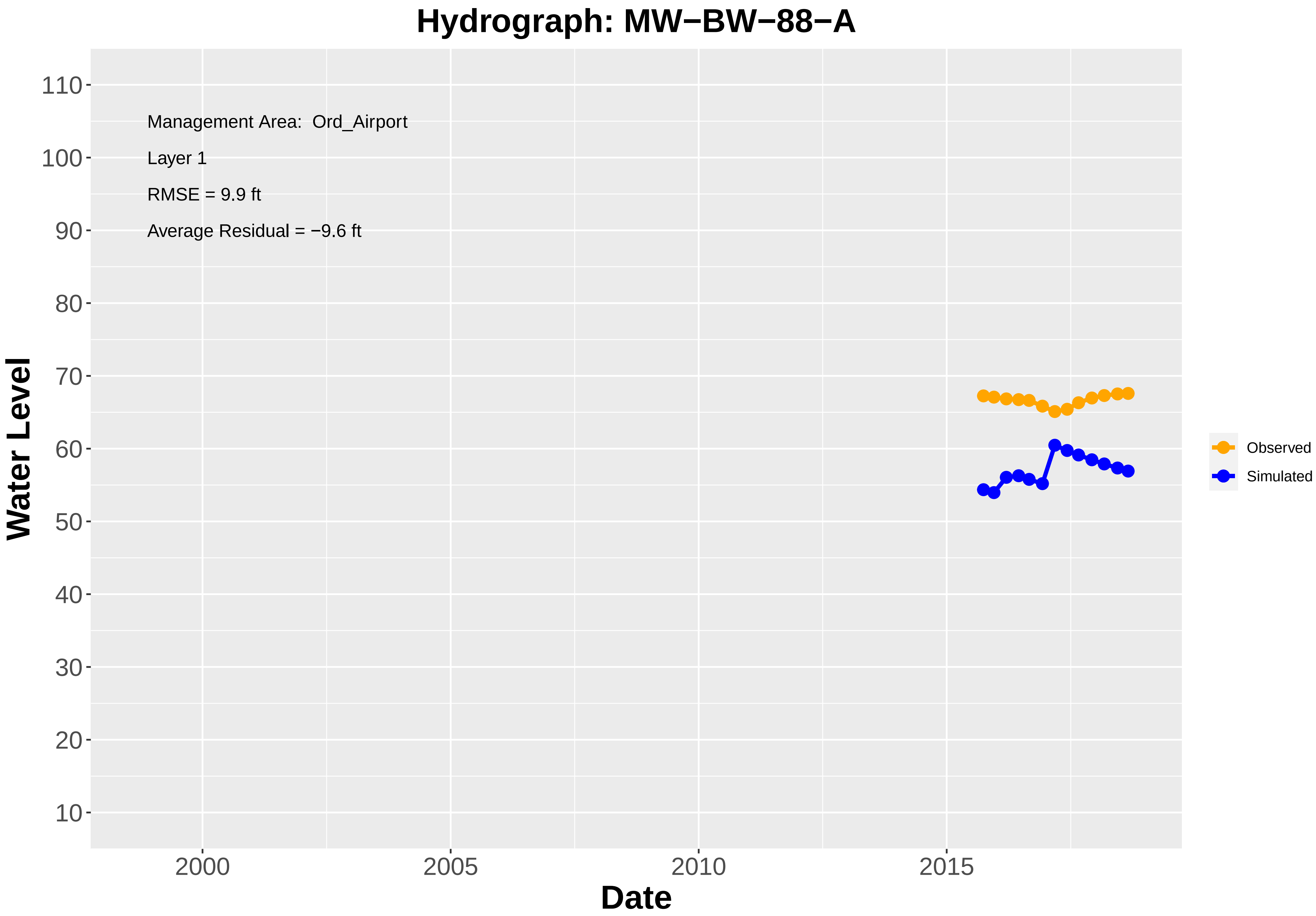

Hydrograph: MW−BW−84−A
Management Area: Marina
Layer 1
RMSE = 18.0 ft
Average Residual = 17.9 ft
Water Level
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−BW−85−A
Management Area: Ord_Airport
Layer 1
RMSE = 12.6 ft
Average Residual = −12.5 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

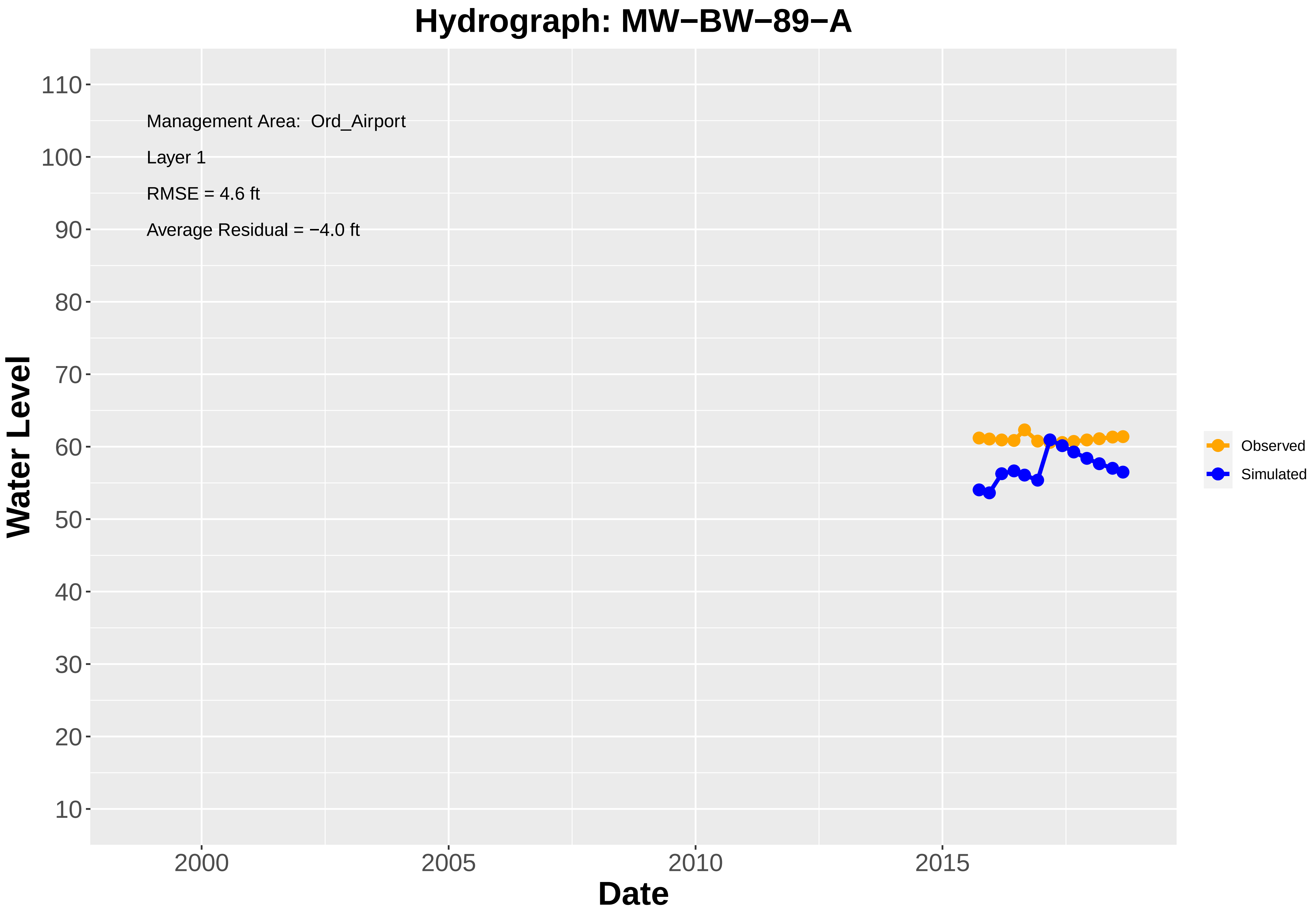

Hydrograph: MW−BW−86−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.3 ft
Average Residual = −11.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

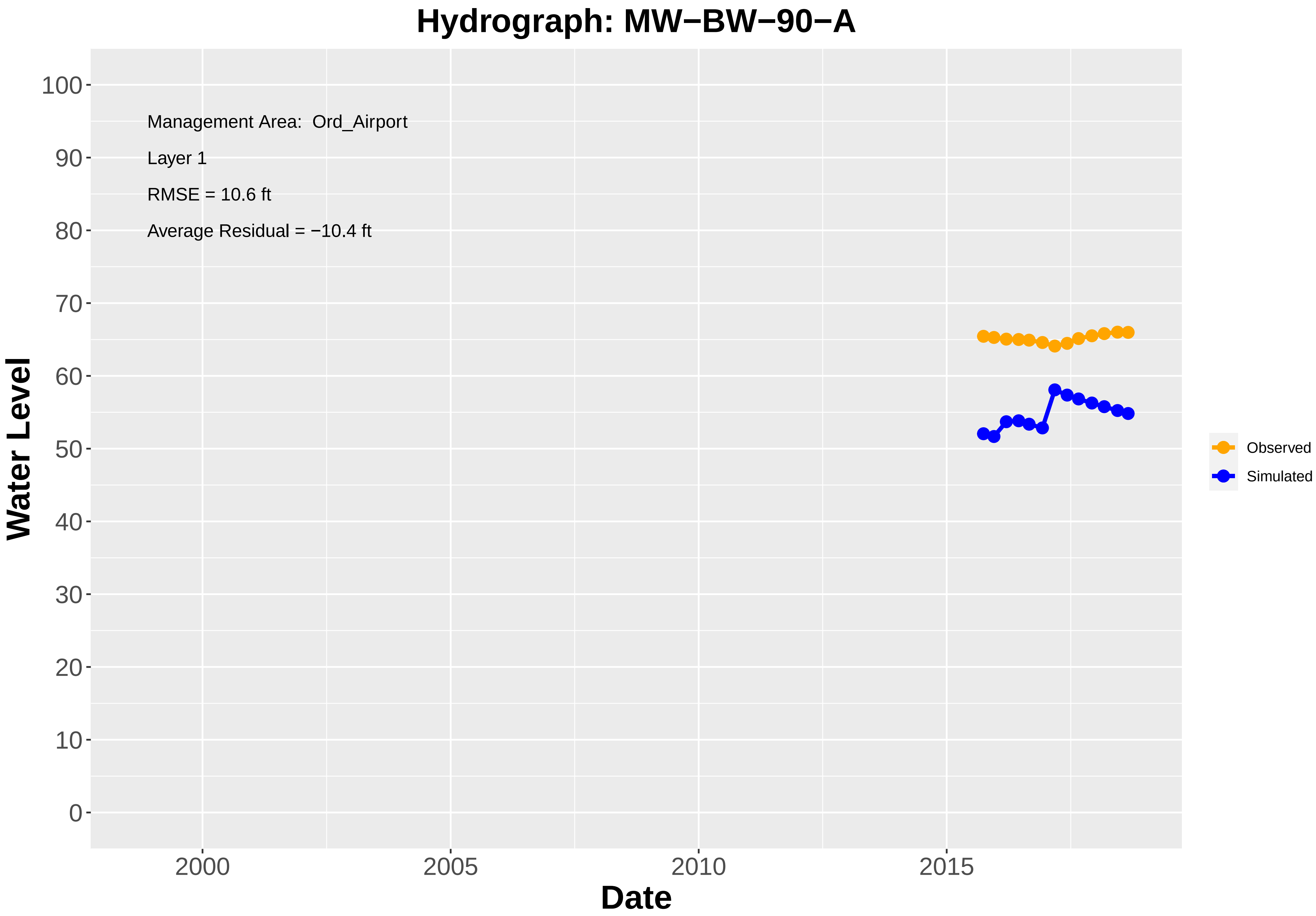


Hydrograph: MW−BW−87−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.4 ft
Average Residual = −10.1 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

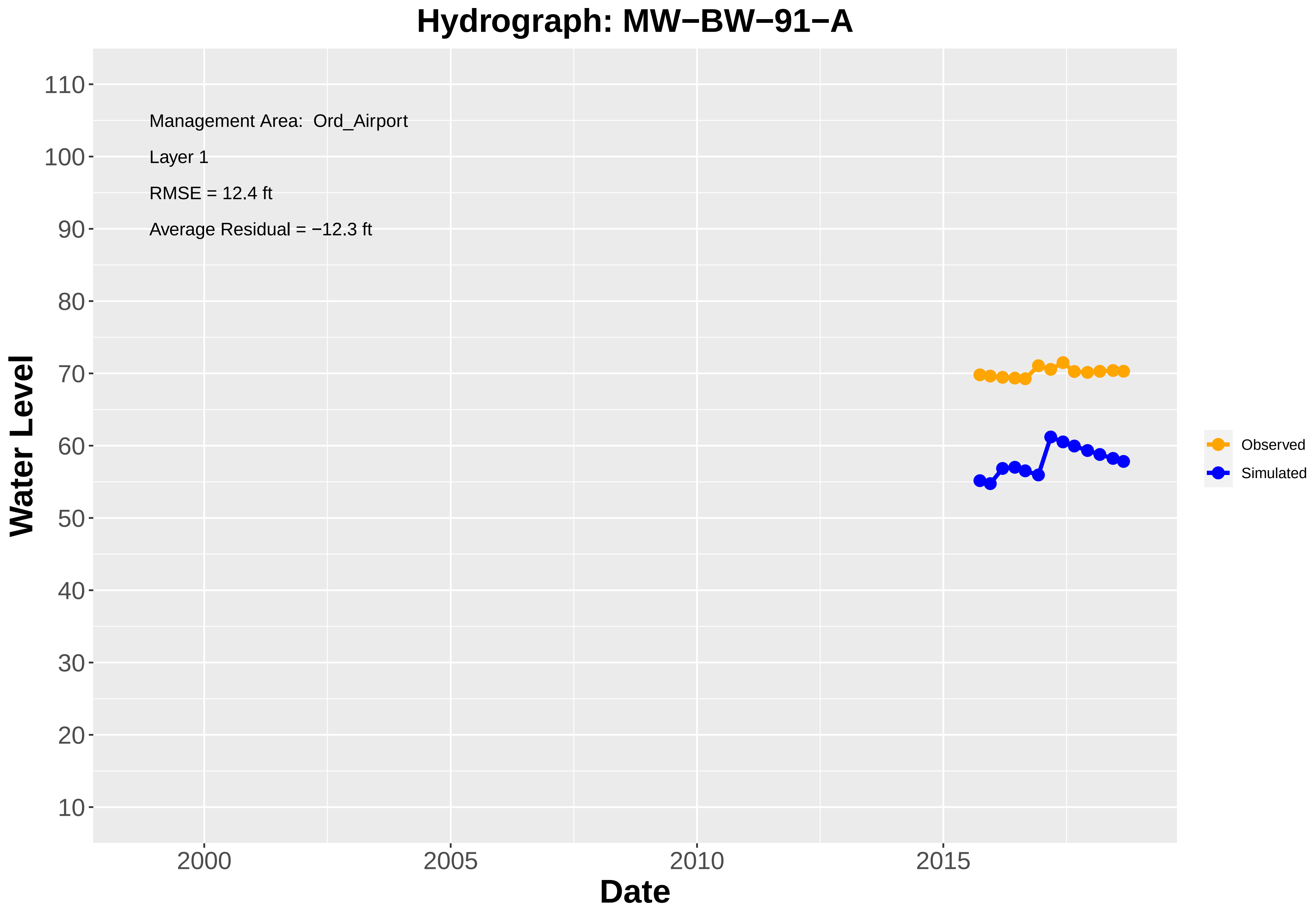


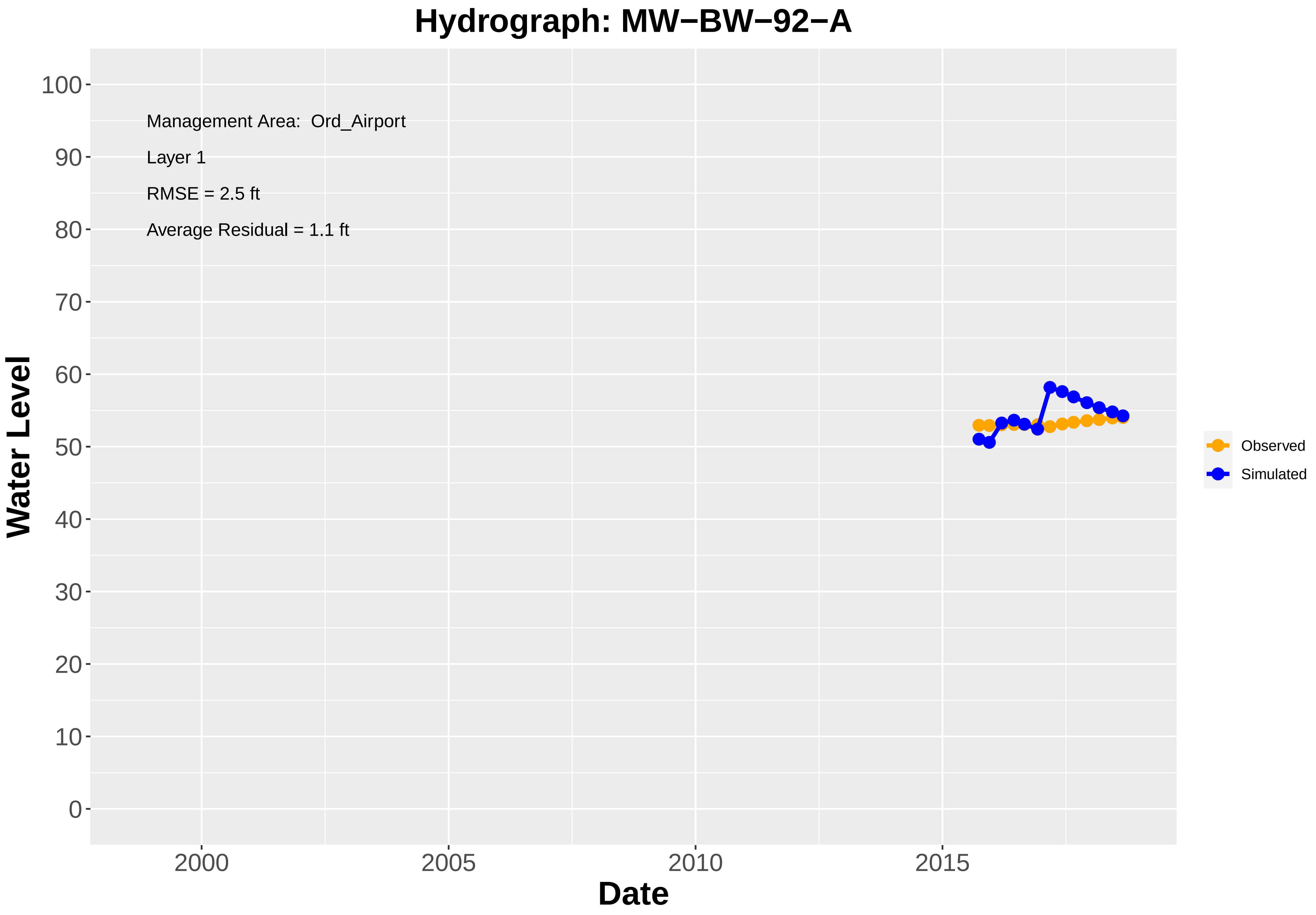
Hydrograph: MW−BW−88−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.9 ft
Average Residual = −9.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−BW−89−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.6 ft
Average Residual = −4.0 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

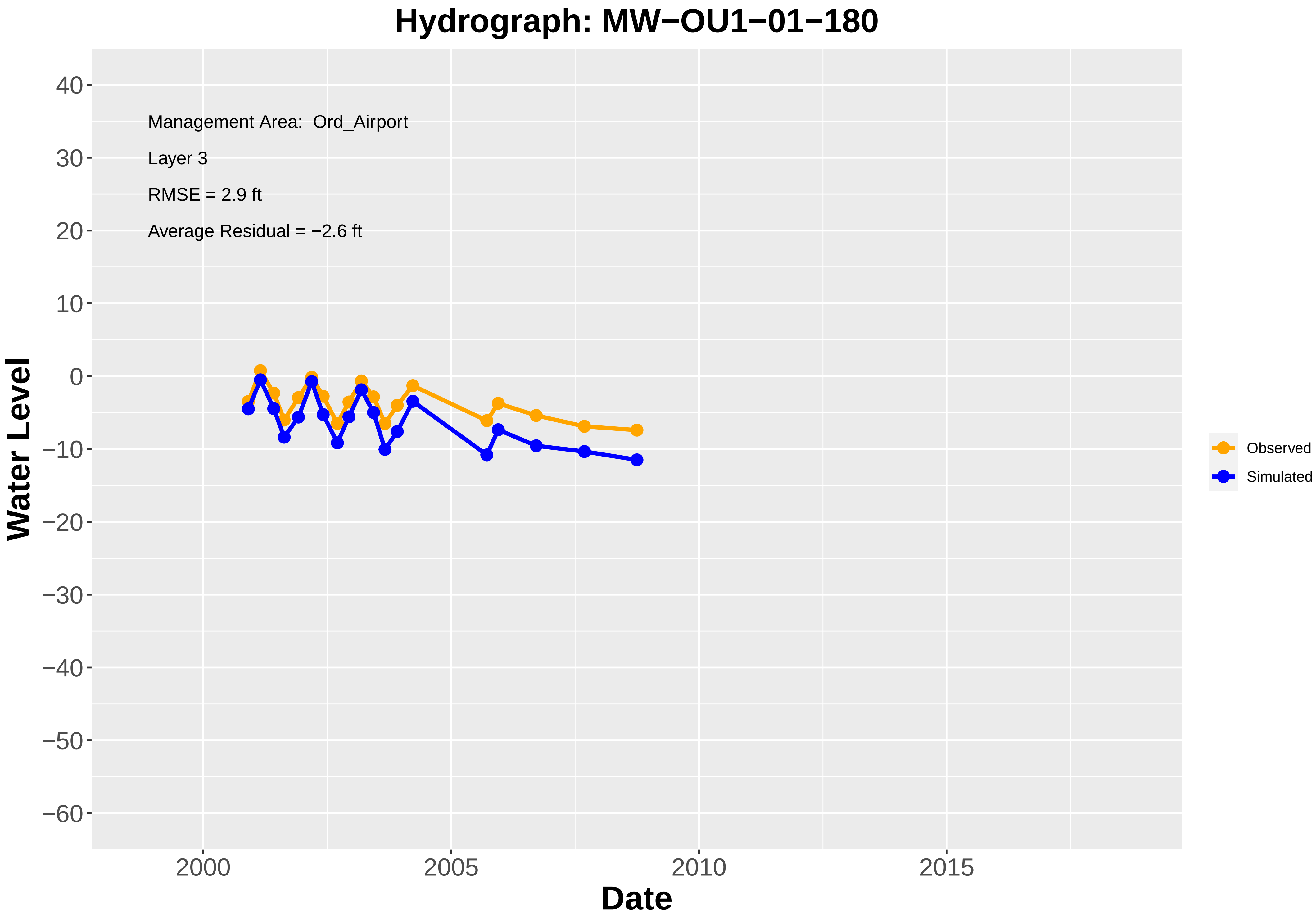


Hydrograph: MW−BW−90−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.6 ft
Average Residual = −10.4 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

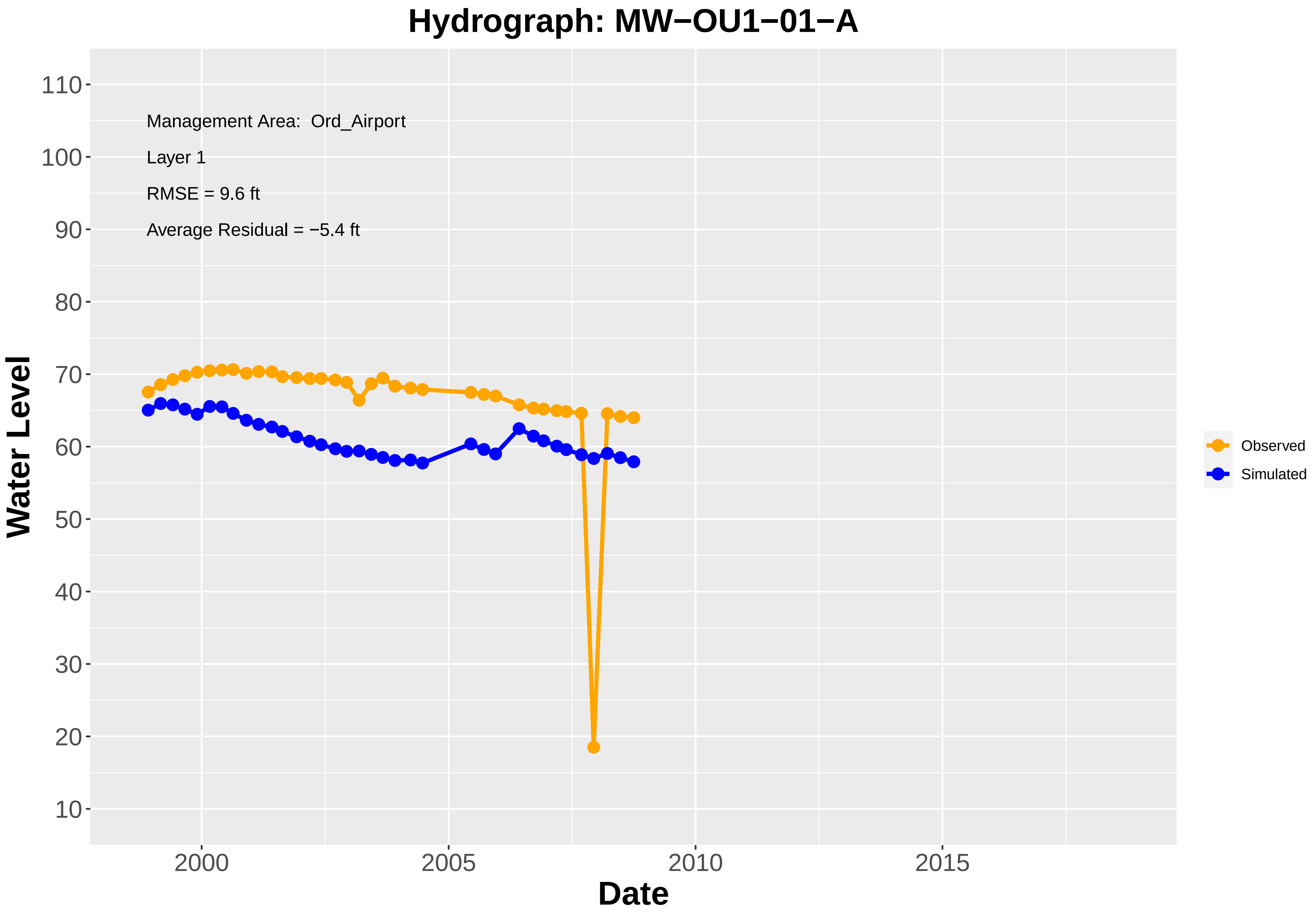

Hydrograph: MW−BW−91−A
Management Area: Ord_Airport
Layer 1
RMSE = 12.4 ft
Average Residual = −12.3 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



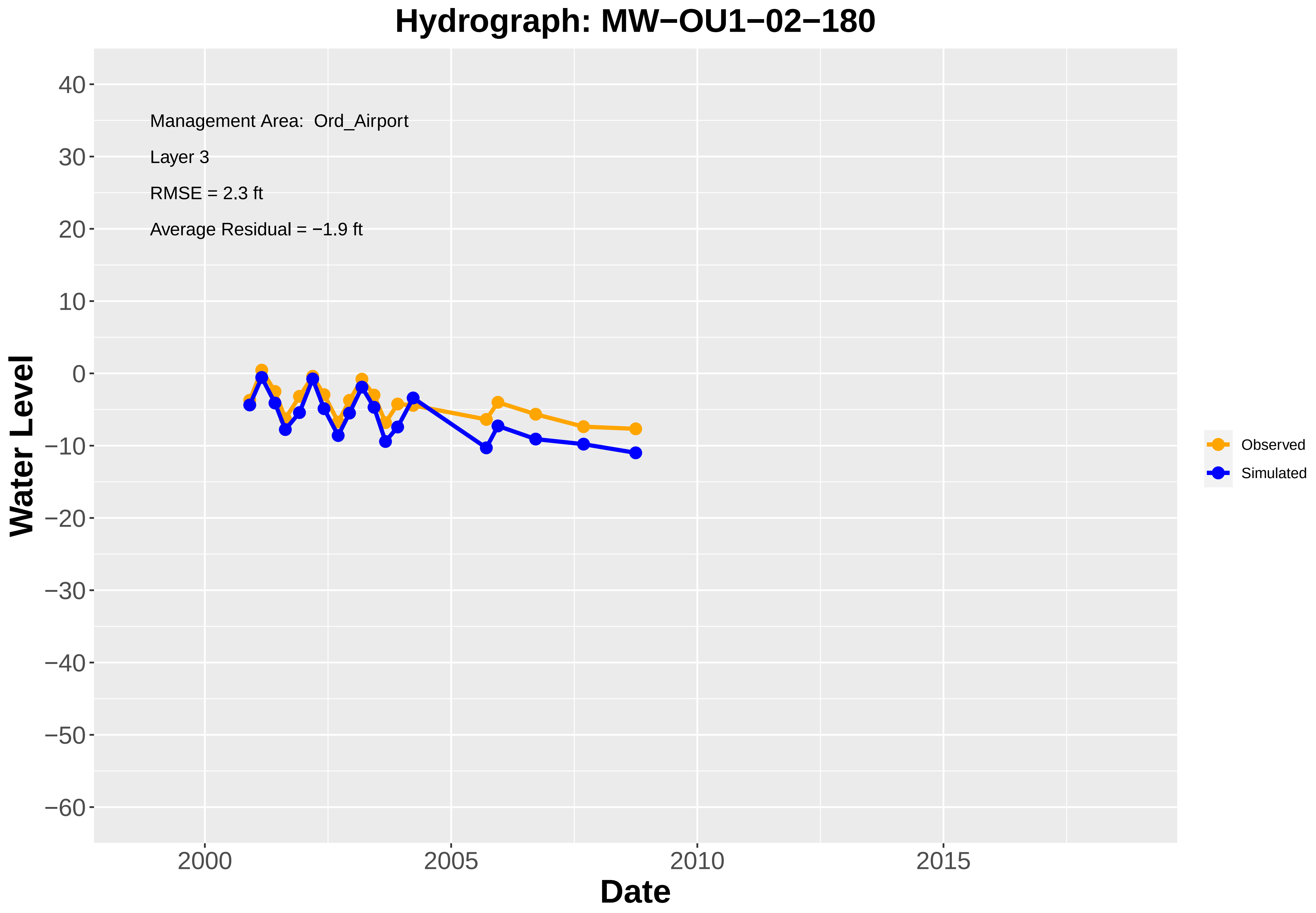
Hydrograph: MW−BW−92−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.5 ft
Average Residual = 1.1 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



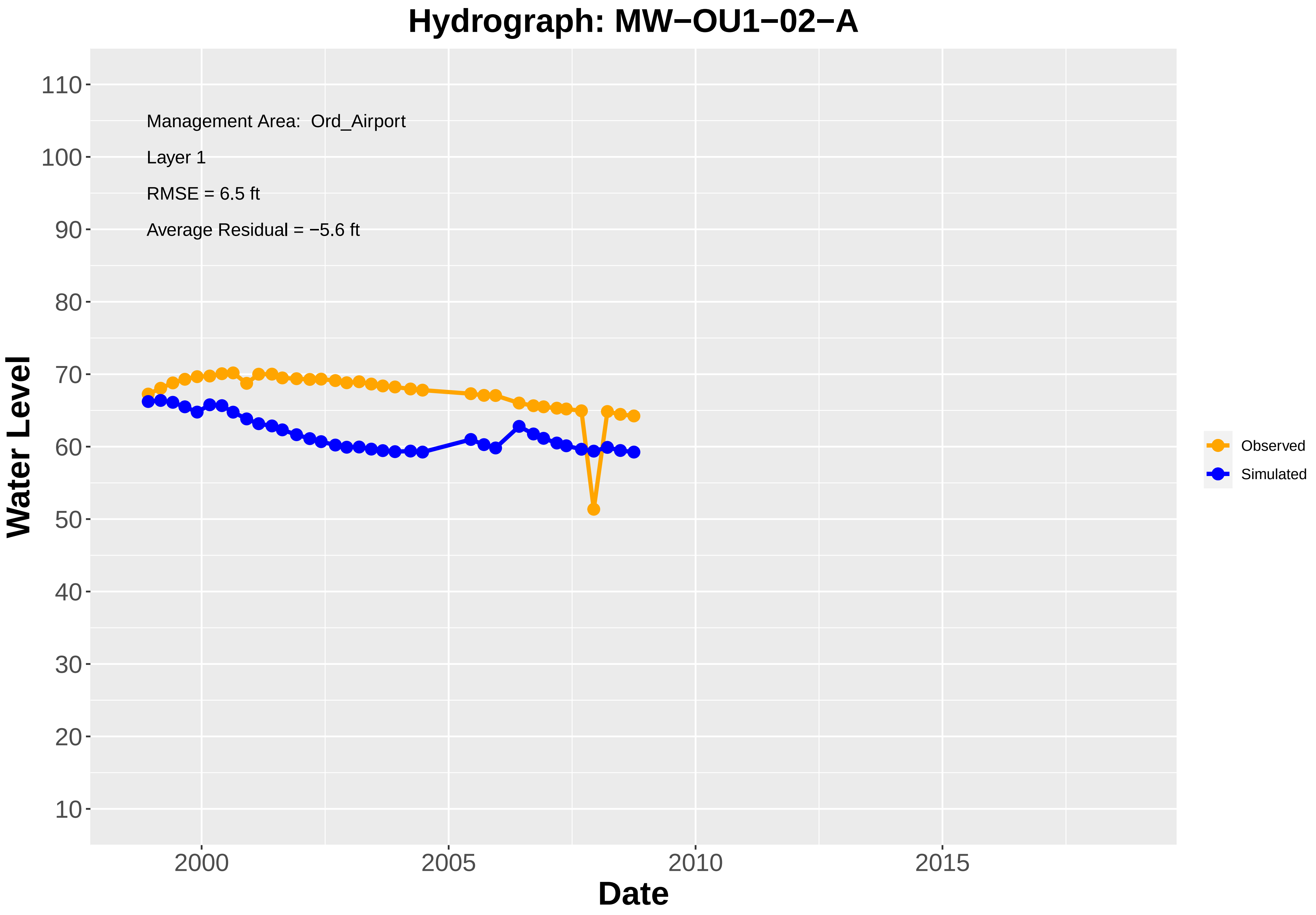
Hydrograph: MW−OU1−01−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.9 ft
Average Residual = −2.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

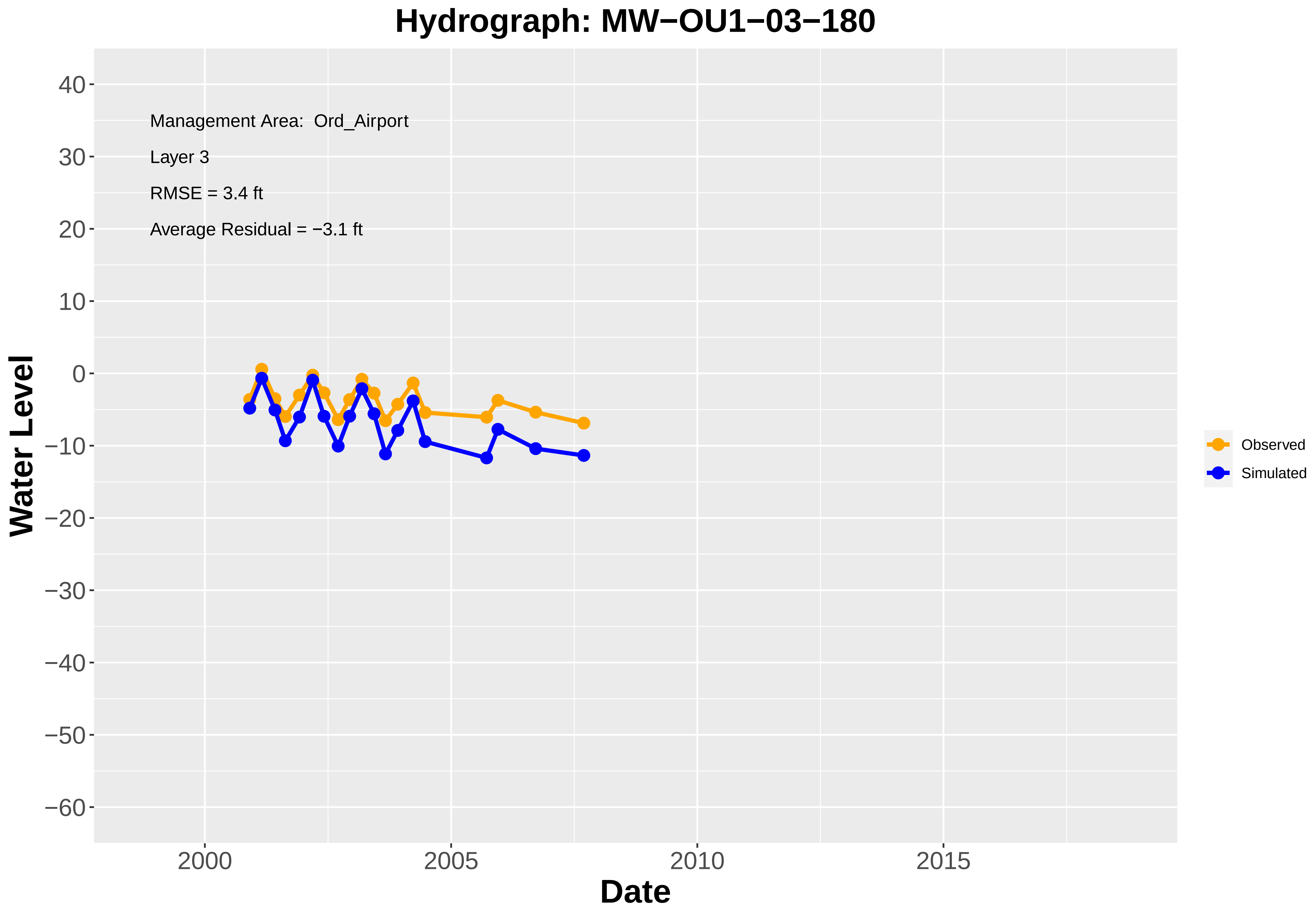


Hydrograph: MW−OU1−01−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.6 ft
Average Residual = −5.4 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

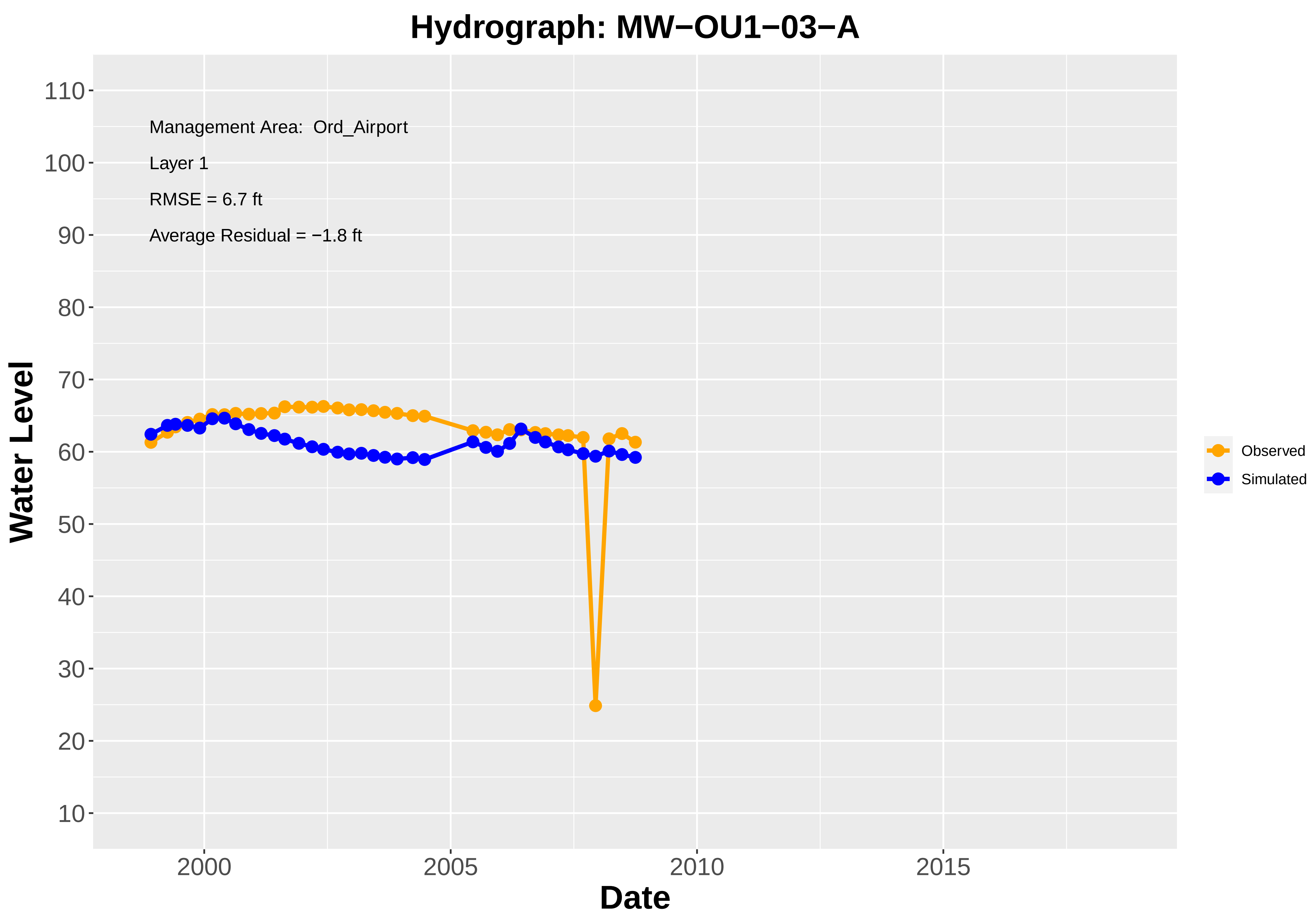


Hydrograph: MW−OU1−02−180
Management Area: Ord_Airport
Layer 3
RMSE = 2.3 ft
Average Residual = −1.9 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

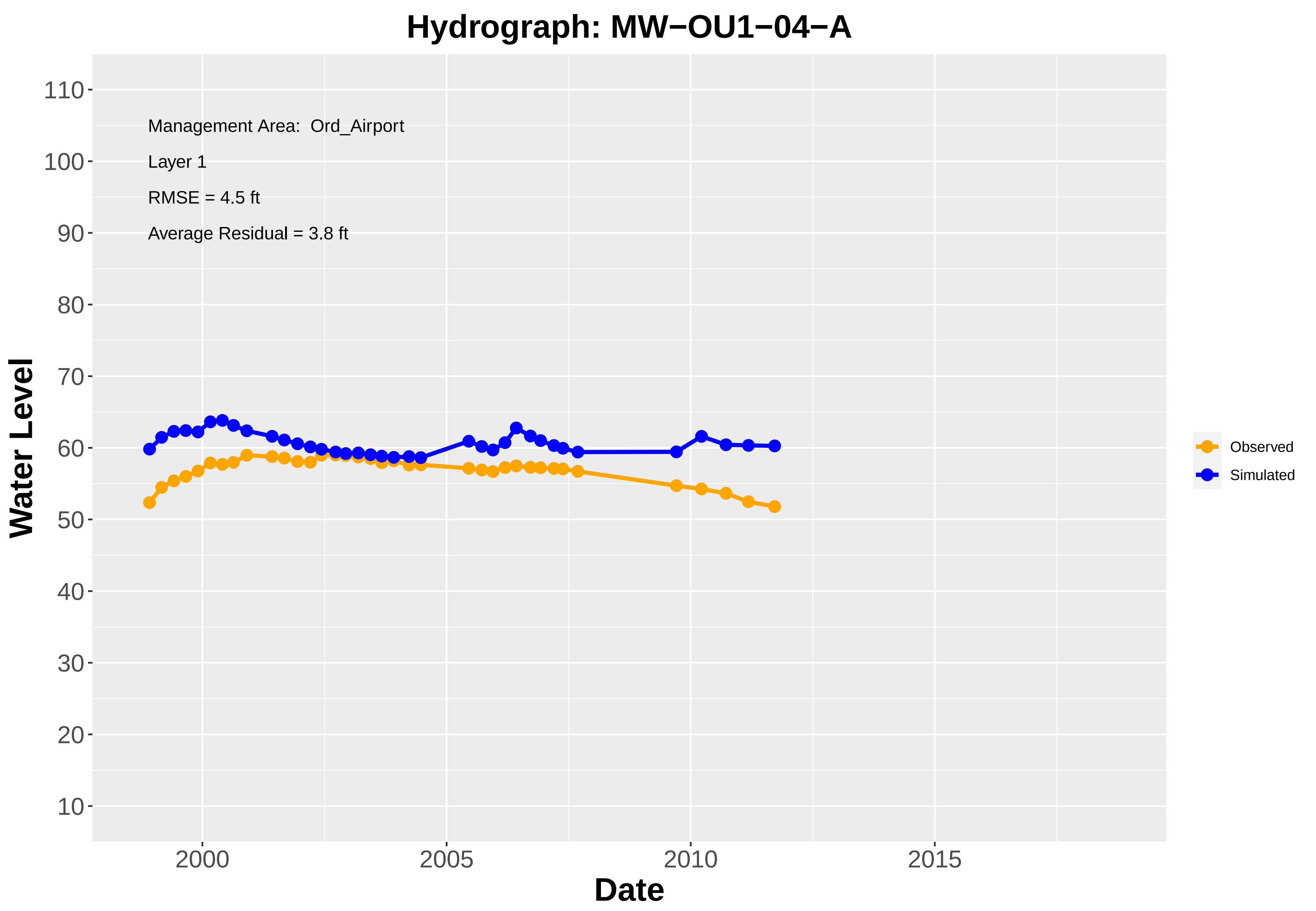

Hydrograph: MW−OU1−02−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.5 ft
Average Residual = −5.6 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



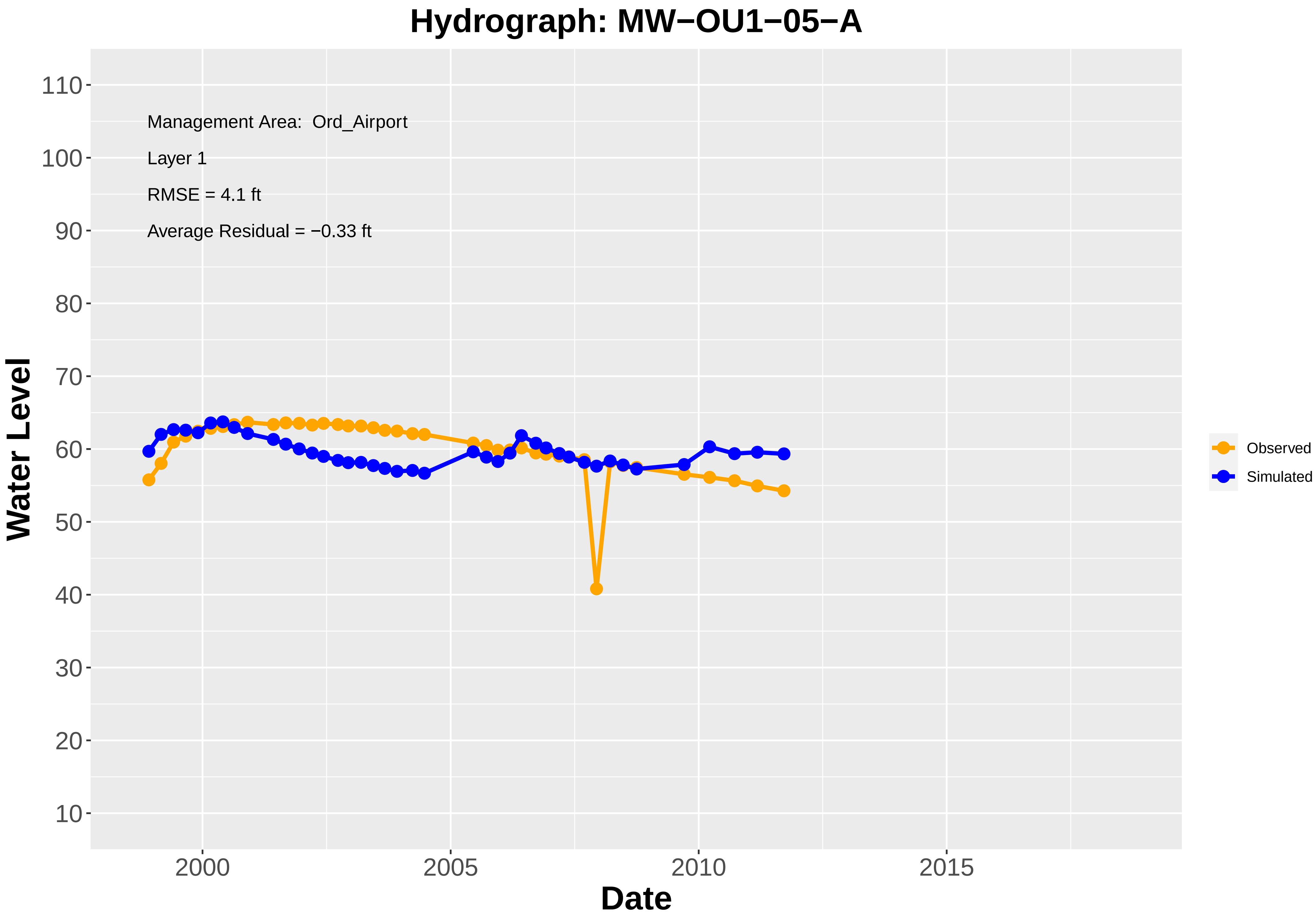
Hydrograph: MW−OU1−03−180
Management Area: Ord_Airport
Layer 3
RMSE = 3.4 ft
Average Residual = −3.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

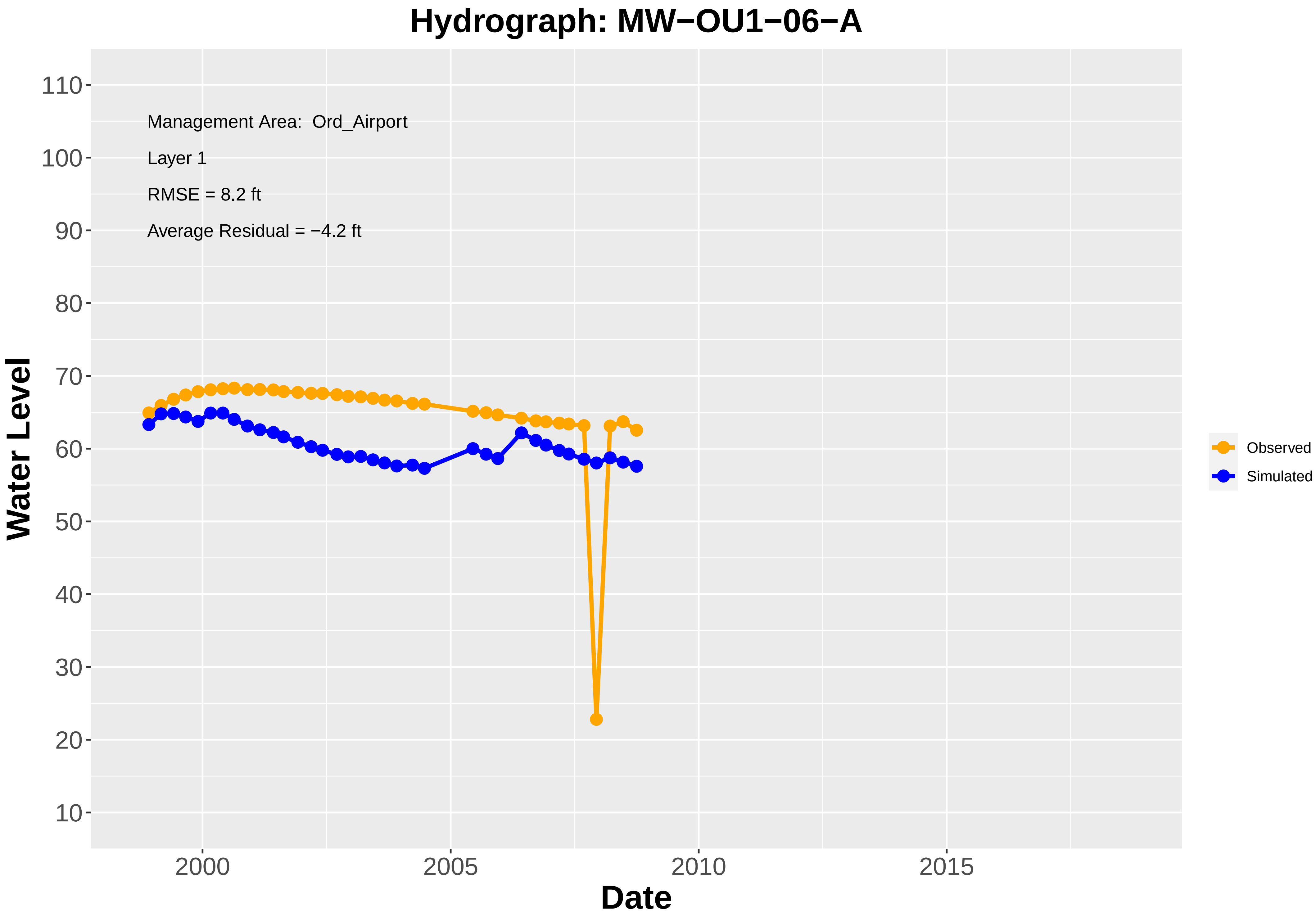


Hydrograph: MW−OU1−03−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.7 ft
Average Residual = −1.8 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

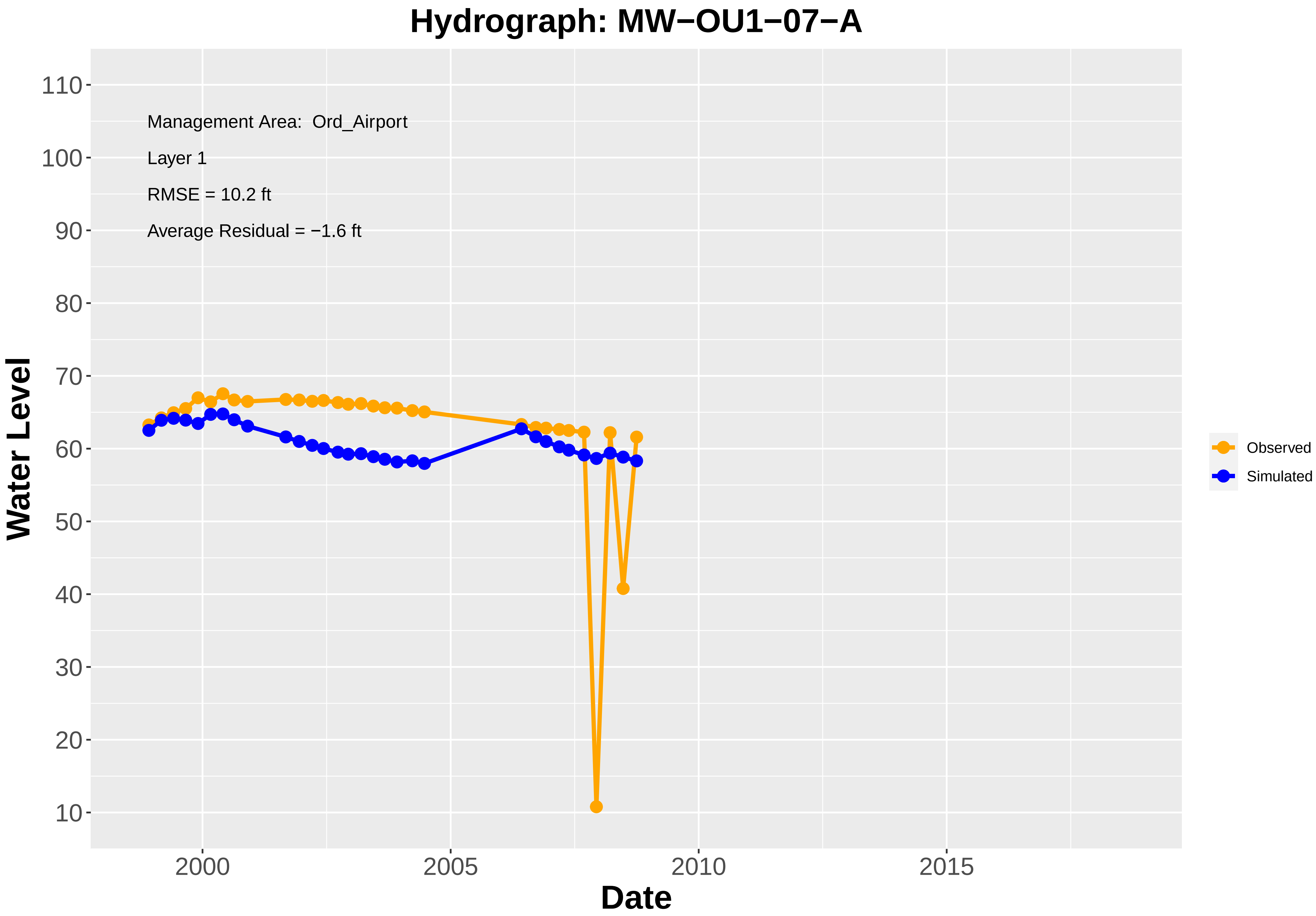


Hydrograph: MW−OU1−04−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.5 ft
Average Residual = 3.8 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

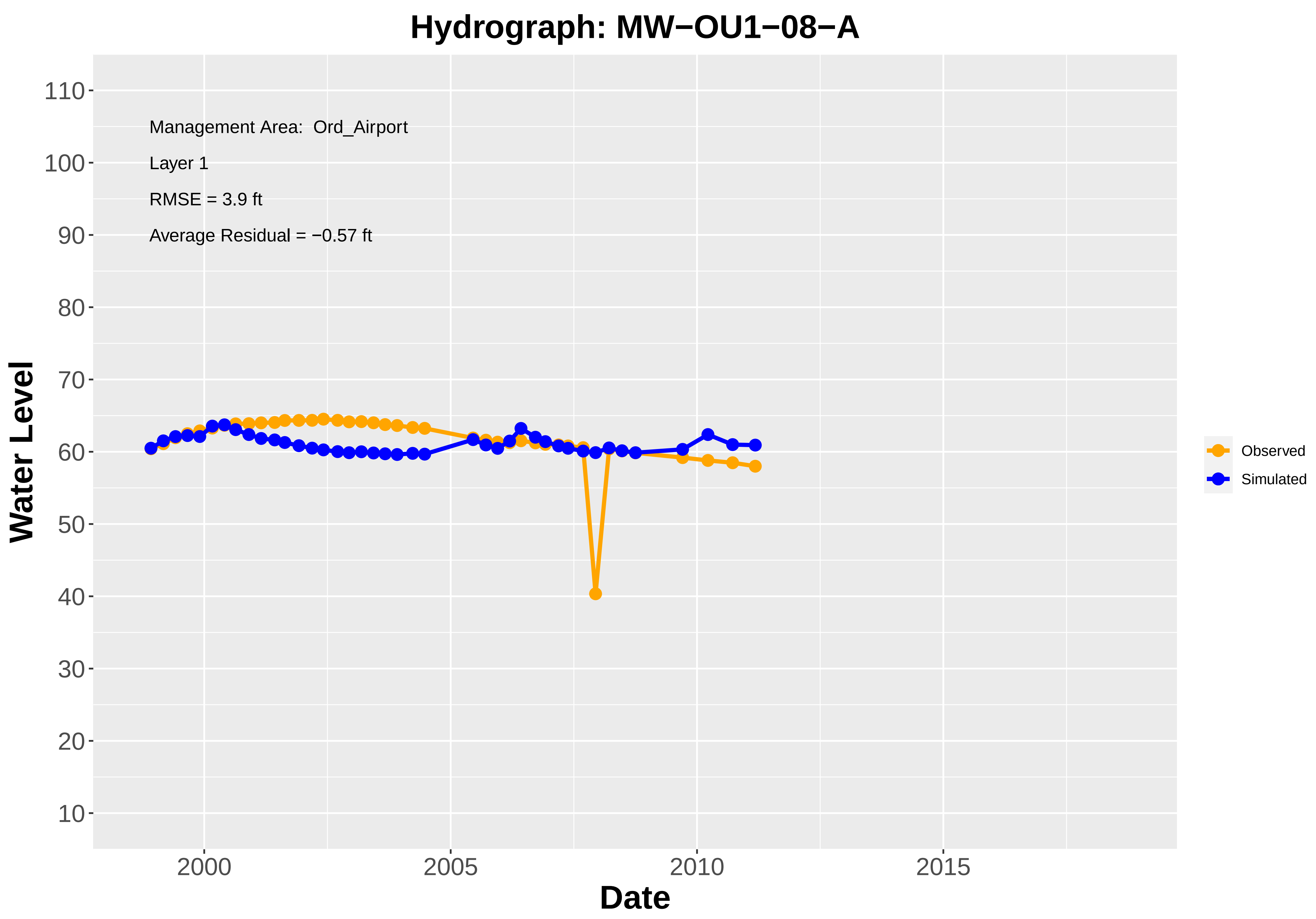

Hydrograph: MW−OU1−05−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.1 ft
Average Residual = −0.33 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



Hydrograph: MW−OU1−06−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.2 ft
Average Residual = −4.2 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

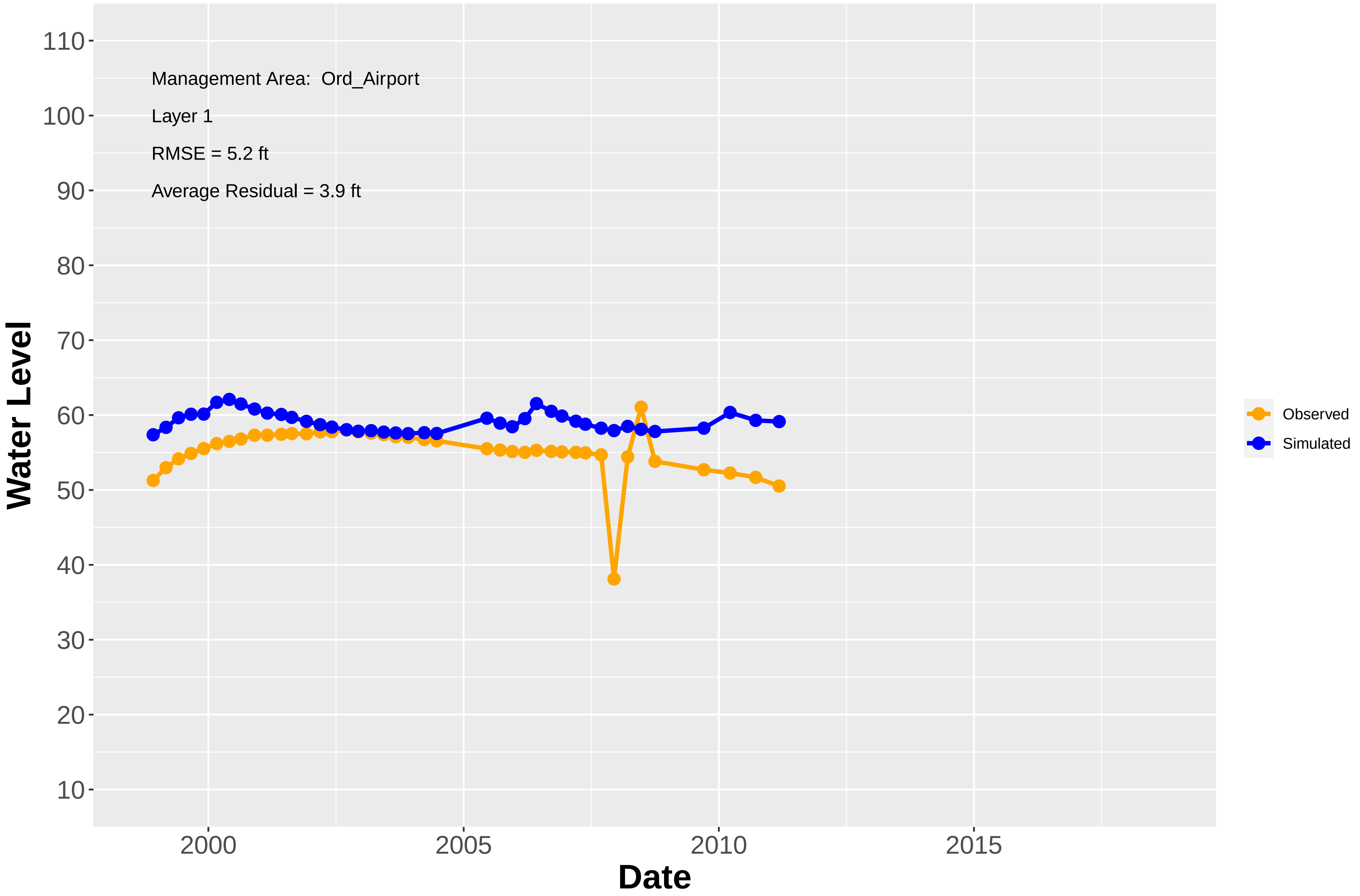


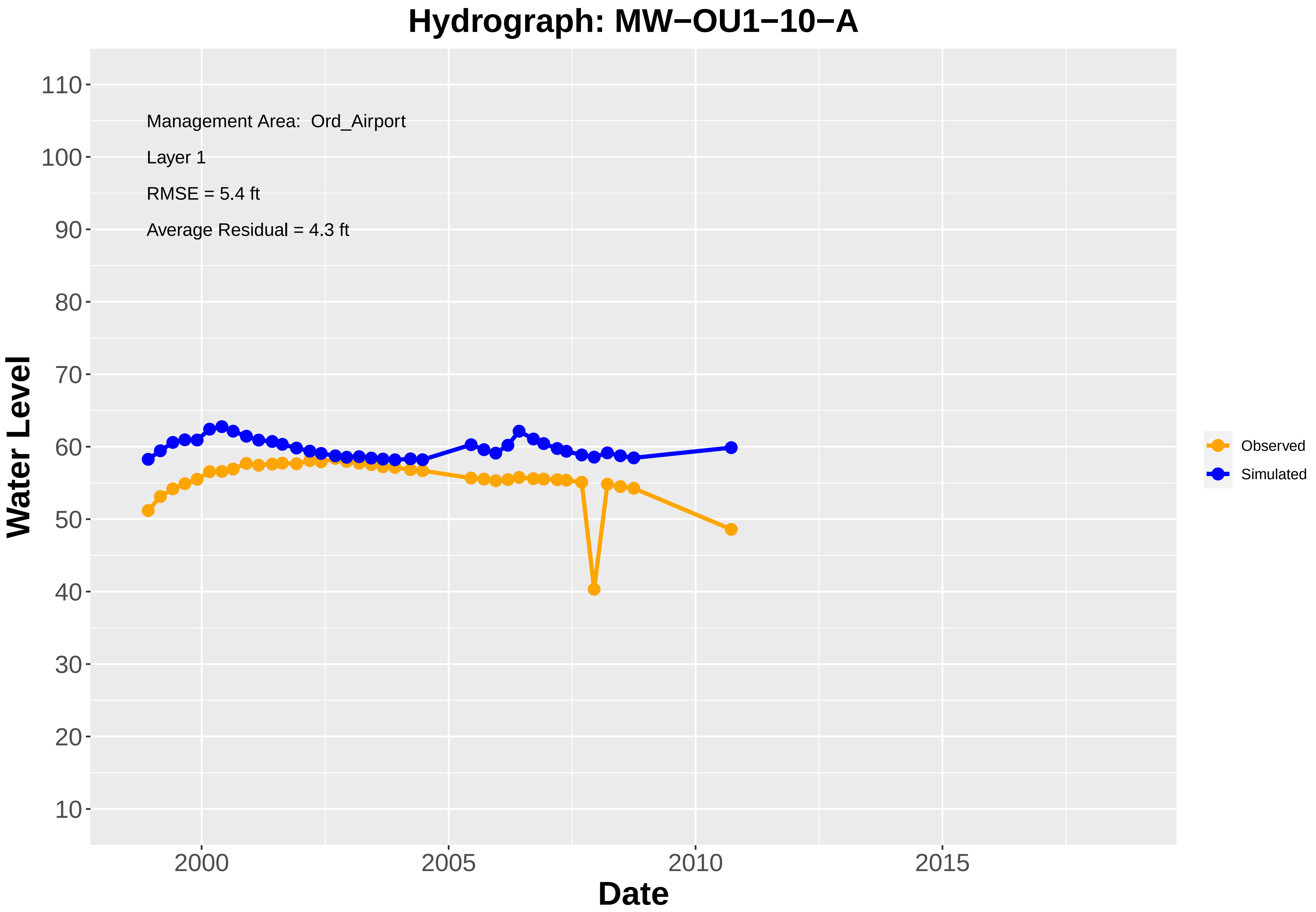
Hydrograph: MW−OU1−07−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.2 ft
Average Residual = −1.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



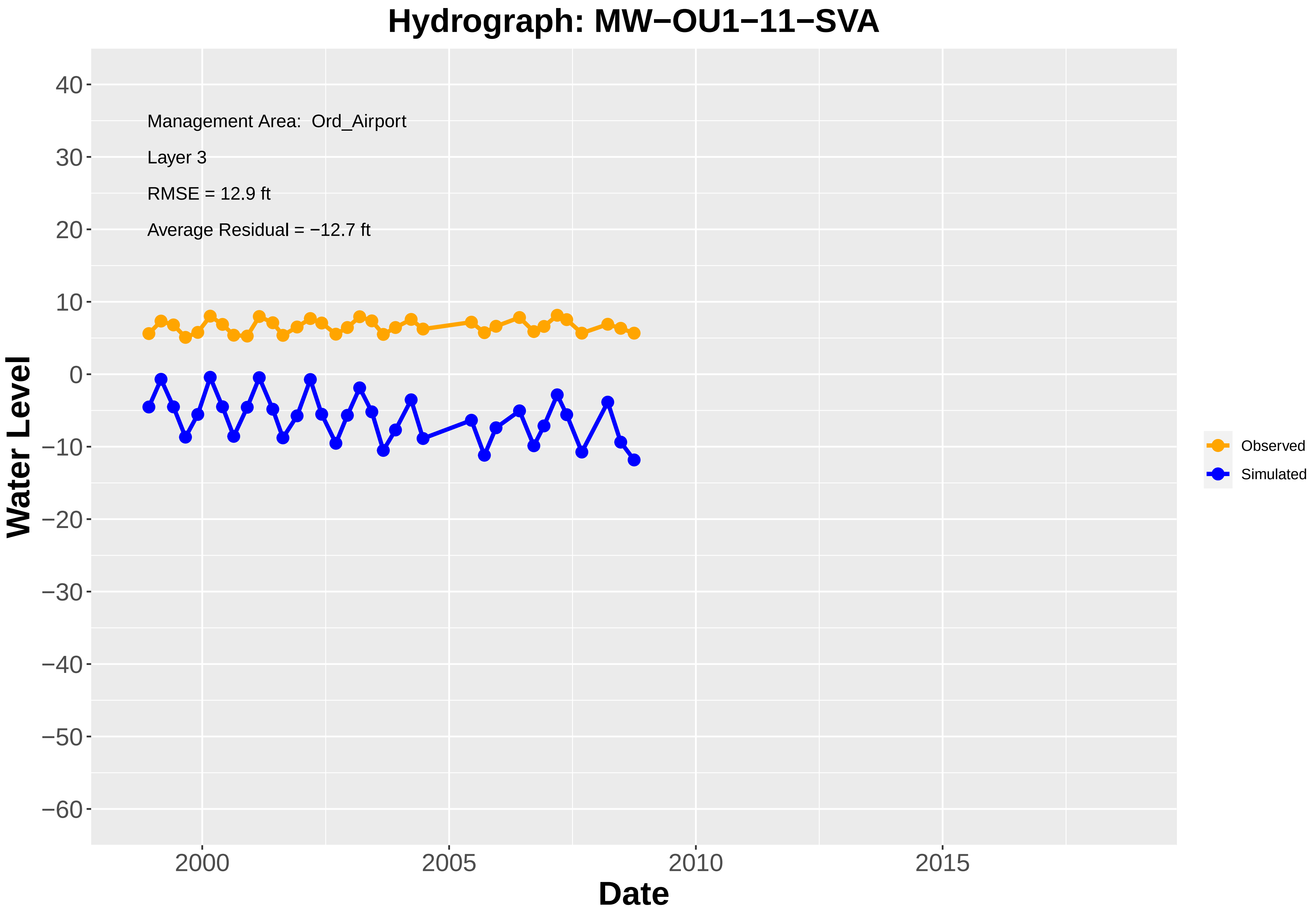
Hydrograph: MW−OU1−08−A
Management Area: Ord_Airport
Layer 1
RMSE = 3.9 ft
Average Residual = −0.57 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

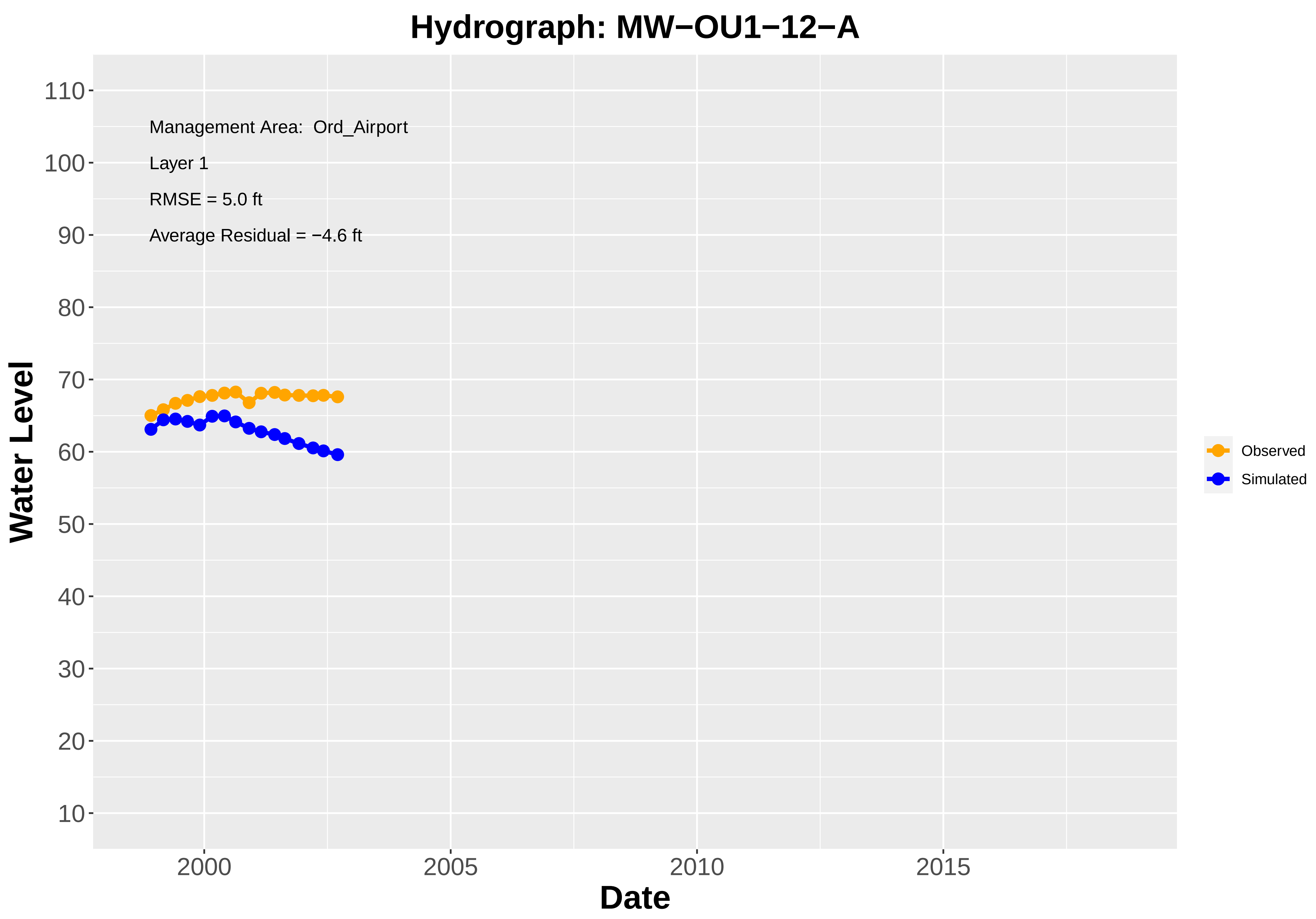
Hydrograph: MW−OU1−09−A

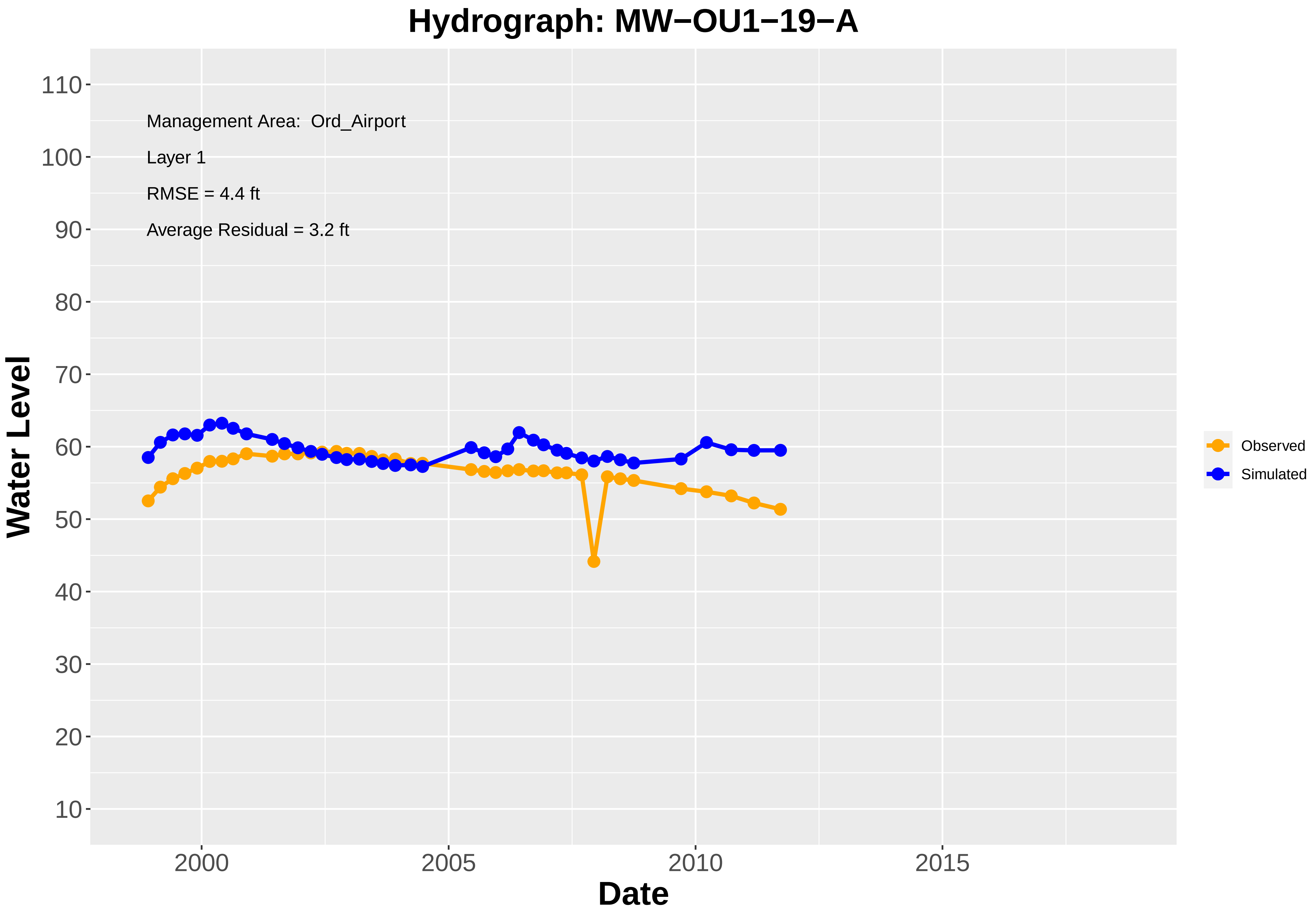




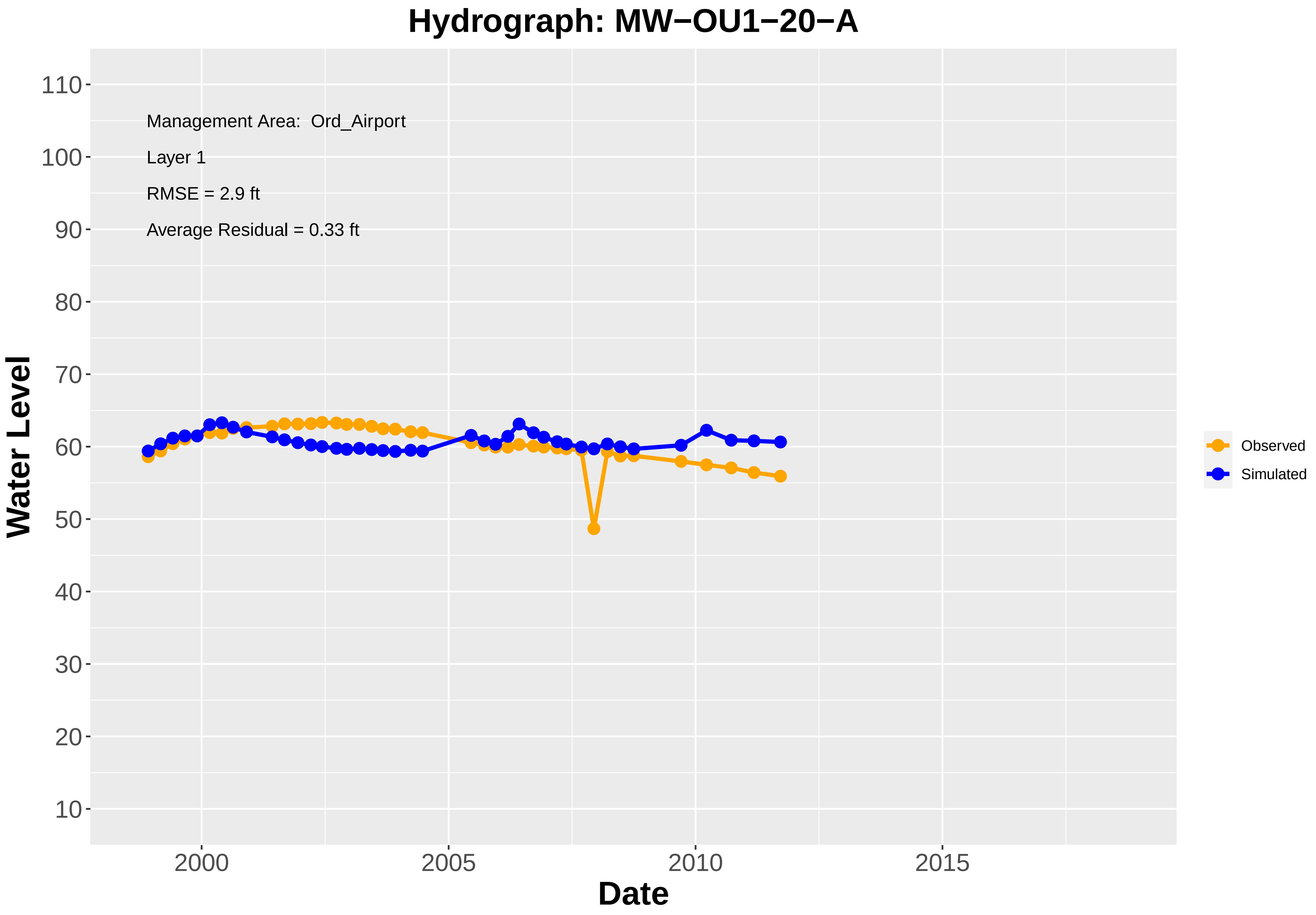
Hydrograph: MW−OU1−10−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.4 ft
Average Residual = 4.3 ft
Water Level
Date
Observed
Simulated
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015


Hydrograph: MW−OU1−11−SVA
Management Area: Ord_Airport
Layer 3
RMSE = 12.9 ft
Average Residual = −12.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

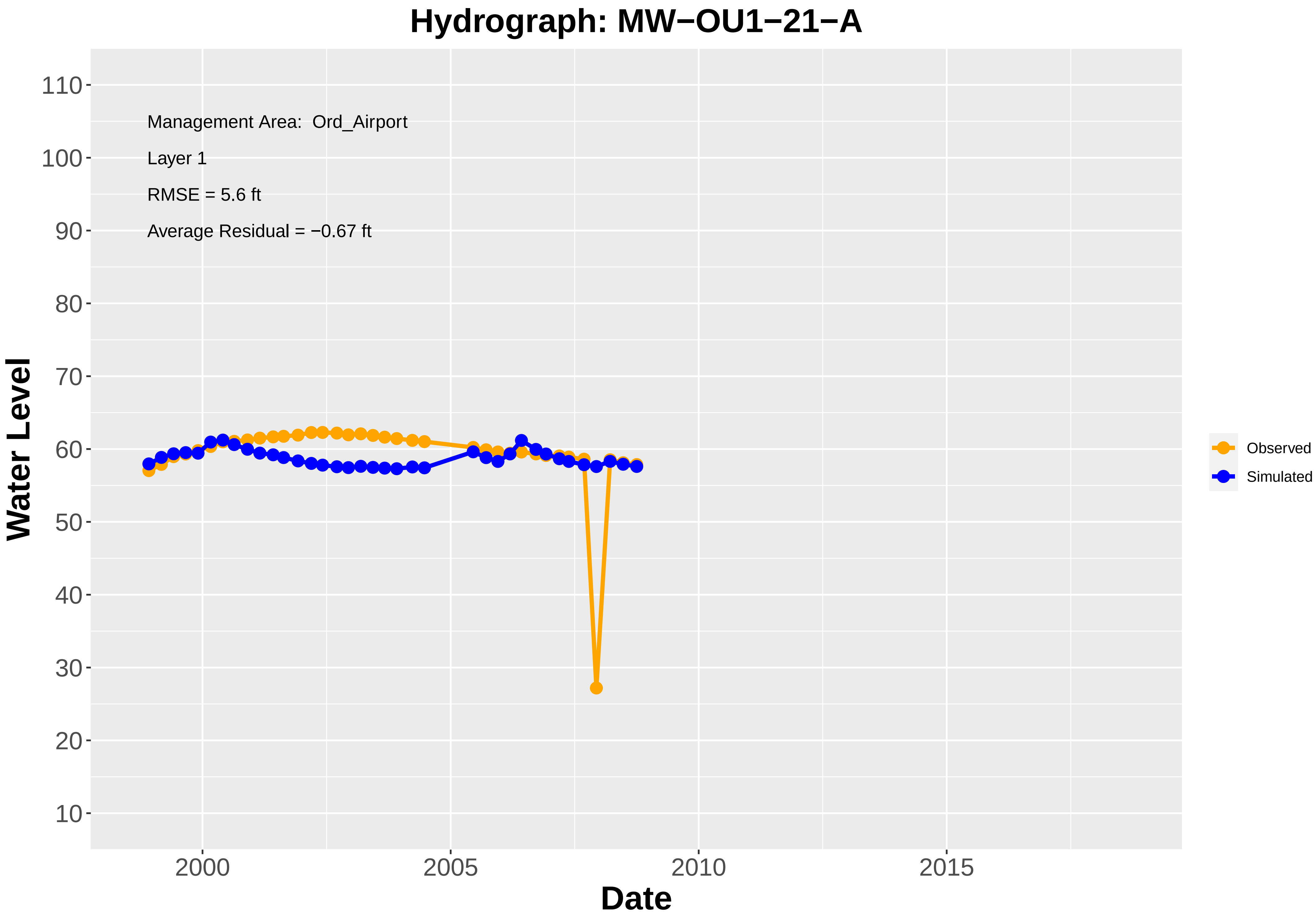

Hydrograph: MW−OU1−12−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.0 ft
Average Residual = −4.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

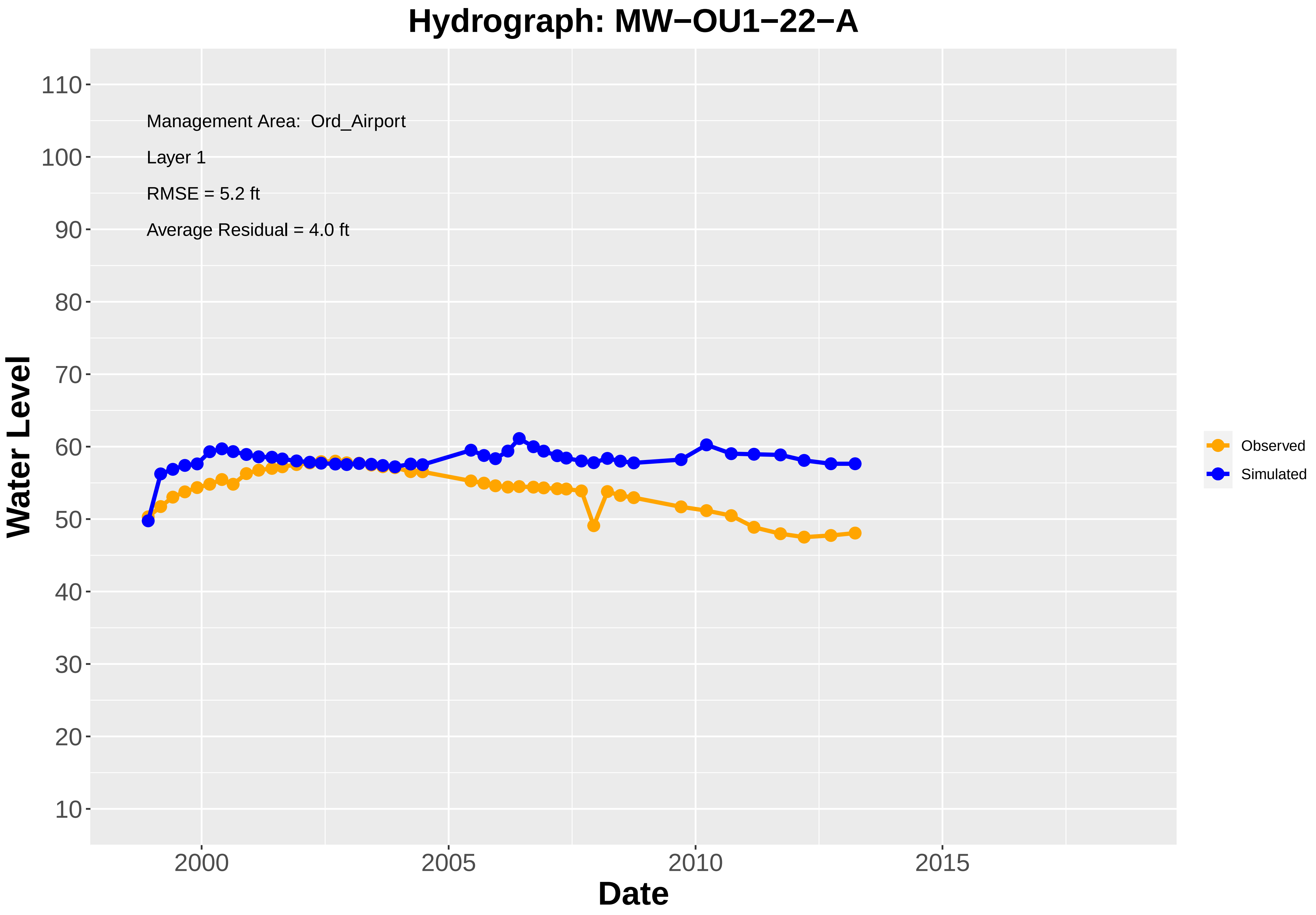


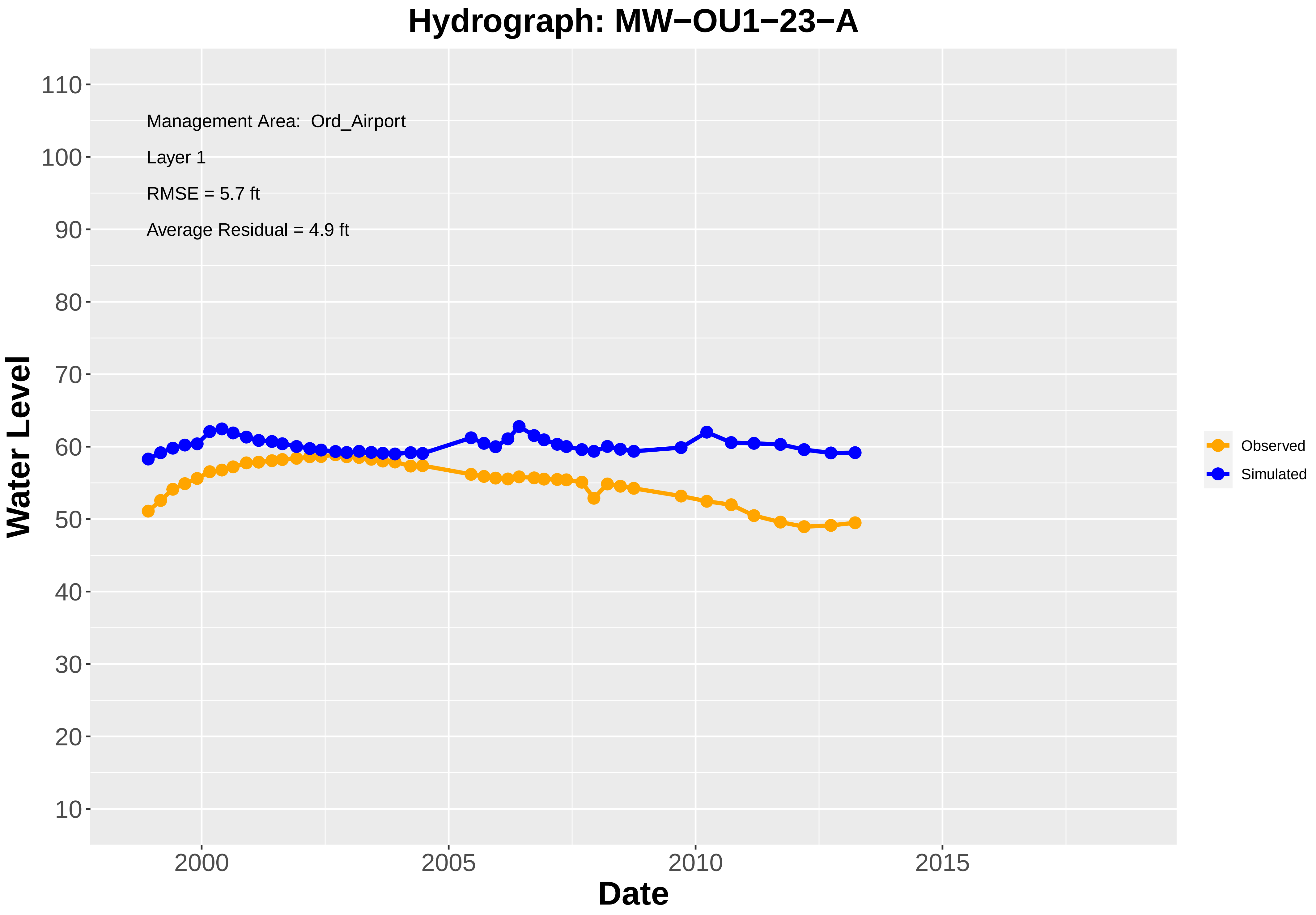
Hydrograph: MW−OU1−19−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.4 ft
Average Residual = 3.2 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



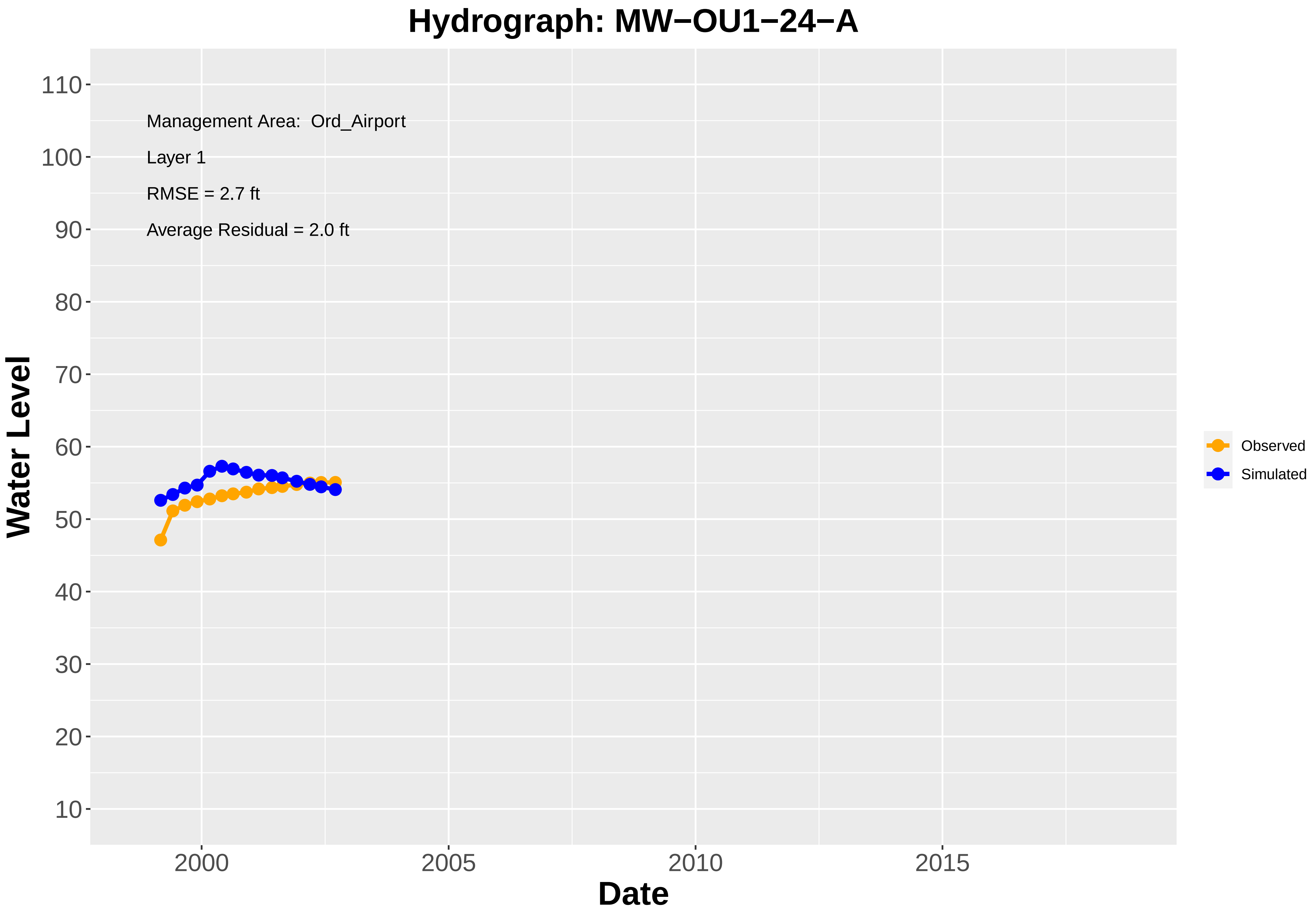
Hydrograph: MW−OU1−20−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.9 ft
Average Residual = 0.33 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

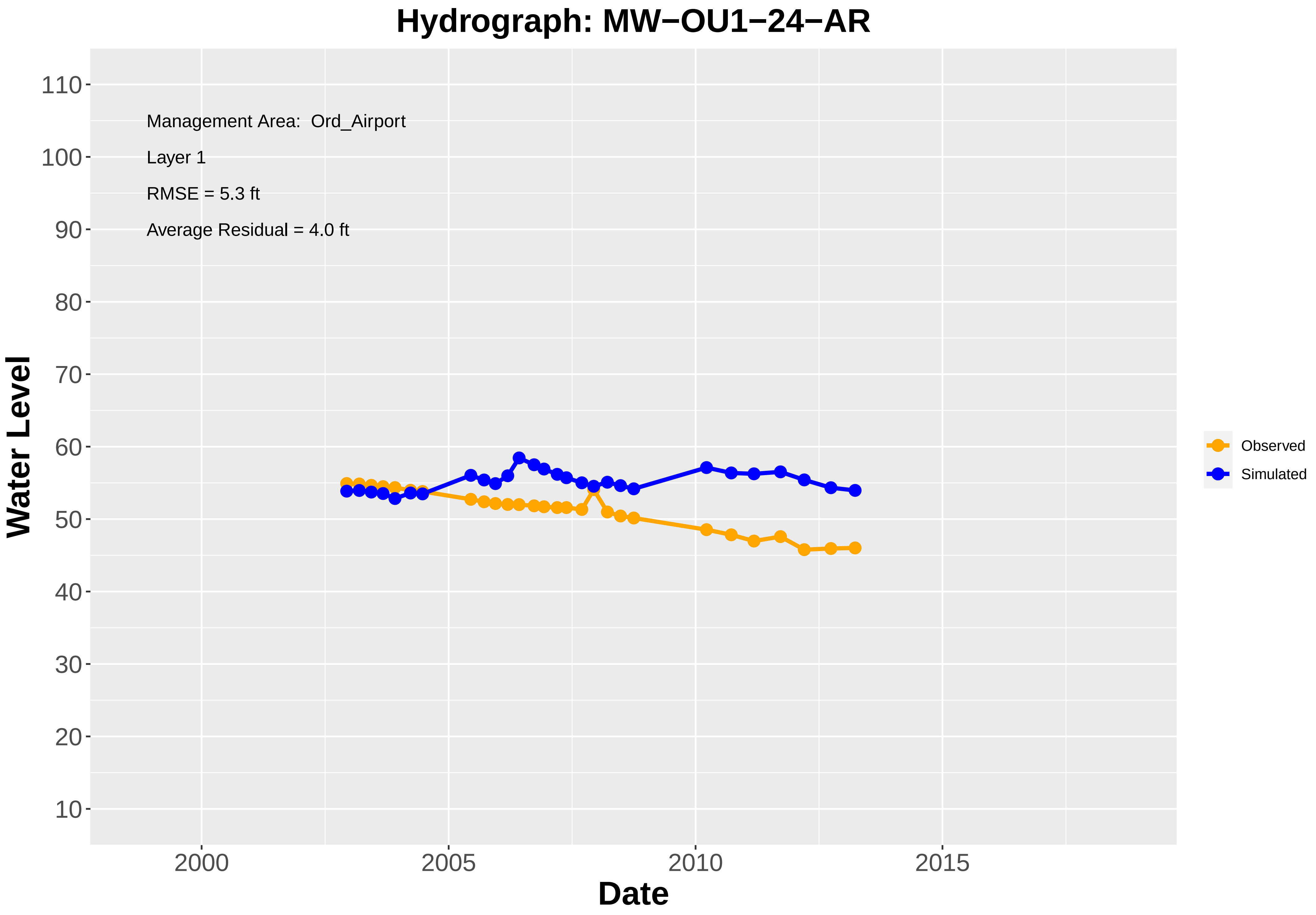

Hydrograph: MW−OU1−21−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.6 ft
Average Residual = −0.67 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−22−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.2 ft
Average Residual = 4.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

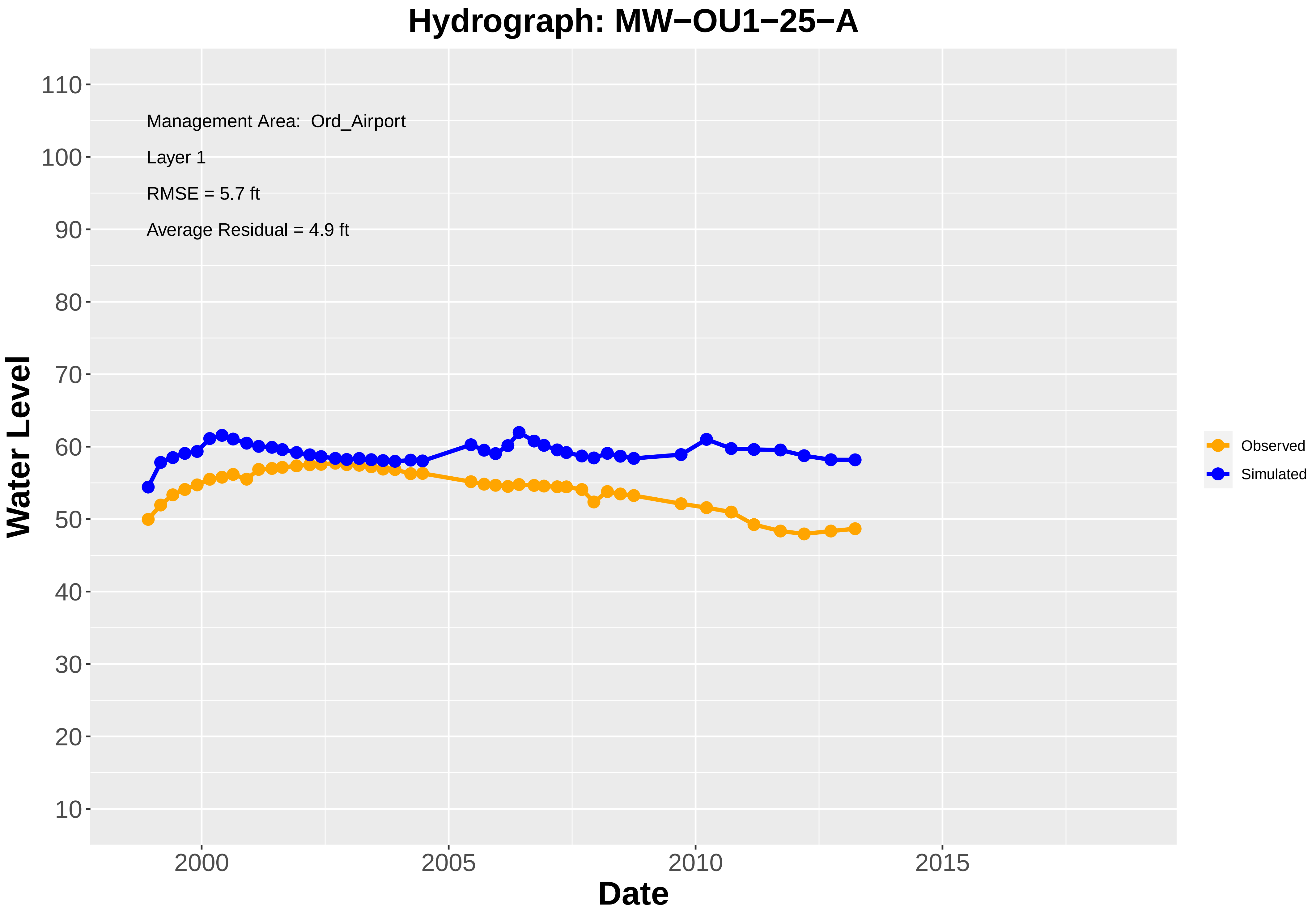


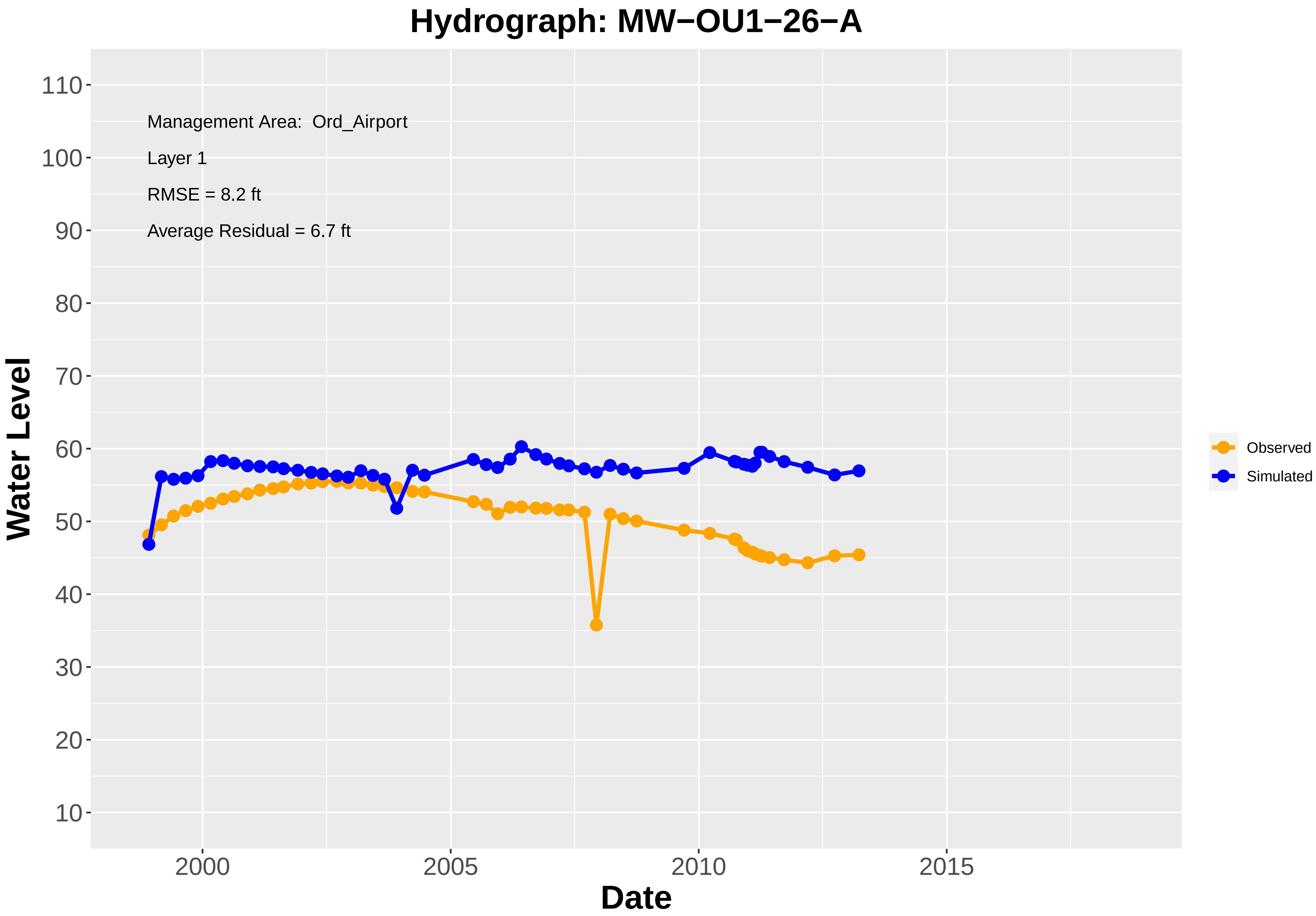
Hydrograph: MW−OU1−23−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.7 ft
Average Residual = 4.9 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−24−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.7 ft
Average Residual = 2.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

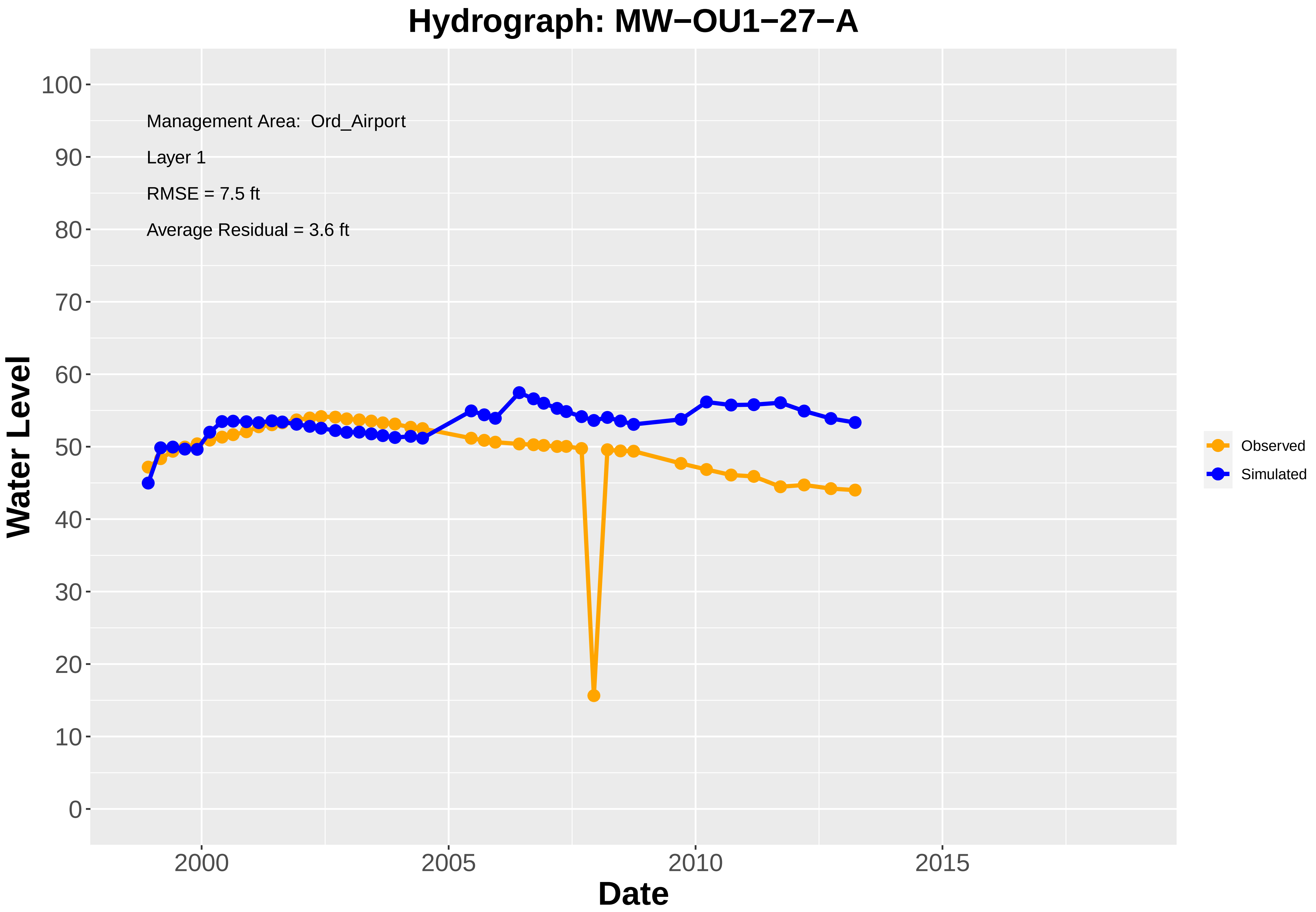


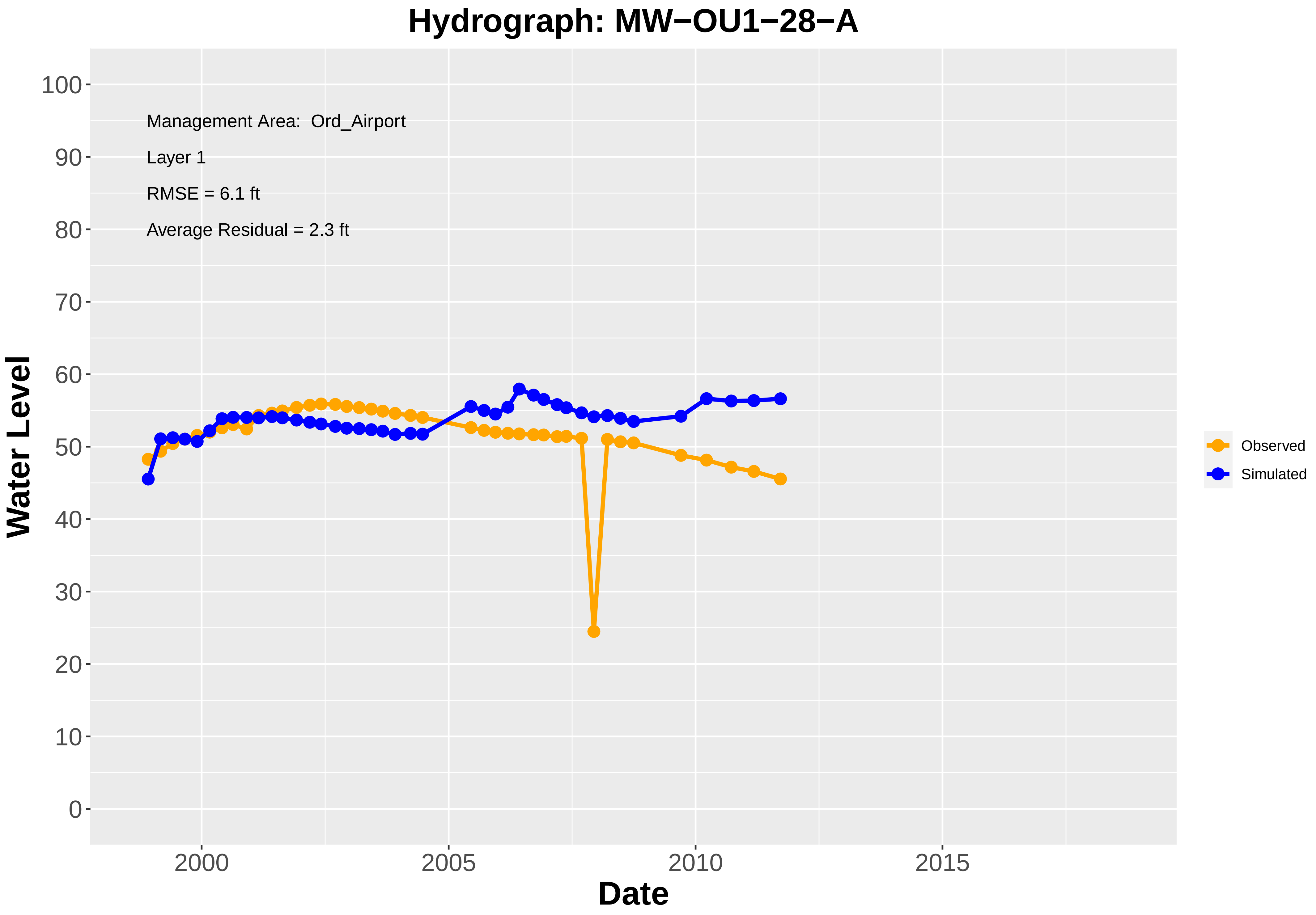
Hydrograph: MW−OU1−24−AR
Management Area: Ord_Airport
Layer 1
RMSE = 5.3 ft
Average Residual = 4.0 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

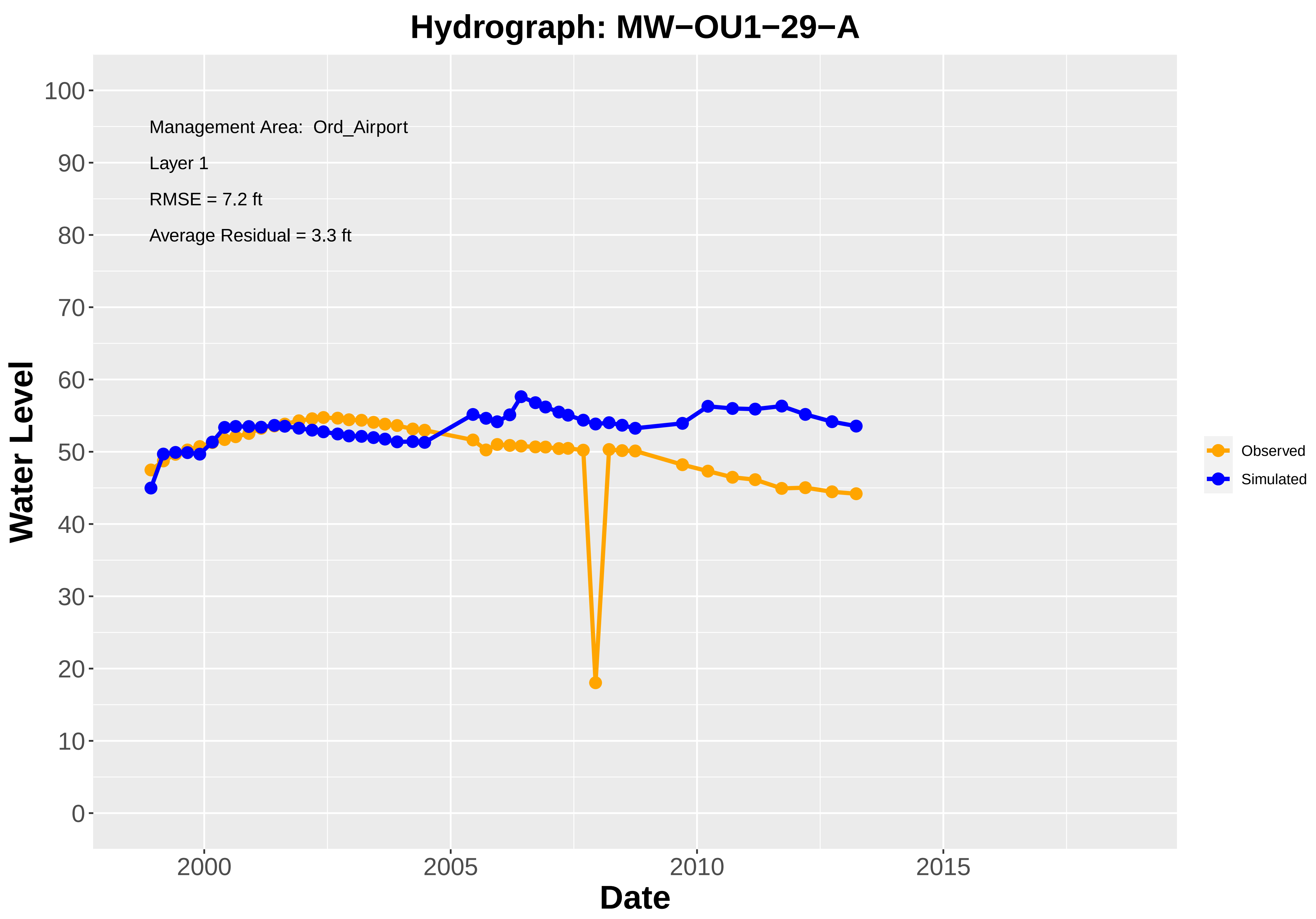

Hydrograph: MW−OU1−25−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.7 ft
Average Residual = 4.9 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

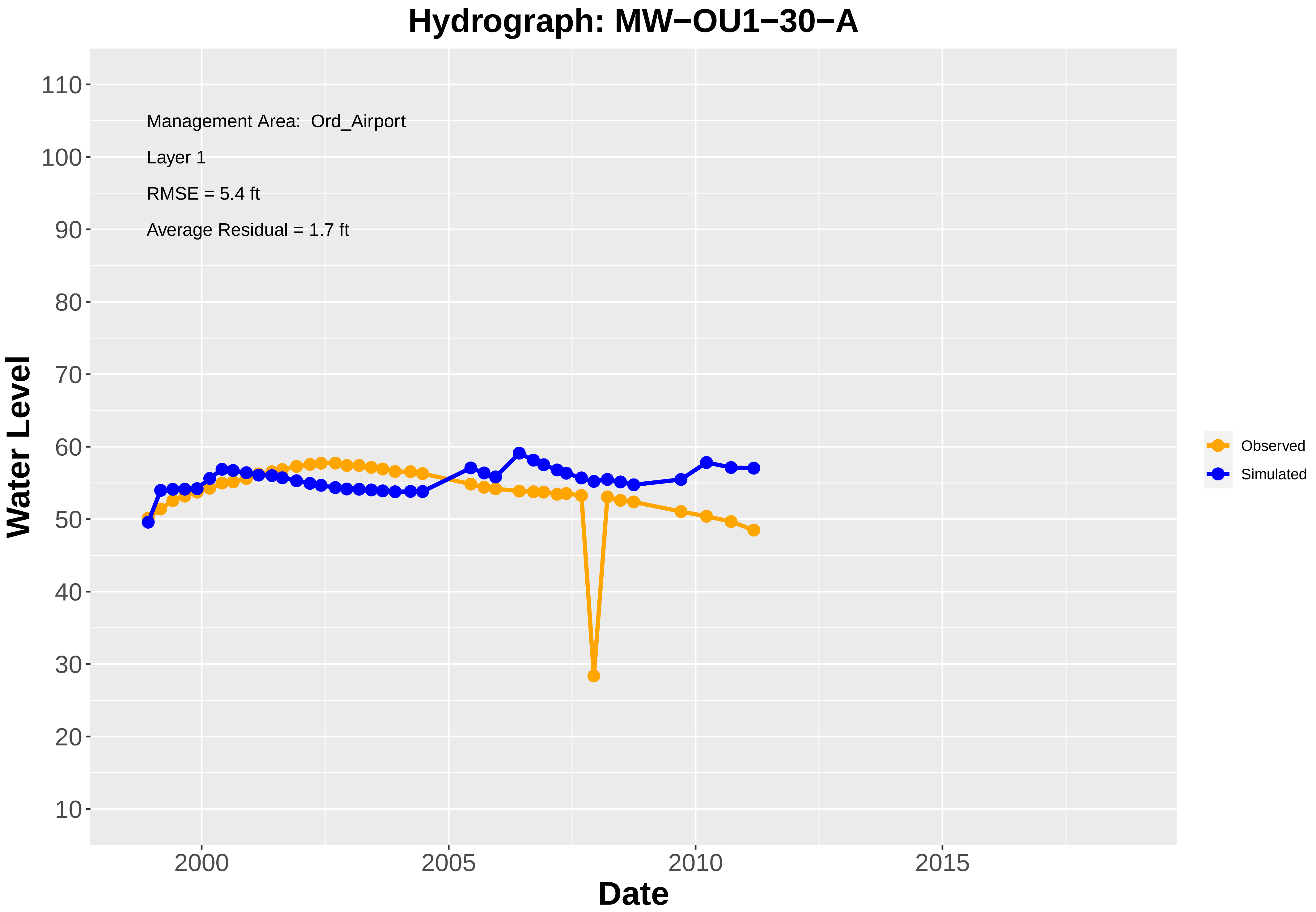


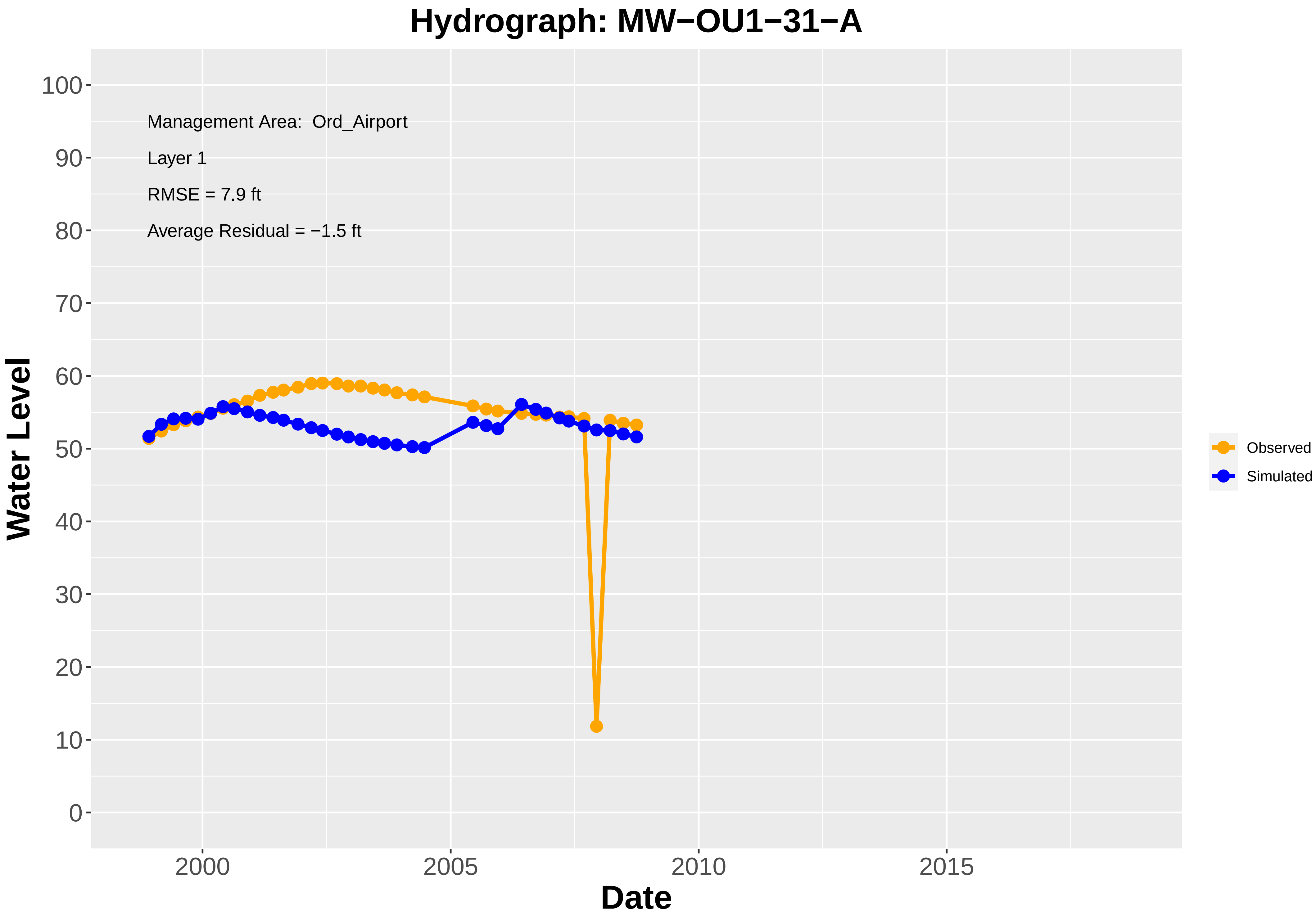
Hydrograph: MW−OU1−26−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.2 ft
Average Residual = 6.7 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−27−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.5 ft
Average Residual = 3.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

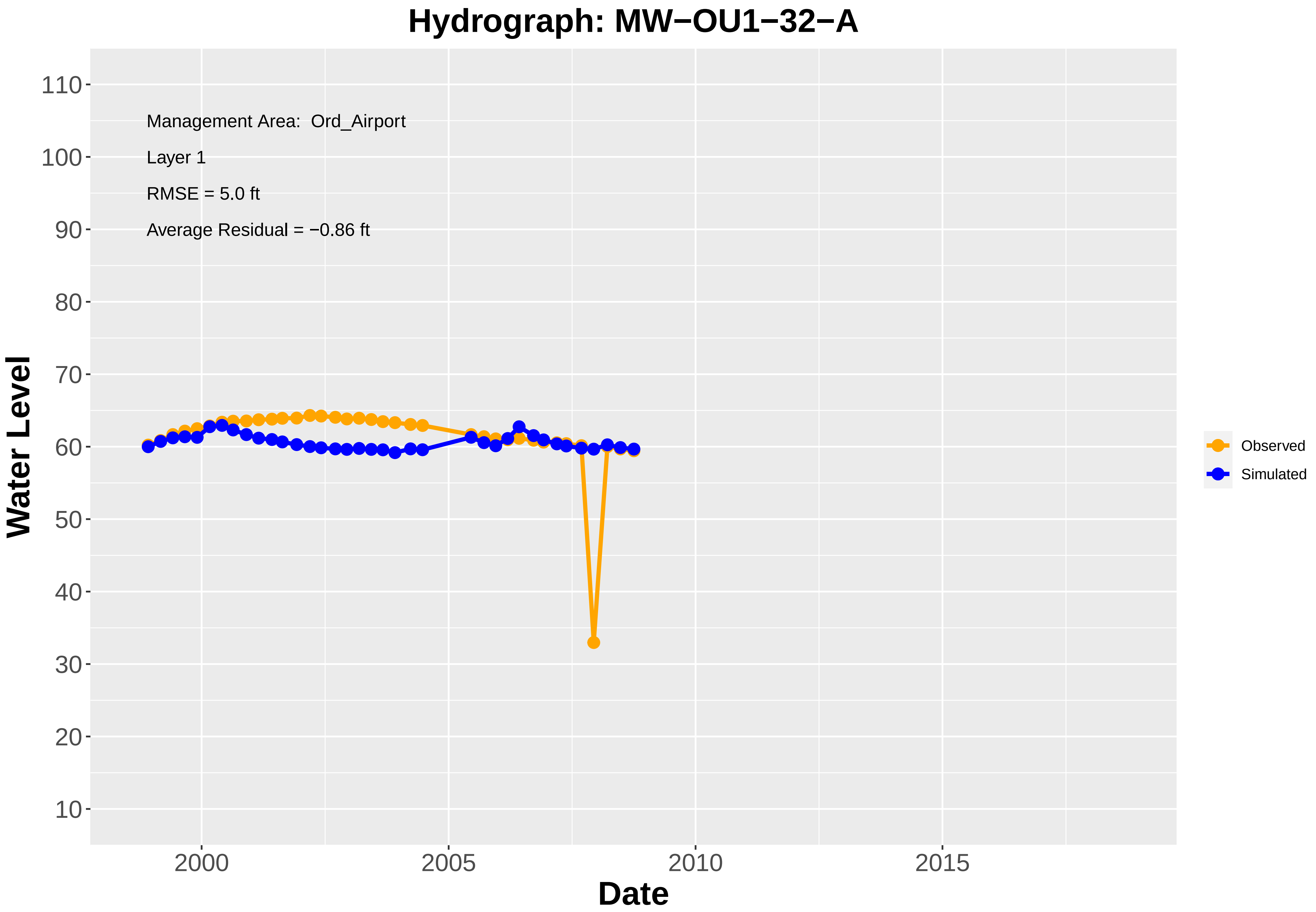

Hydrograph: MW−OU1−28−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.1 ft
Average Residual = 2.3 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−29−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.2 ft
Average Residual = 3.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

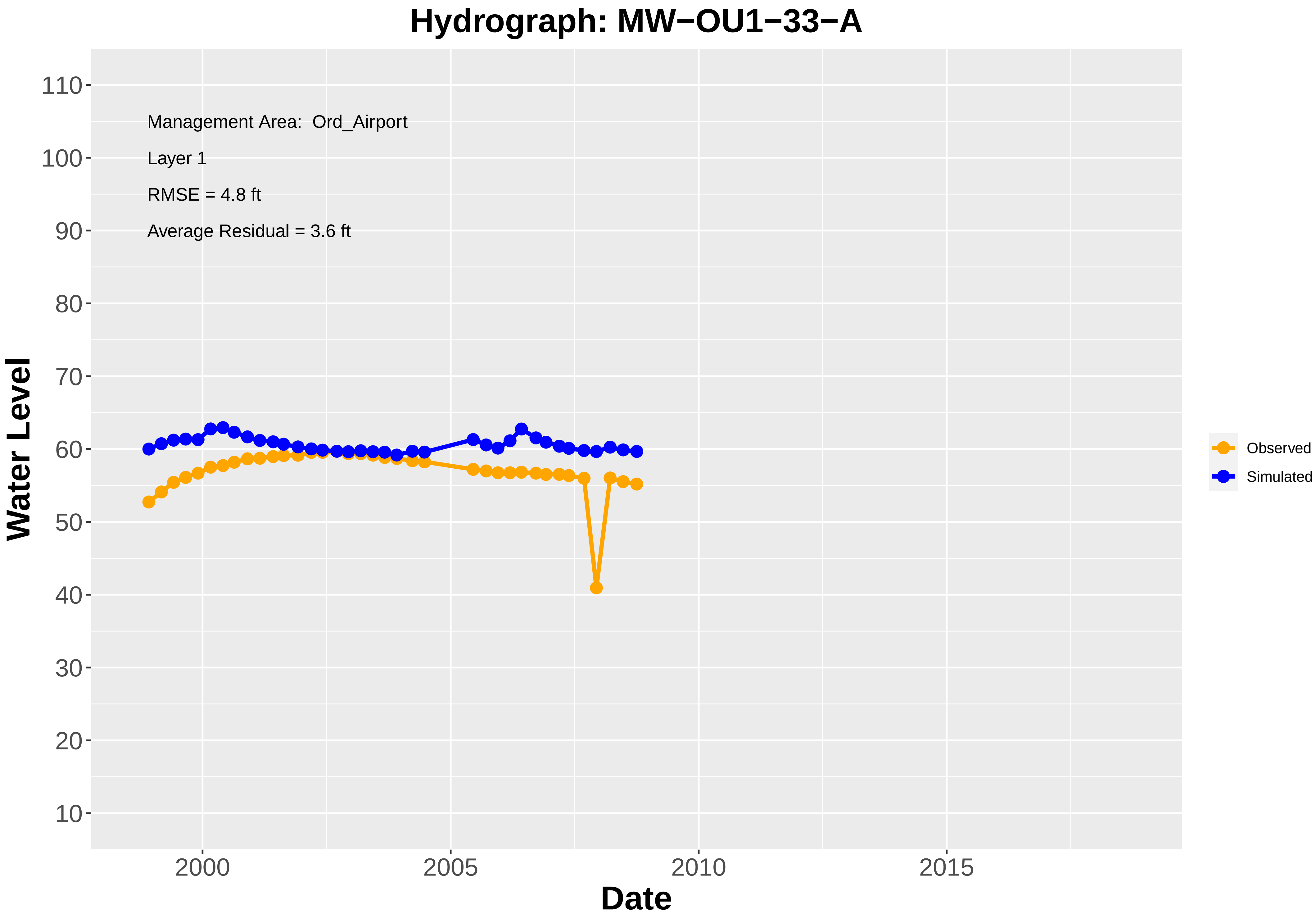

Hydrograph: MW−OU1−30−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.4 ft
Average Residual = 1.7 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated



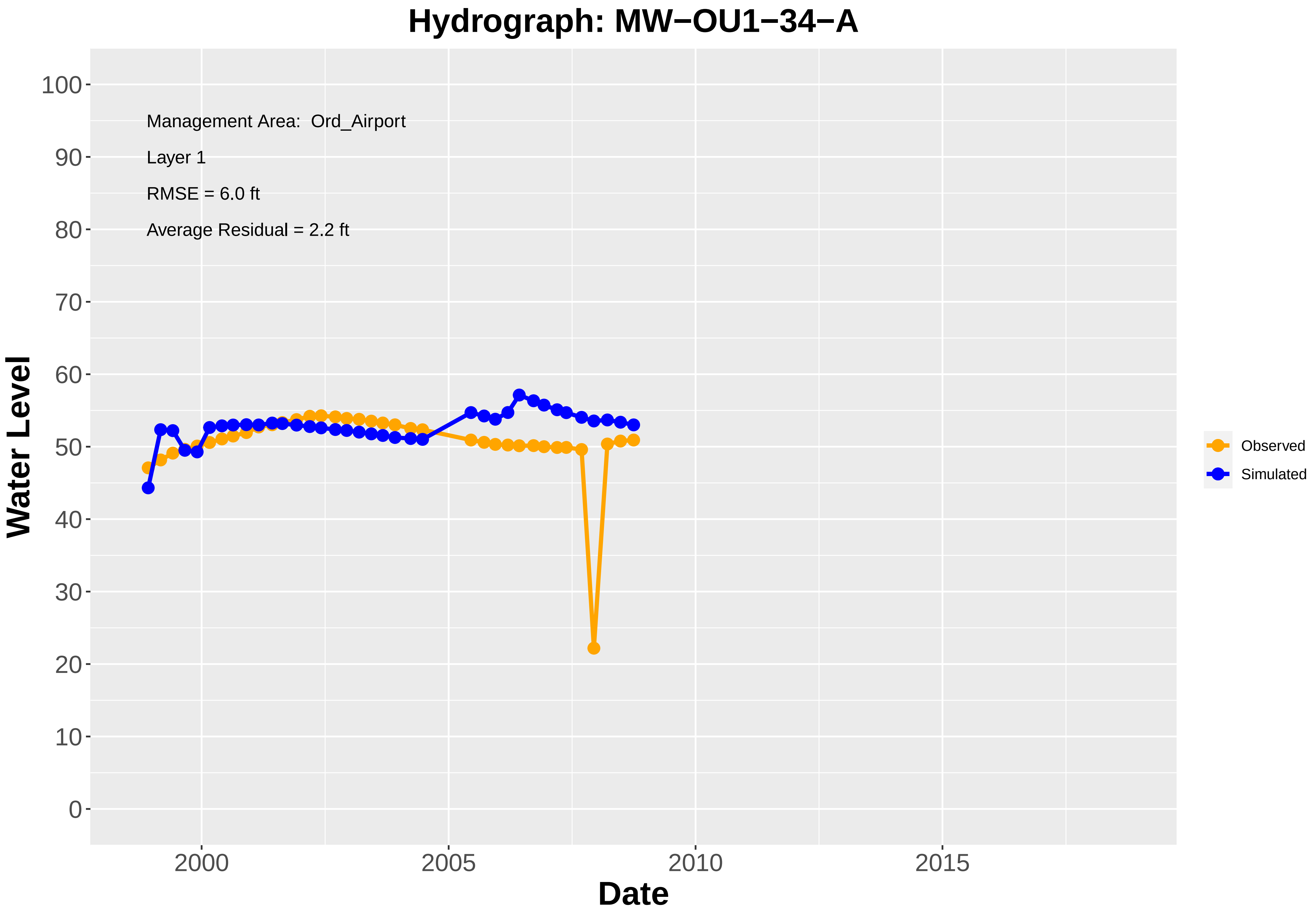
Hydrograph: MW−OU1−31−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.9 ft
Average Residual = −1.5 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



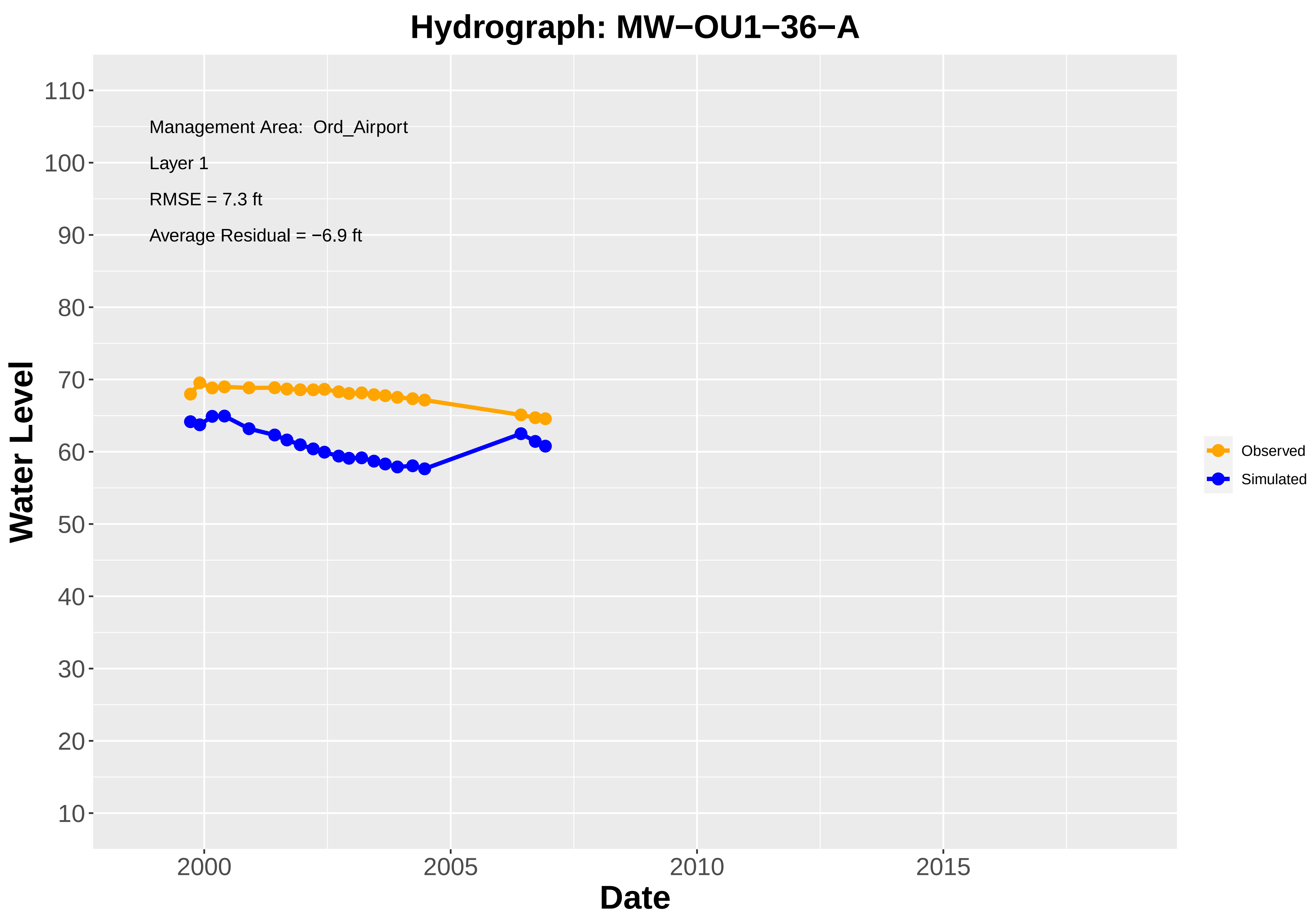
Hydrograph: MW−OU1−32−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.0 ft
Average Residual = −0.86 ft
110
100
90
80
70
60
50
40
30
20
10
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

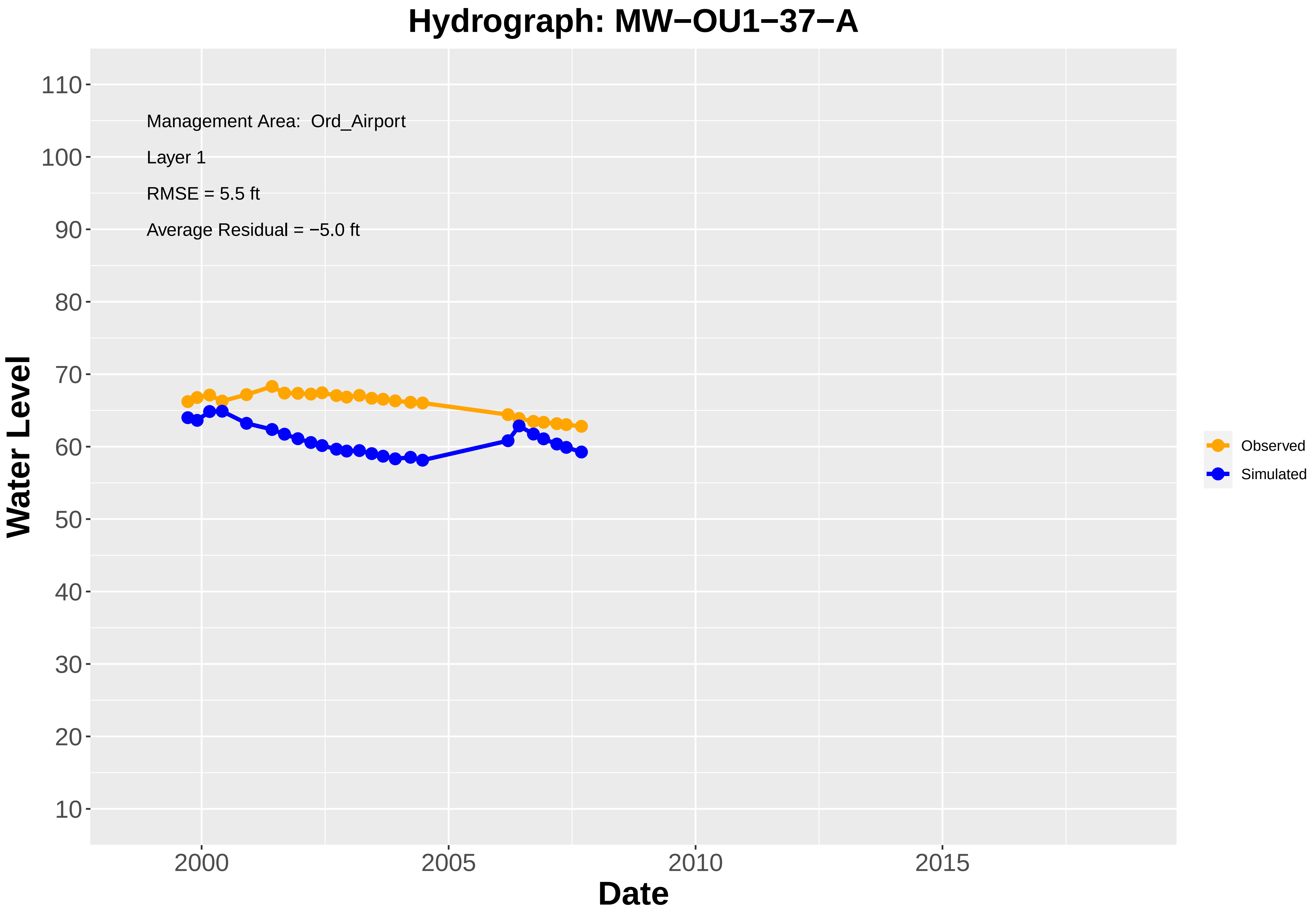


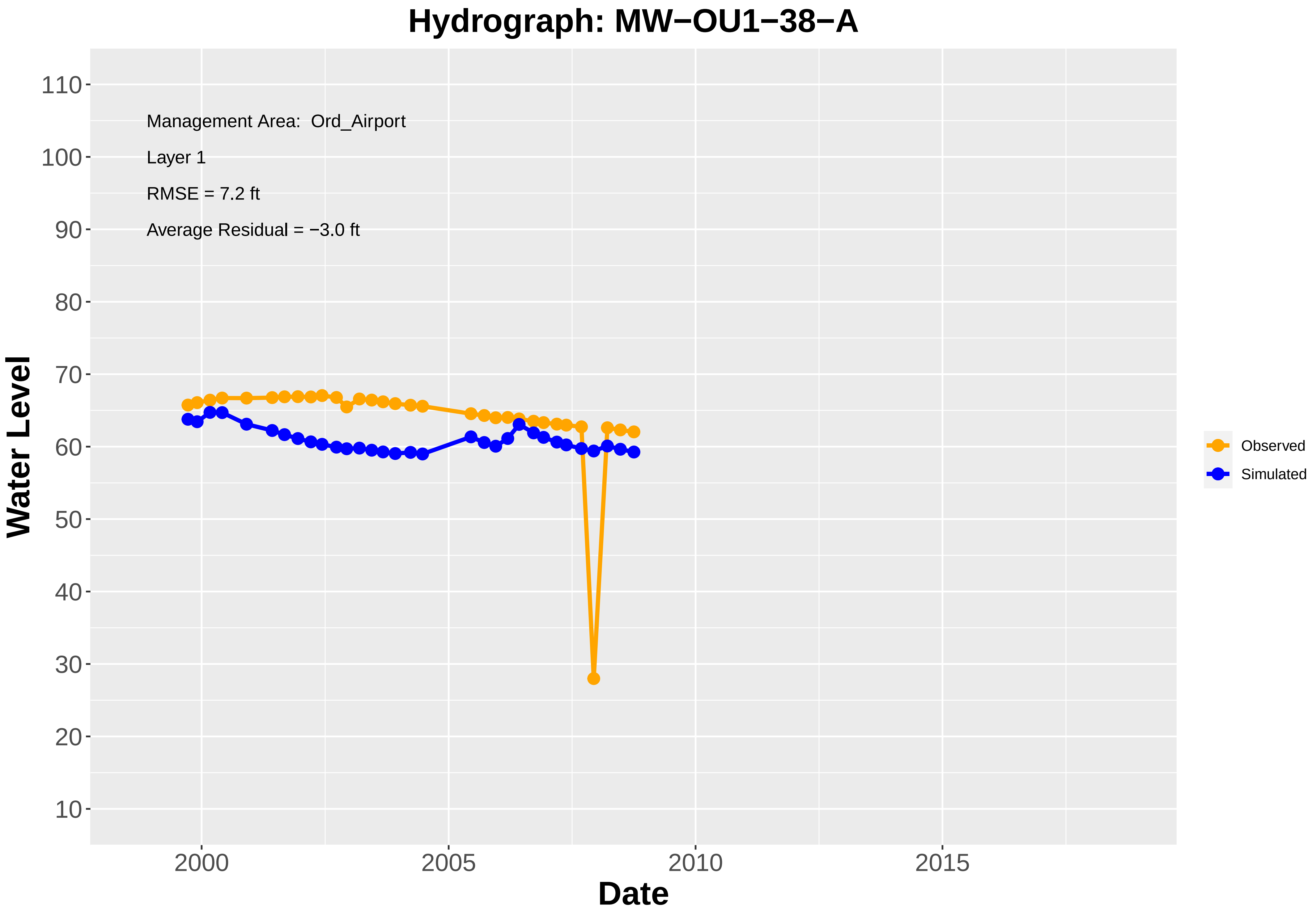
Hydrograph: MW−OU1−33−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.8 ft
Average Residual = 3.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

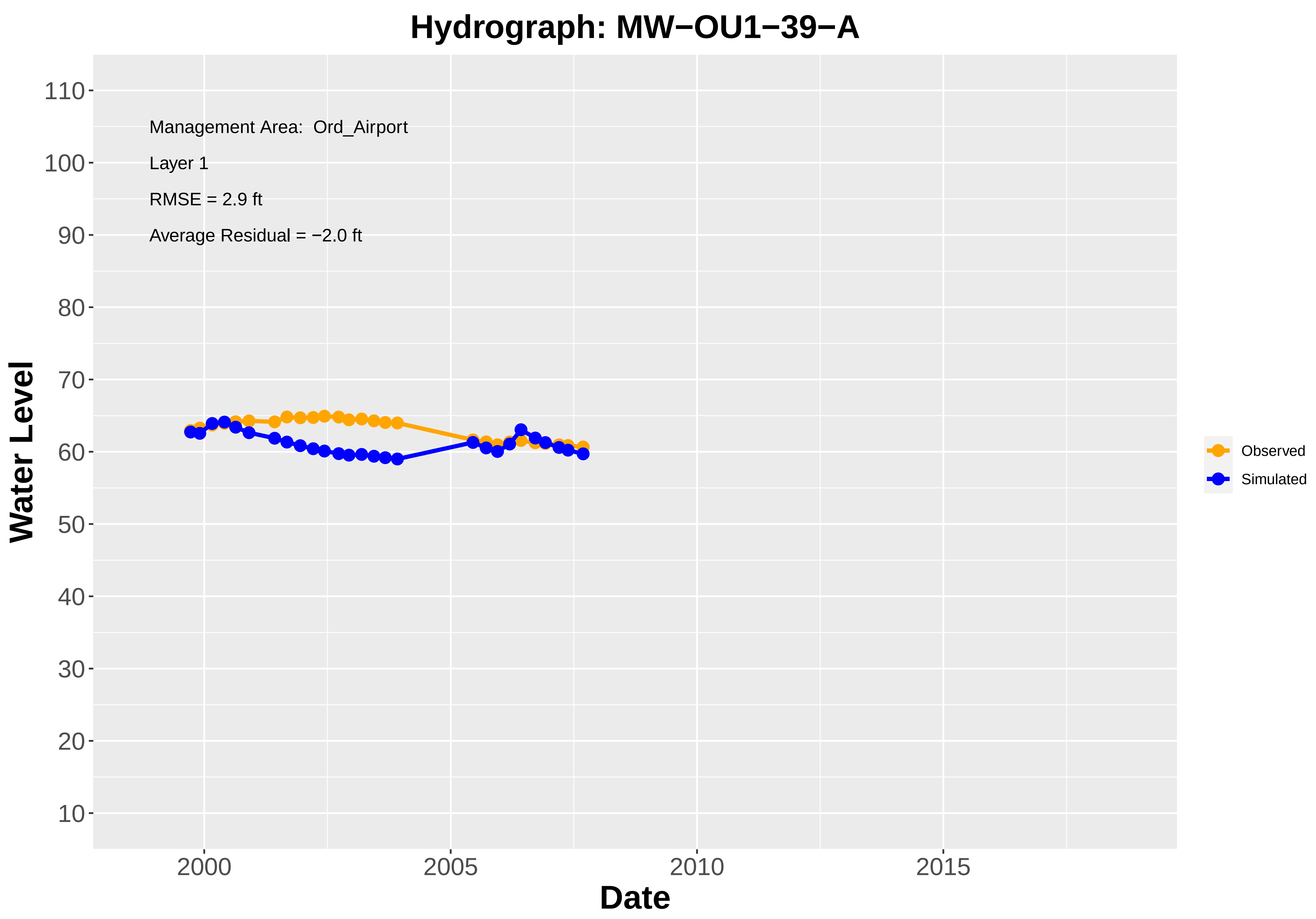


Hydrograph: MW−OU1−34−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.0 ft
Average Residual = 2.2 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

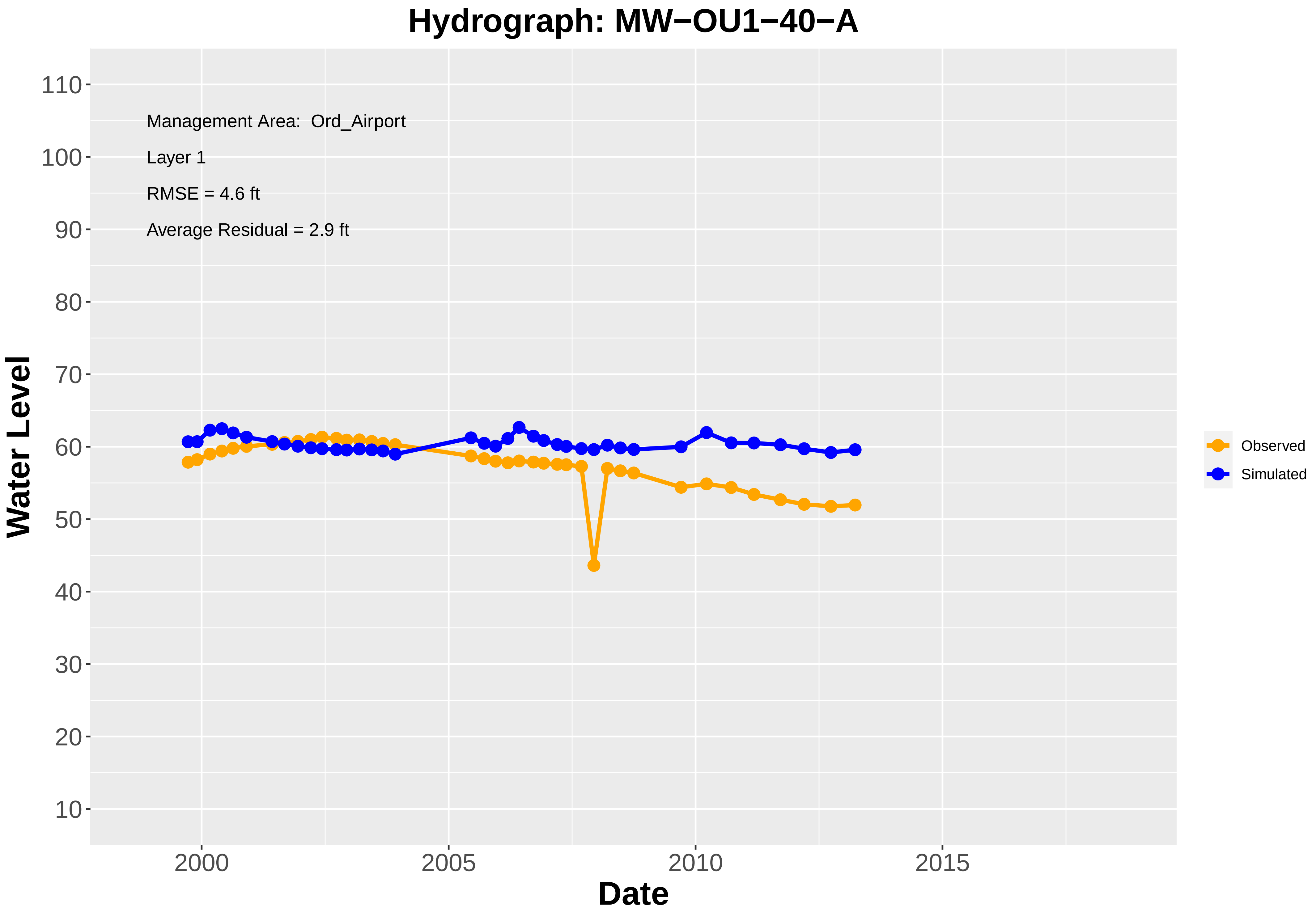

Hydrograph: MW−OU1−36−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.3 ft
Average Residual = −6.9 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−37−A
Management Area: Ord_Airport
Layer 1
RMSE = 5.5 ft
Average Residual = −5.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

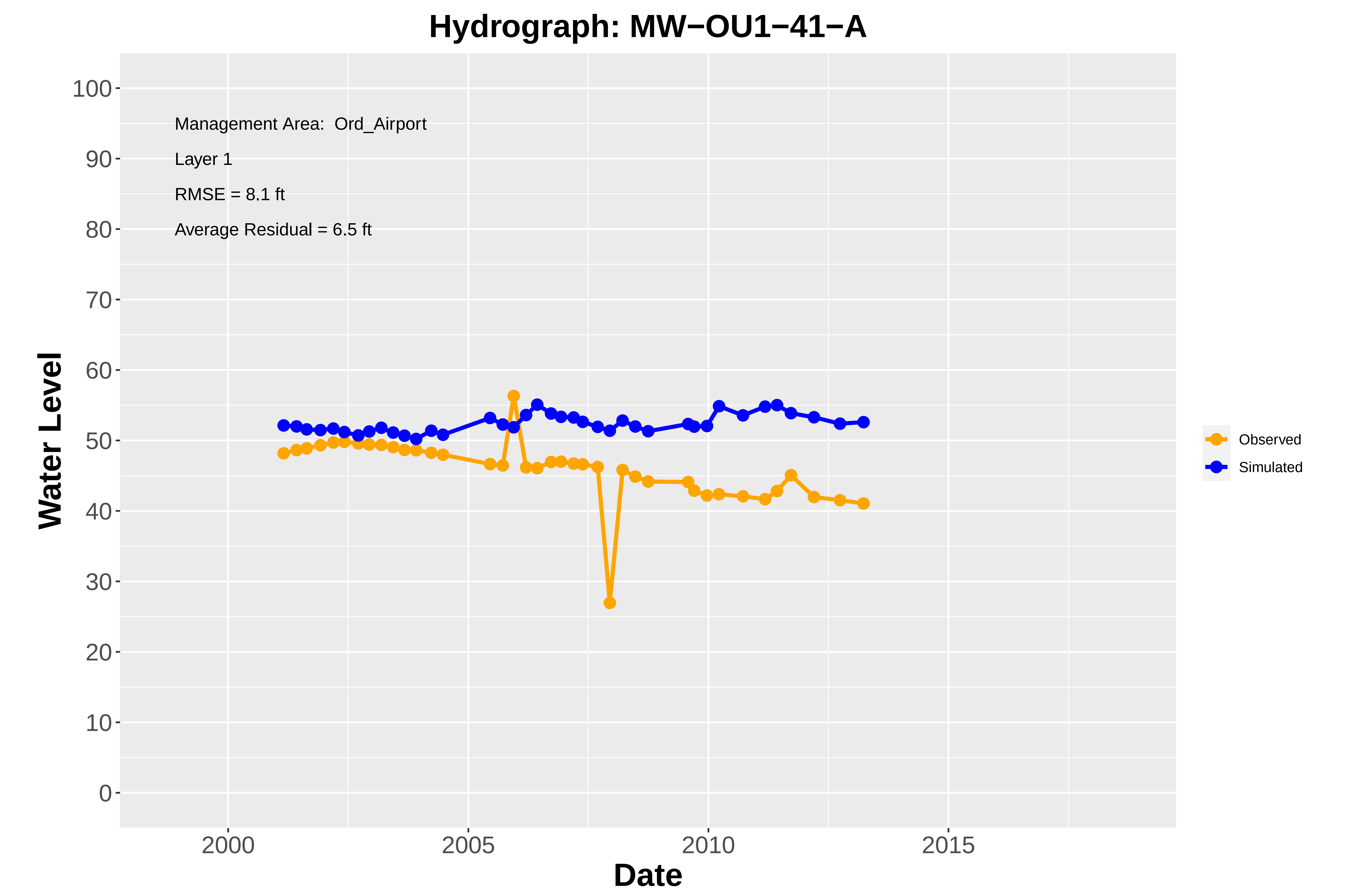

Hydrograph: MW−OU1−38−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.2 ft
Average Residual = −3.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

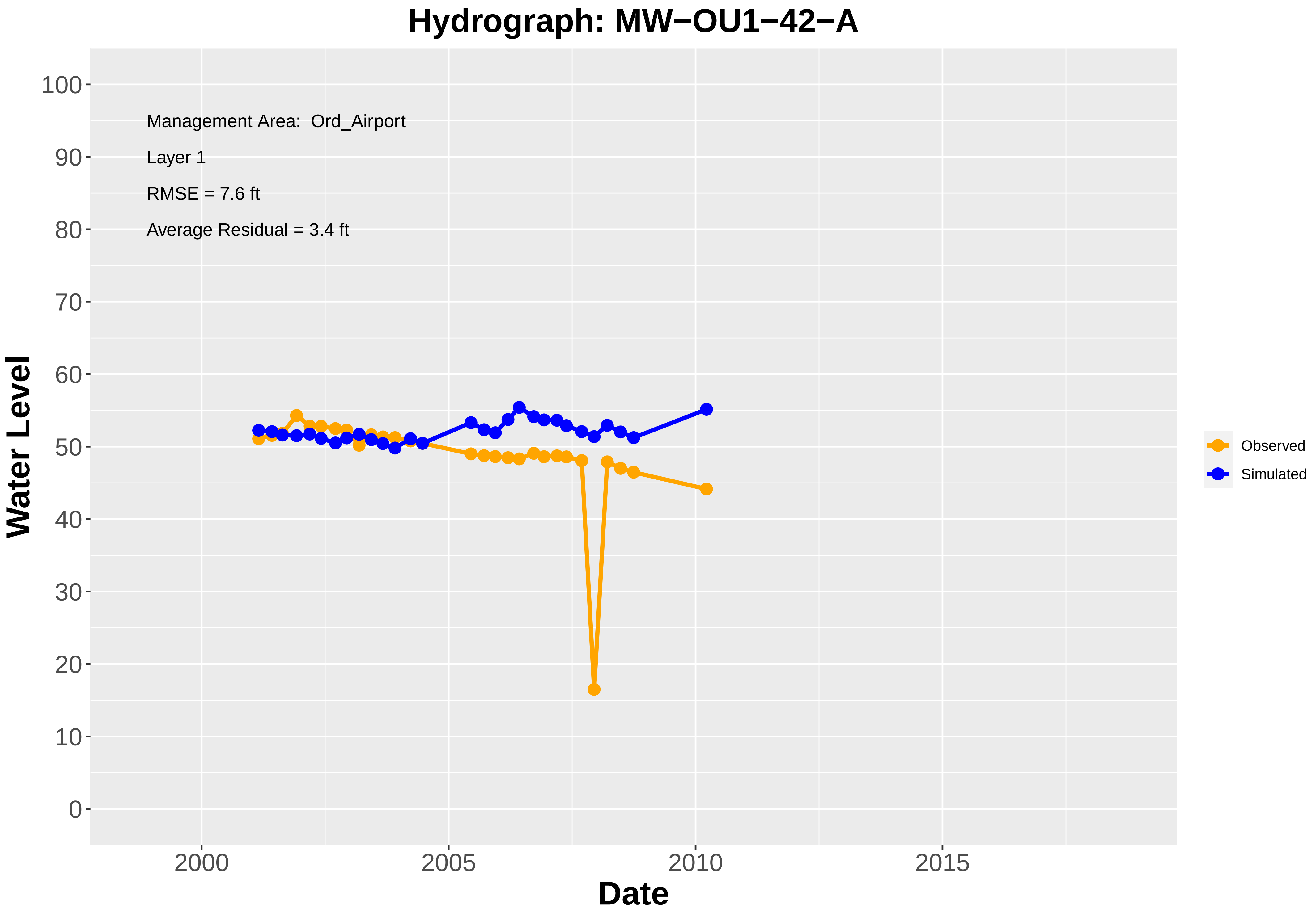


Hydrograph: MW−OU1−39−A
Management Area: Ord_Airport
Layer 1
RMSE = 2.9 ft
Average Residual = −2.0 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

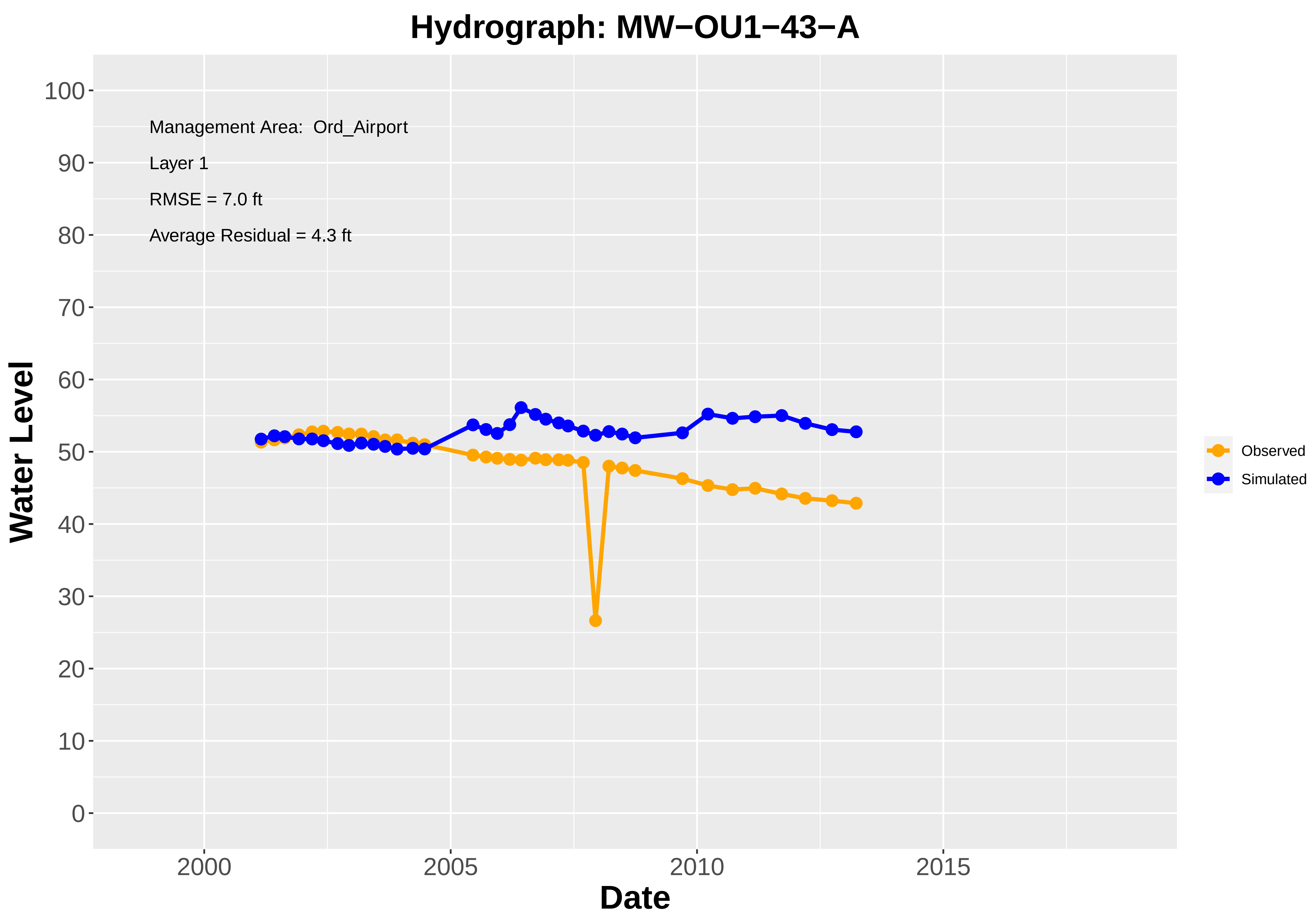


Hydrograph: MW−OU1−40−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.6 ft
Average Residual = 2.9 ft
110
100
90
80
70
60
50
40
30
20
10
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

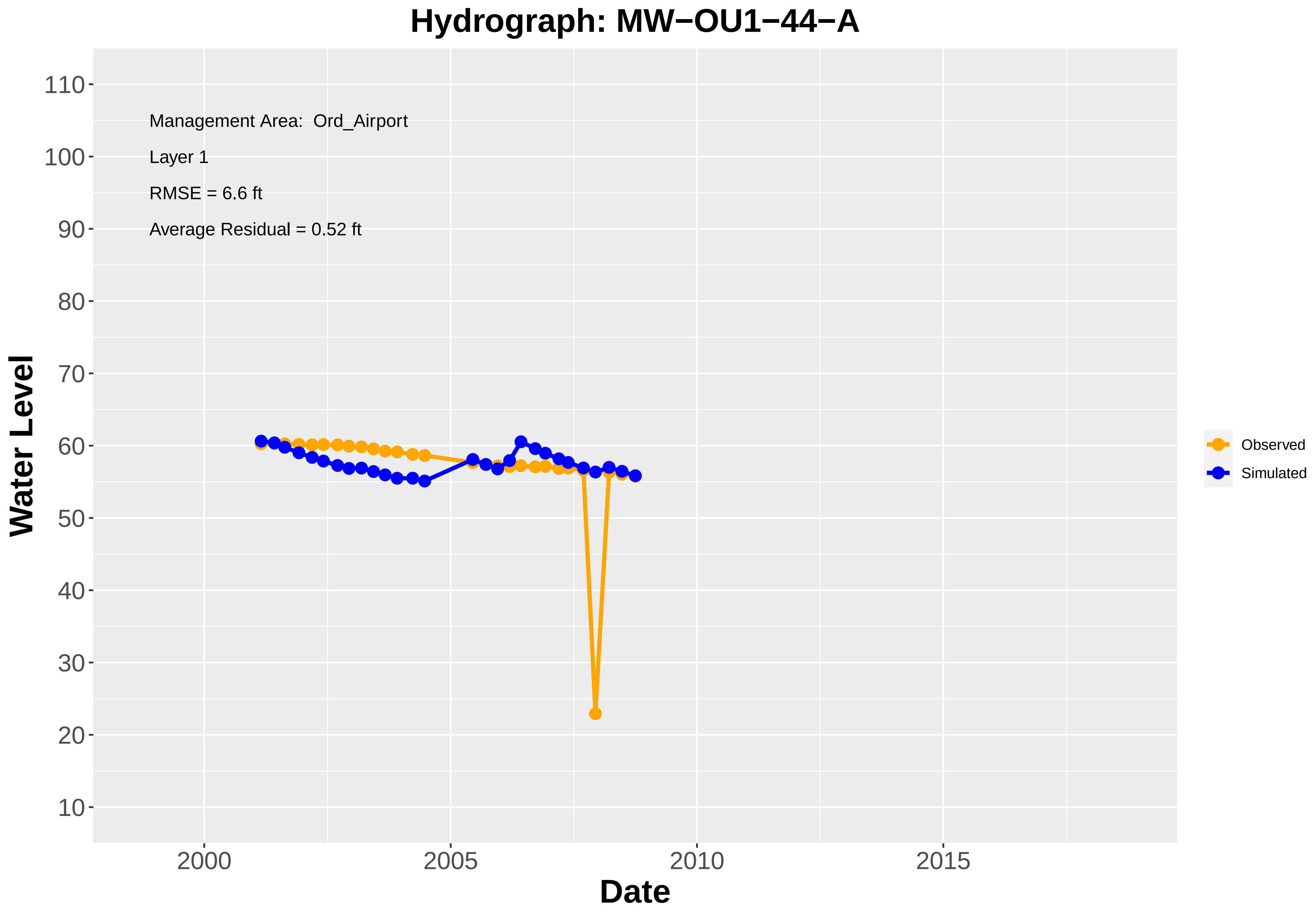

Hydrograph: MW−OU1−41−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.1 ft
Average Residual = 6.5 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated

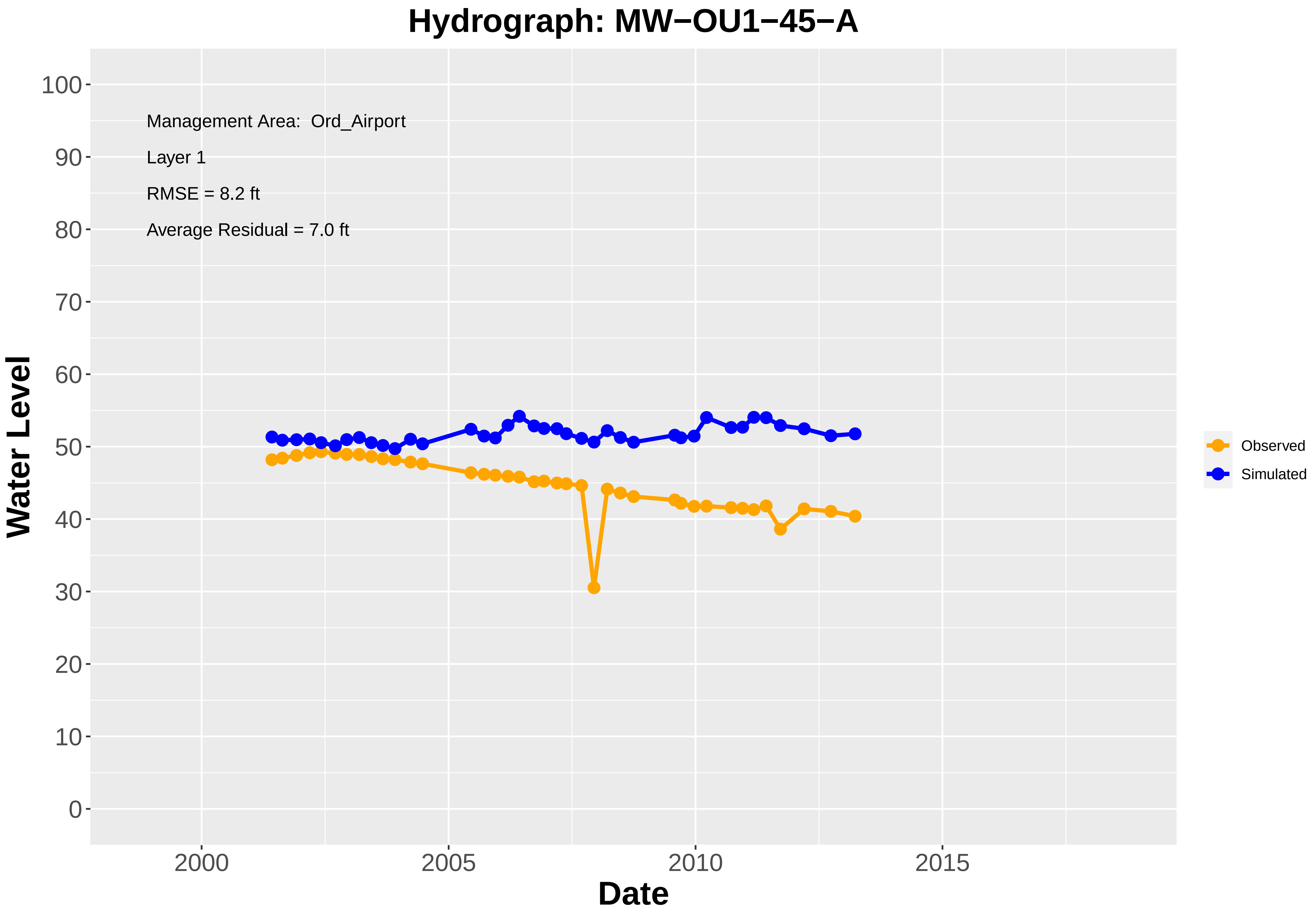


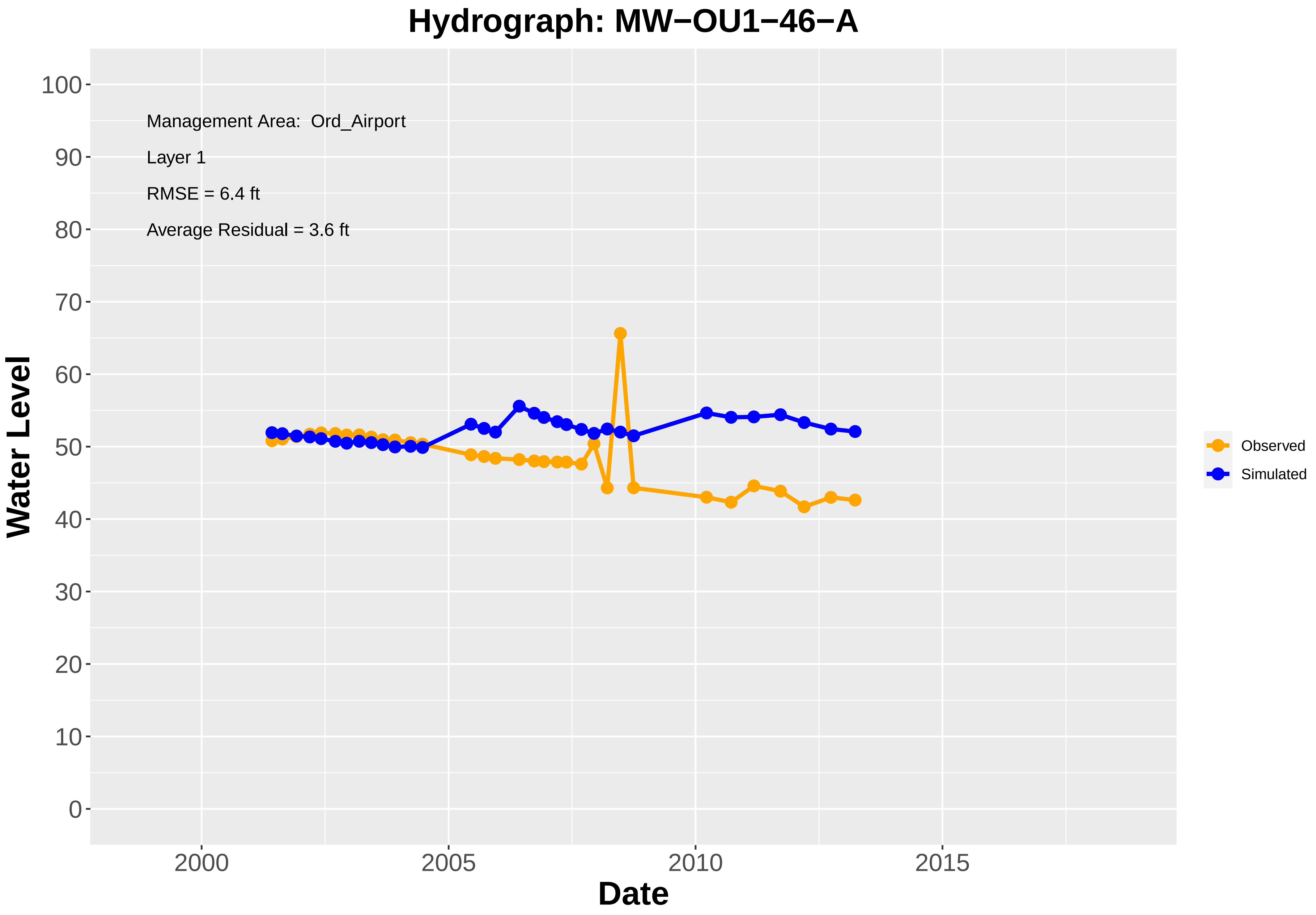
Hydrograph: MW−OU1−42−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.6 ft
Average Residual = 3.4 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



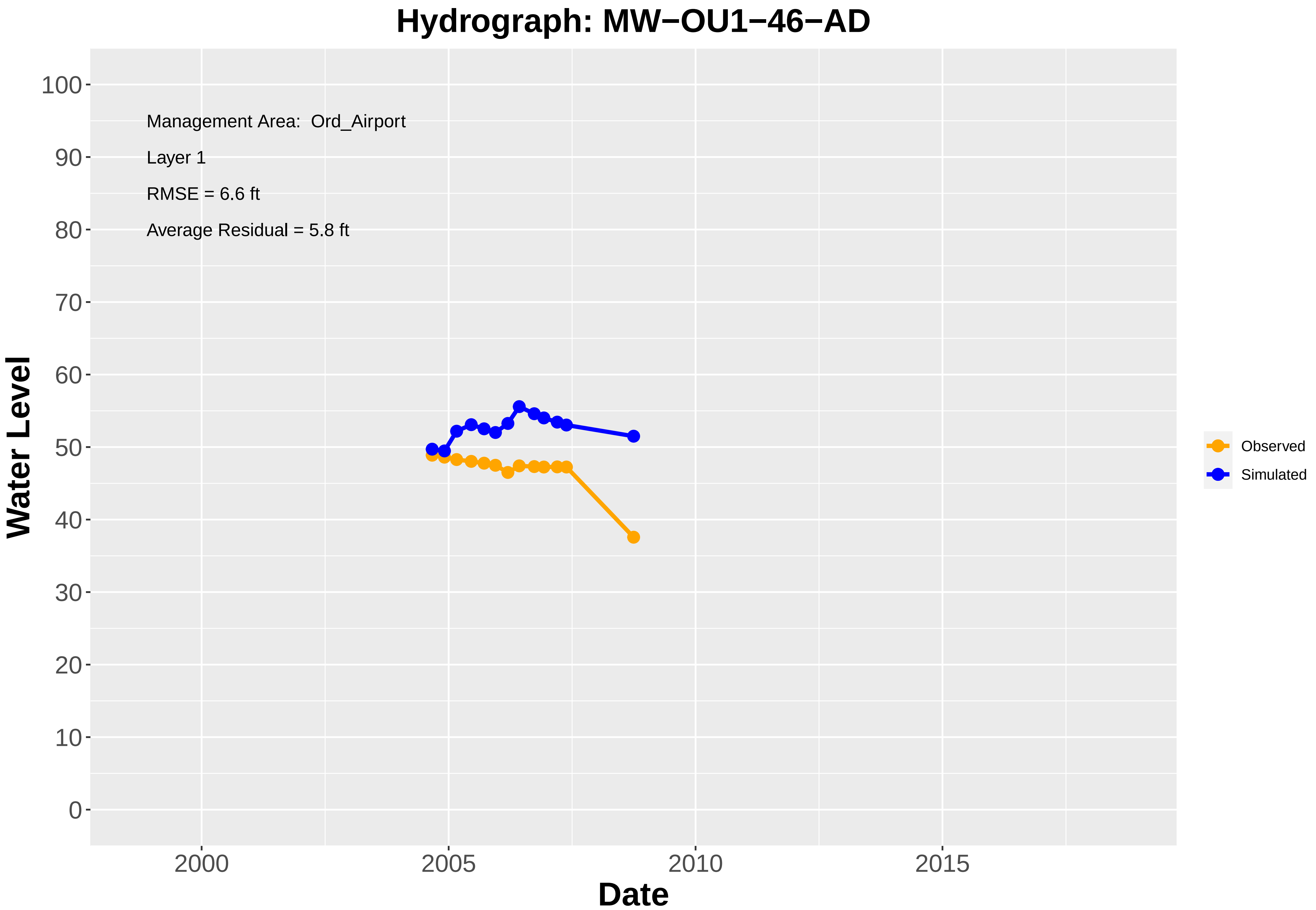
Hydrograph: MW−OU1−43−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.0 ft
Average Residual = 4.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−44−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.6 ft
Average Residual = 0.52 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

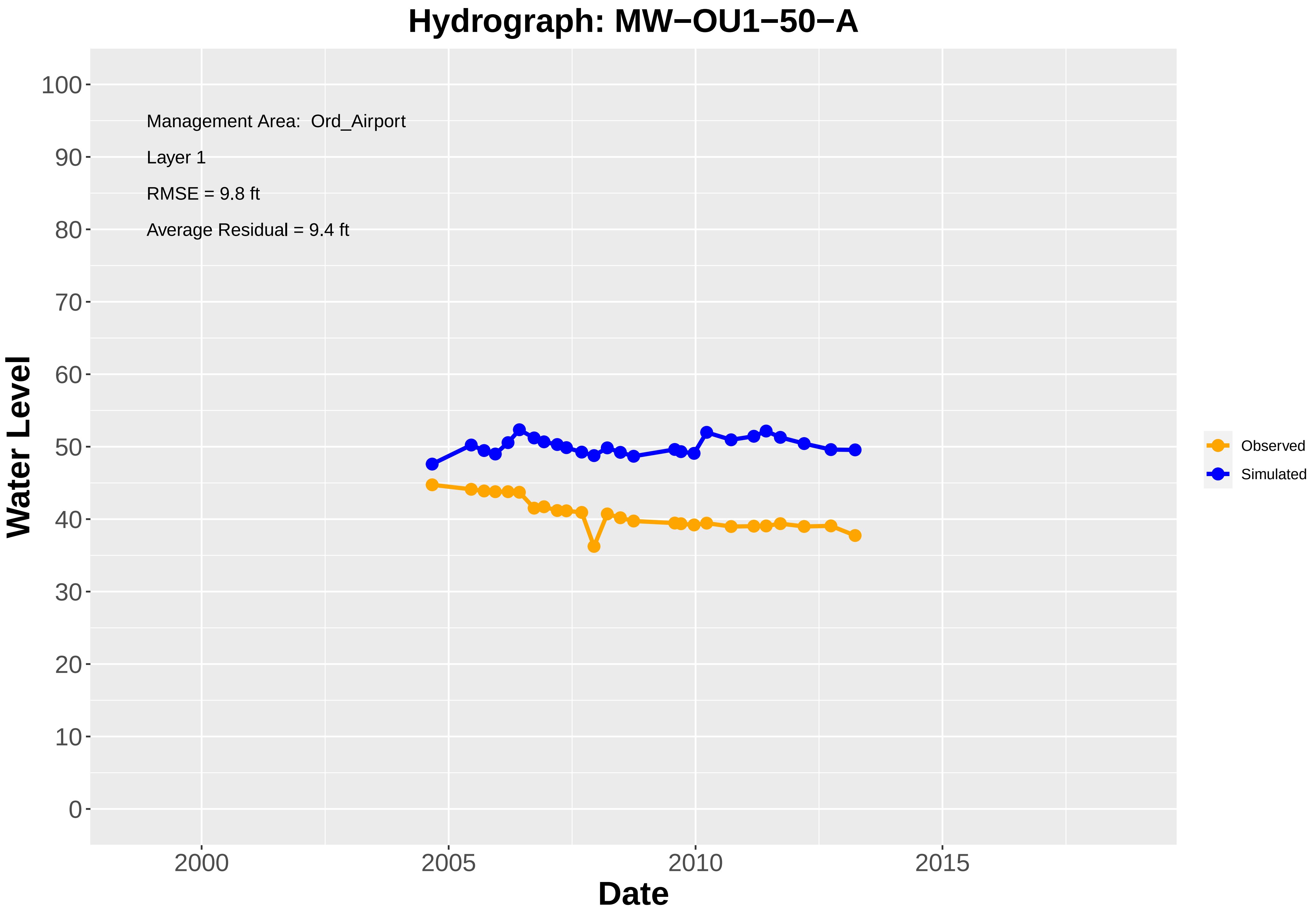

Hydrograph: MW−OU1−45−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.2 ft
Average Residual = 7.0 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



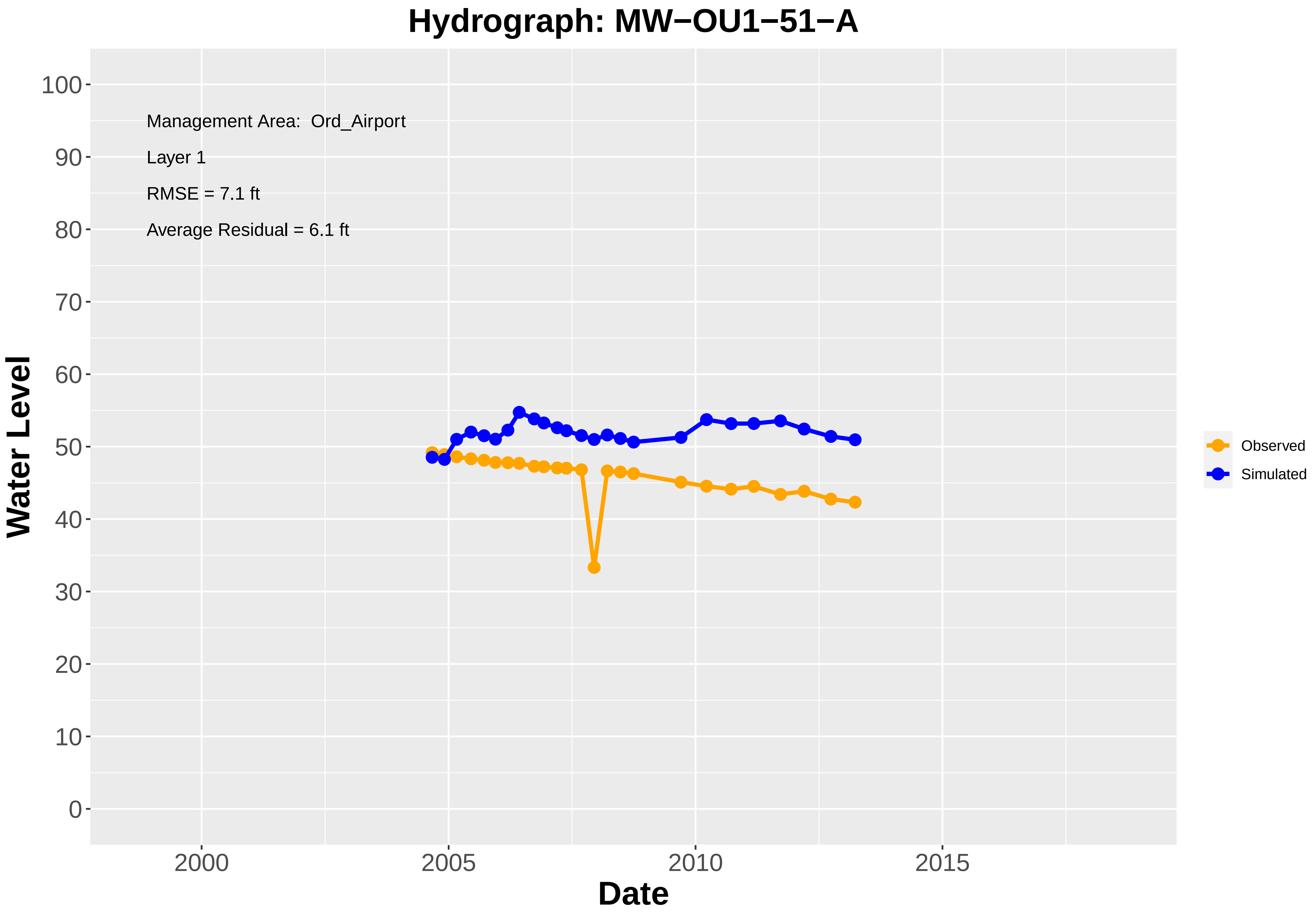
Hydrograph: MW−OU1−46−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.4 ft
Average Residual = 3.6 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated



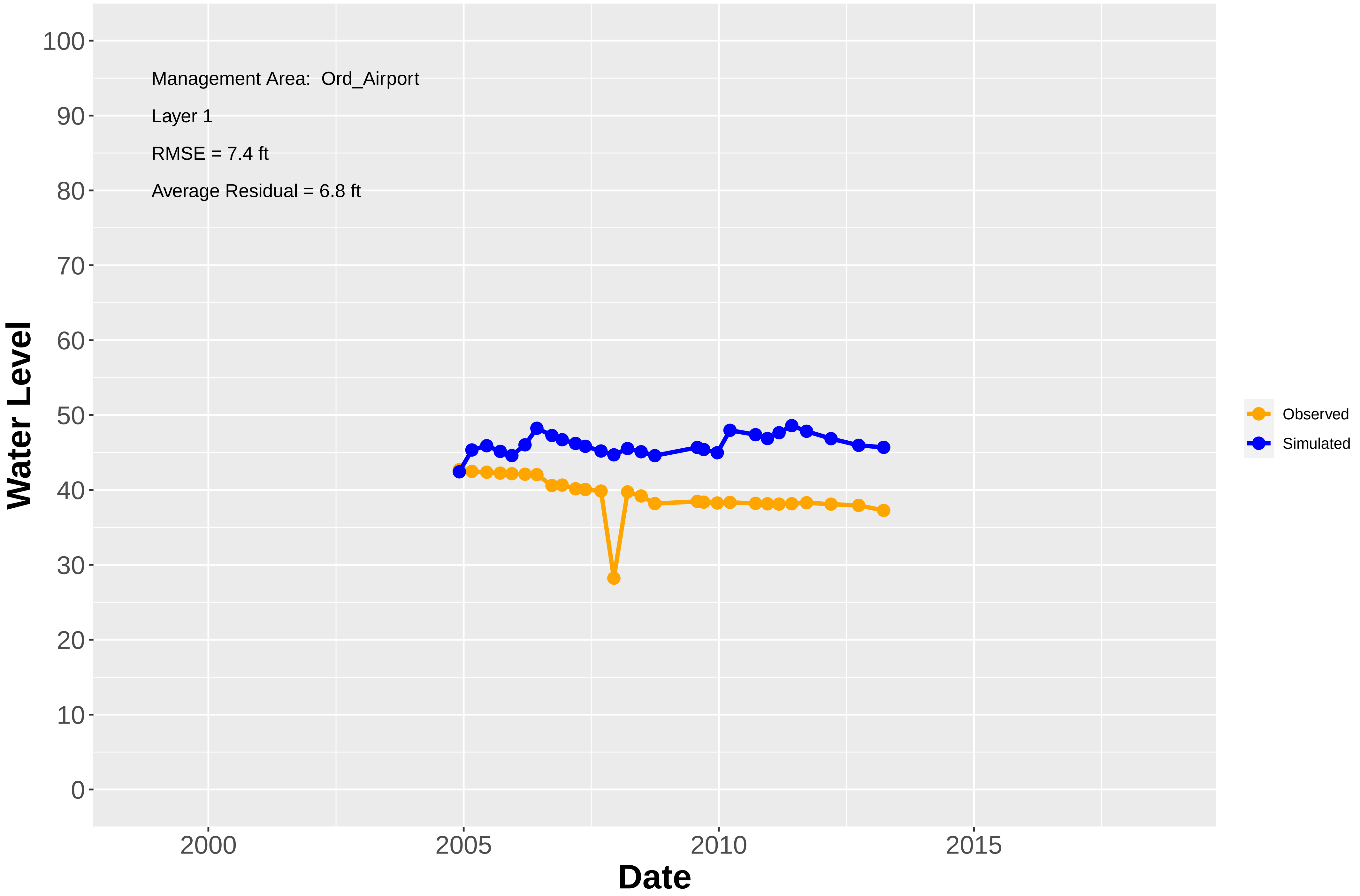
Hydrograph: MW−OU1−46−AD
Management Area: Ord_Airport
Layer 1
RMSE = 6.6 ft
Average Residual = 5.8 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

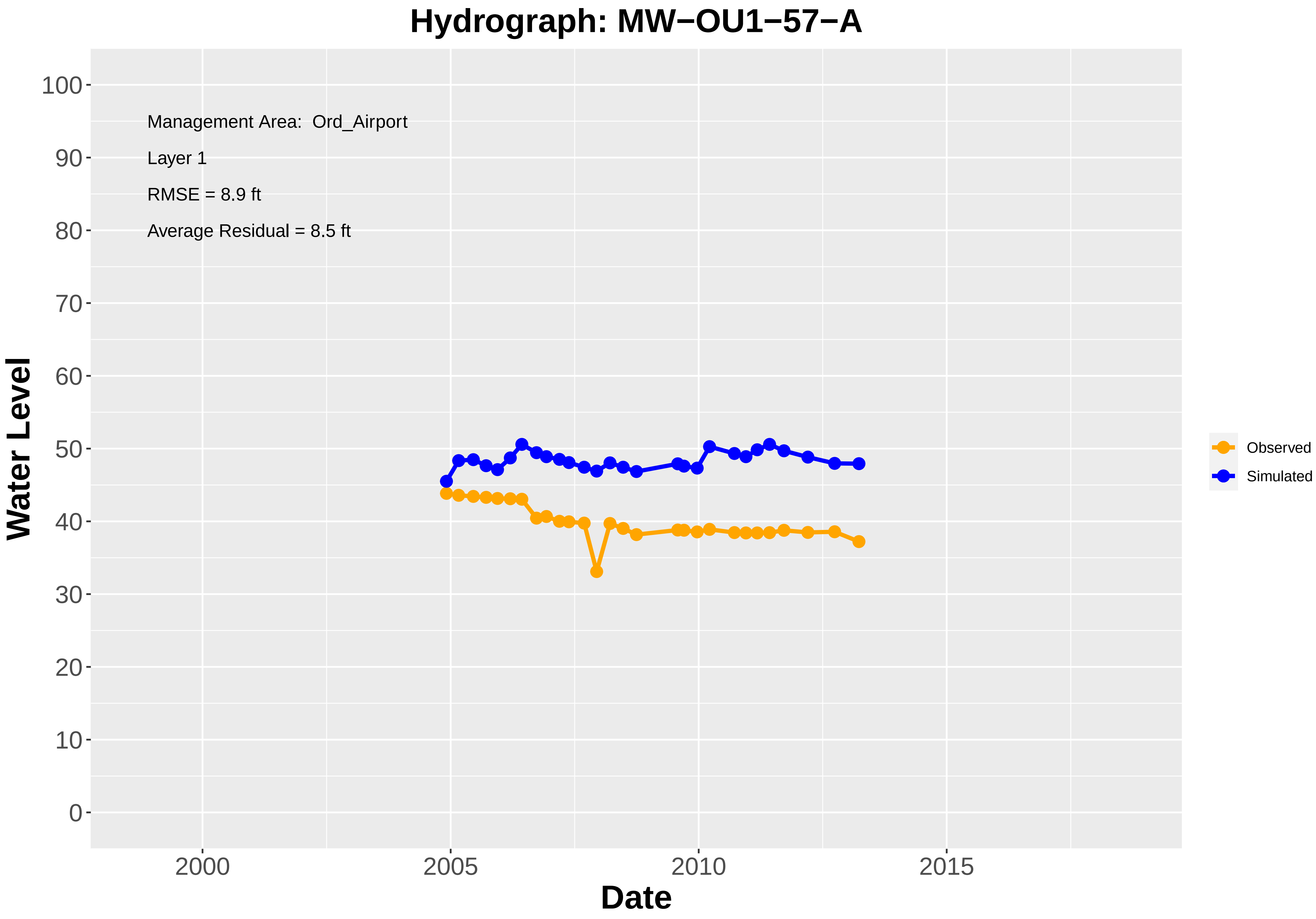


Hydrograph: MW−OU1−50−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.8 ft
Average Residual = 9.4 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

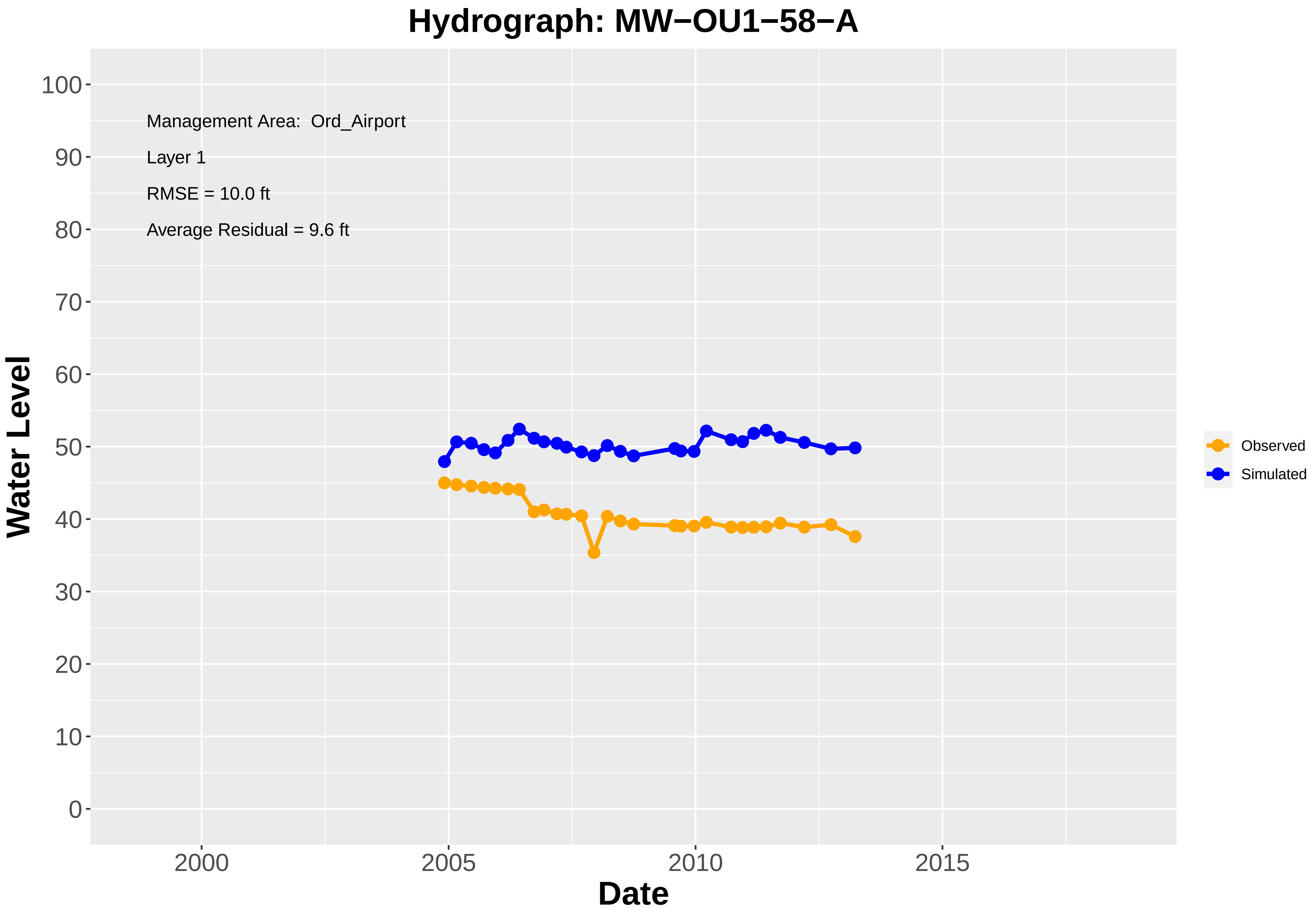

Hydrograph: MW−OU1−51−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.1 ft
Average Residual = 6.1 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

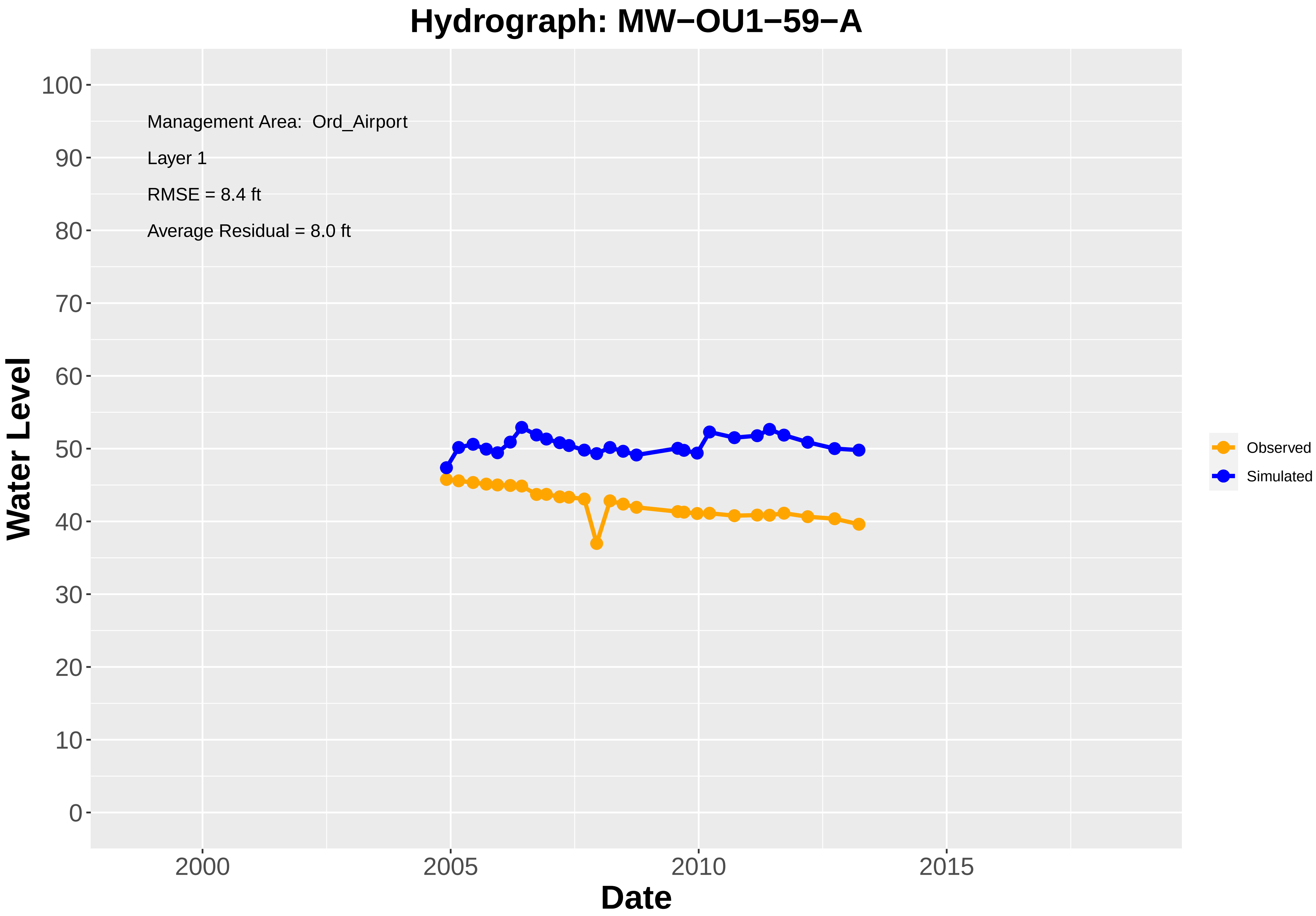
Hydrograph: MW−OU1−56−A



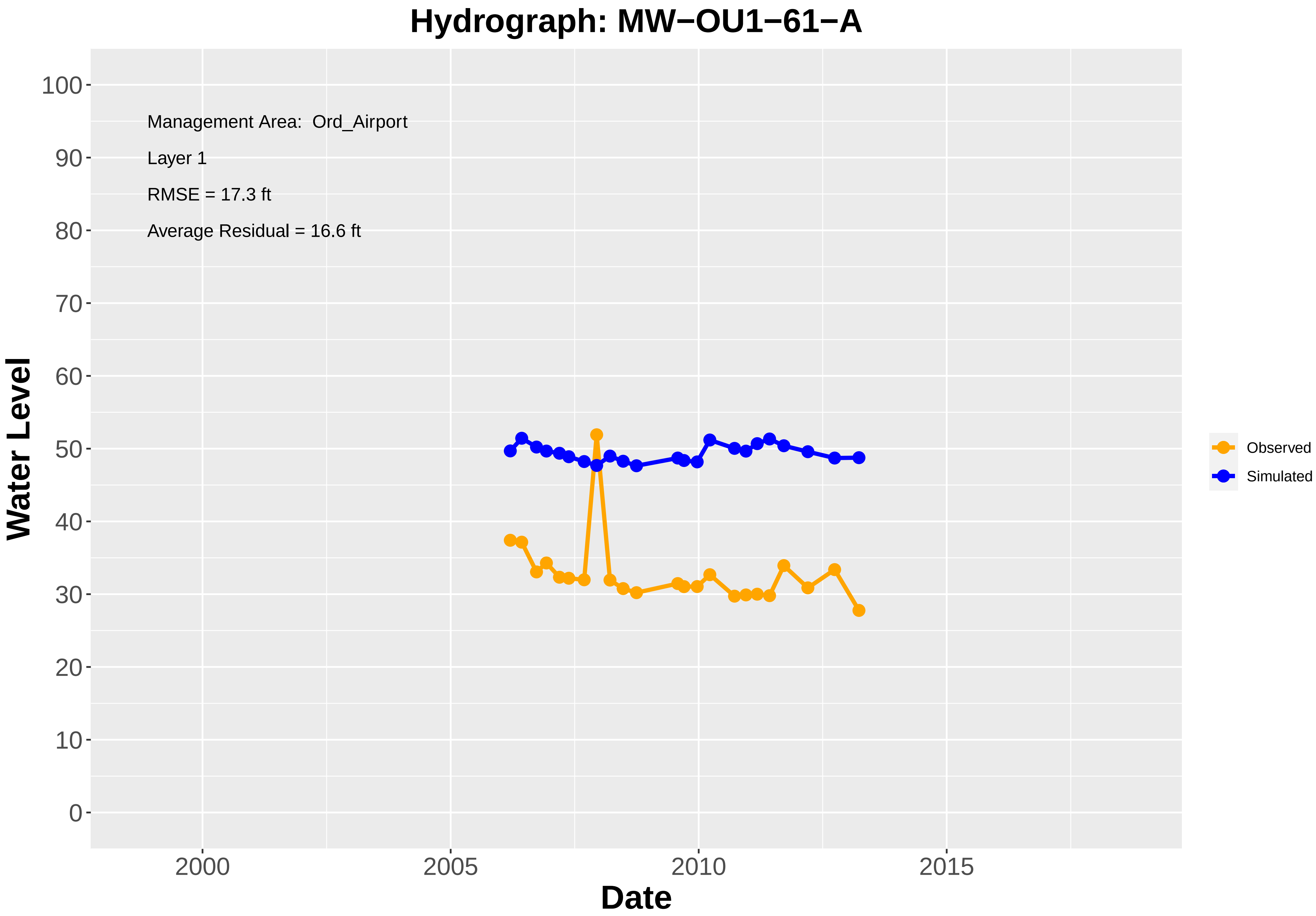


Hydrograph: MW−OU1−57−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.9 ft
Average Residual = 8.5 ft
Water Level
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Date
Observed
Simulated

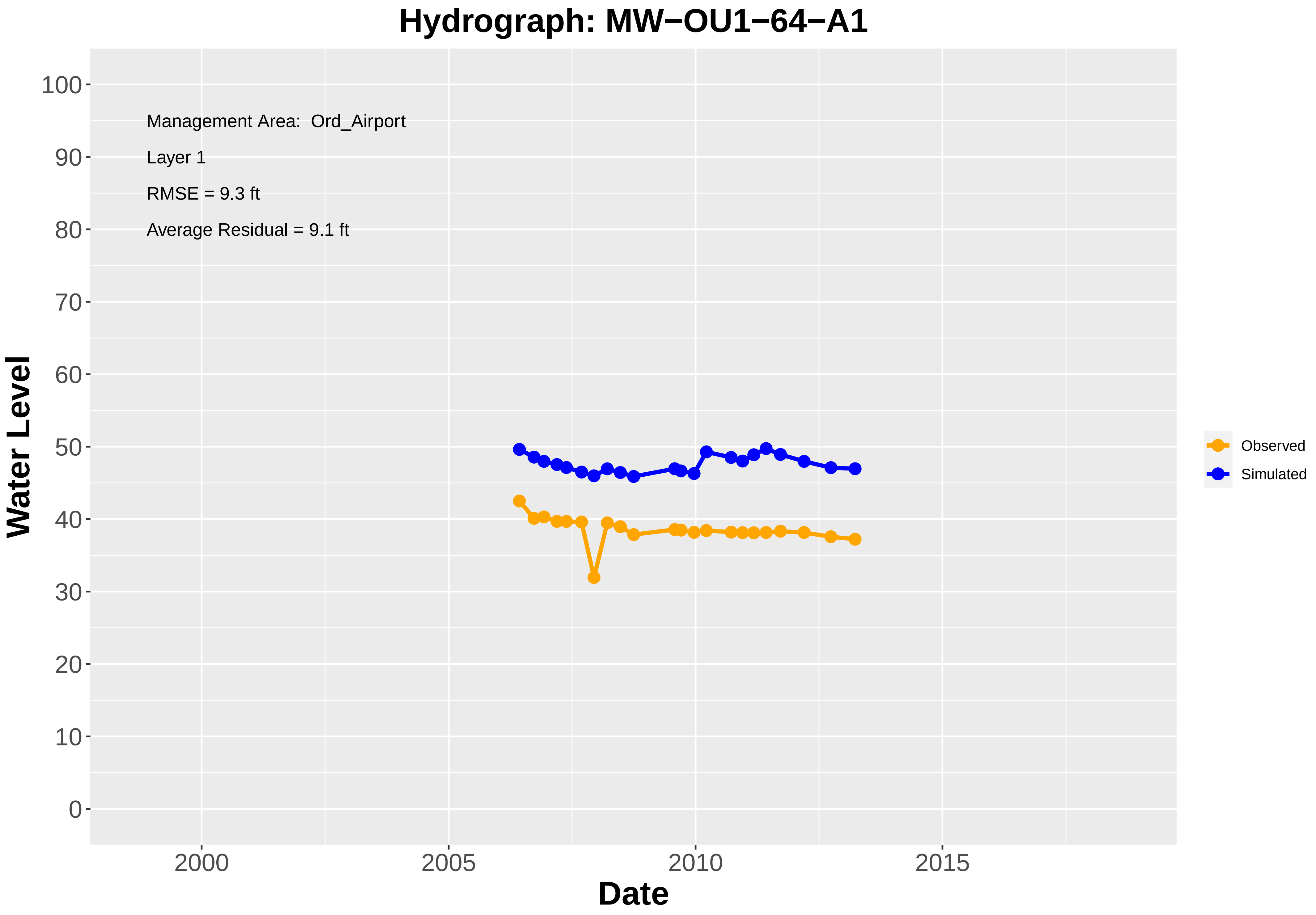

Hydrograph: MW−OU1−58−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.0 ft
Average Residual = 9.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



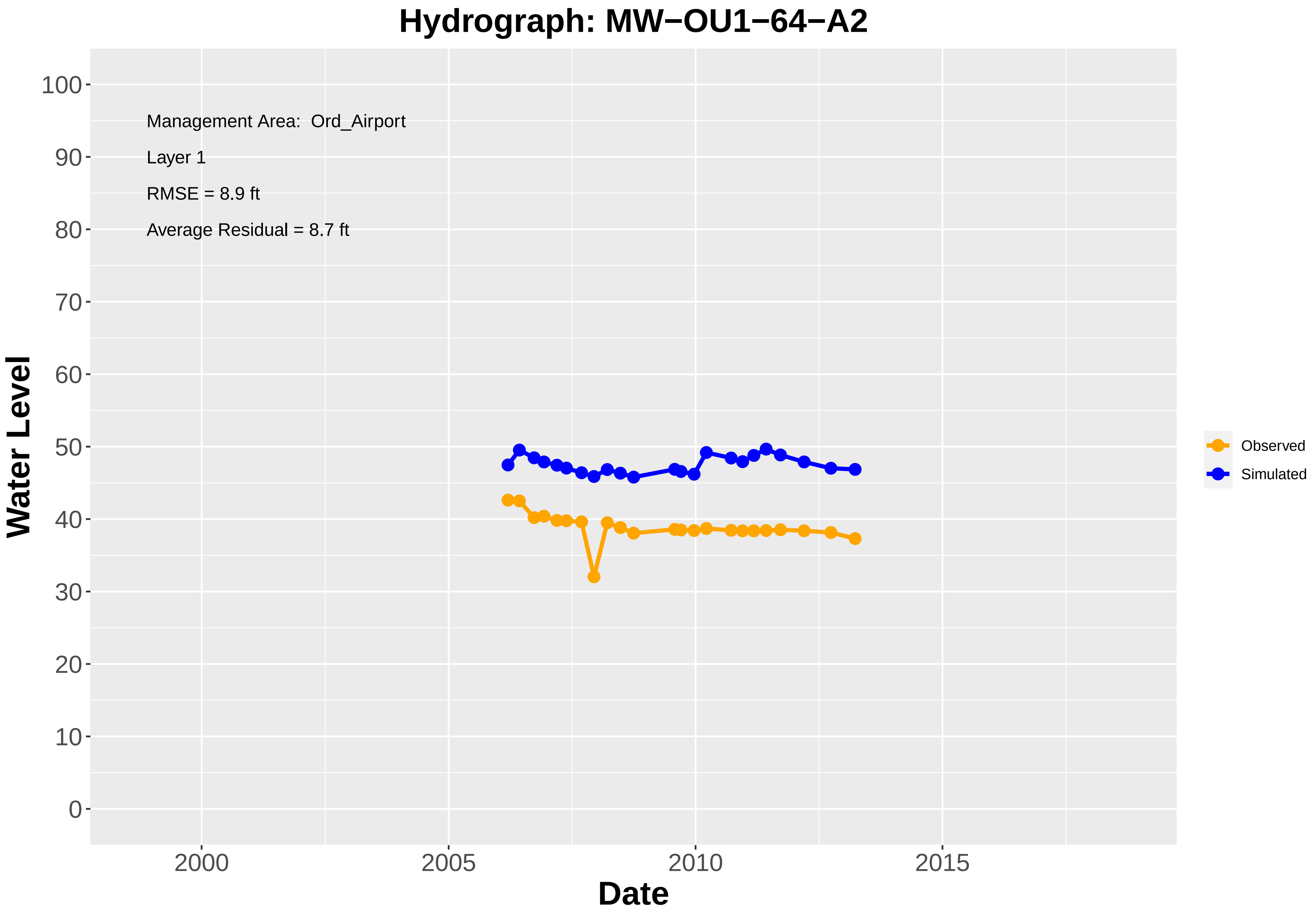
Hydrograph: MW−OU1−59−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.4 ft
Average Residual = 8.0 ft
Water Level
Date
Observed
Simulated
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015

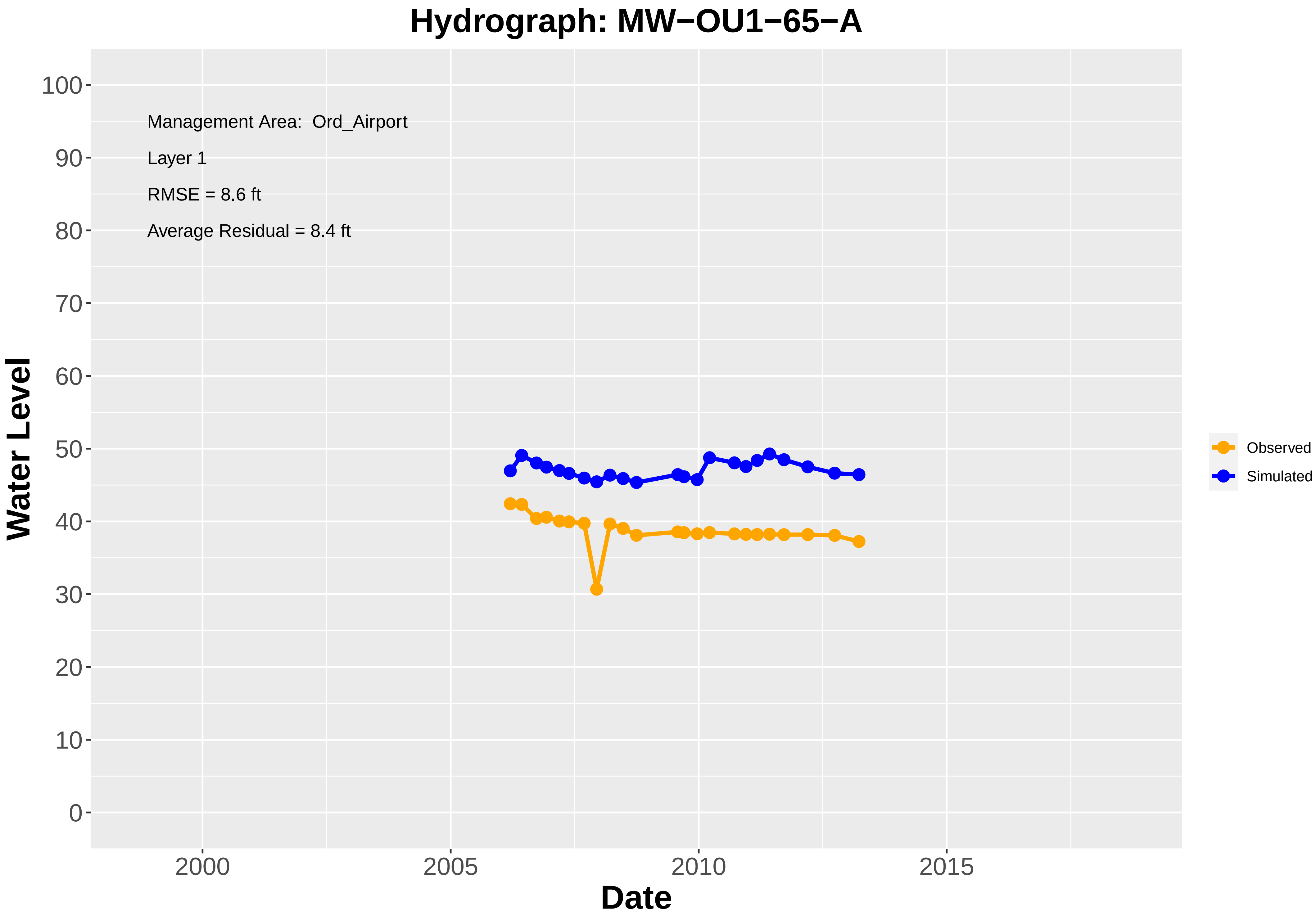


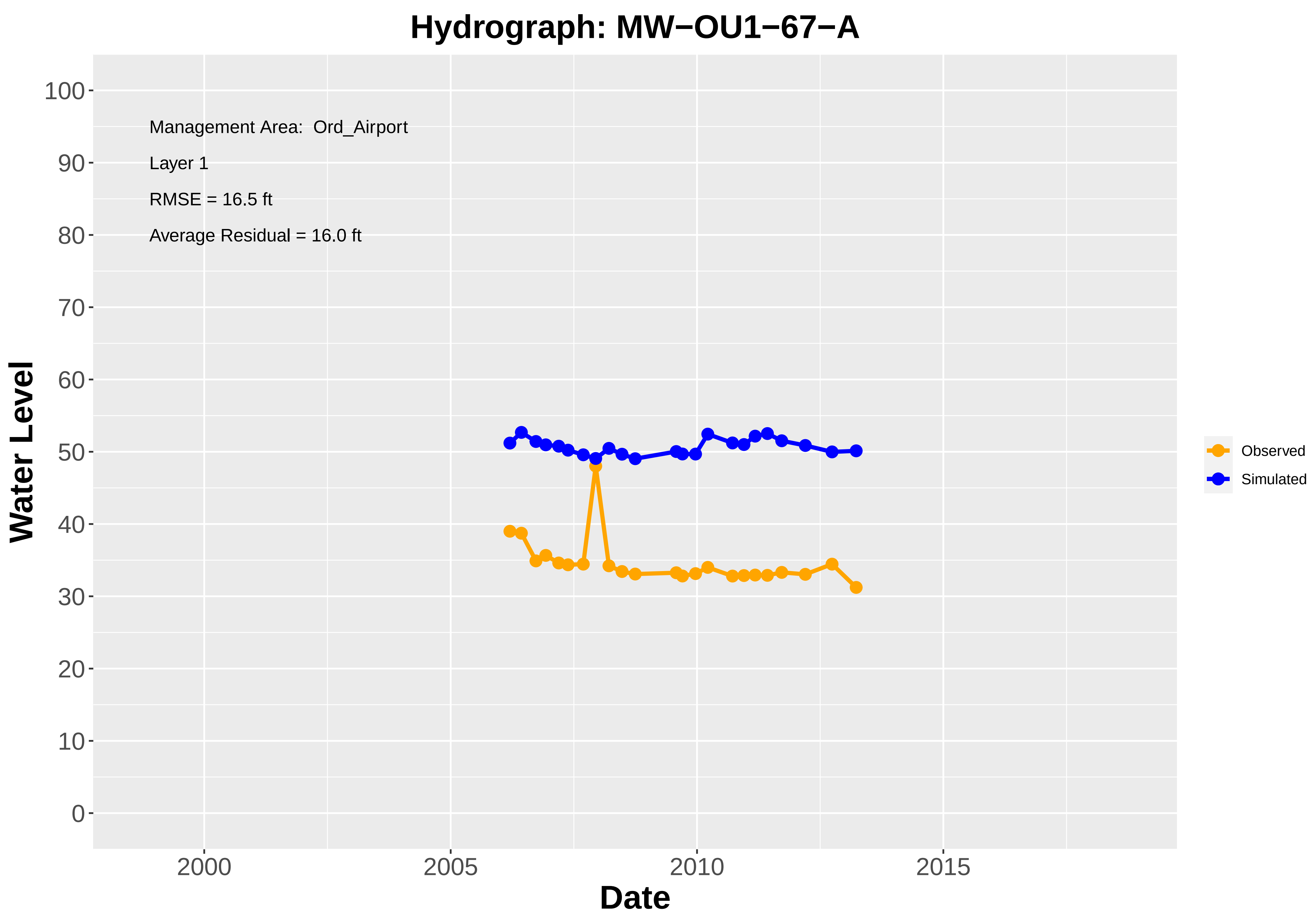
Hydrograph: MW−OU1−61−A
Management Area: Ord_Airport
Layer 1
RMSE = 17.3 ft
Average Residual = 16.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



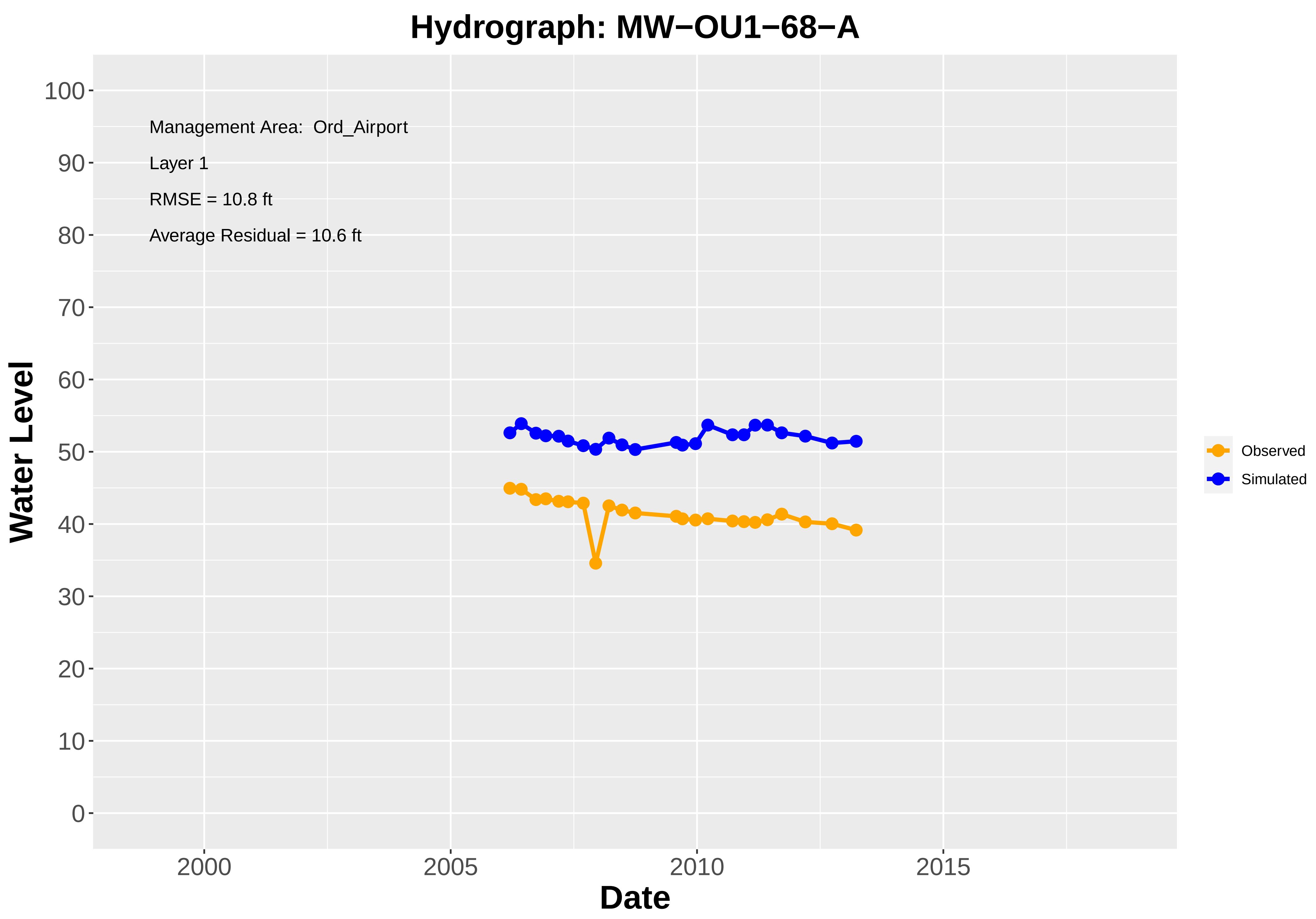
Hydrograph: MW−OU1−64−A1
Management Area: Ord_Airport
Layer 1
RMSE = 9.3 ft
Average Residual = 9.1 ft
Water Level
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU1−64−A2
Management Area: Ord_Airport
Layer 1
RMSE = 8.9 ft
Average Residual = 8.7 ft
Water Level
Date
Observed
Simulated
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015

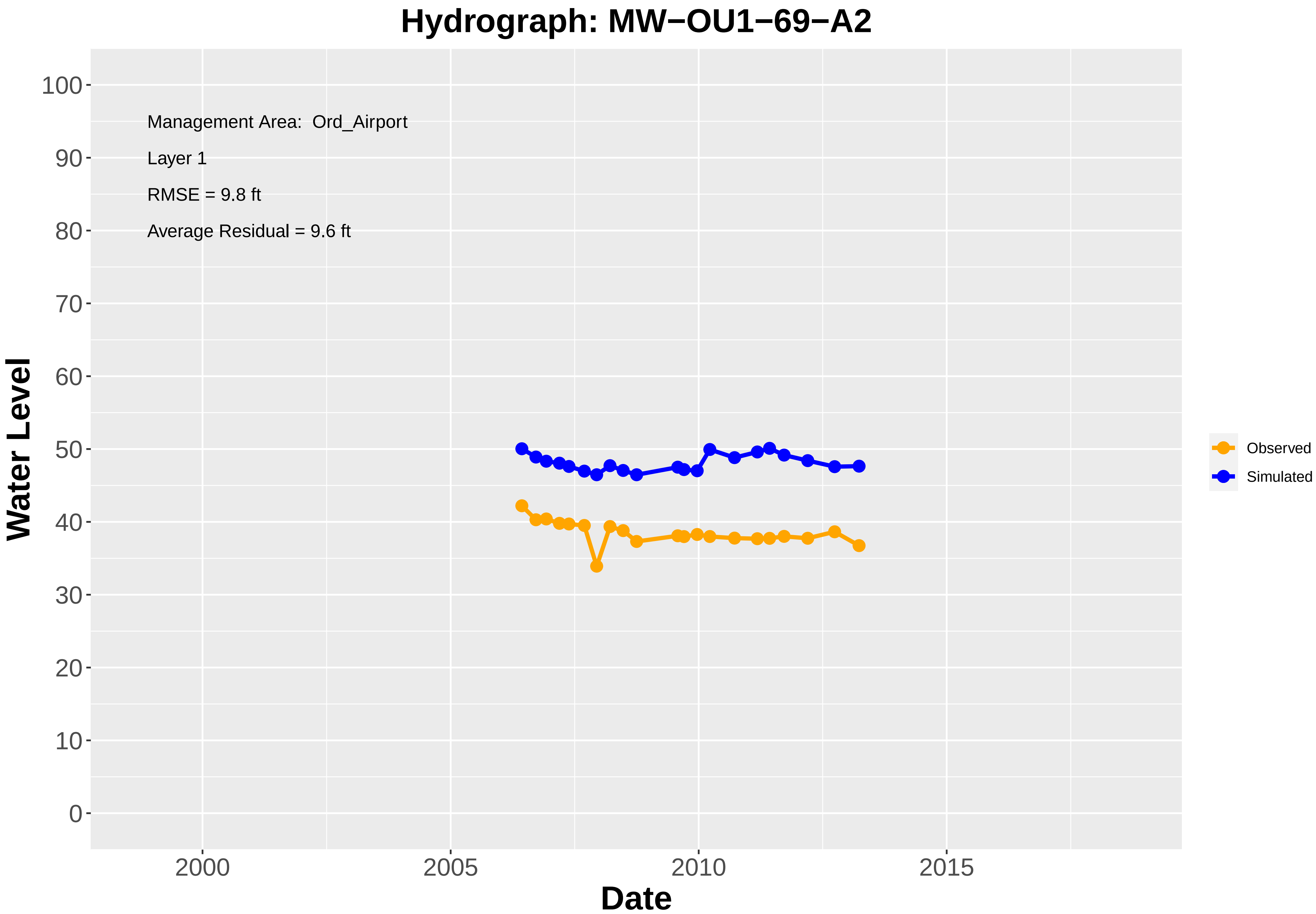

Hydrograph: MW−OU1−65−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.6 ft
Average Residual = 8.4 ft
Water Level
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Date
Observed
Simulated

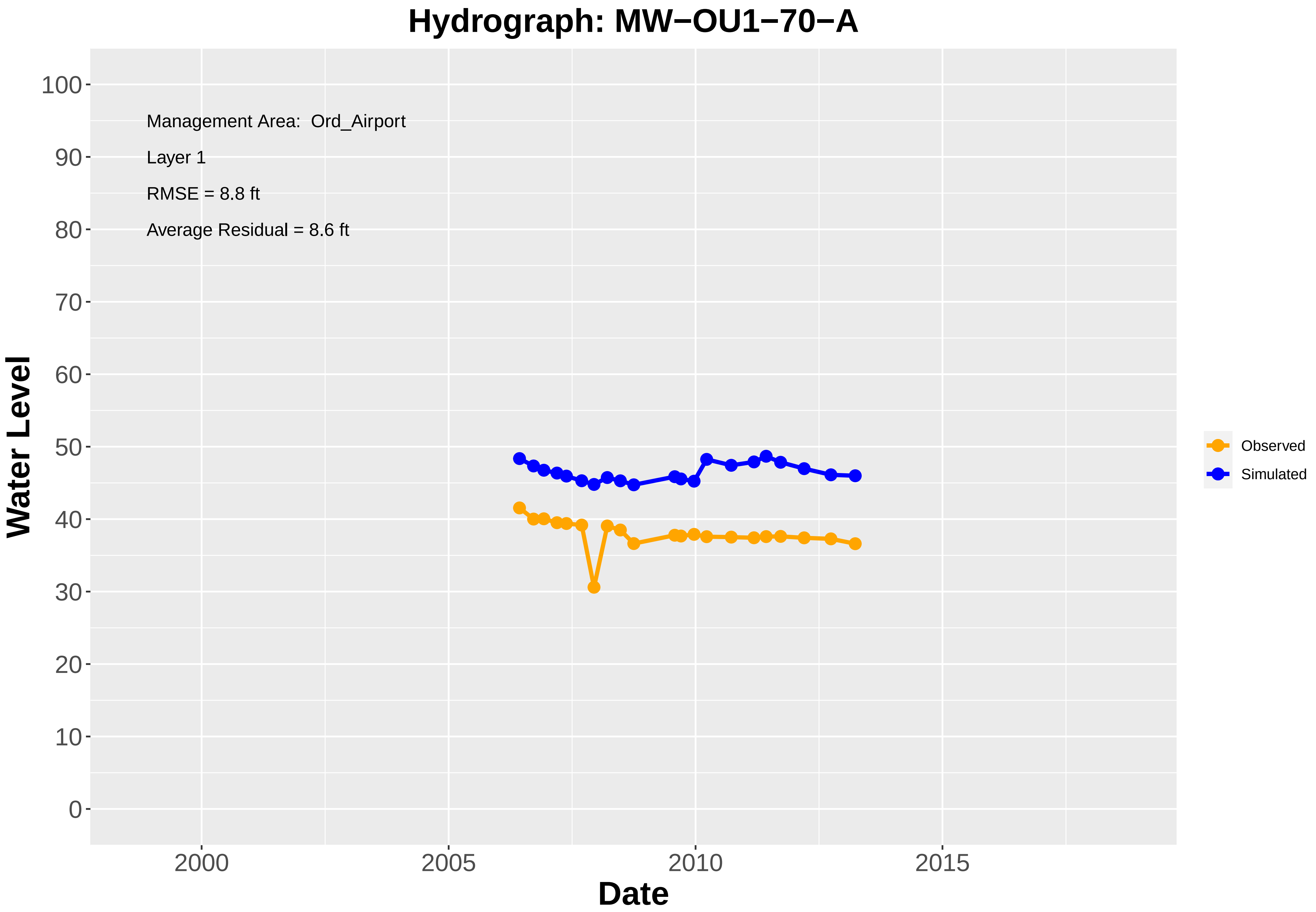


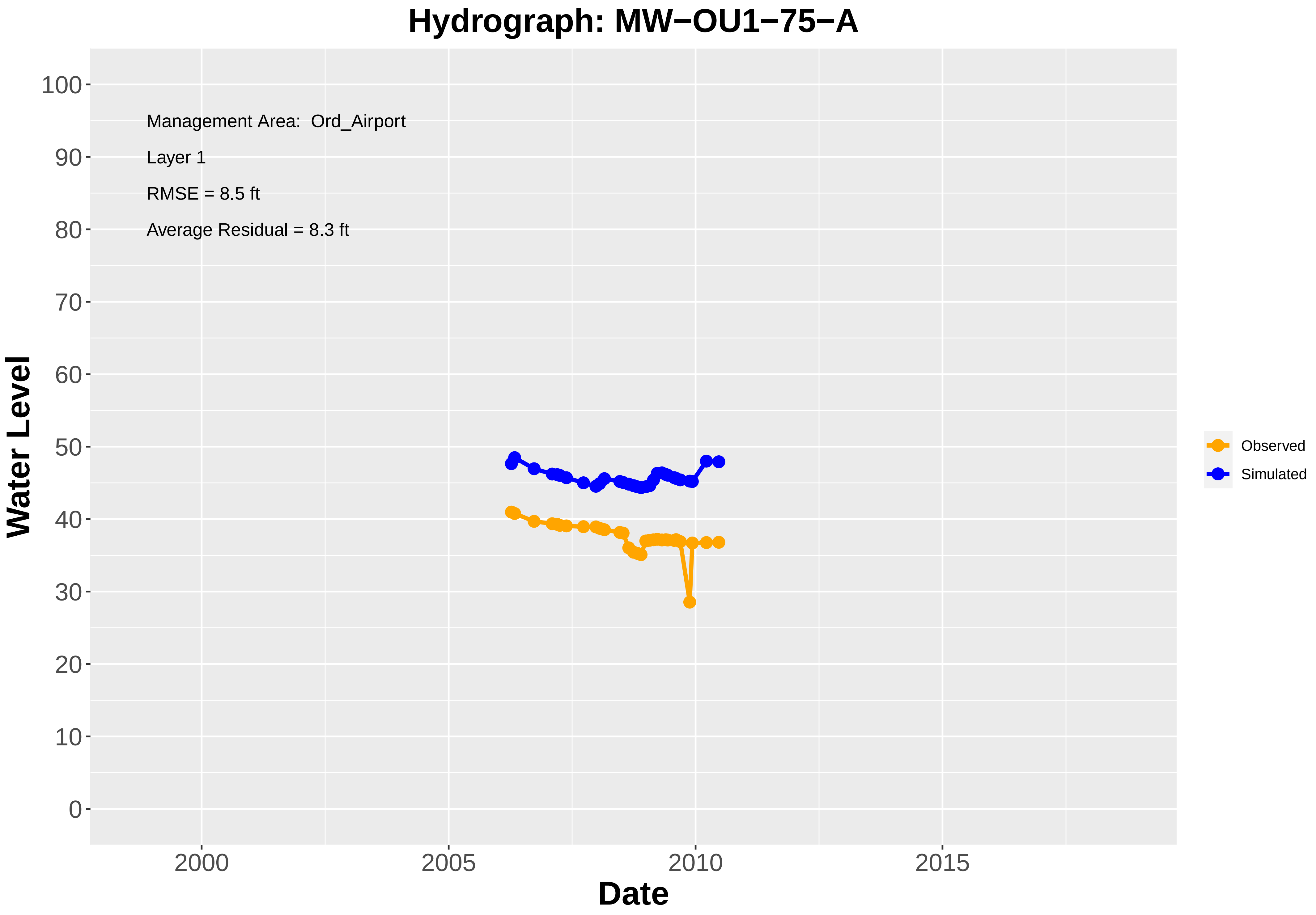
Hydrograph: MW−OU1−67−A
Management Area: Ord_Airport
Layer 1
RMSE = 16.5 ft
Average Residual = 16.0 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

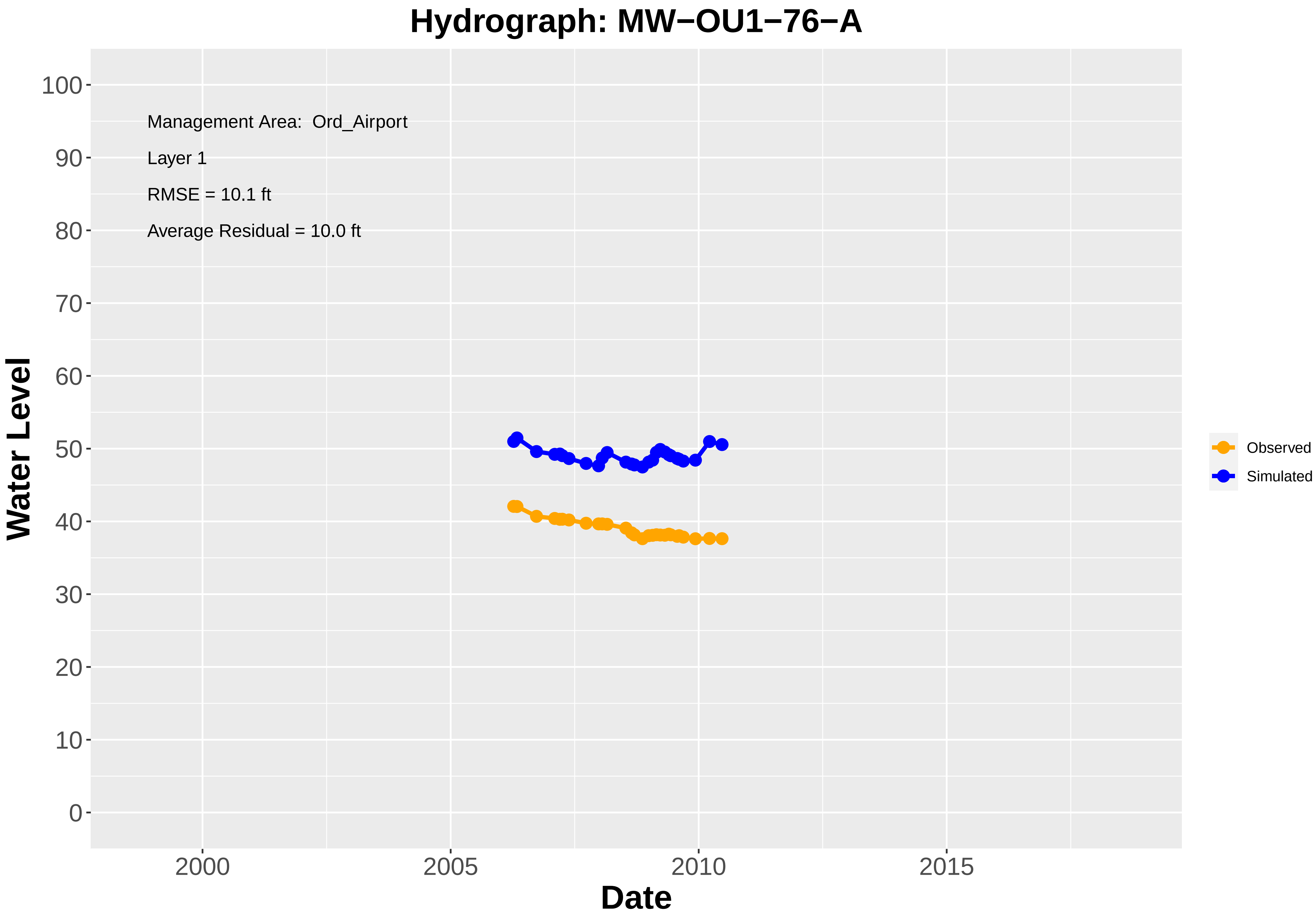


Hydrograph: MW−OU1−68−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.8 ft
Average Residual = 10.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

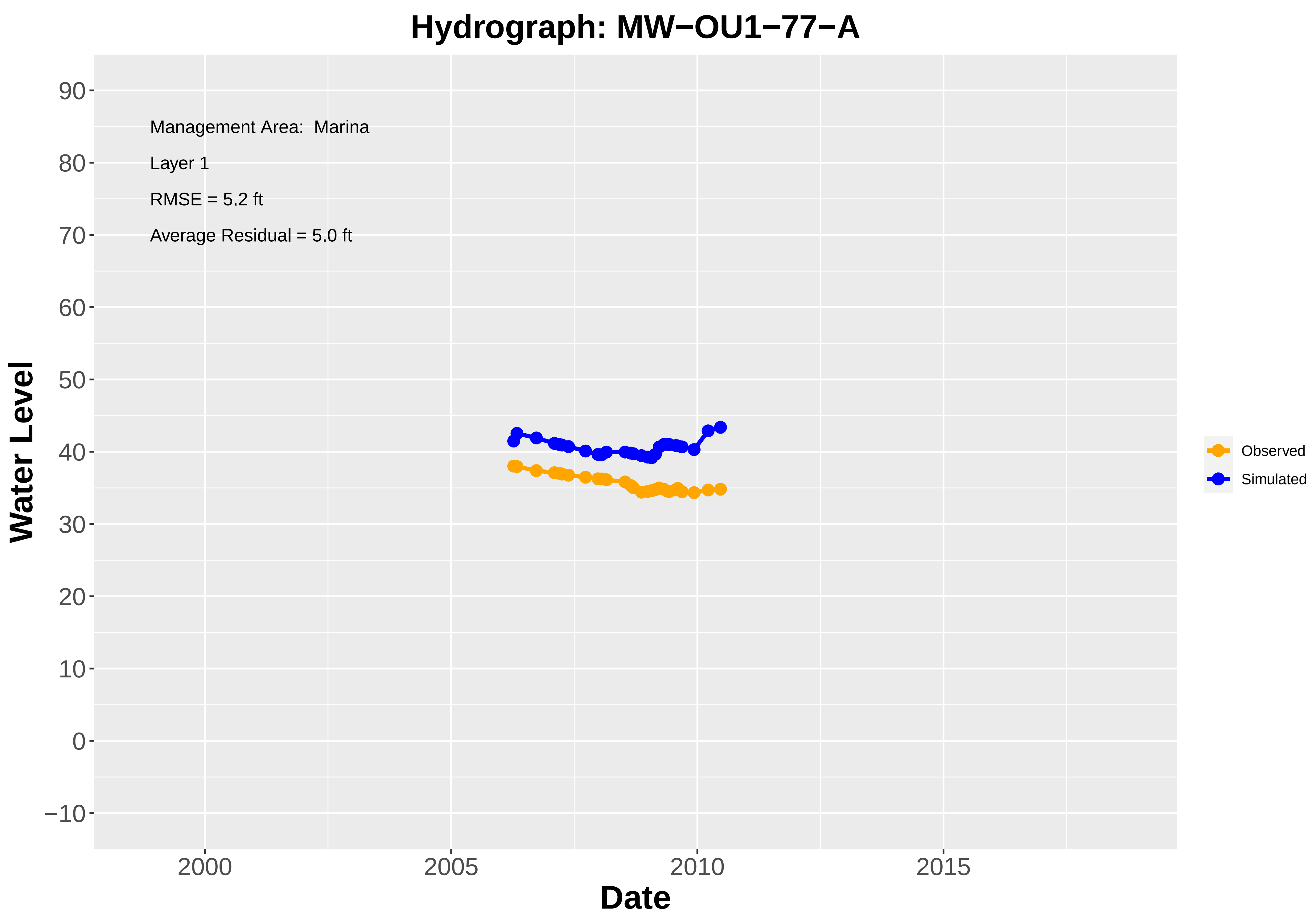

Hydrograph: MW−OU1−69−A2
Management Area: Ord_Airport
Layer 1
RMSE = 9.8 ft
Average Residual = 9.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−70−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.8 ft
Average Residual = 8.6 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

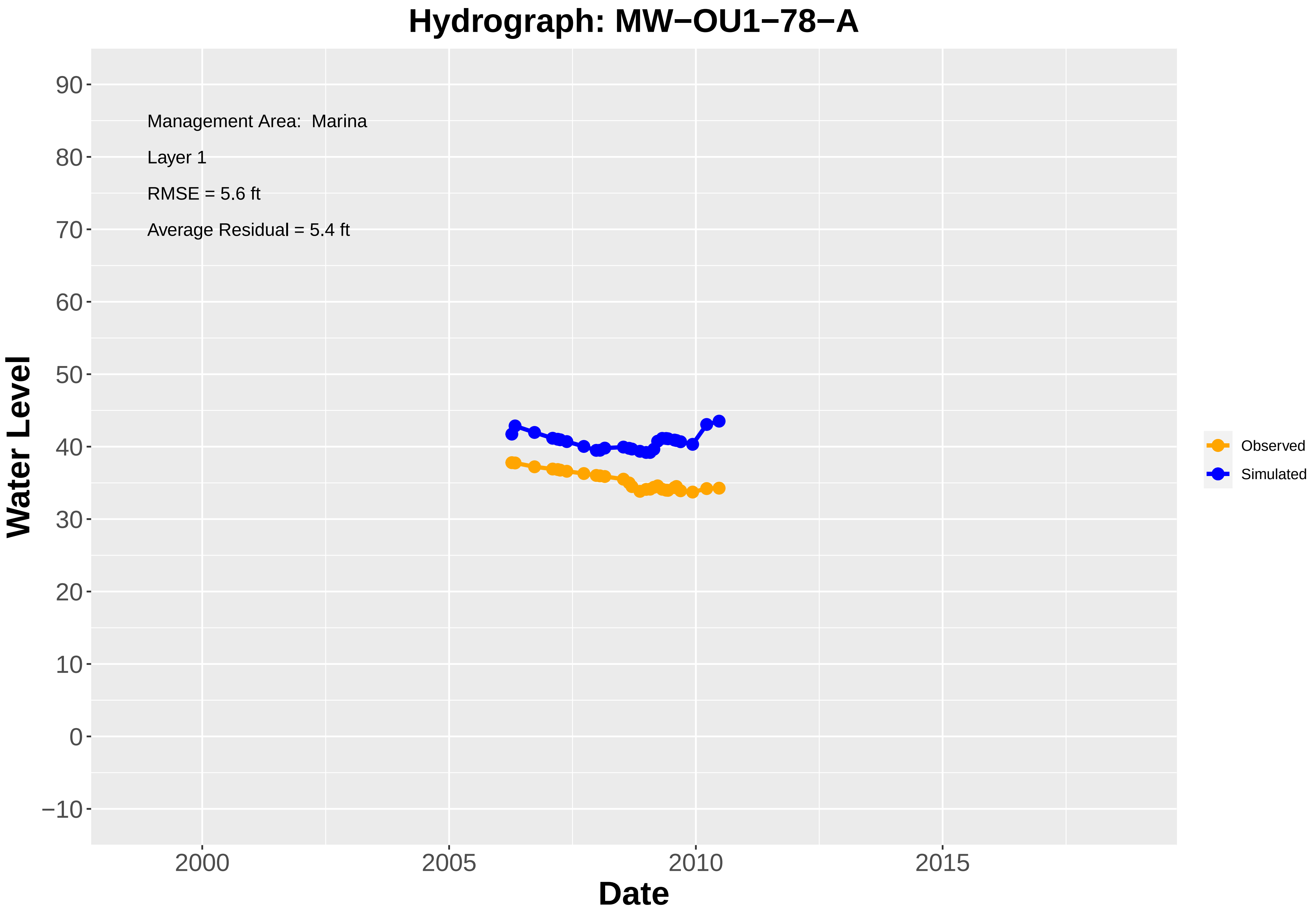

Hydrograph: MW−OU1−75−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.5 ft
Average Residual = 8.3 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



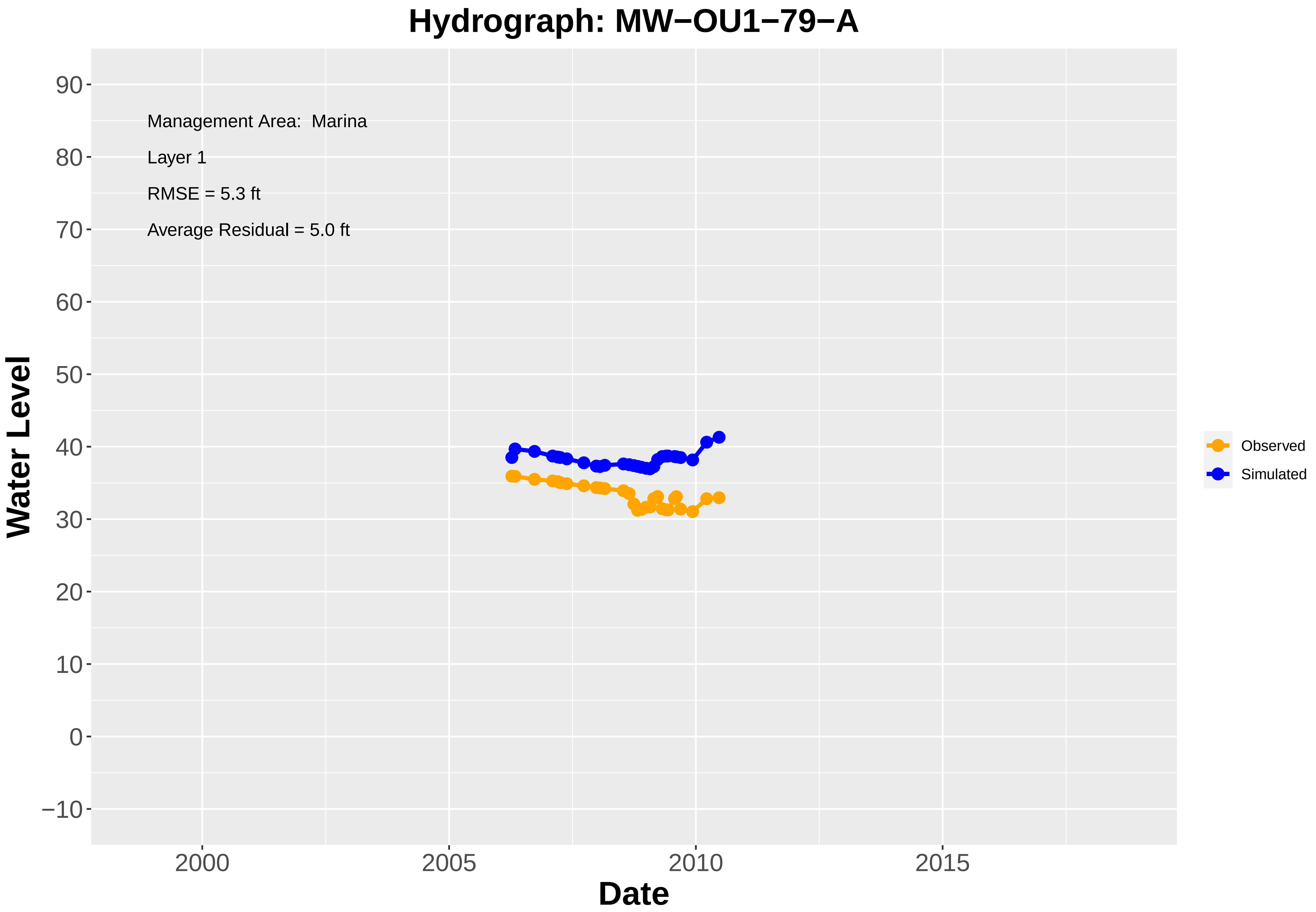
Hydrograph: MW−OU1−76−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.1 ft
Average Residual = 10.0 ft
Water Level
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Date
Observed
Simulated

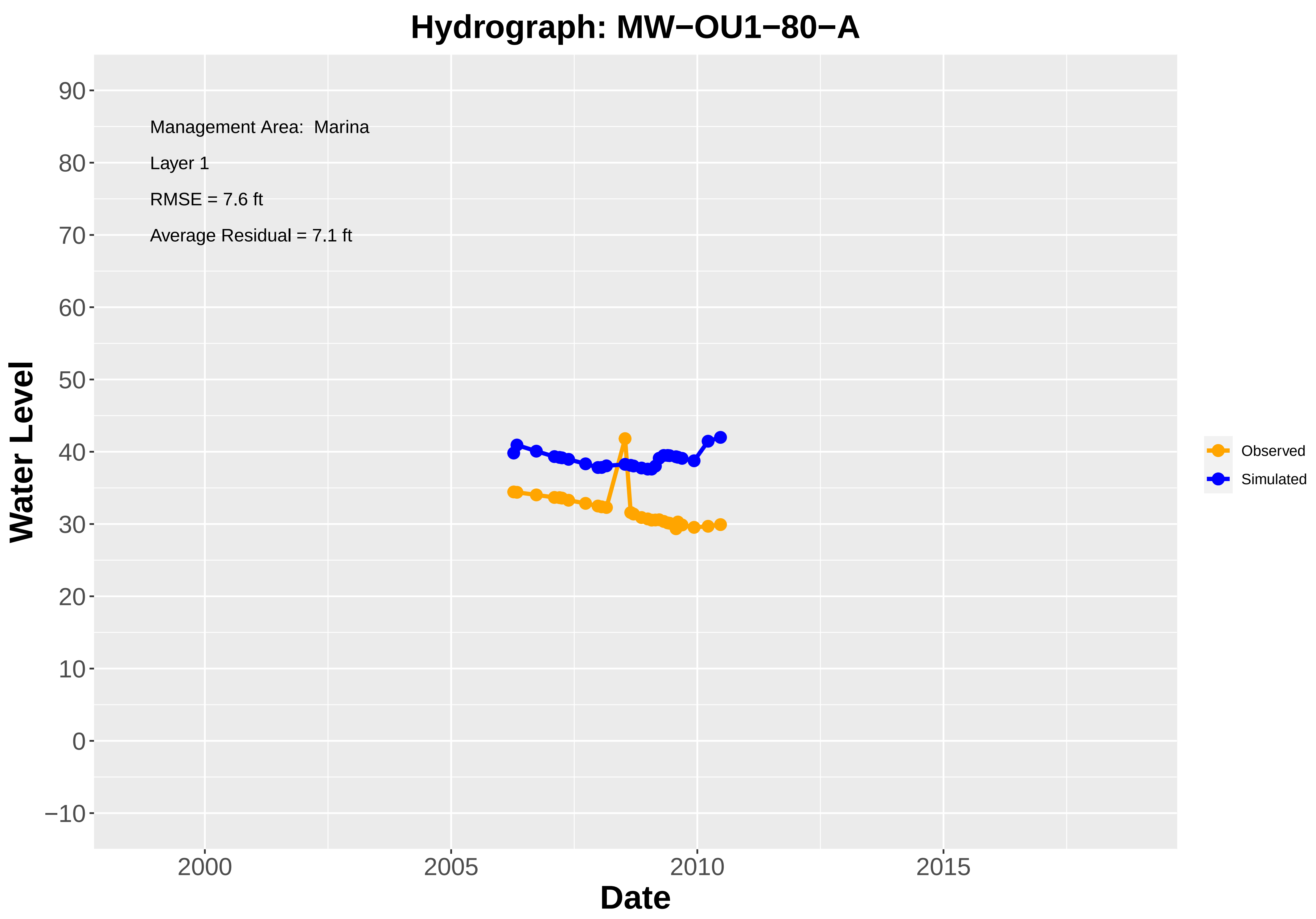


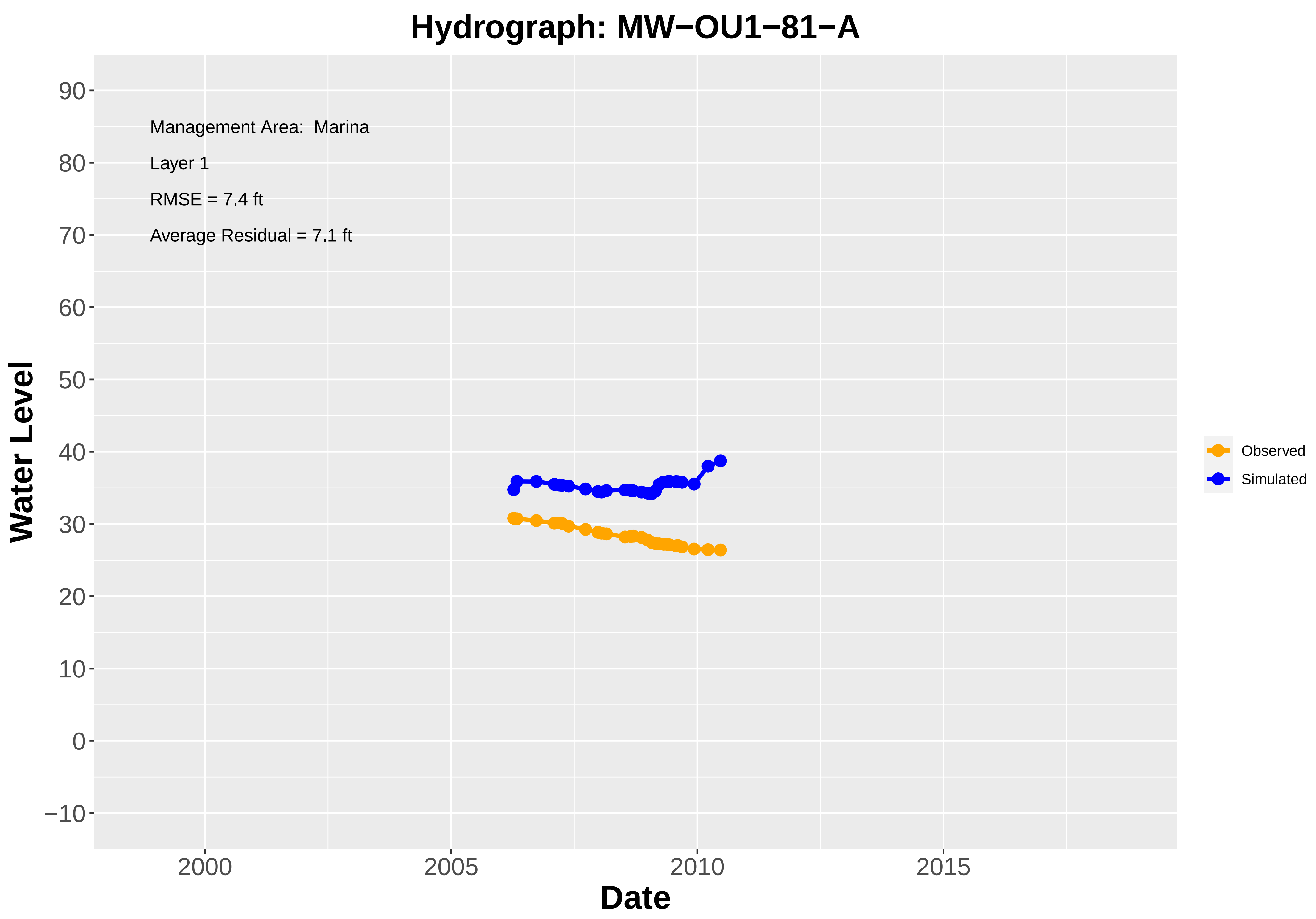
Hydrograph: MW−OU1−77−A
Management Area: Marina
Layer 1
RMSE = 5.2 ft
Average Residual = 5.0 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

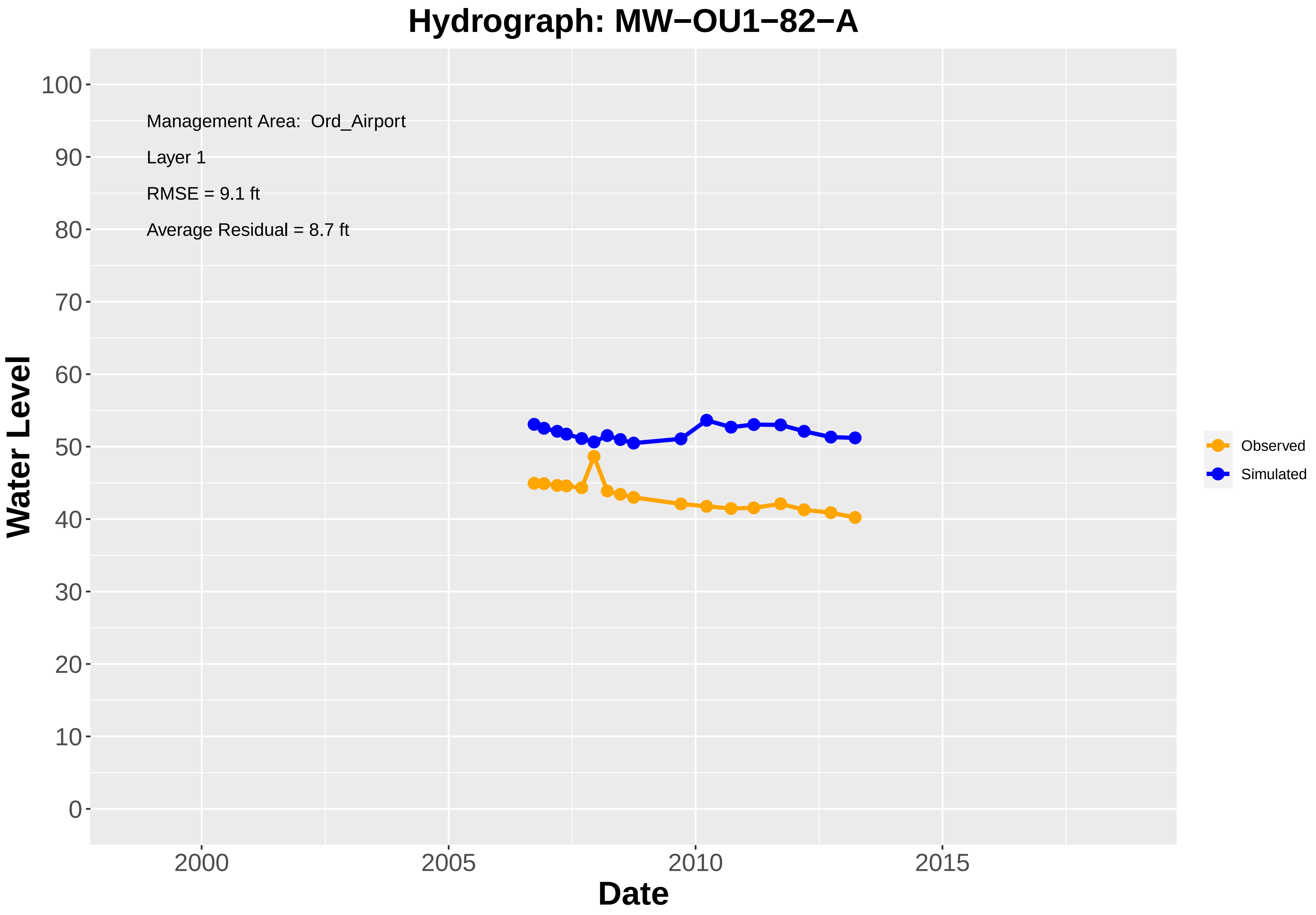


Hydrograph: MW−OU1−78−A
Management Area: Marina
Layer 1
RMSE = 5.6 ft
Average Residual = 5.4 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

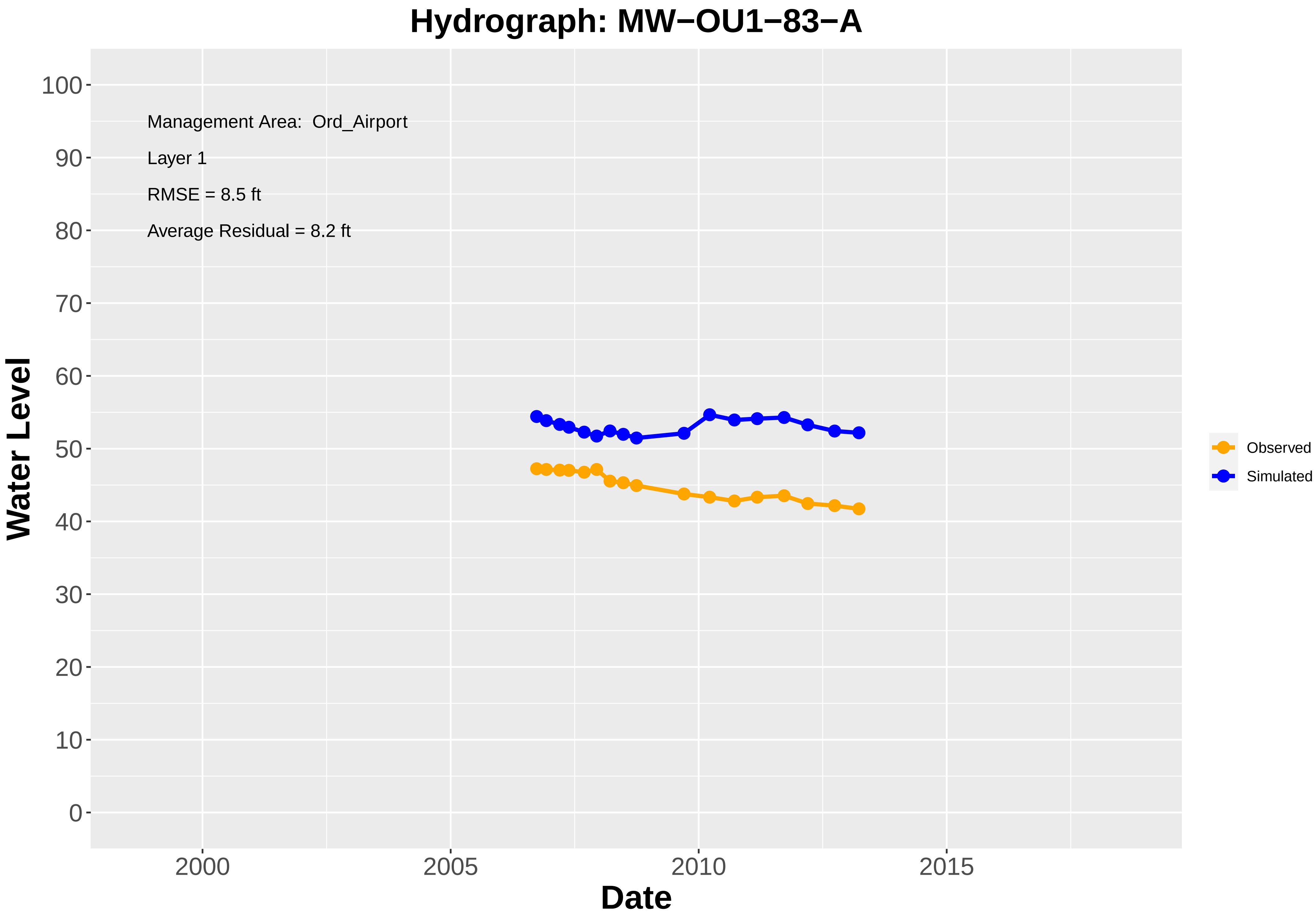

Hydrograph: MW−OU1−79−A
Management Area: Marina
Layer 1
RMSE = 5.3 ft
Average Residual = 5.0 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−80−A
Management Area: Marina
Layer 1
RMSE = 7.6 ft
Average Residual = 7.1 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

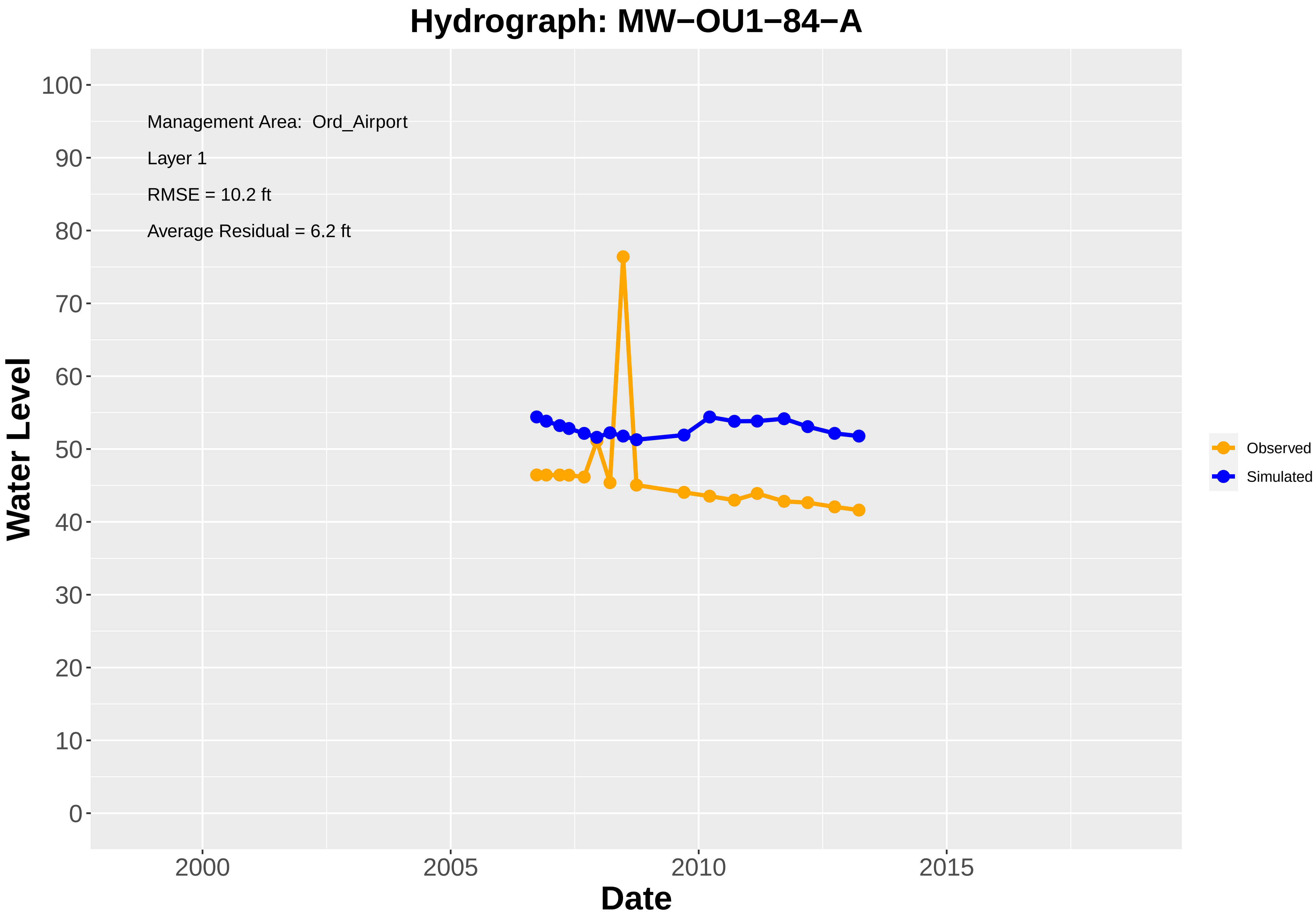

Hydrograph: MW−OU1−81−A
Management Area: Marina
Layer 1
RMSE = 7.4 ft
Average Residual = 7.1 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

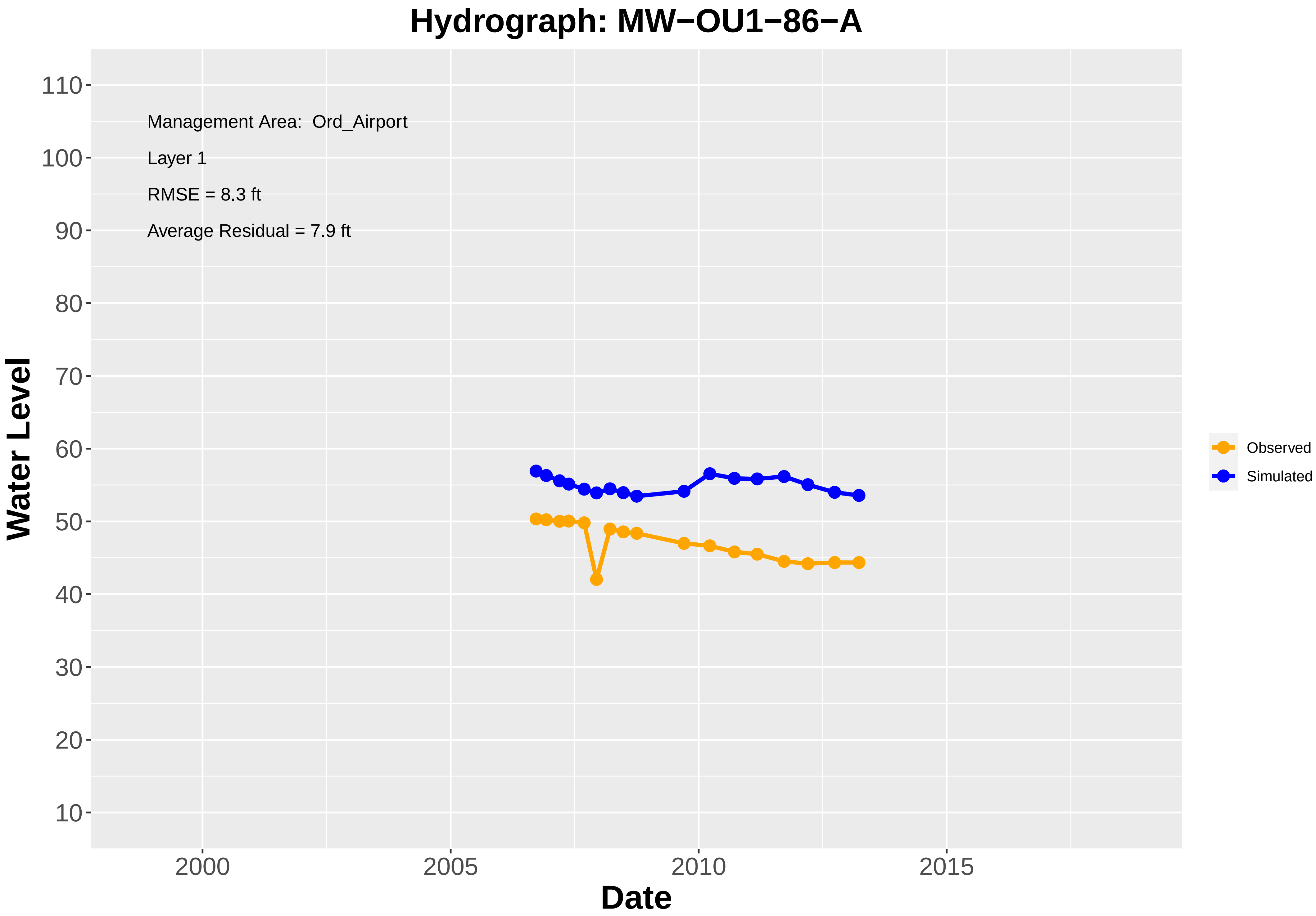


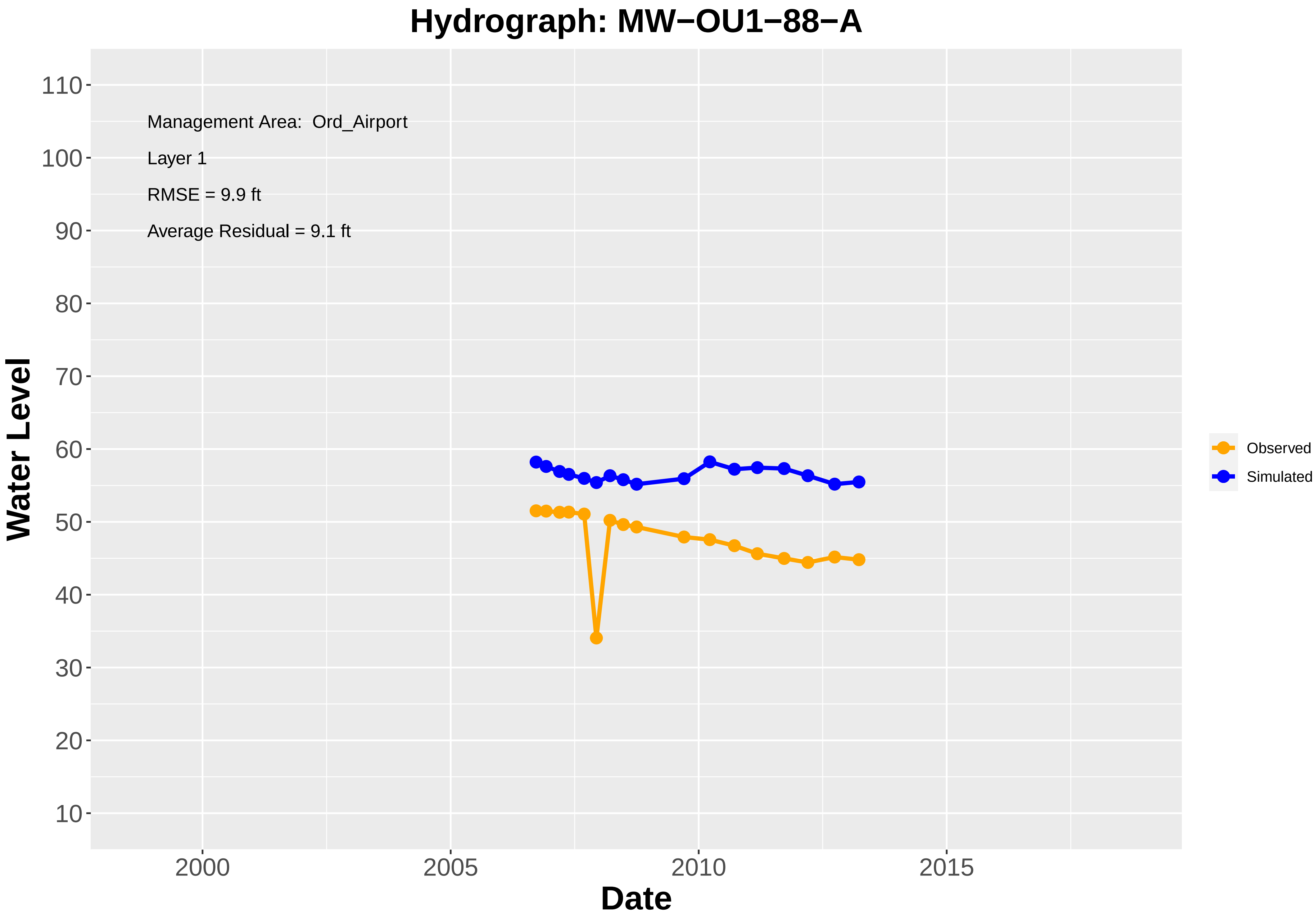
Hydrograph: MW−OU1−82−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.1 ft
Average Residual = 8.7 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



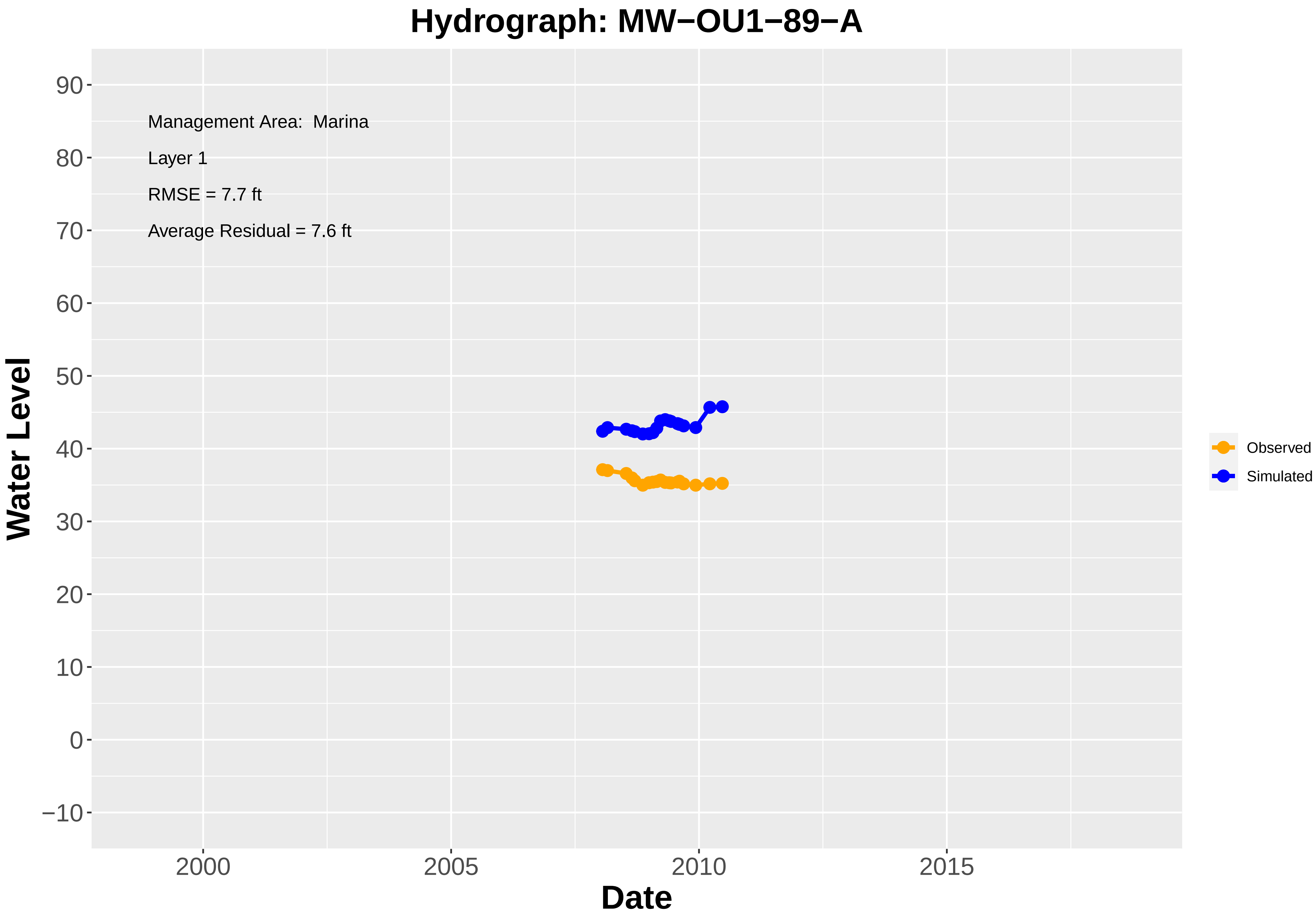
Hydrograph: MW−OU1−83−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.5 ft
Average Residual = 8.2 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU1−84−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.2 ft
Average Residual = 6.2 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

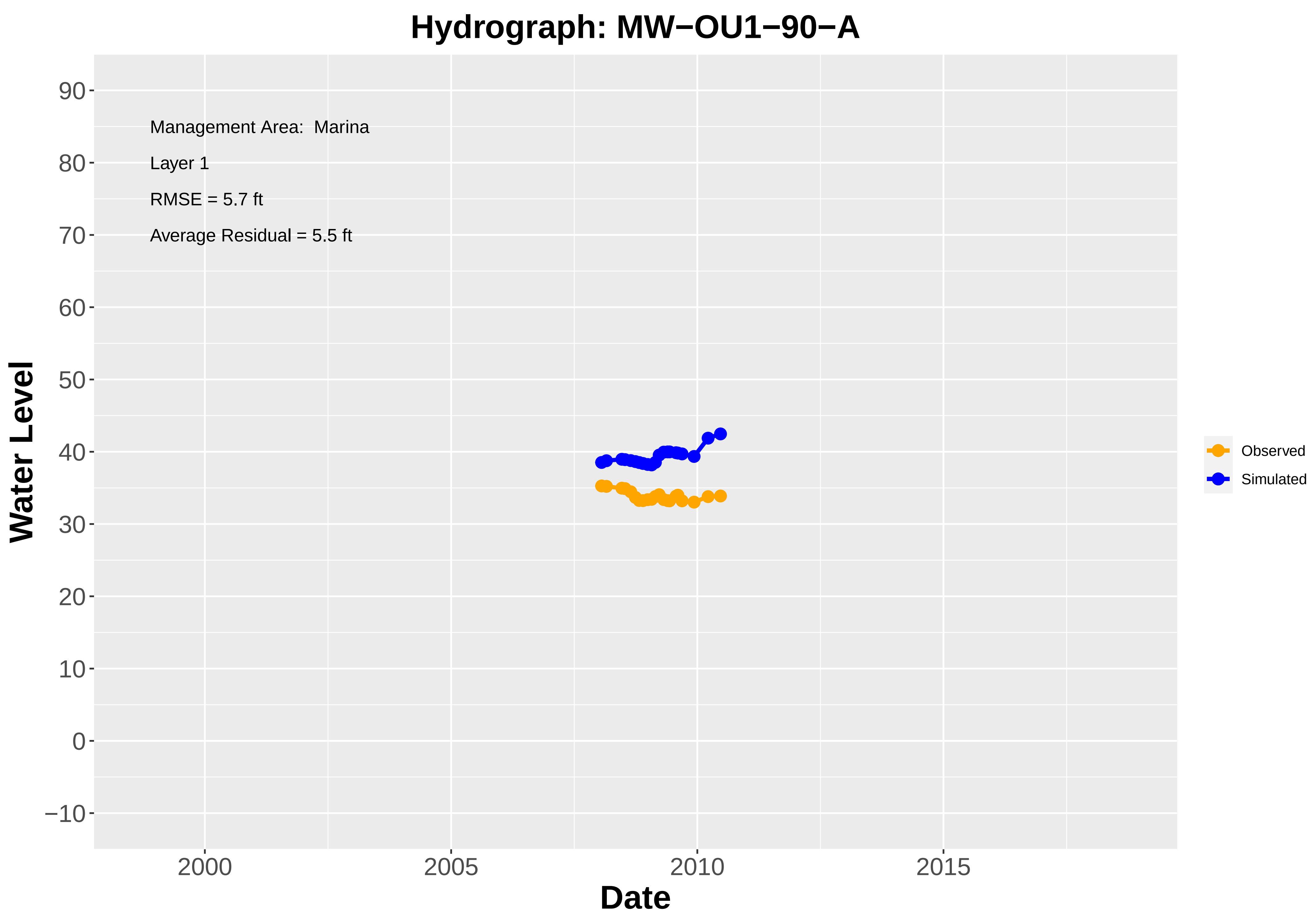

Hydrograph: MW−OU1−86−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.3 ft
Average Residual = 7.9 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

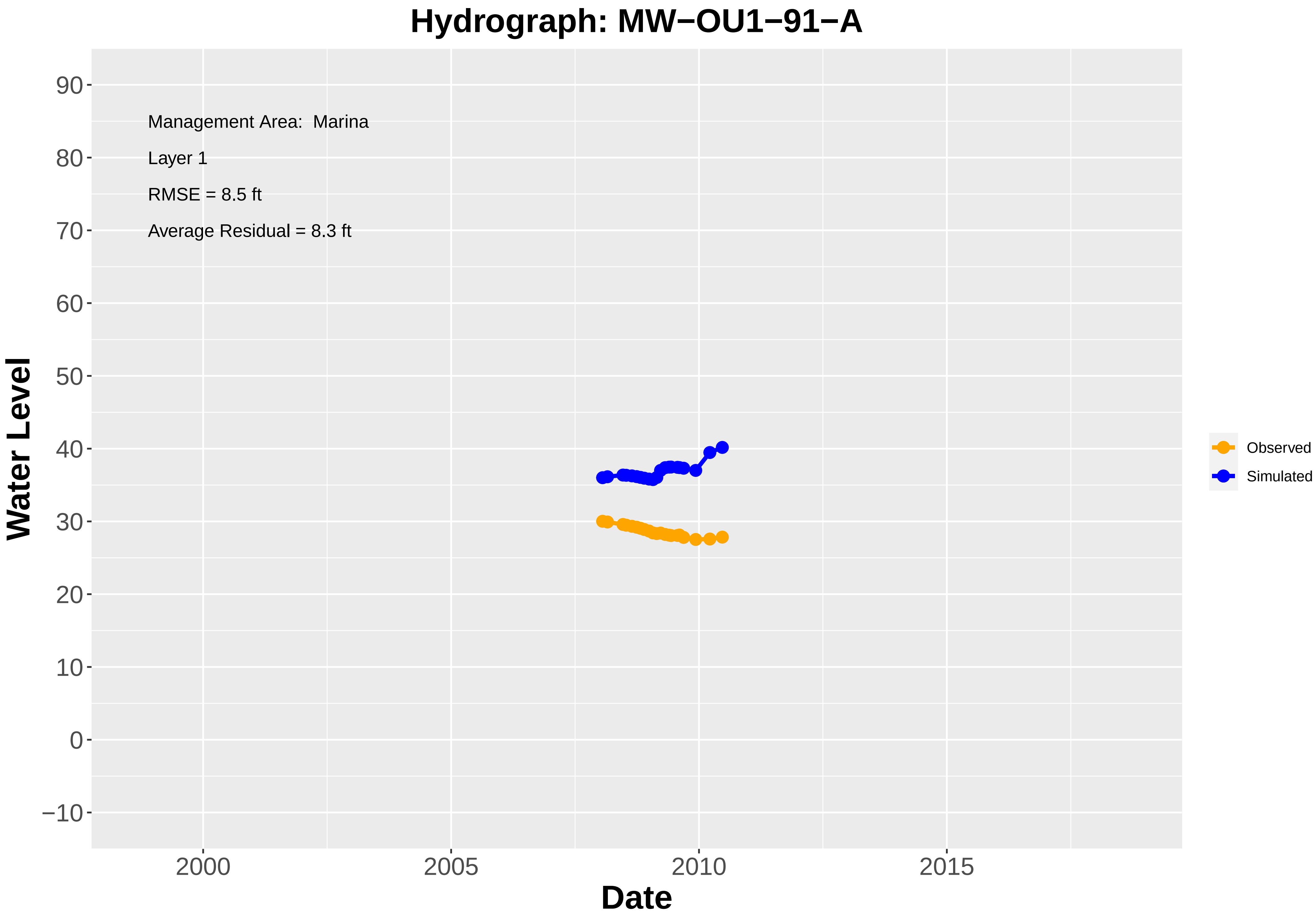


Hydrograph: MW−OU1−88−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.9 ft
Average Residual = 9.1 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

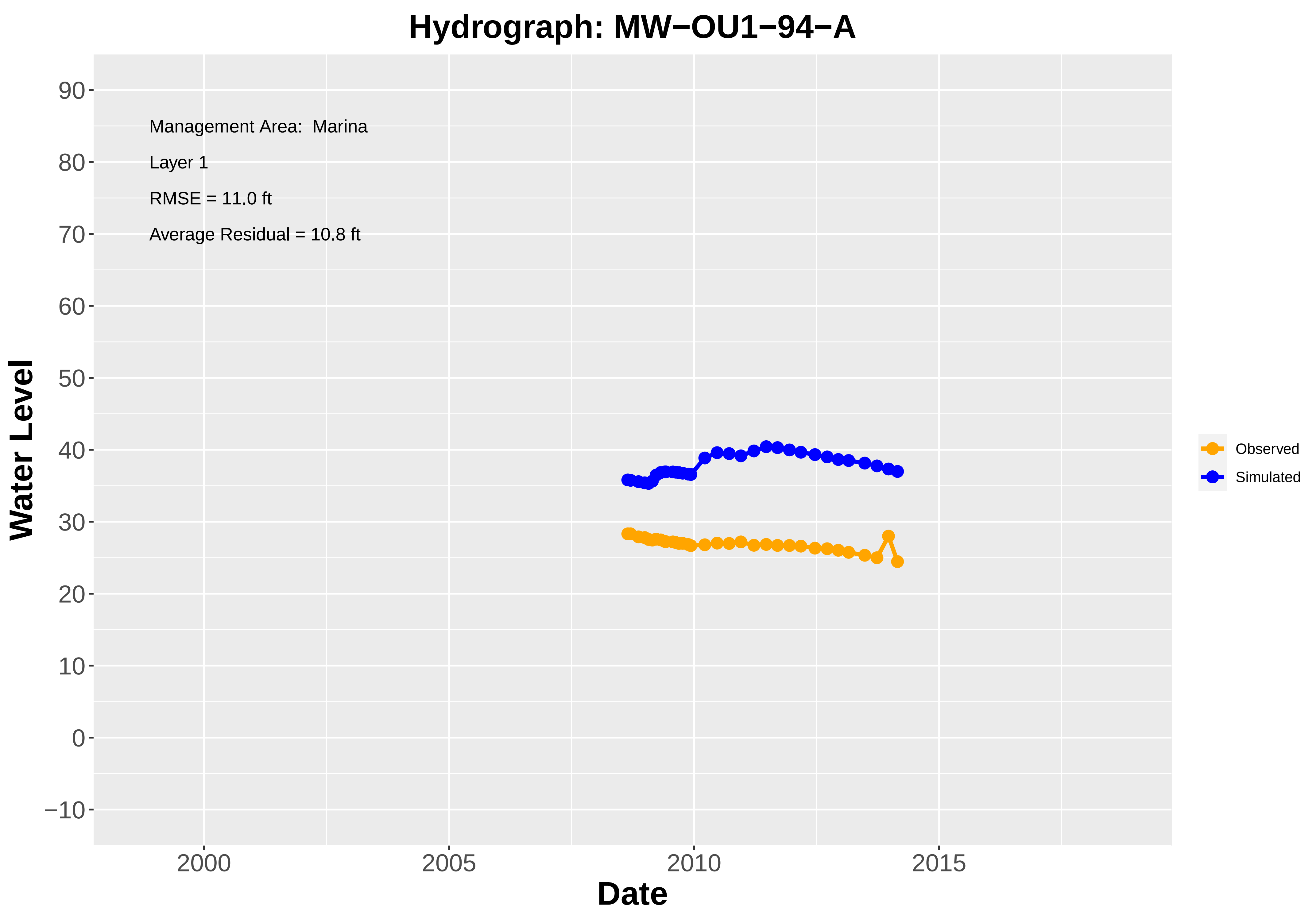


Hydrograph: MW−OU1−89−A
Management Area: Marina
Layer 1
RMSE = 7.7 ft
Average Residual = 7.6 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated

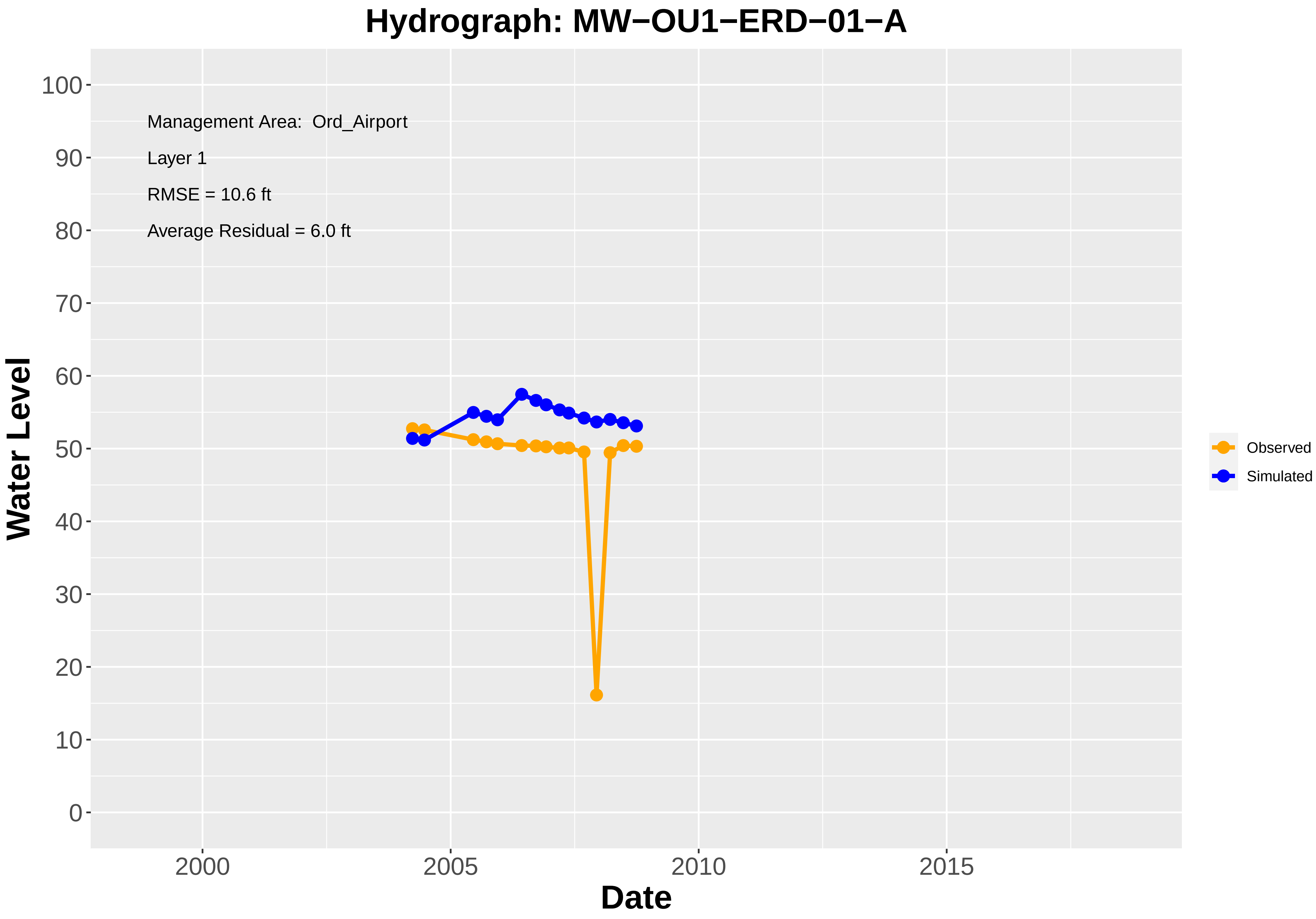

Hydrograph: MW−OU1−90−A
Management Area: Marina
Layer 1
RMSE = 5.7 ft
Average Residual = 5.5 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

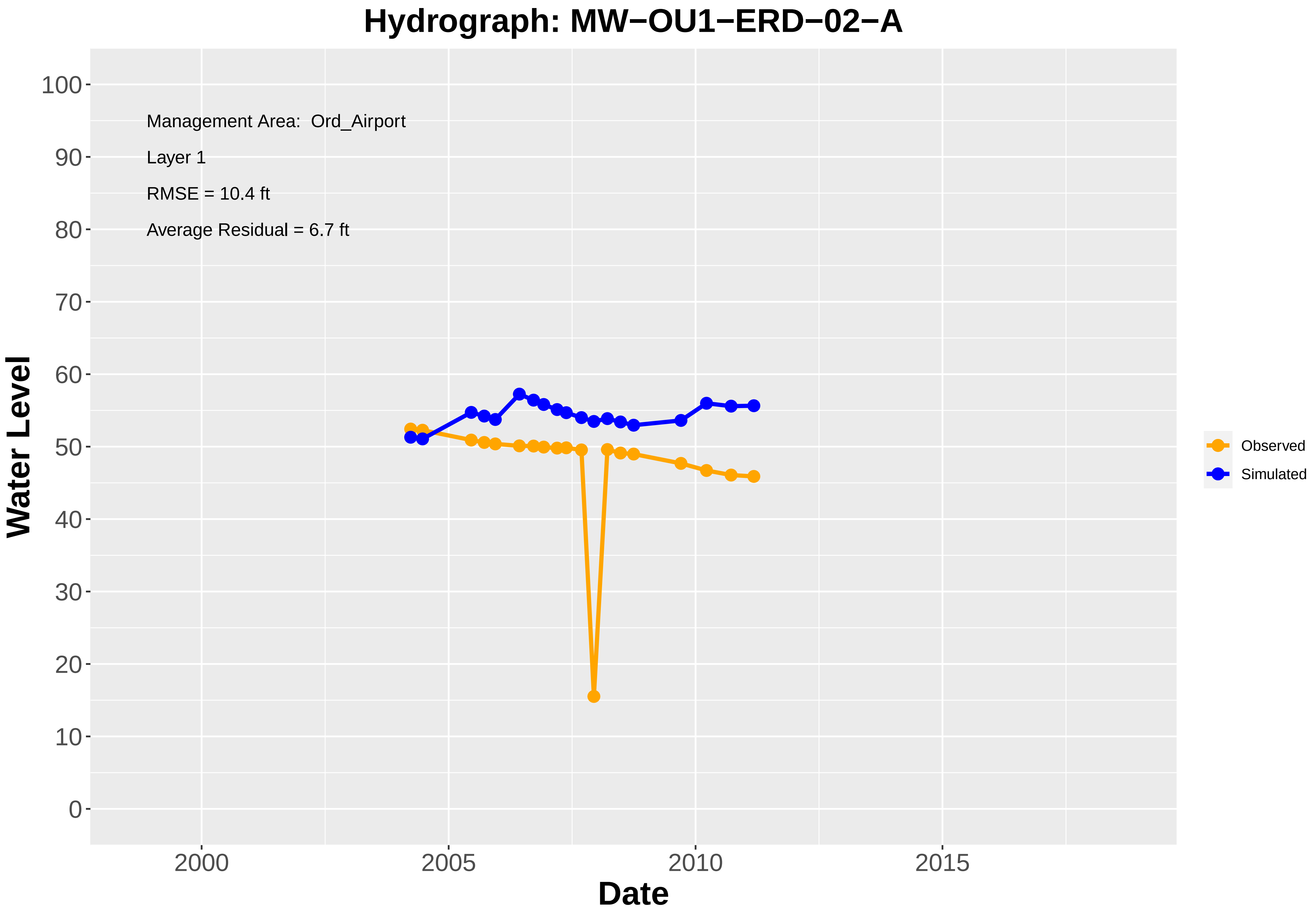


Hydrograph: MW−OU1−91−A
Management Area: Marina
Layer 1
RMSE = 8.5 ft
Average Residual = 8.3 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



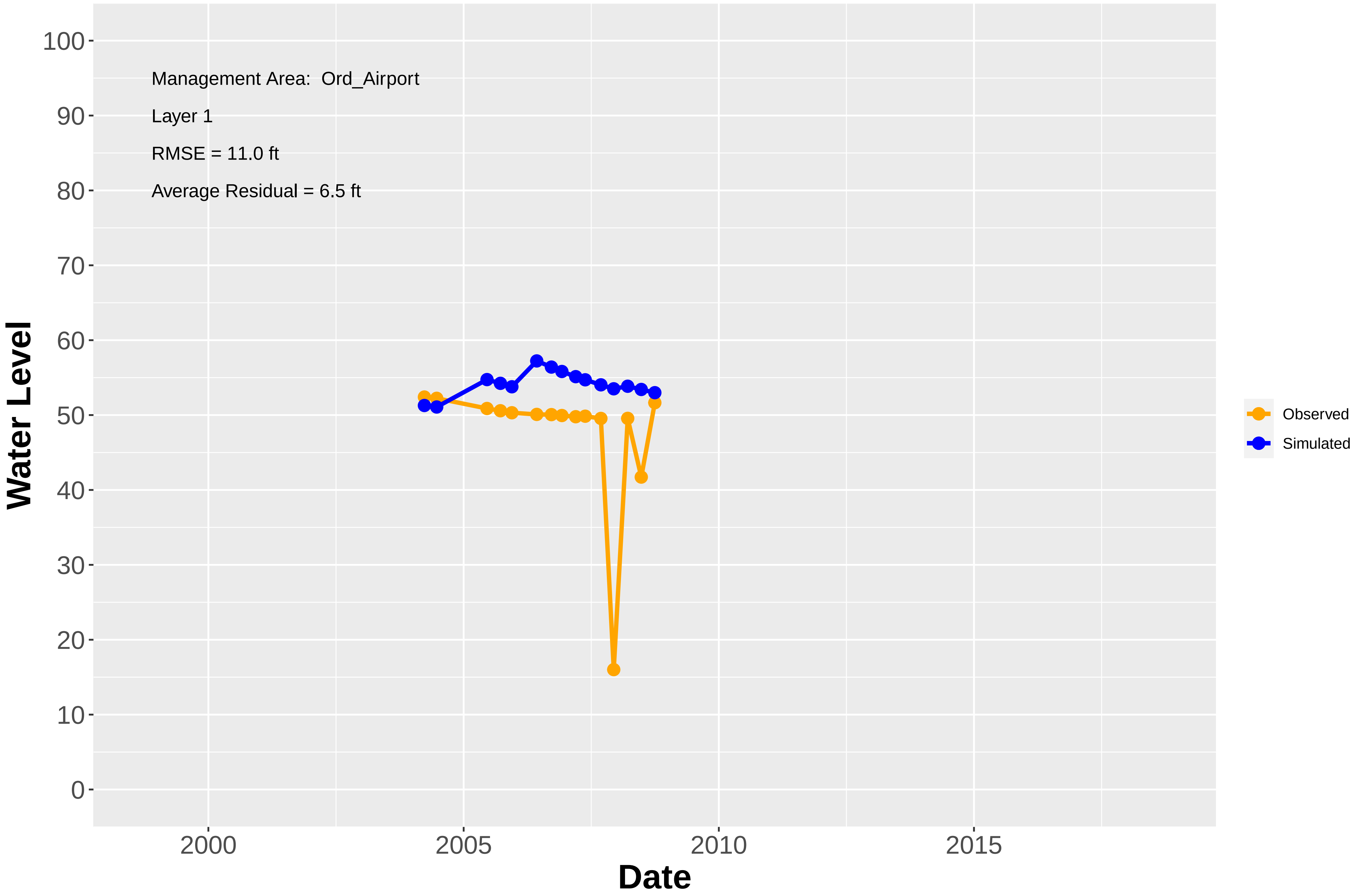
Hydrograph: MW−OU1−94−A
Management Area: Marina
Layer 1
RMSE = 11.0 ft
Average Residual = 10.8 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

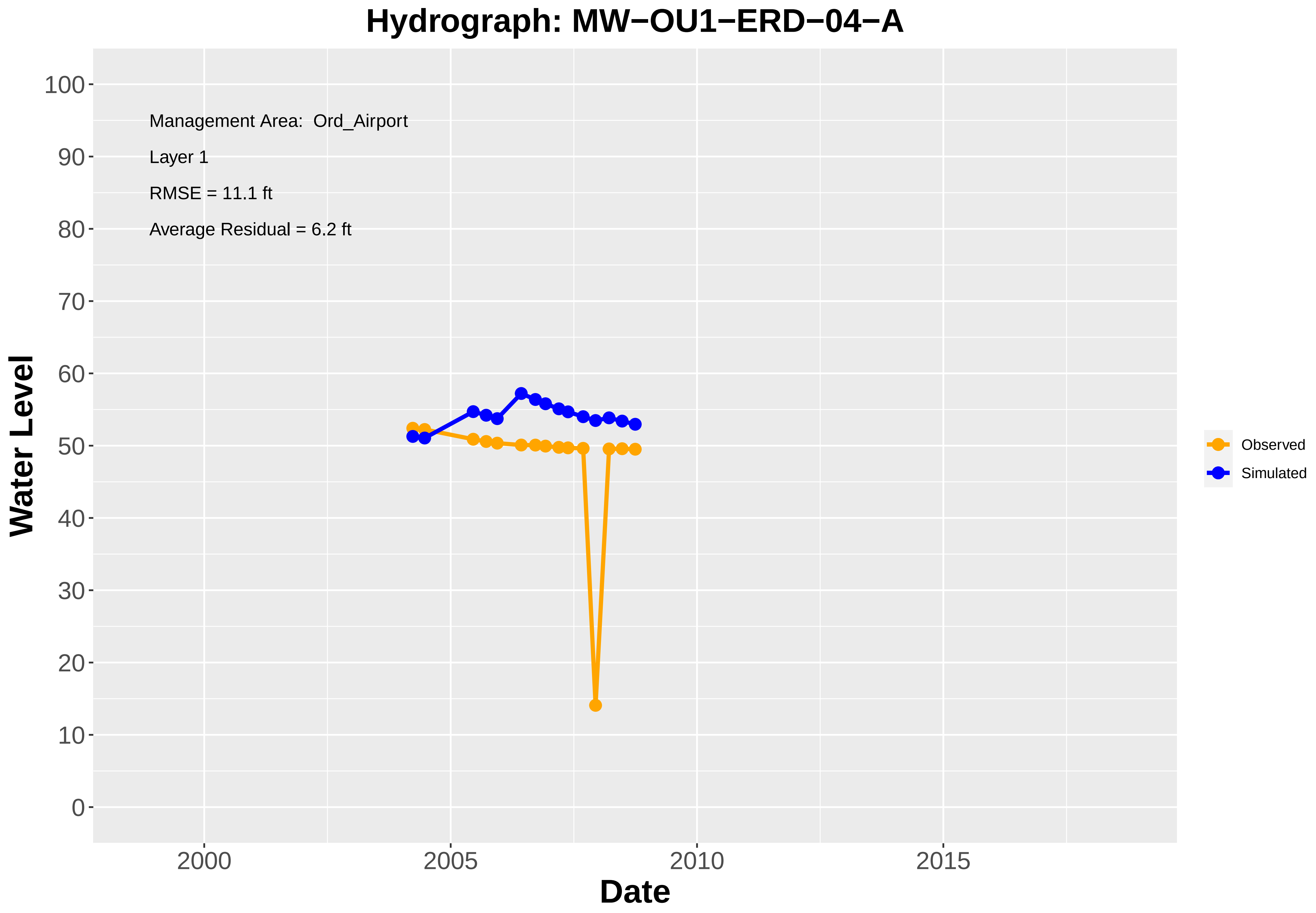

Hydrograph: MW−OU1−ERD−01−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.6 ft
Average Residual = 6.0 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated



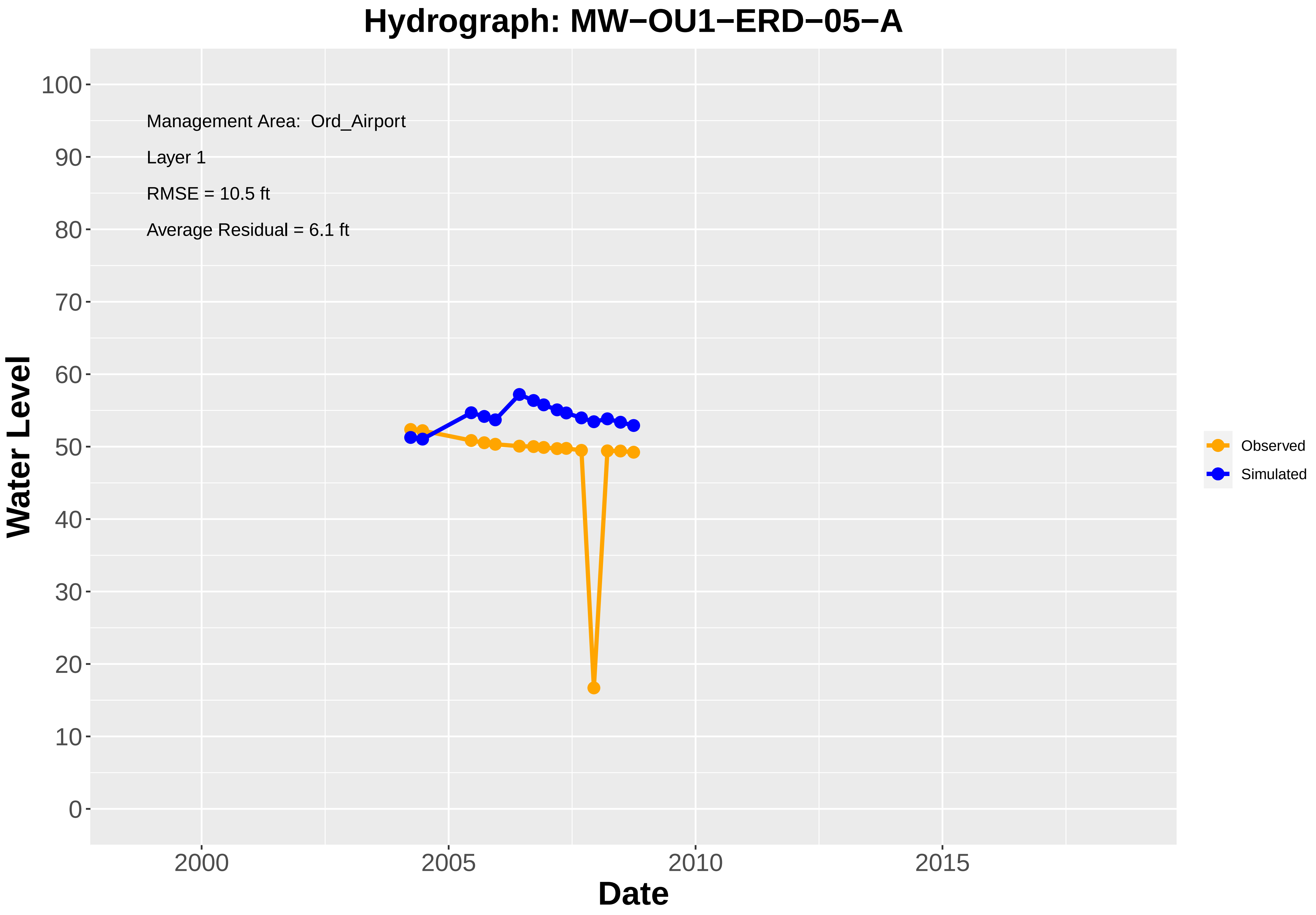
Hydrograph: MW−OU1−ERD−02−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.4 ft
Average Residual = 6.7 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

Hydrograph: MW−OU1−ERD−03−A

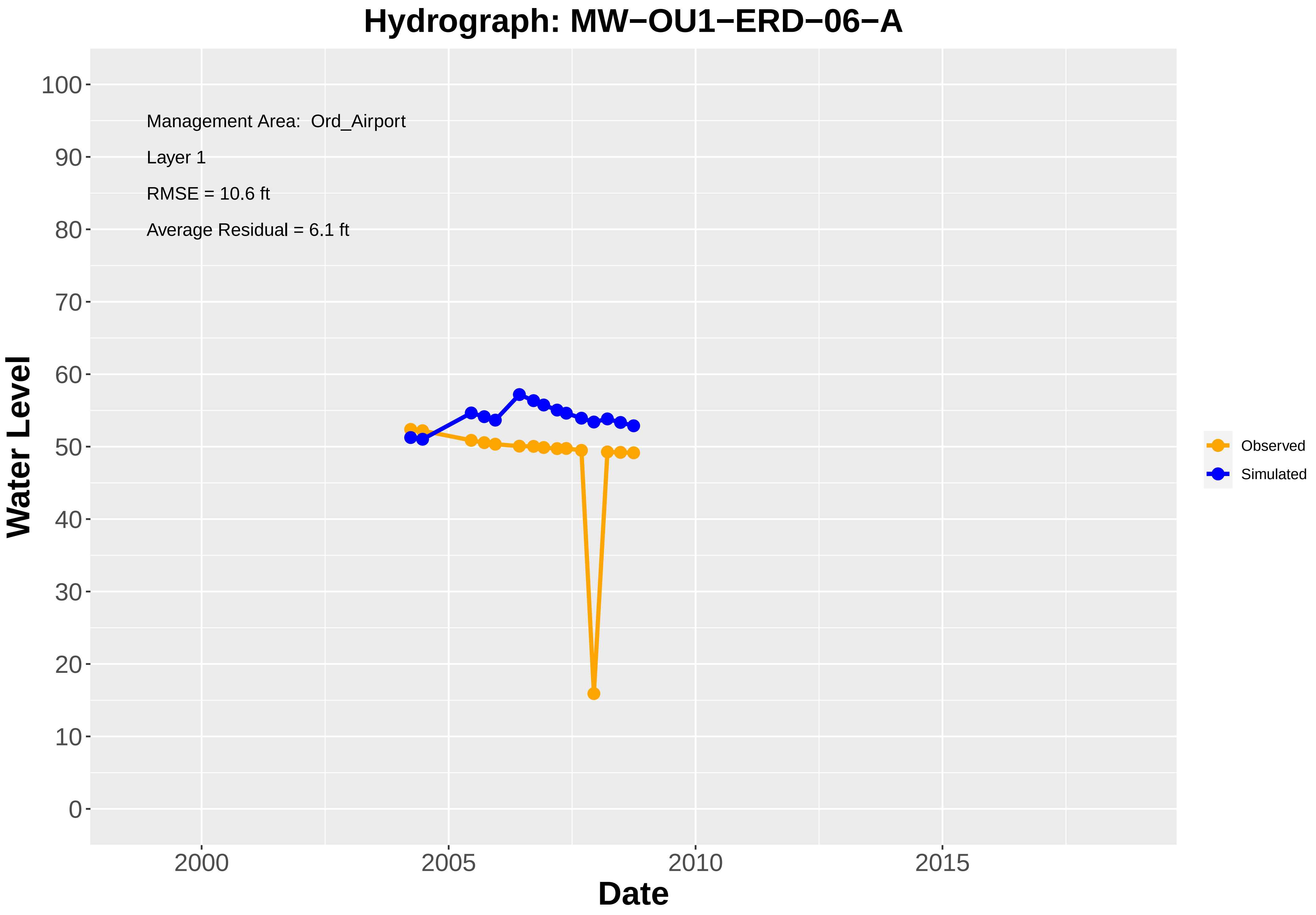


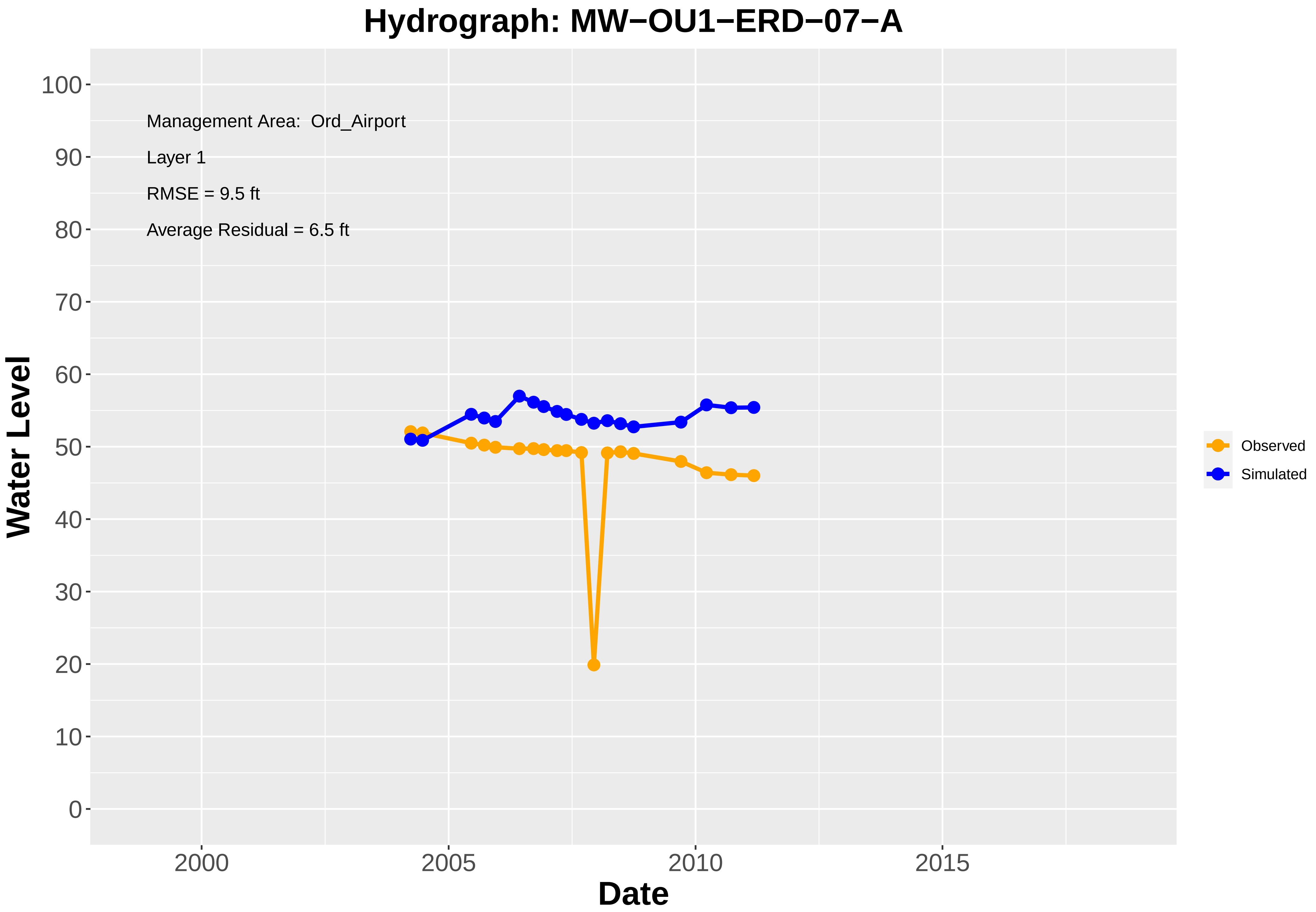


Hydrograph: MW−OU1−ERD−04−A
Management Area: Ord_Airport
Layer 1
RMSE = 11.1 ft
Average Residual = 6.2 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

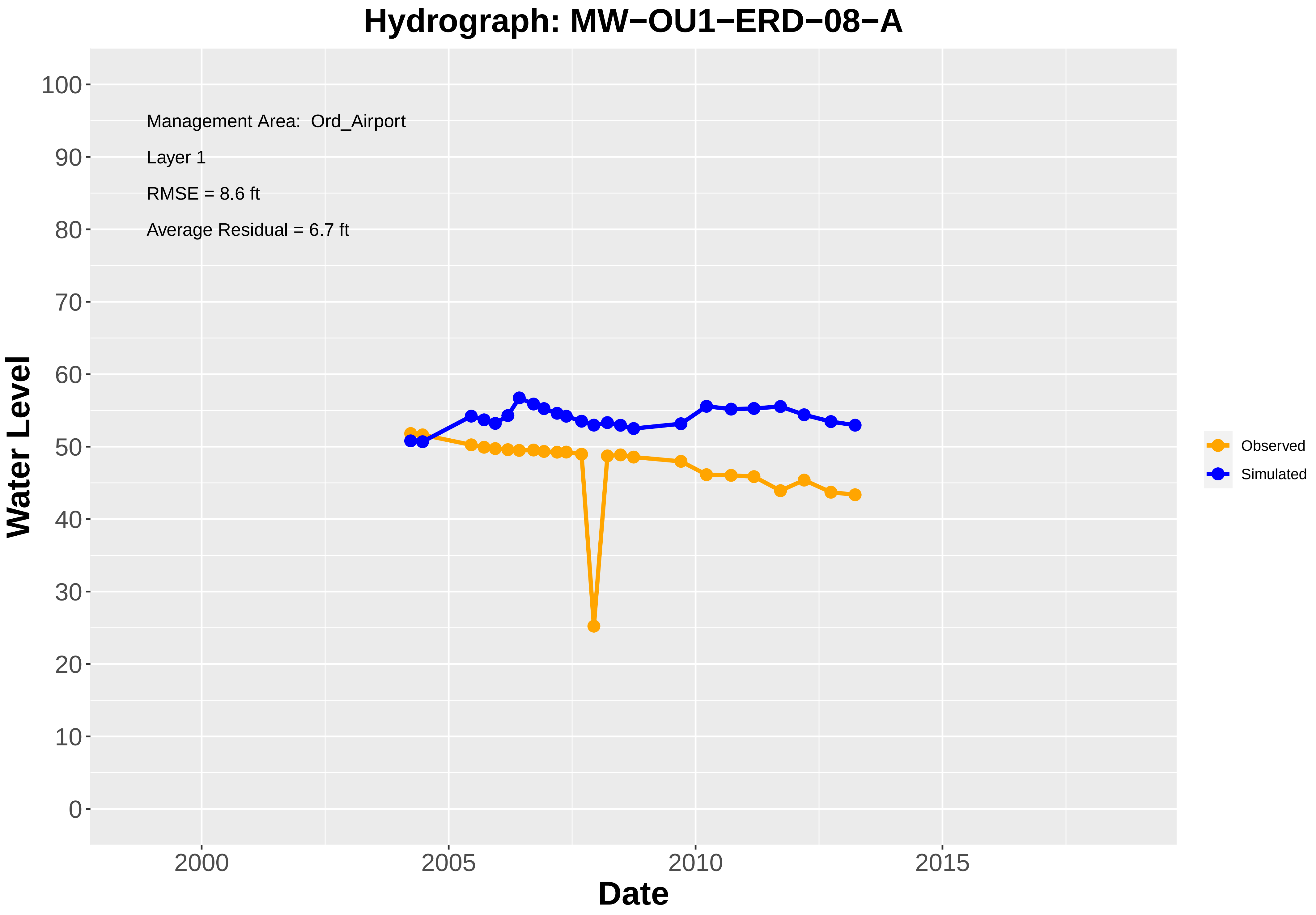


Hydrograph: MW−OU1−ERD−05−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.5 ft
Average Residual = 6.1 ft
Water Level
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Date
Observed
Simulated

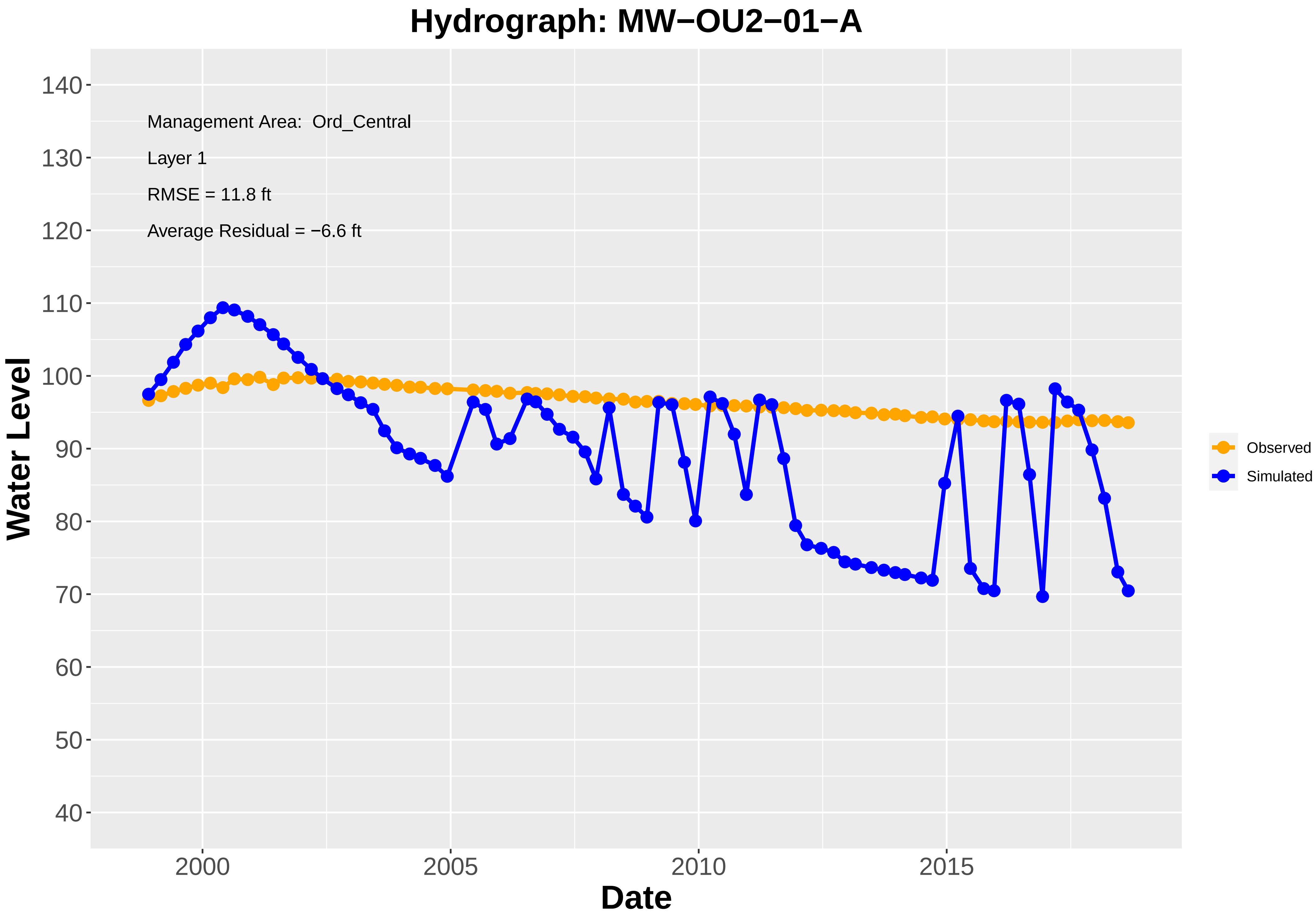

Hydrograph: MW−OU1−ERD−06−A
Management Area: Ord_Airport
Layer 1
RMSE = 10.6 ft
Average Residual = 6.1 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated



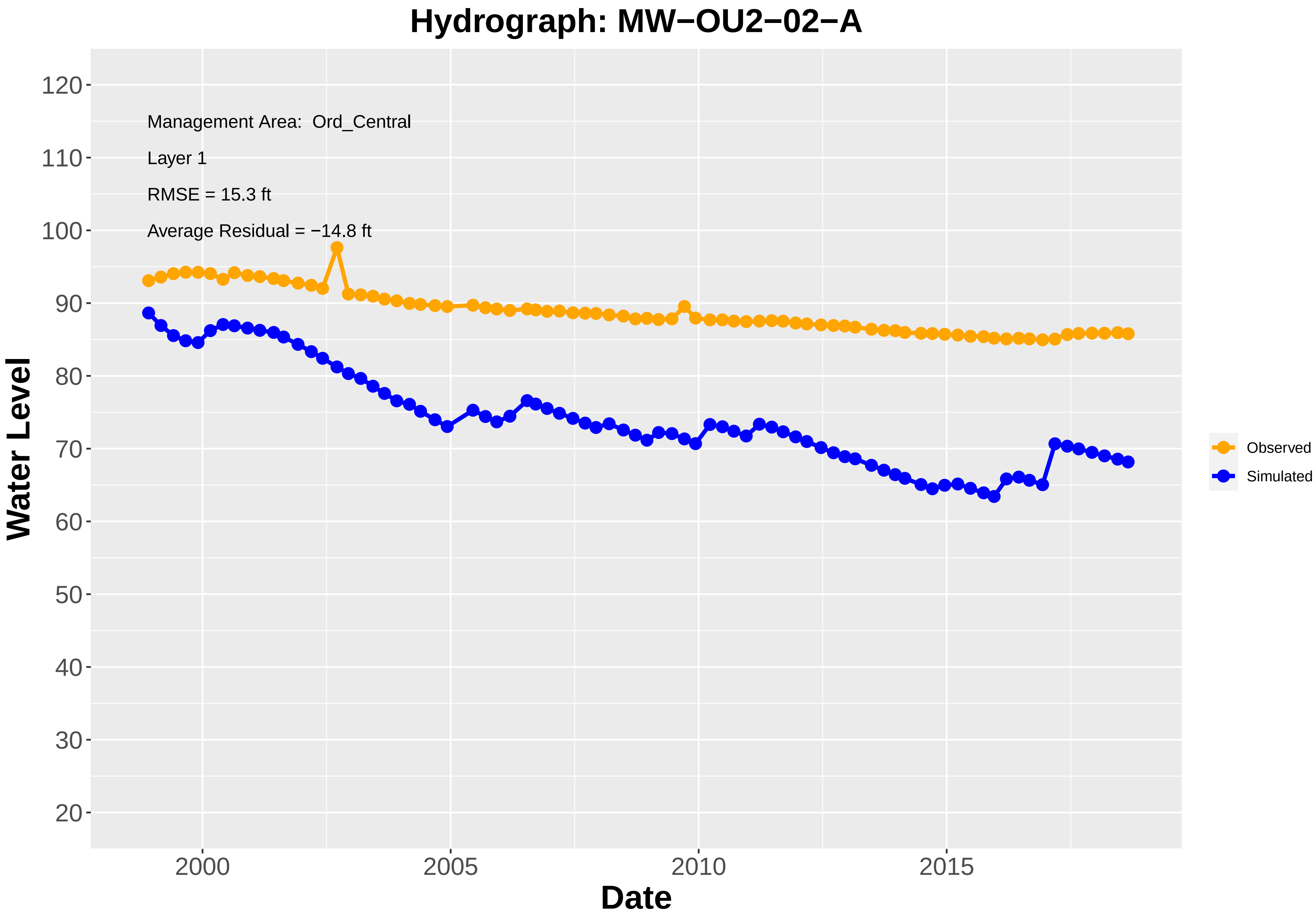
Hydrograph: MW−OU1−ERD−07−A
Management Area: Ord_Airport
Layer 1
RMSE = 9.5 ft
Average Residual = 6.5 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated



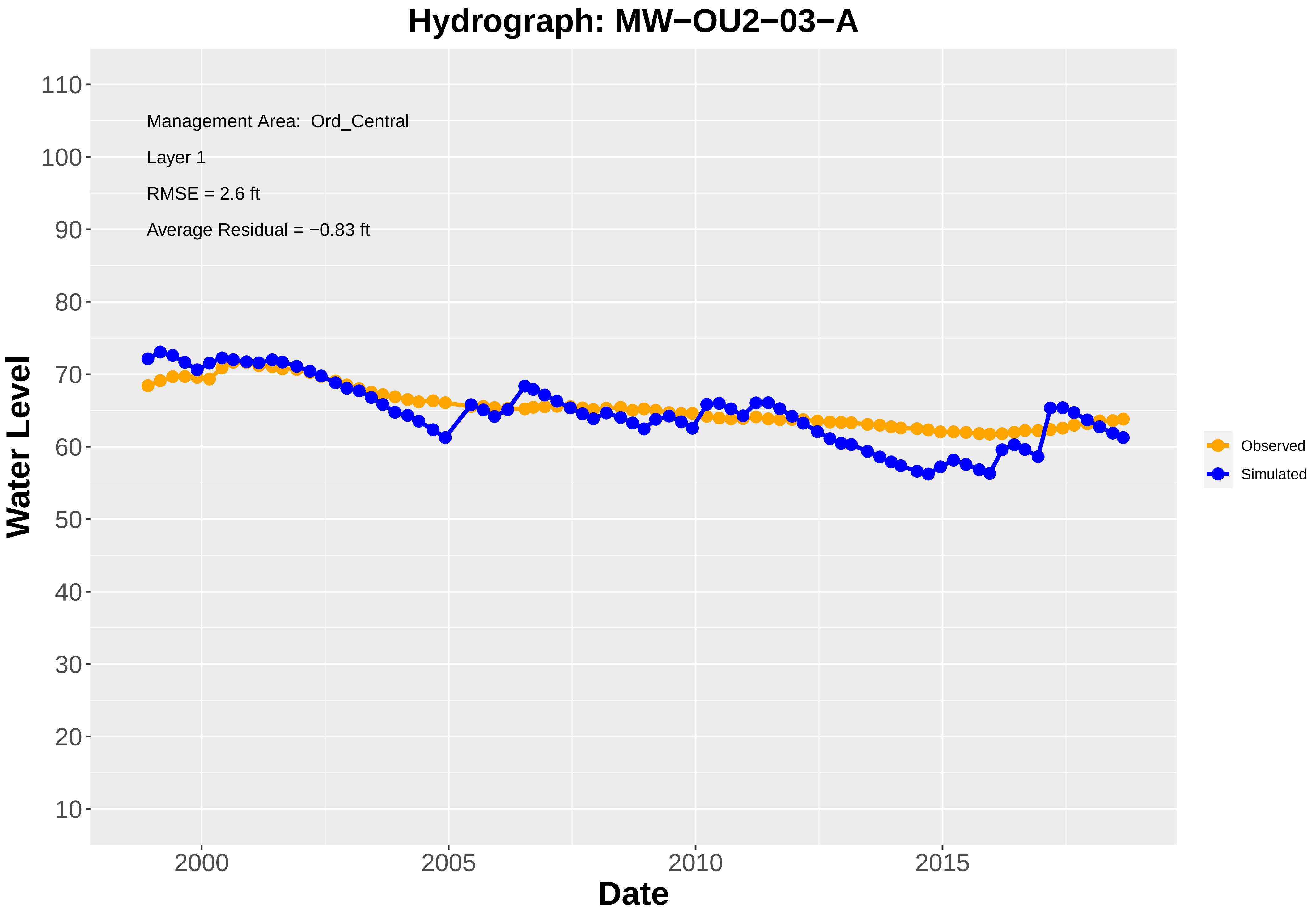
Hydrograph: MW−OU1−ERD−08−A
Management Area: Ord_Airport
Layer 1
RMSE = 8.6 ft
Average Residual = 6.7 ft
Water Level
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Date
Observed
Simulated

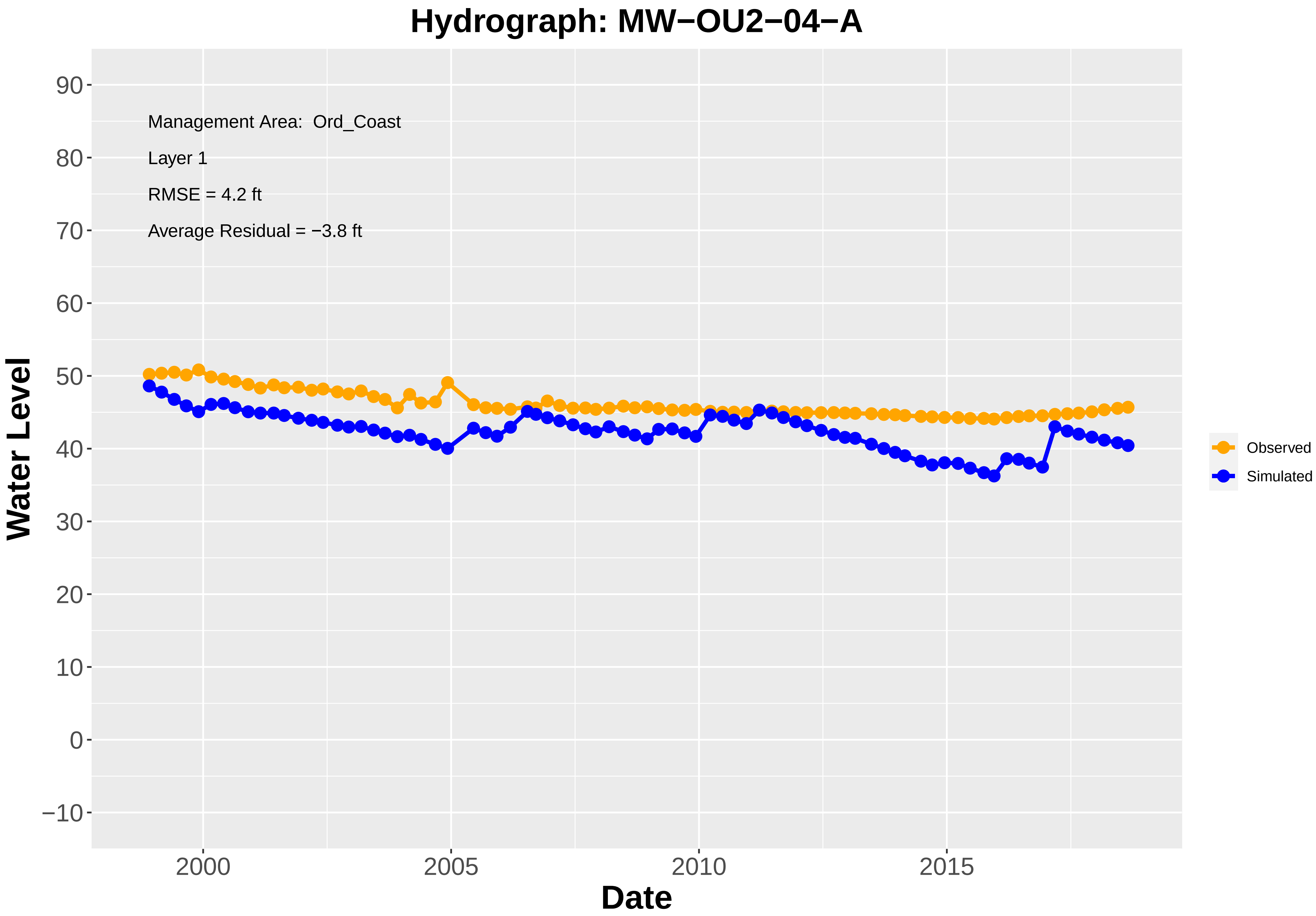


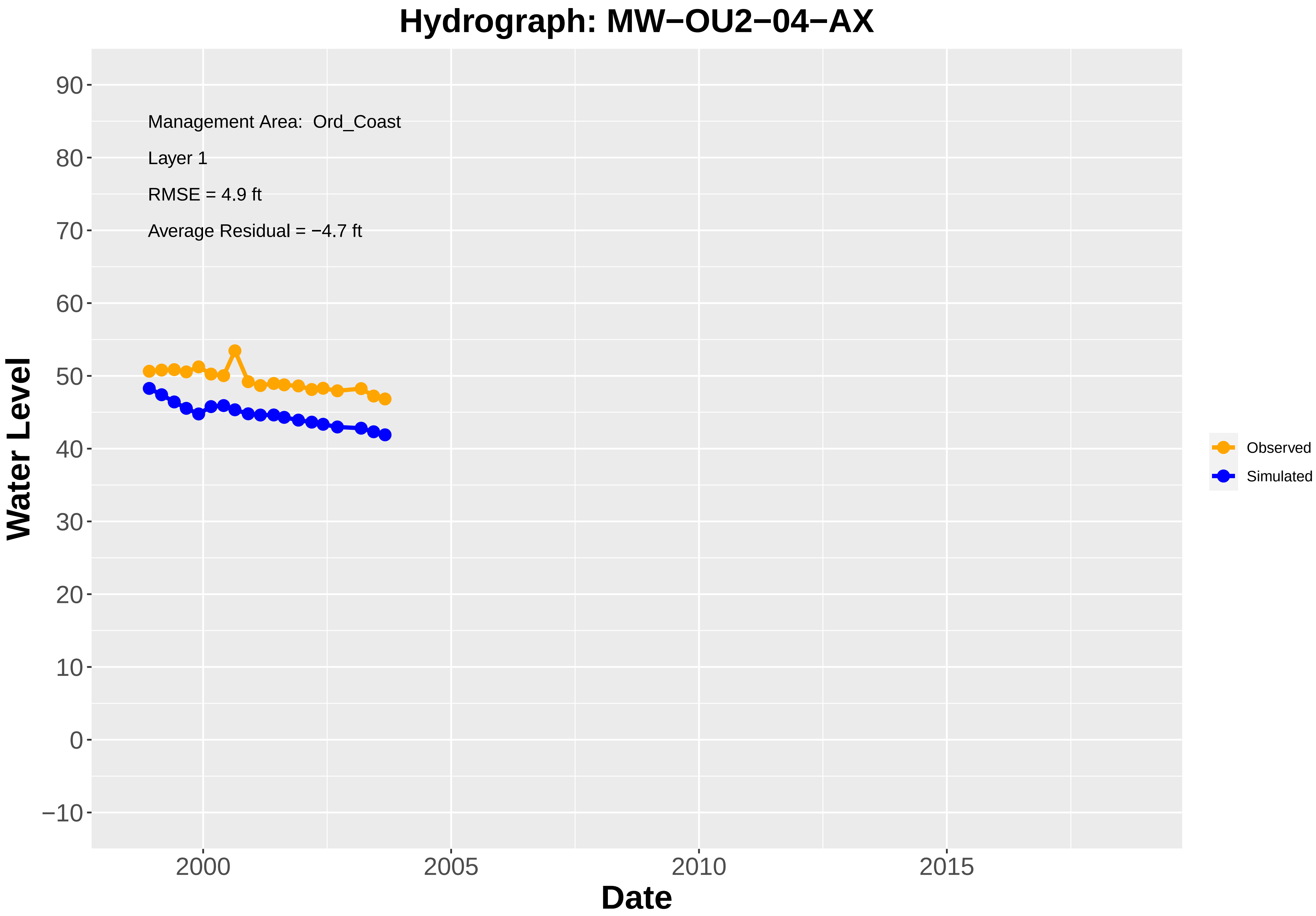
Hydrograph: MW−OU2−01−A
Management Area: Ord_Central
Layer 1
RMSE = 11.8 ft
Average Residual = −6.6 ft
Water Level
Date
Observed
Simulated
140
130
120
110
100
90
80
70
60
50
40
2000
2005
2010
2015

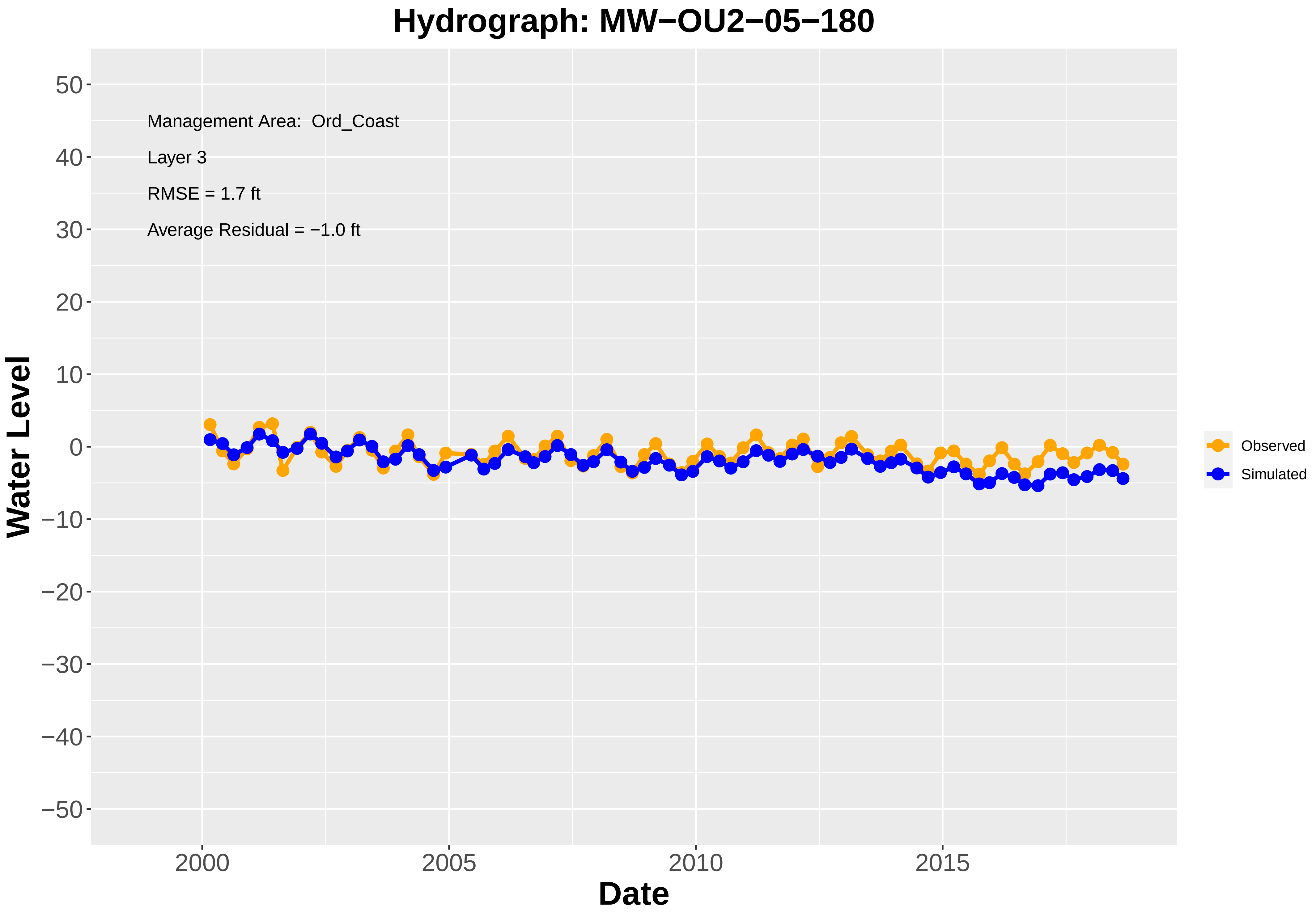


Hydrograph: MW−OU2−02−A
Management Area: Ord_Central
Layer 1
RMSE = 15.3 ft
Average Residual = −14.8 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−03−A
Management Area: Ord_Central
Layer 1
RMSE = 2.6 ft
Average Residual = −0.83 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

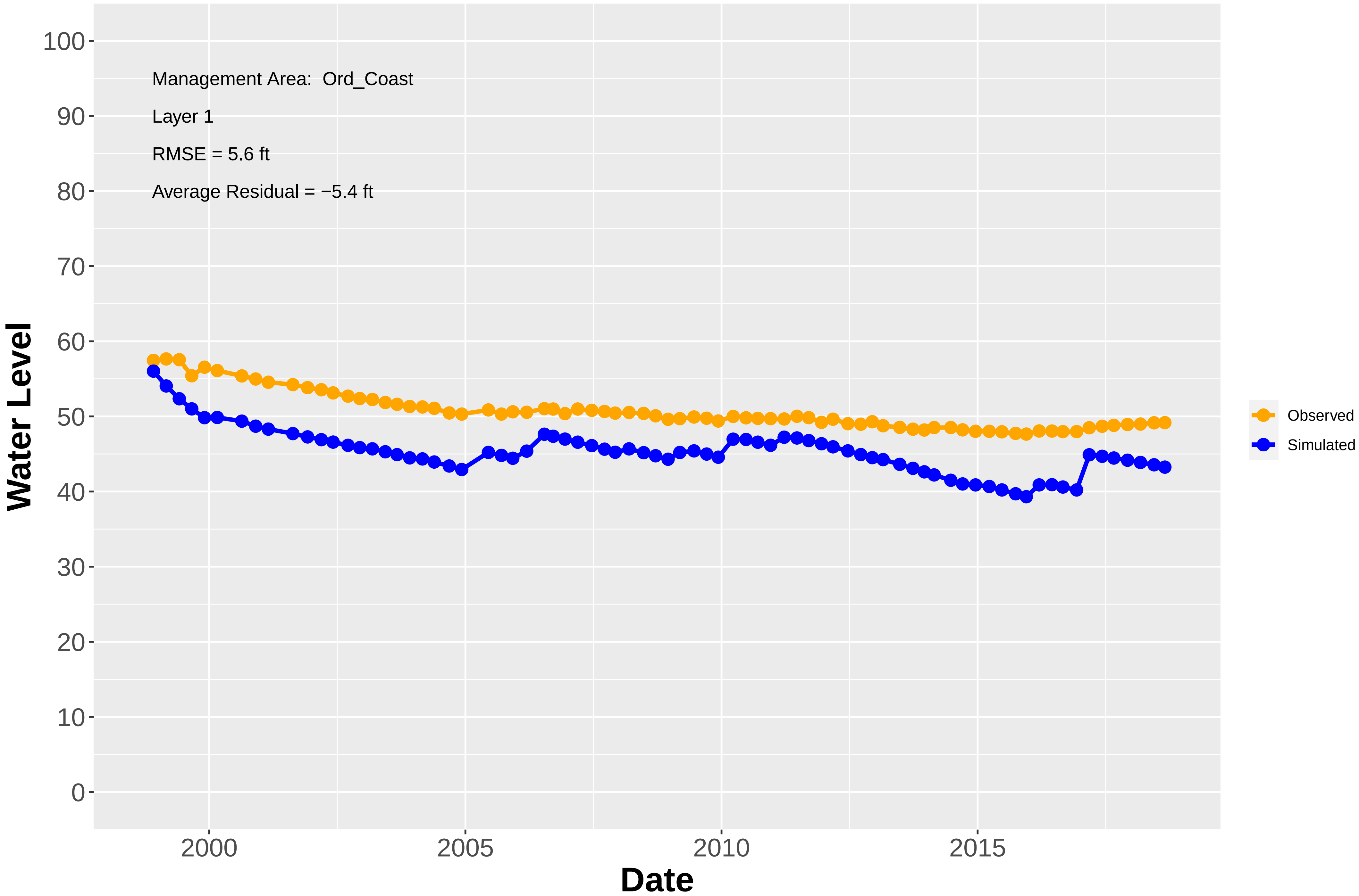

Hydrograph: MW−OU2−04−A
Management Area: Ord_Coast
Layer 1
RMSE = 4.2 ft
Average Residual = −3.8 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated

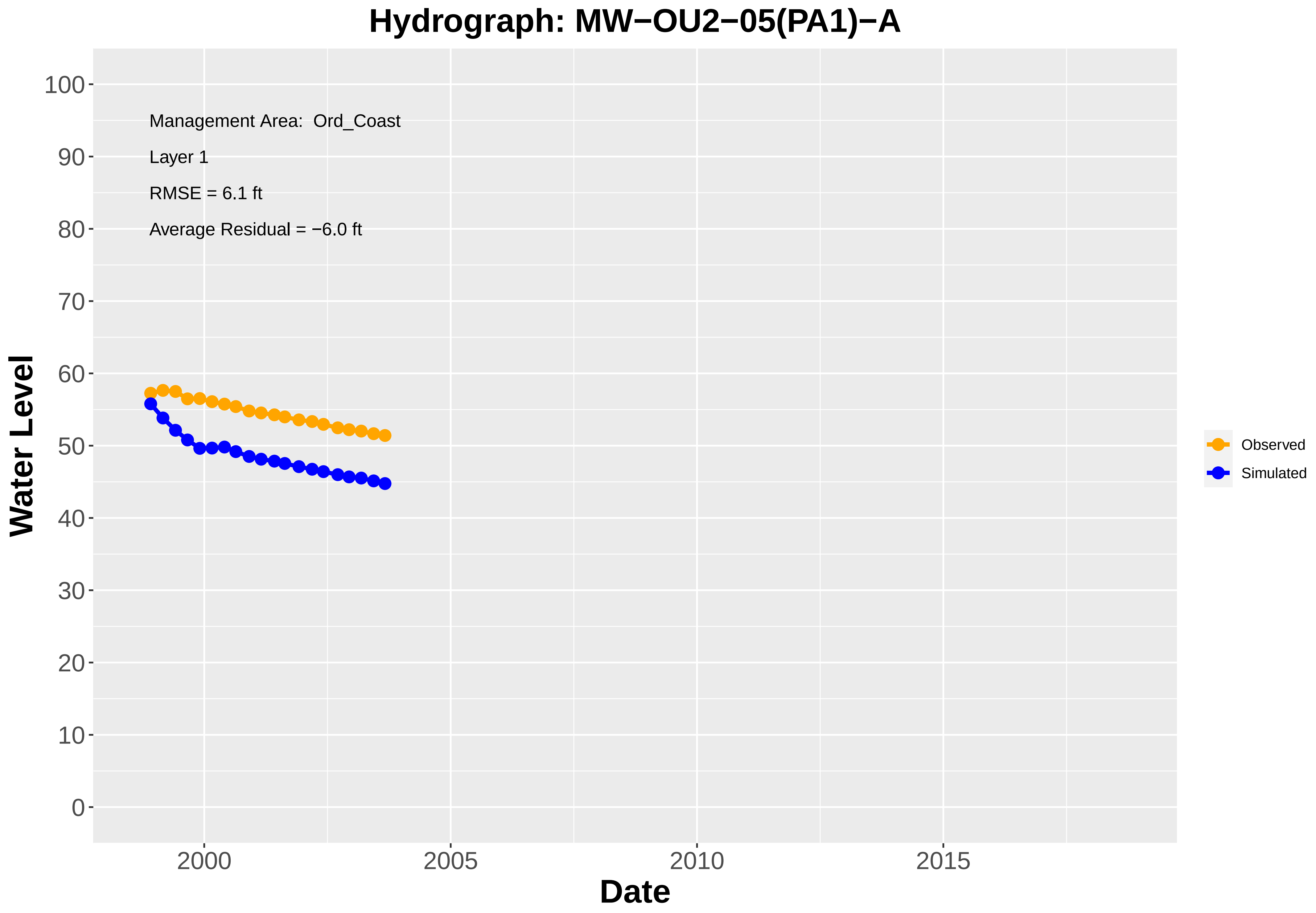

Hydrograph: MW−OU2−04−AX
Management Area: Ord_Coast
Layer 1
RMSE = 4.9 ft
Average Residual = −4.7 ft
Water Level
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Date
Observed
Simulated

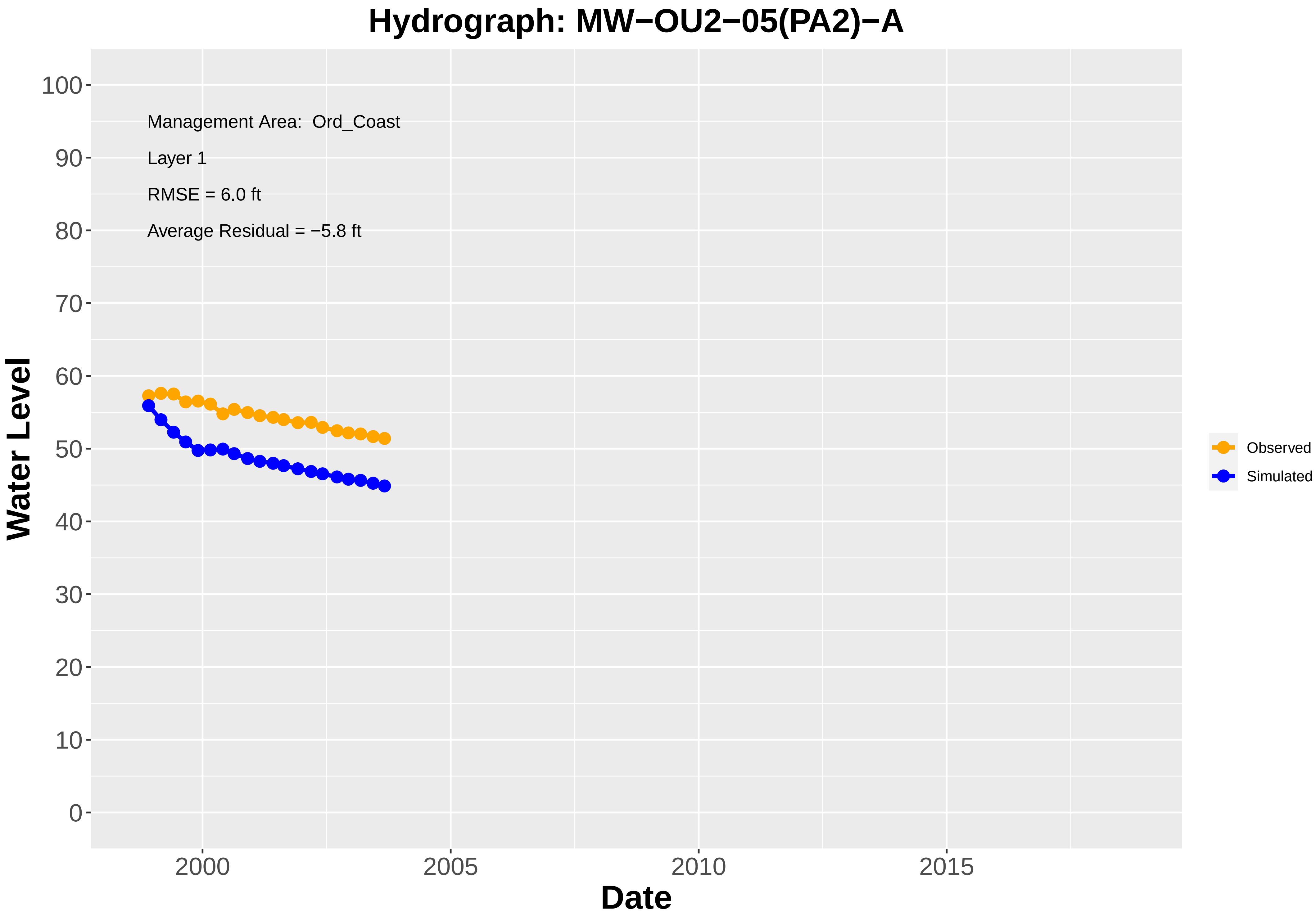


Hydrograph: MW−OU2−05−180
Management Area: Ord_Coast
Layer 3
RMSE = 1.7 ft
Average Residual = −1.0 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

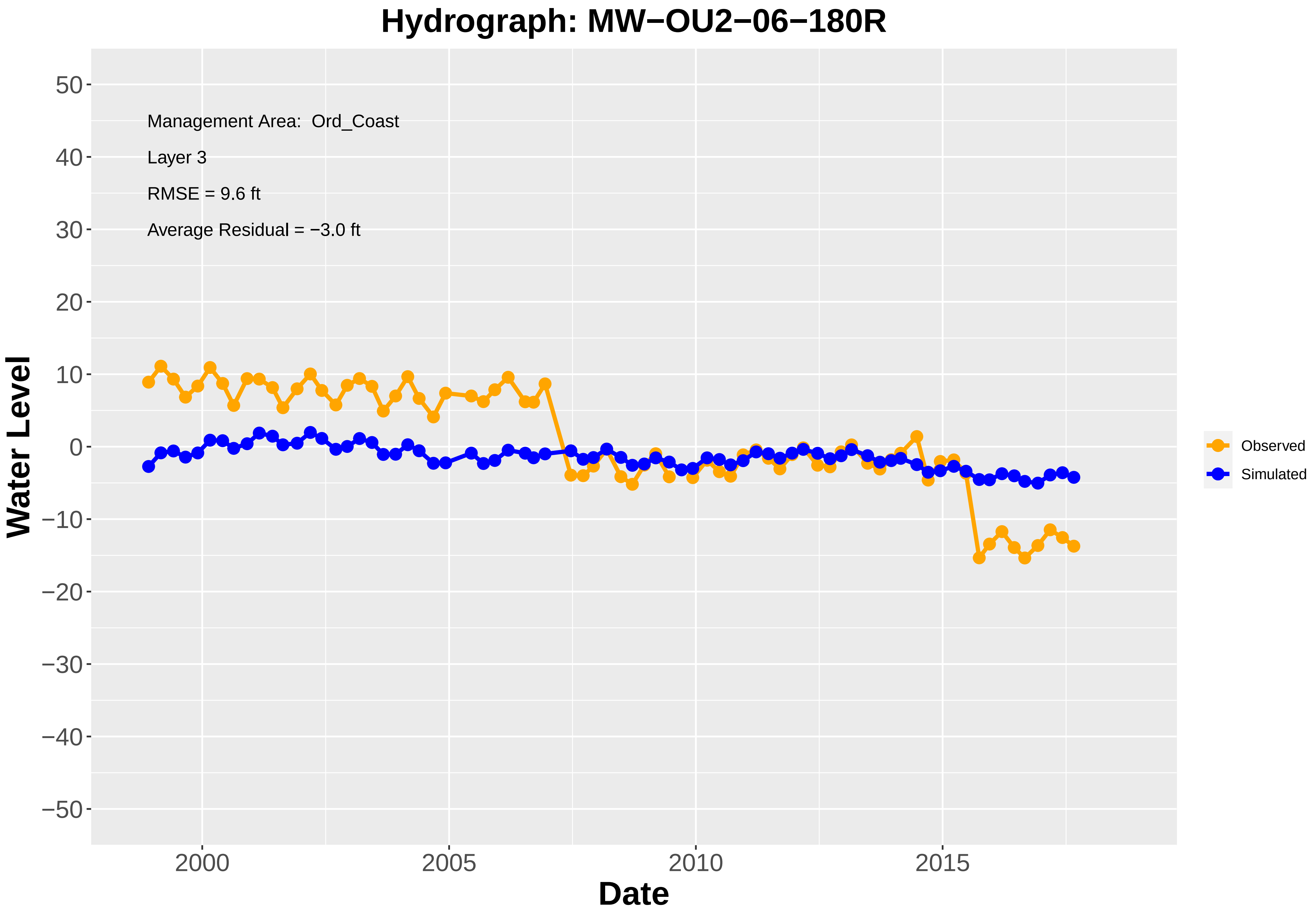
Hydrograph: MW−OU2−05−A

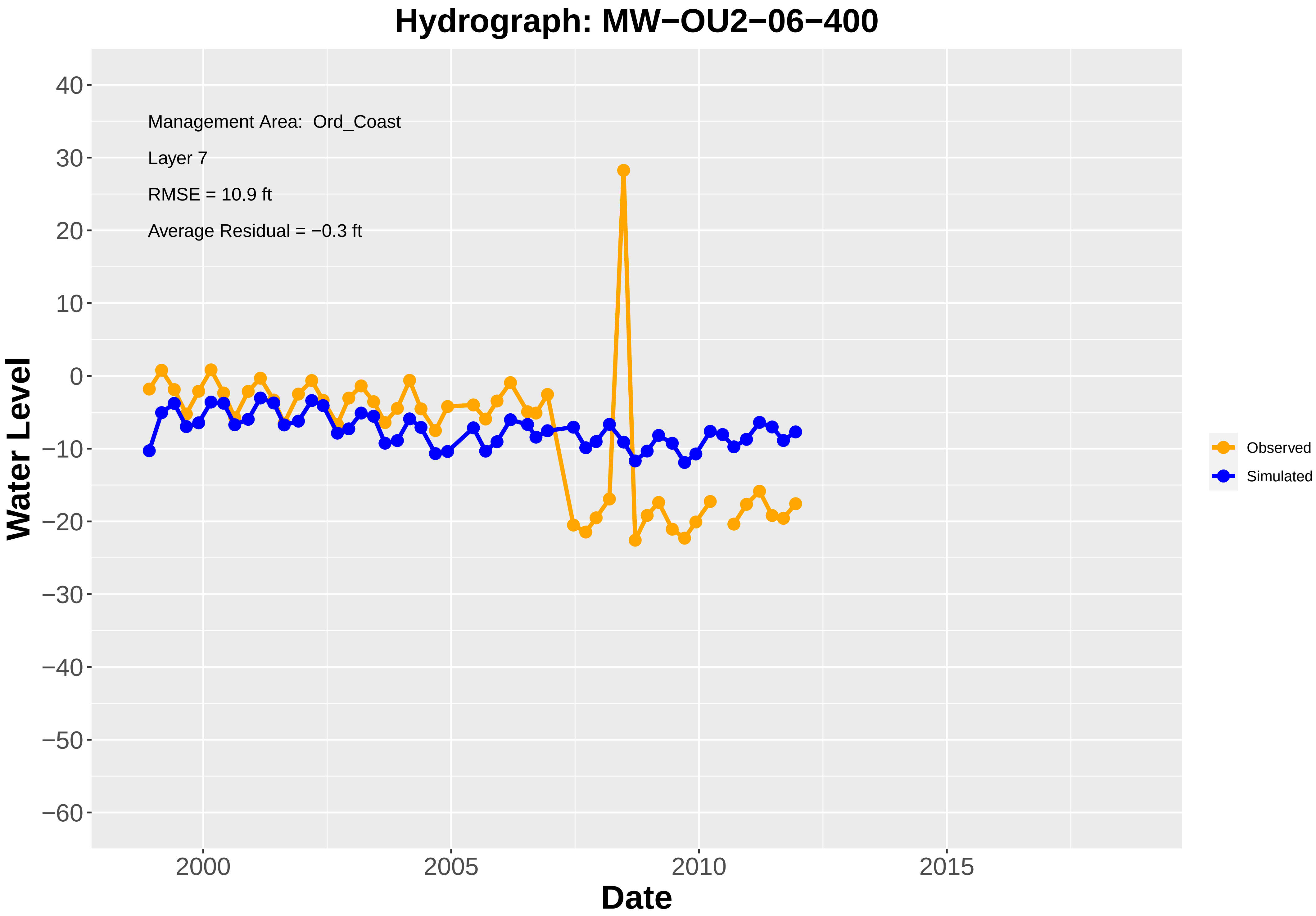


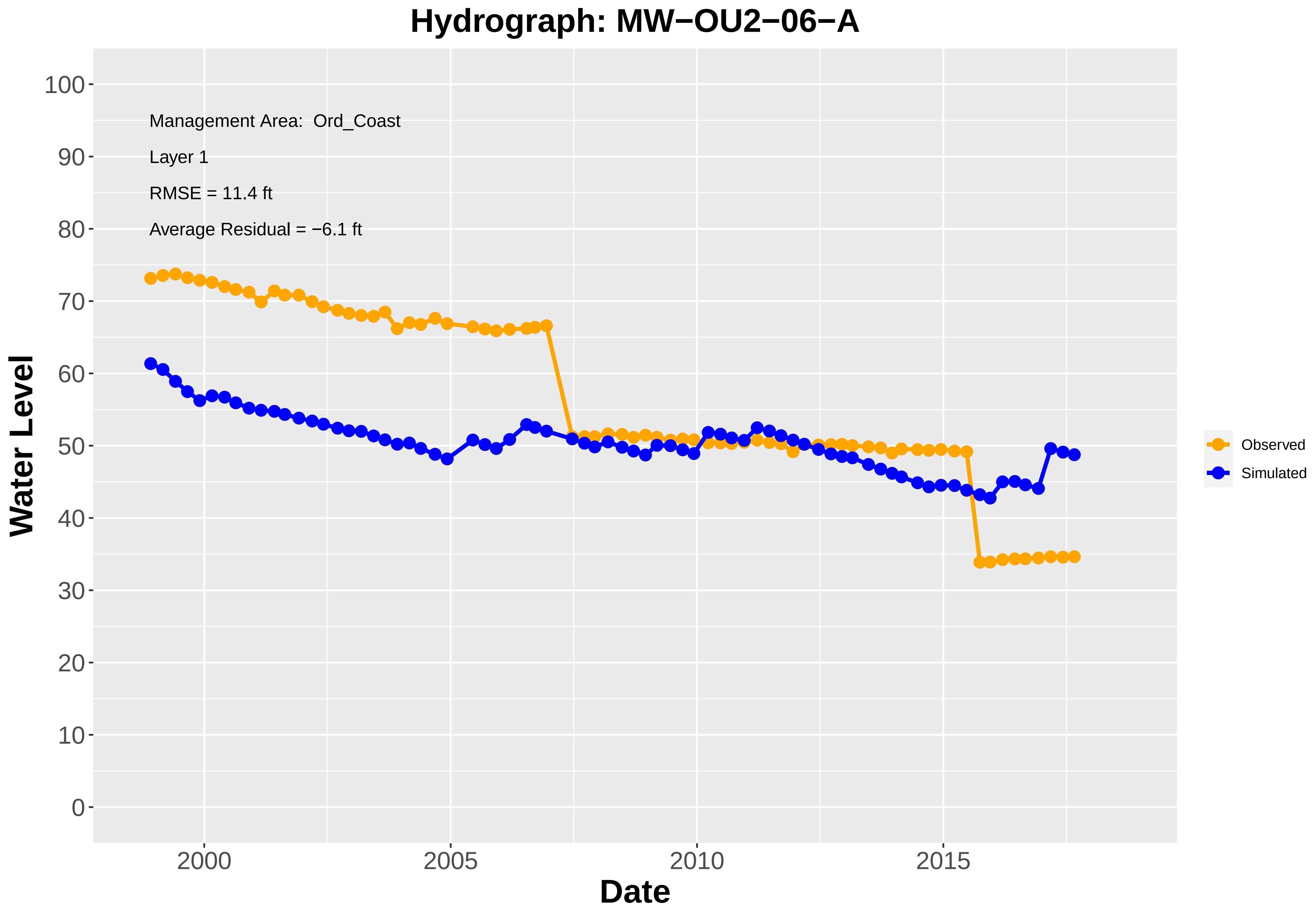

Hydrograph: MW−OU2−05(PA1)−A
Management Area: Ord_Coast
Layer 1
RMSE = 6.1 ft
Average Residual = −6.0 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

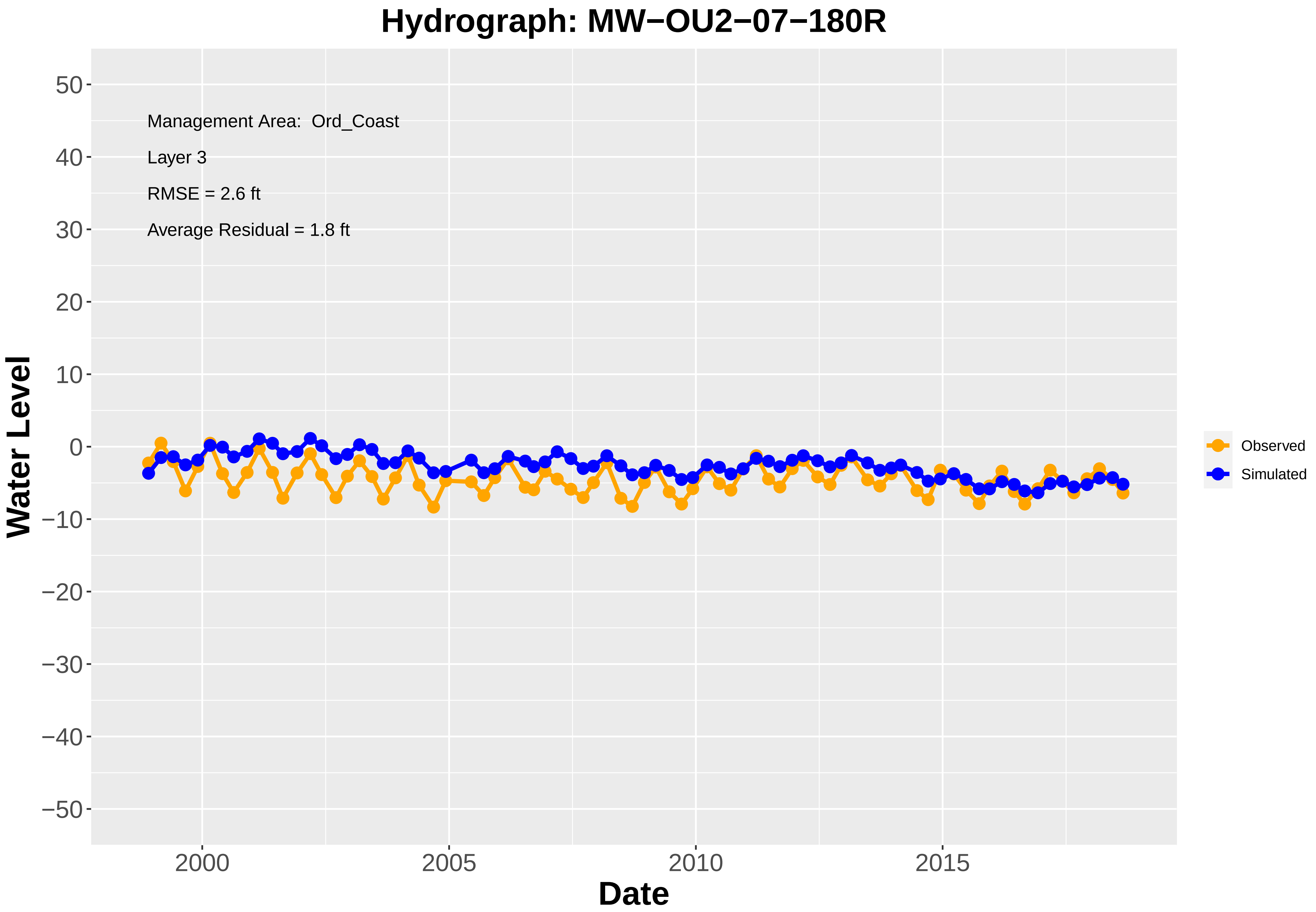


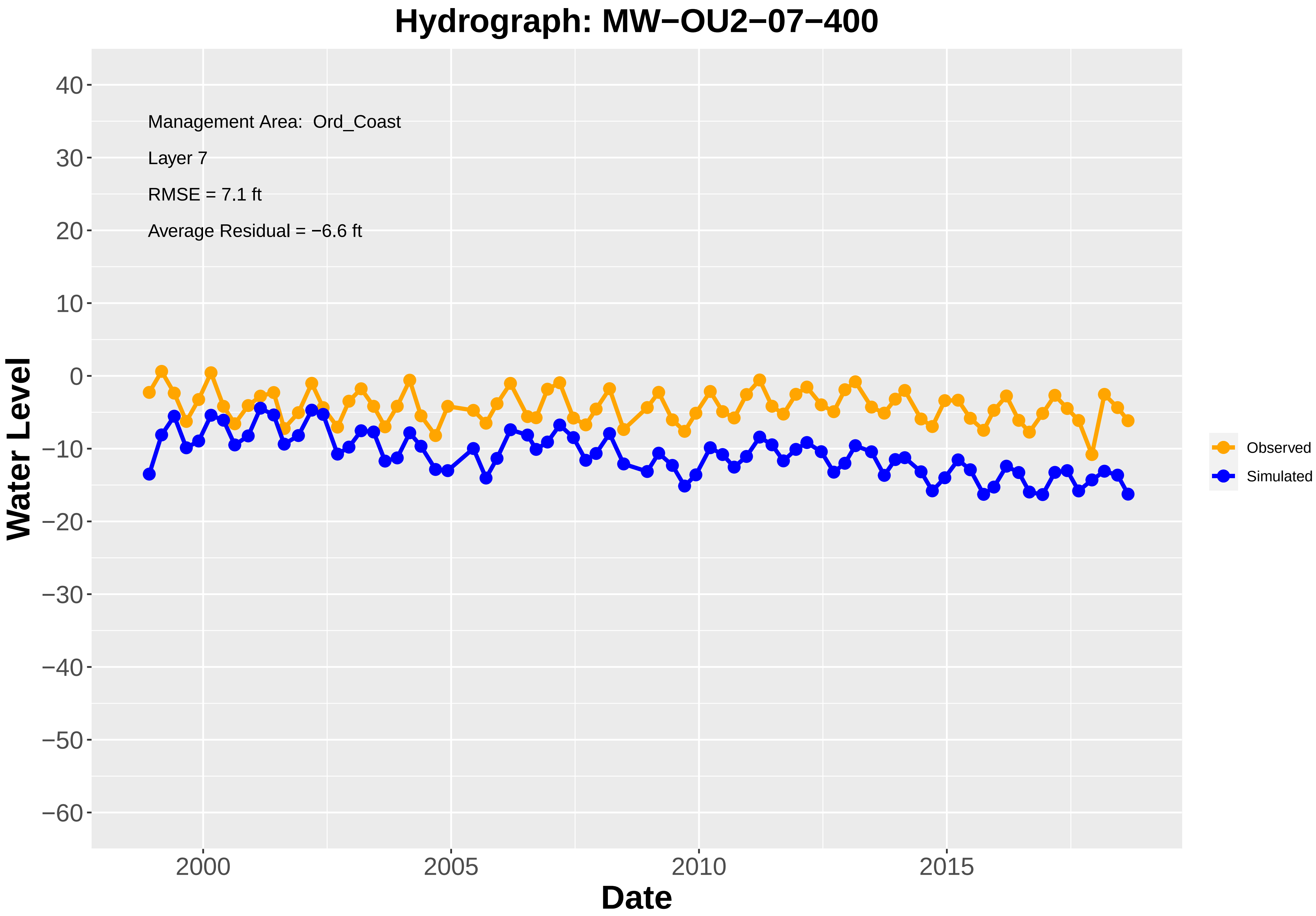
Hydrograph: MW−OU2−05(PA2)−A
Management Area: Ord_Coast
Layer 1
RMSE = 6.0 ft
Average Residual = −5.8 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−06−180R
Management Area: Ord_Coast
Layer 3
RMSE = 9.6 ft
Average Residual = −3.0 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

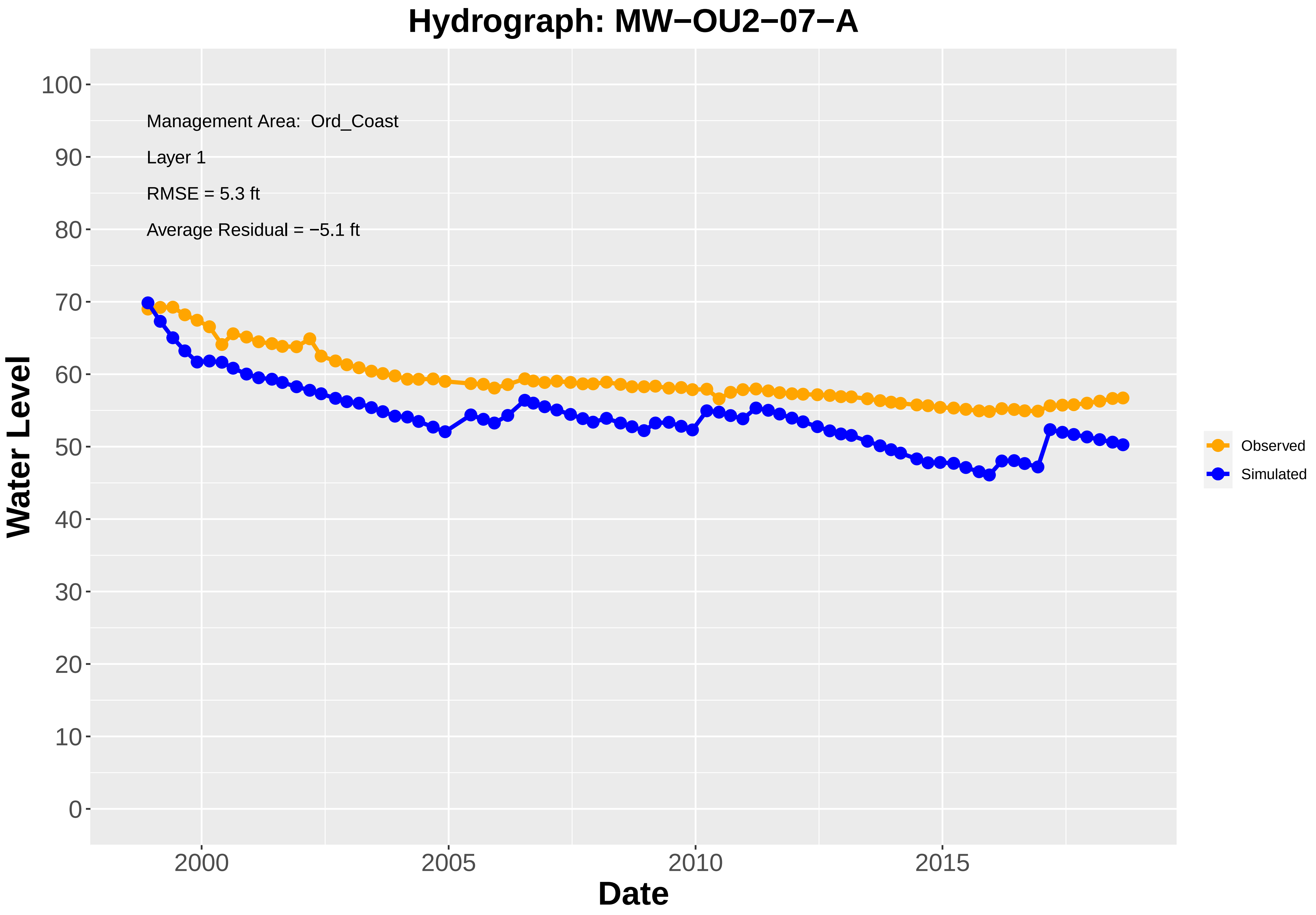

Hydrograph: MW−OU2−06−400
Management Area: Ord_Coast
Layer 7
RMSE = 10.9 ft
Average Residual = −0.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−06−A
Management Area: Ord_Coast
Layer 1
RMSE = 11.4 ft
Average Residual = −6.1 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

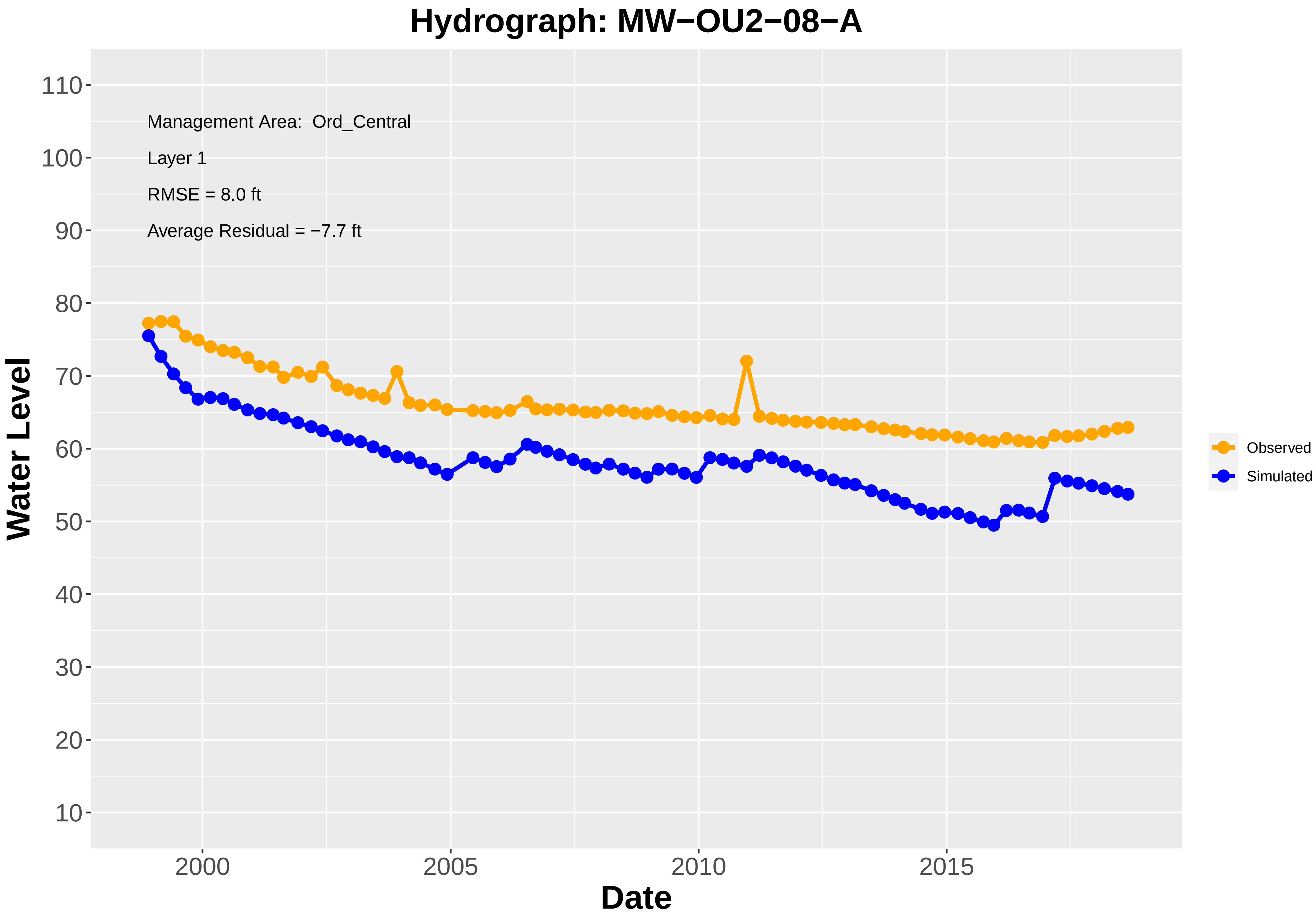

Hydrograph: MW−OU2−07−180R
Management Area: Ord_Coast
Layer 3
RMSE = 2.6 ft
Average Residual = 1.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



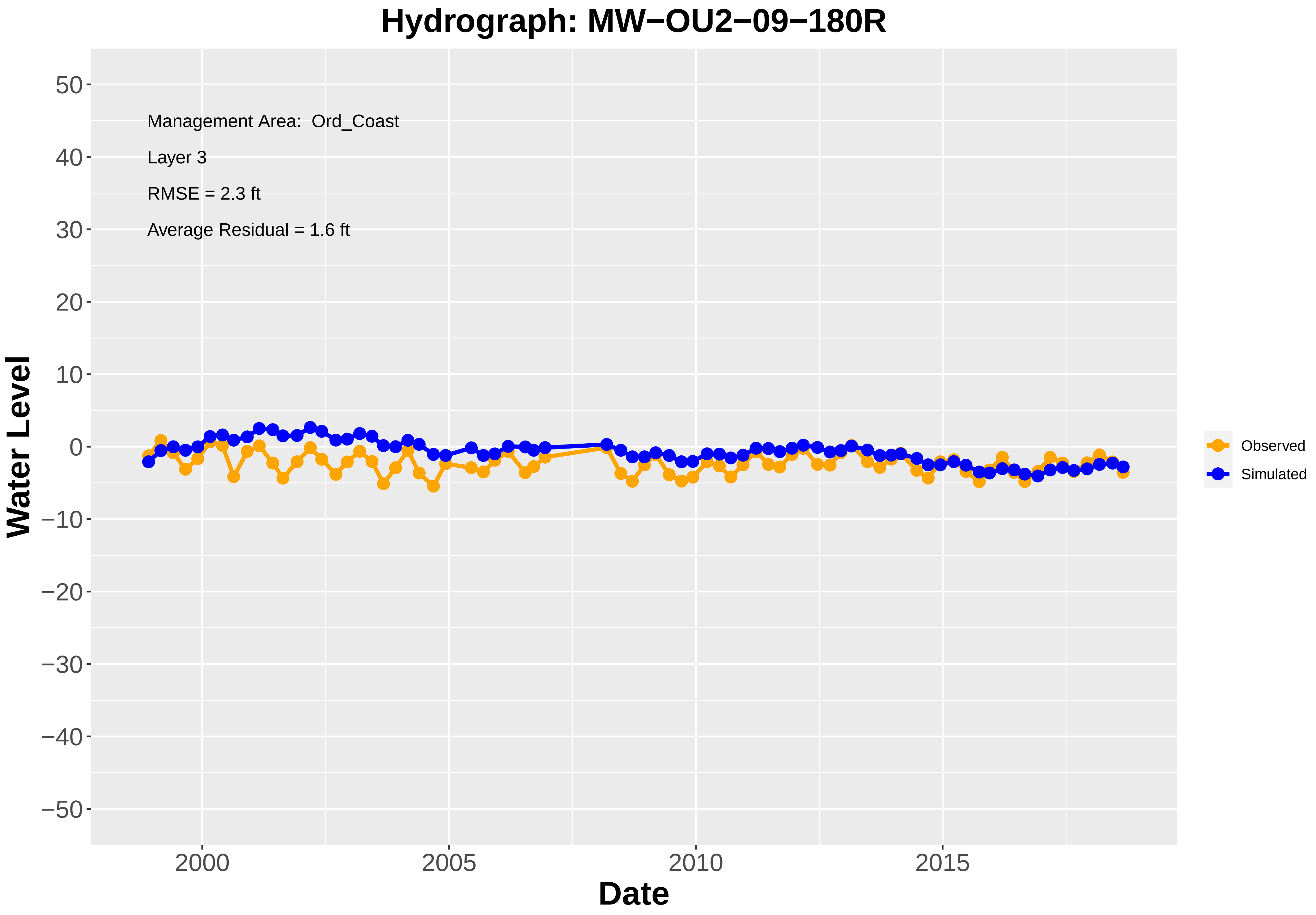
Hydrograph: MW−OU2−07−400
Management Area: Ord_Coast
Layer 7
RMSE = 7.1 ft
Average Residual = −6.6 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

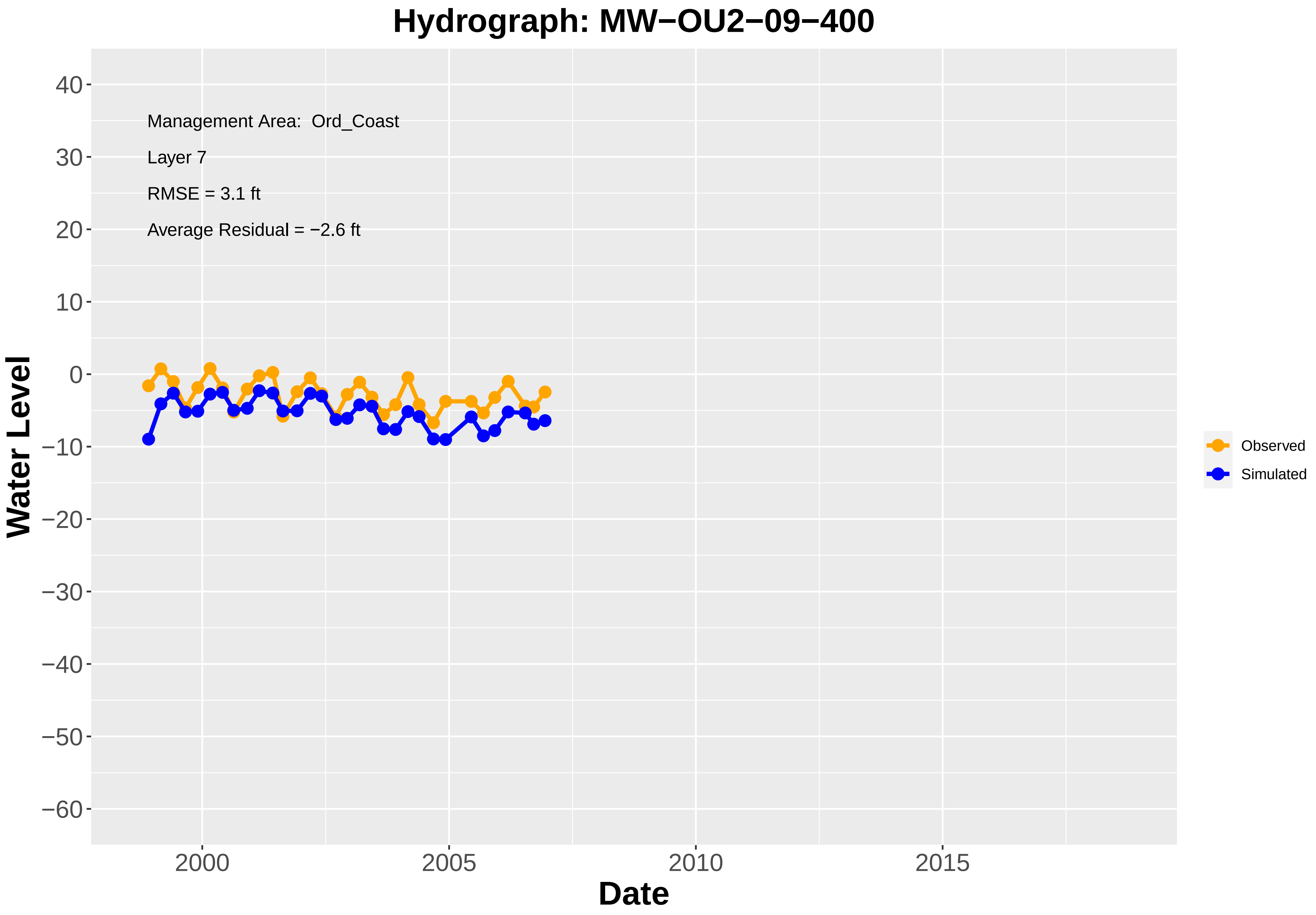


Hydrograph: MW−OU2−07−A
Management Area: Ord_Coast
Layer 1
RMSE = 5.3 ft
Average Residual = −5.1 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated

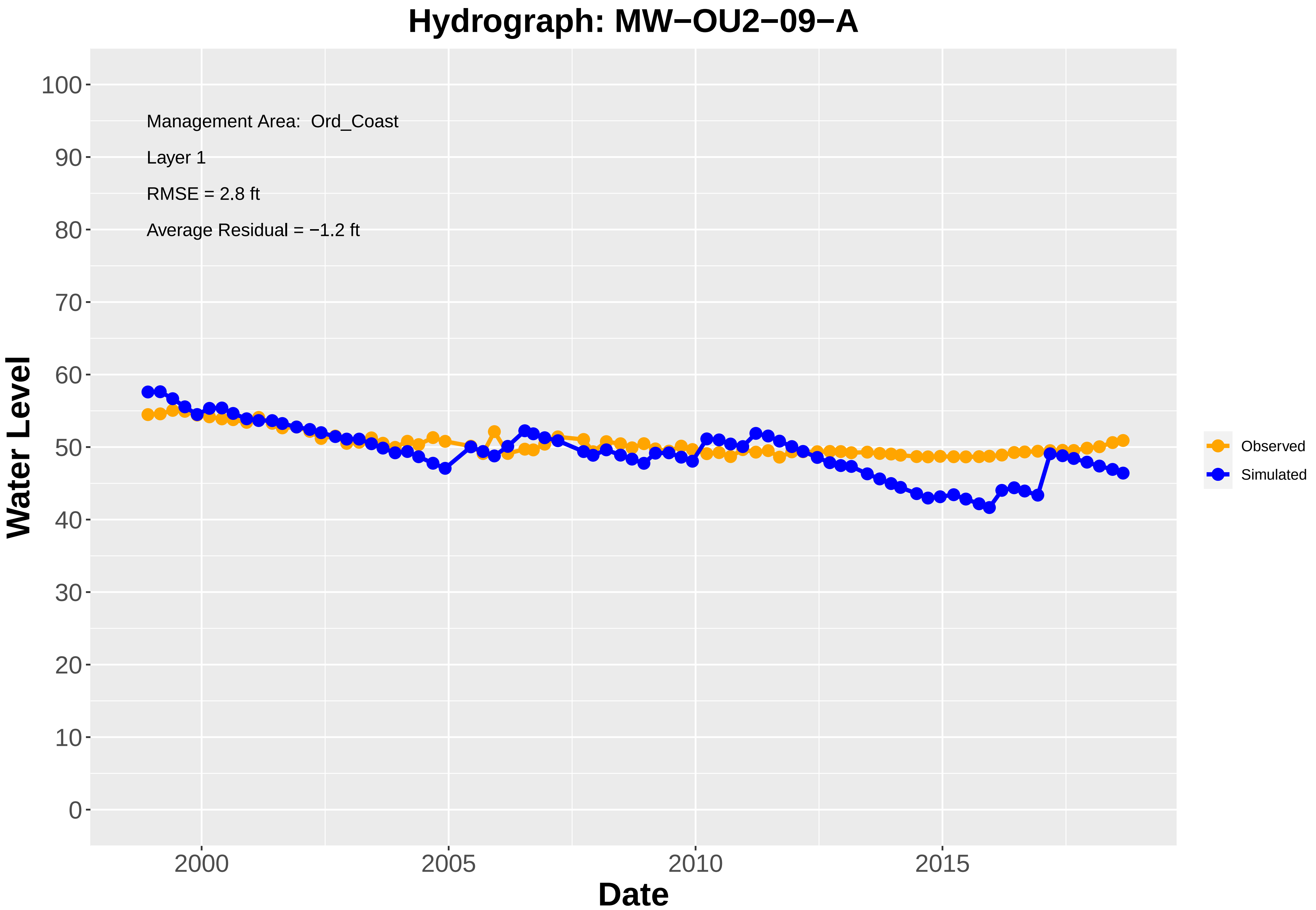


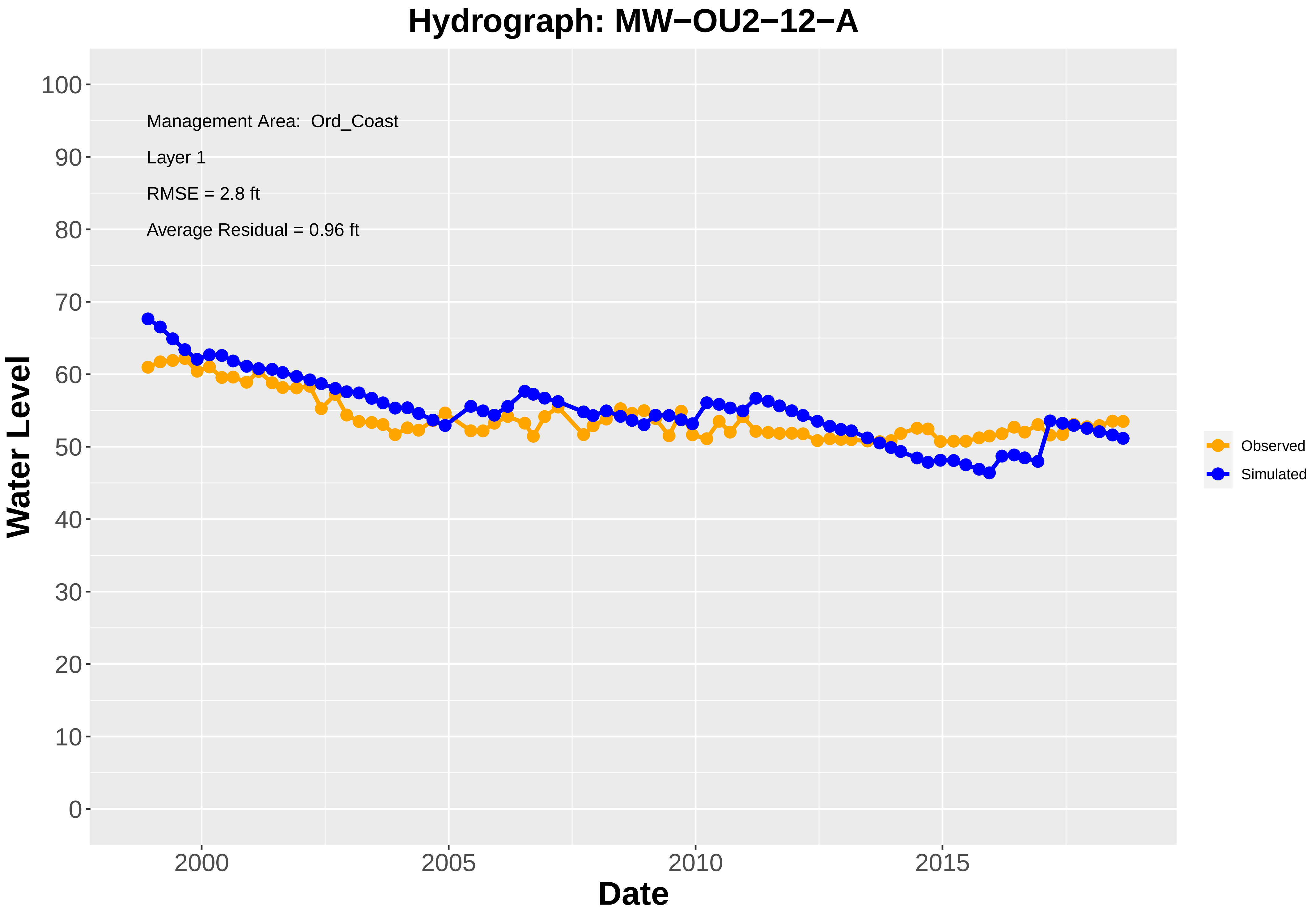
Hydrograph: MW−OU2−08−A
Management Area: Ord_Central
Layer 1
RMSE = 8.0 ft
Average Residual = −7.7 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

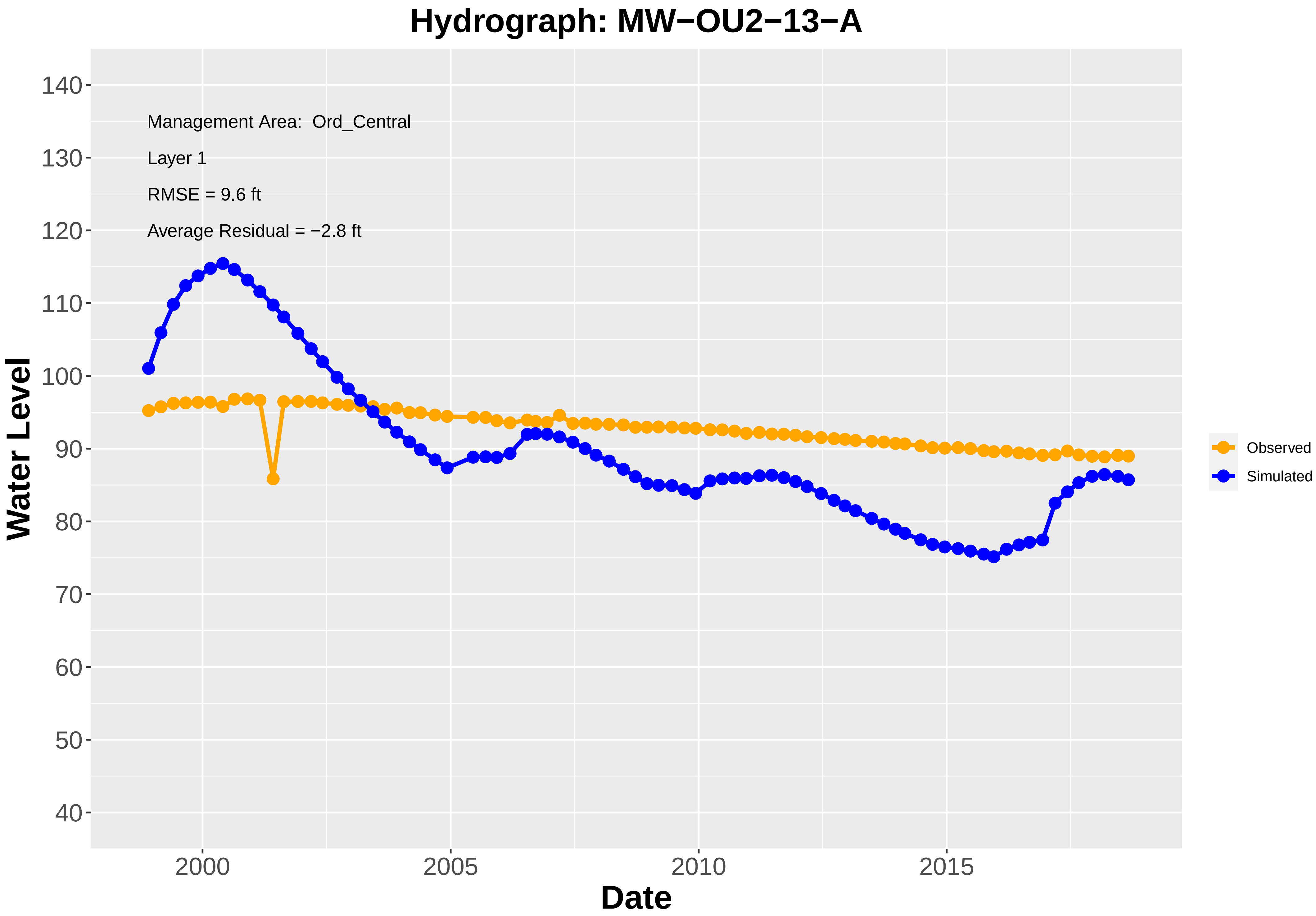

Hydrograph: MW−OU2−09−180R
Management Area: Ord_Coast
Layer 3
RMSE = 2.3 ft
Average Residual = 1.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
Date
2000
2005
2010
2015
Observed
Simulated



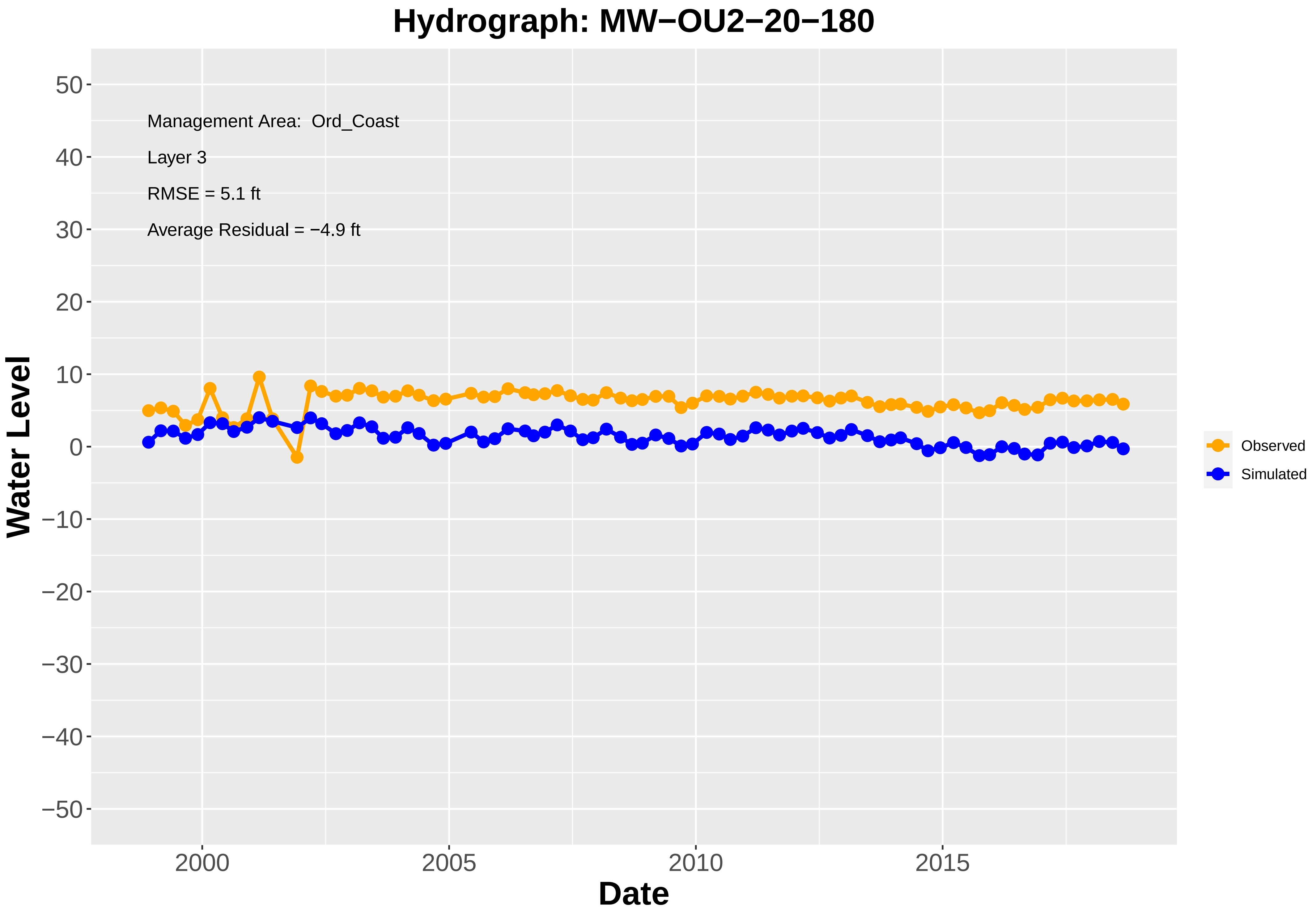
Hydrograph: MW−OU2−09−400
Management Area: Ord_Coast
Layer 7
RMSE = 3.1 ft
Average Residual = −2.6 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−09−A
Management Area: Ord_Coast
Layer 1
RMSE = 2.8 ft
Average Residual = −1.2 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

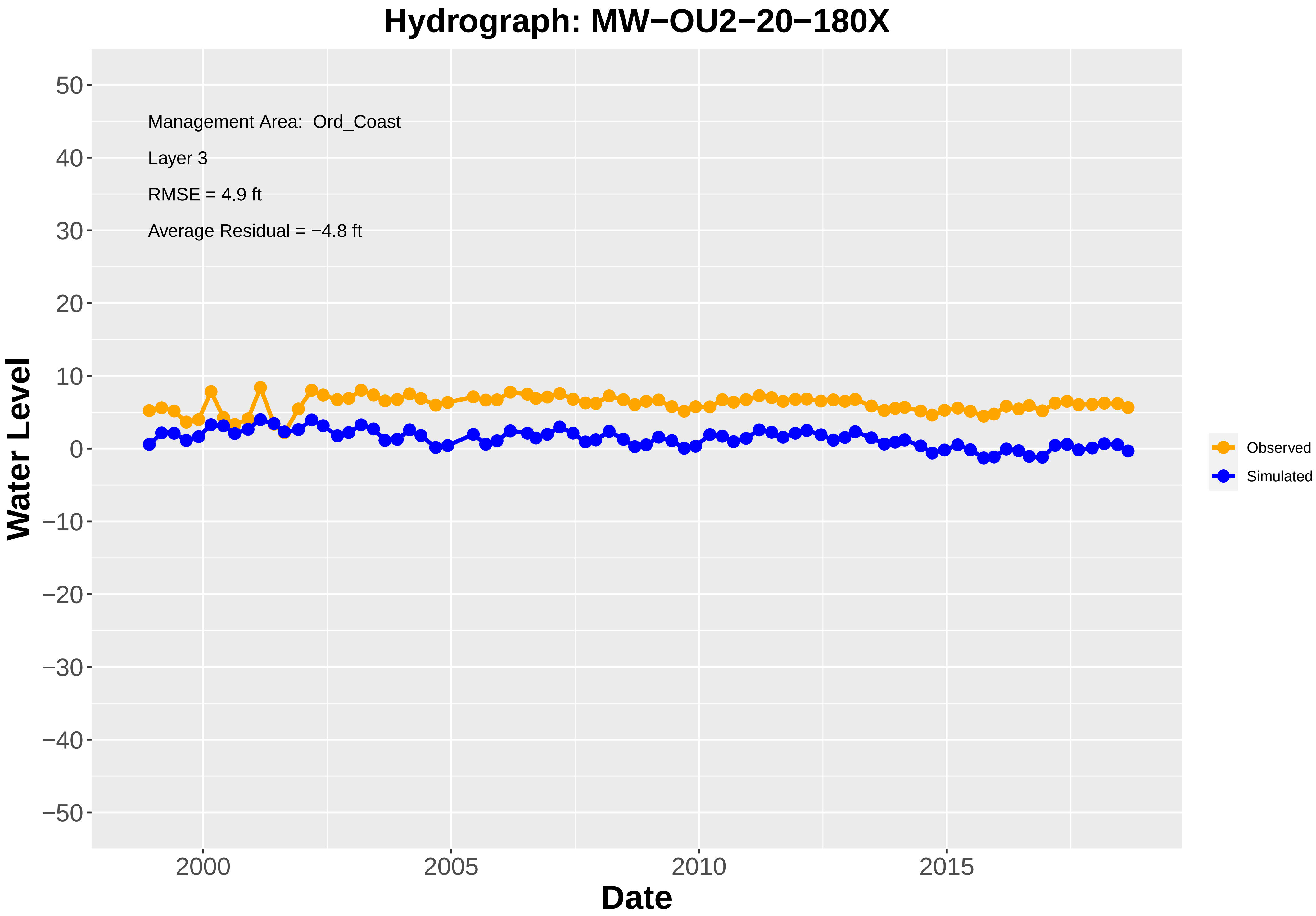

Hydrograph: MW−OU2−12−A
Management Area: Ord_Coast
Layer 1
RMSE = 2.8 ft
Average Residual = 0.96 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated



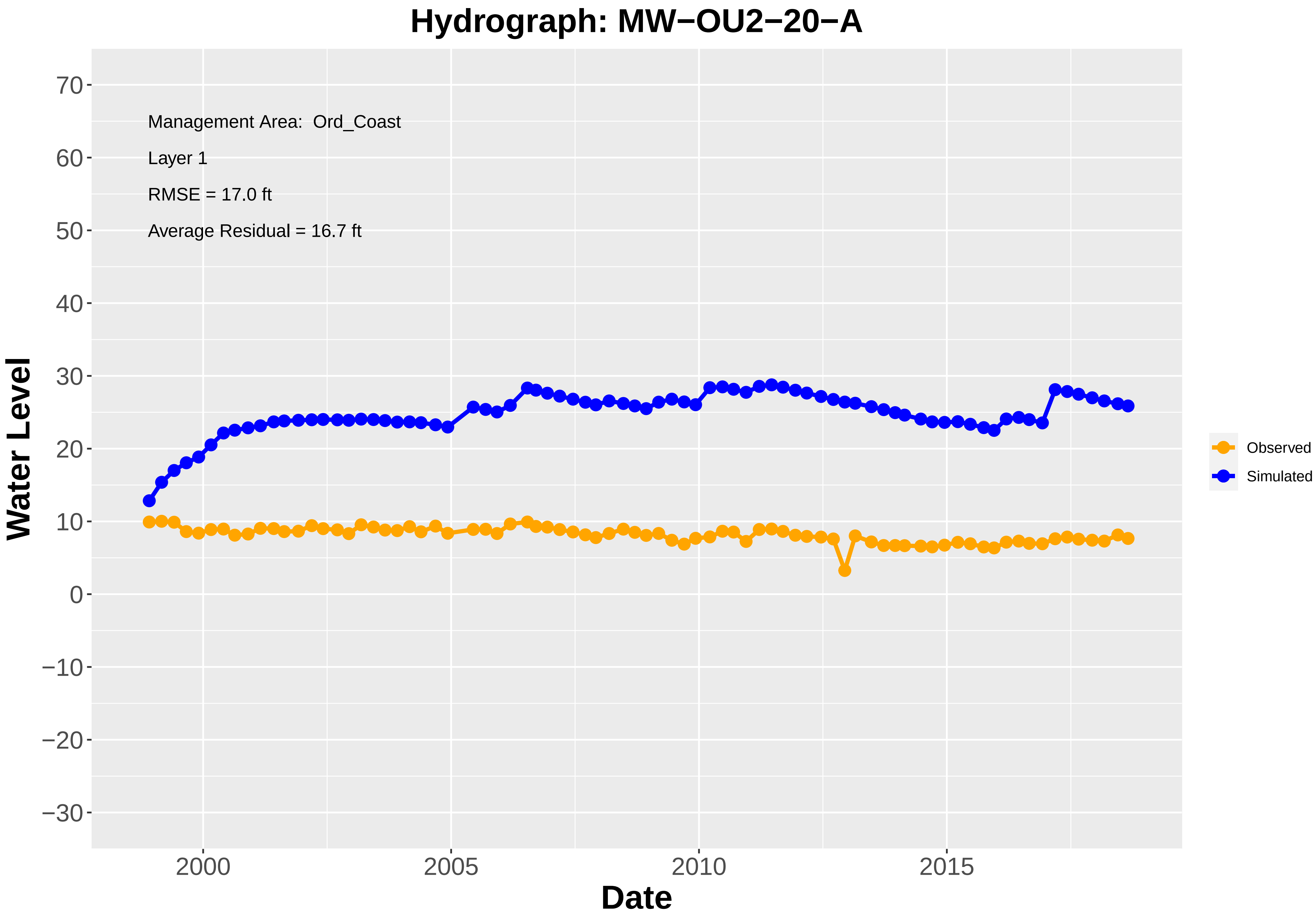
Hydrograph: MW−OU2−13−A
Management Area: Ord_Central
Layer 1
RMSE = 9.6 ft
Average Residual = −2.8 ft
Water Level
140
130
120
110
100
90
80
70
60
50
40
Date
2000
2005
2010
2015
Observed
Simulated

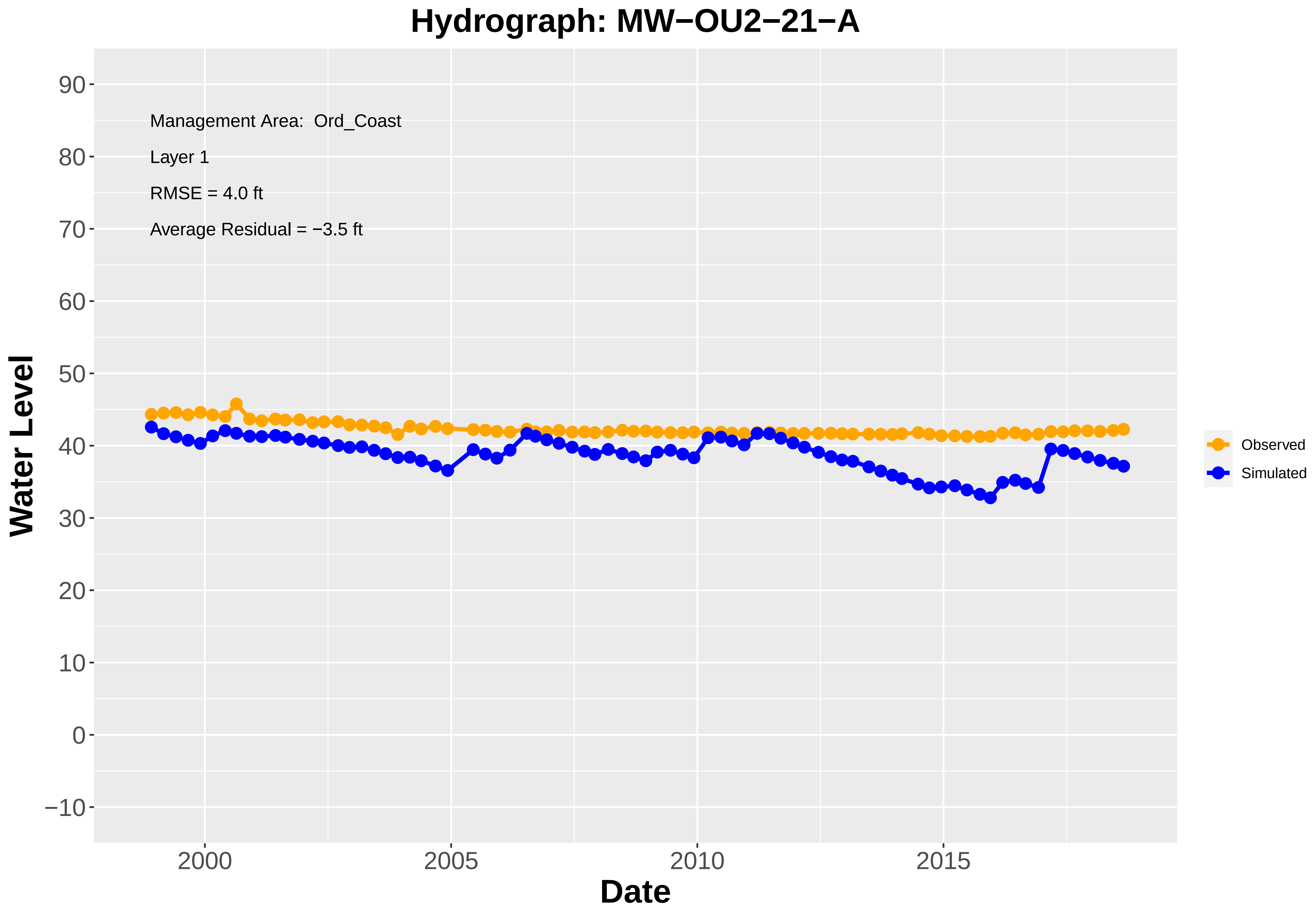


Hydrograph: MW−OU2−20−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.1 ft
Average Residual = −4.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

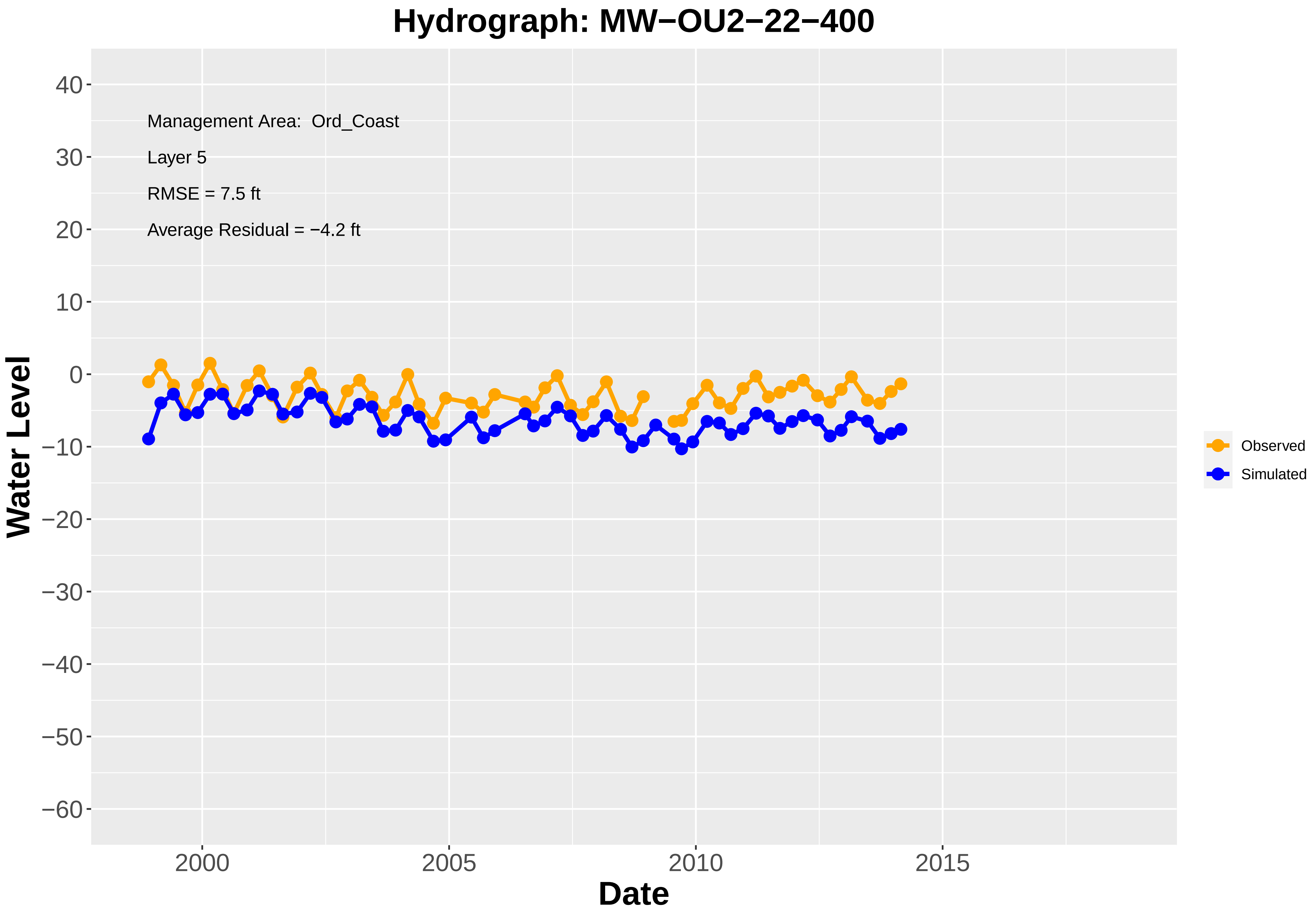


Hydrograph: MW−OU2−20−180X
Management Area: Ord_Coast
Layer 3
RMSE = 4.9 ft
Average Residual = −4.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

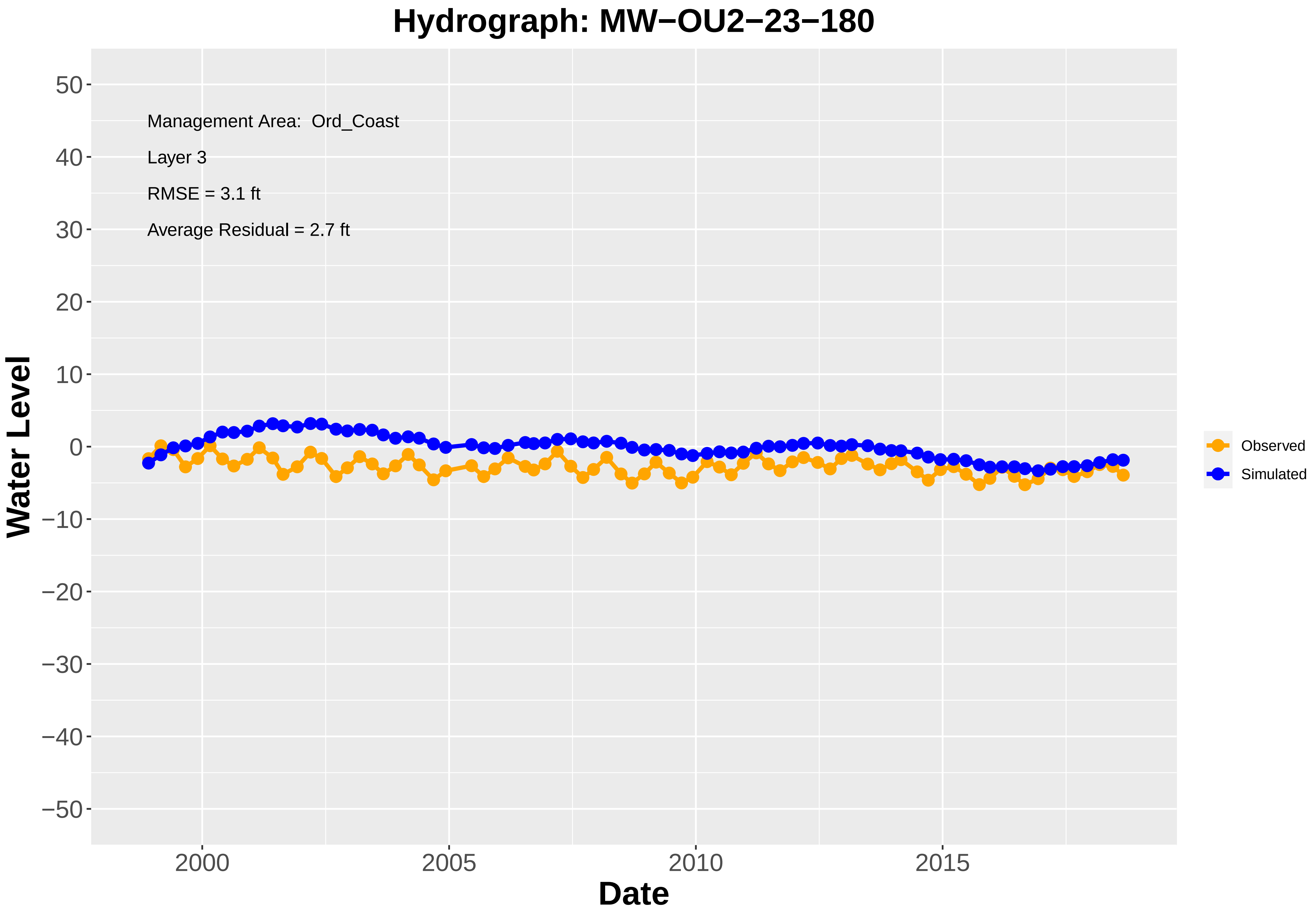

Hydrograph: MW−OU2−20−A
Management Area: Ord_Coast
Layer 1
RMSE = 17.0 ft
Average Residual = 16.7 ft
Water Level
Date
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Observed
Simulated

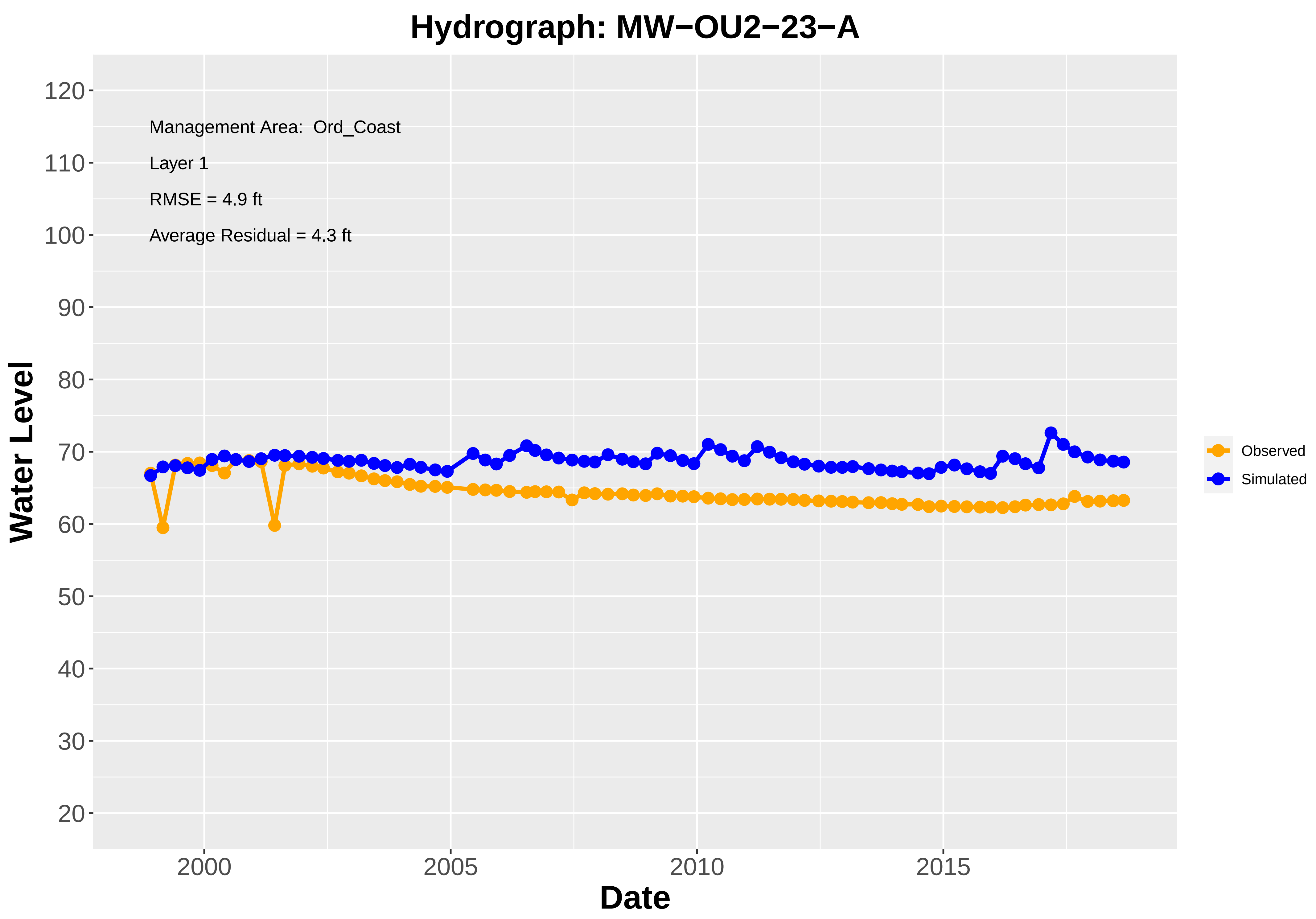


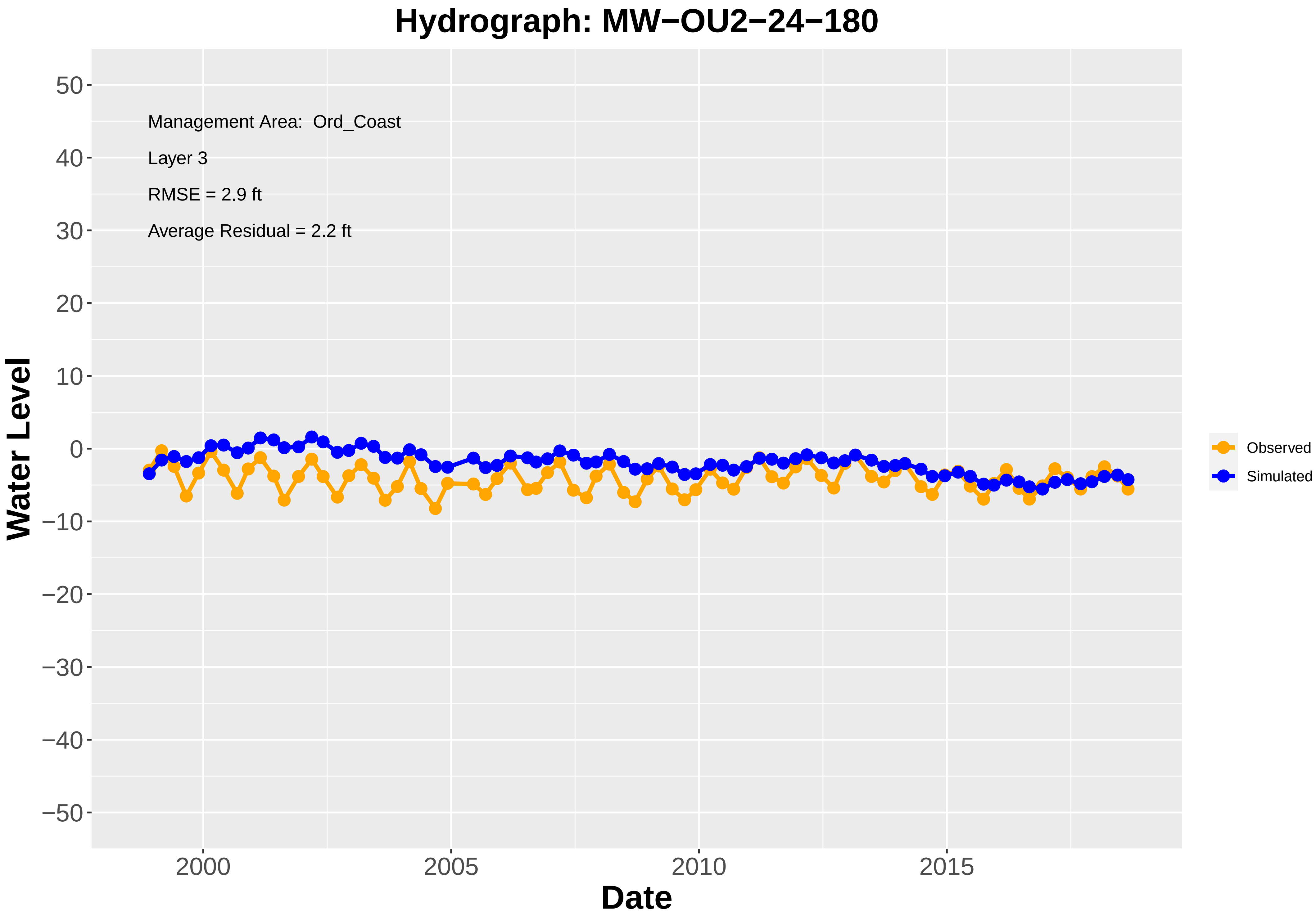
Hydrograph: MW−OU2−21−A
Management Area: Ord_Coast
Layer 1
RMSE = 4.0 ft
Average Residual = −3.5 ft
Water Level
Date
90
80
70
60
50
40
30
20
10
0
−10
2000
2005
2010
2015
Observed
Simulated



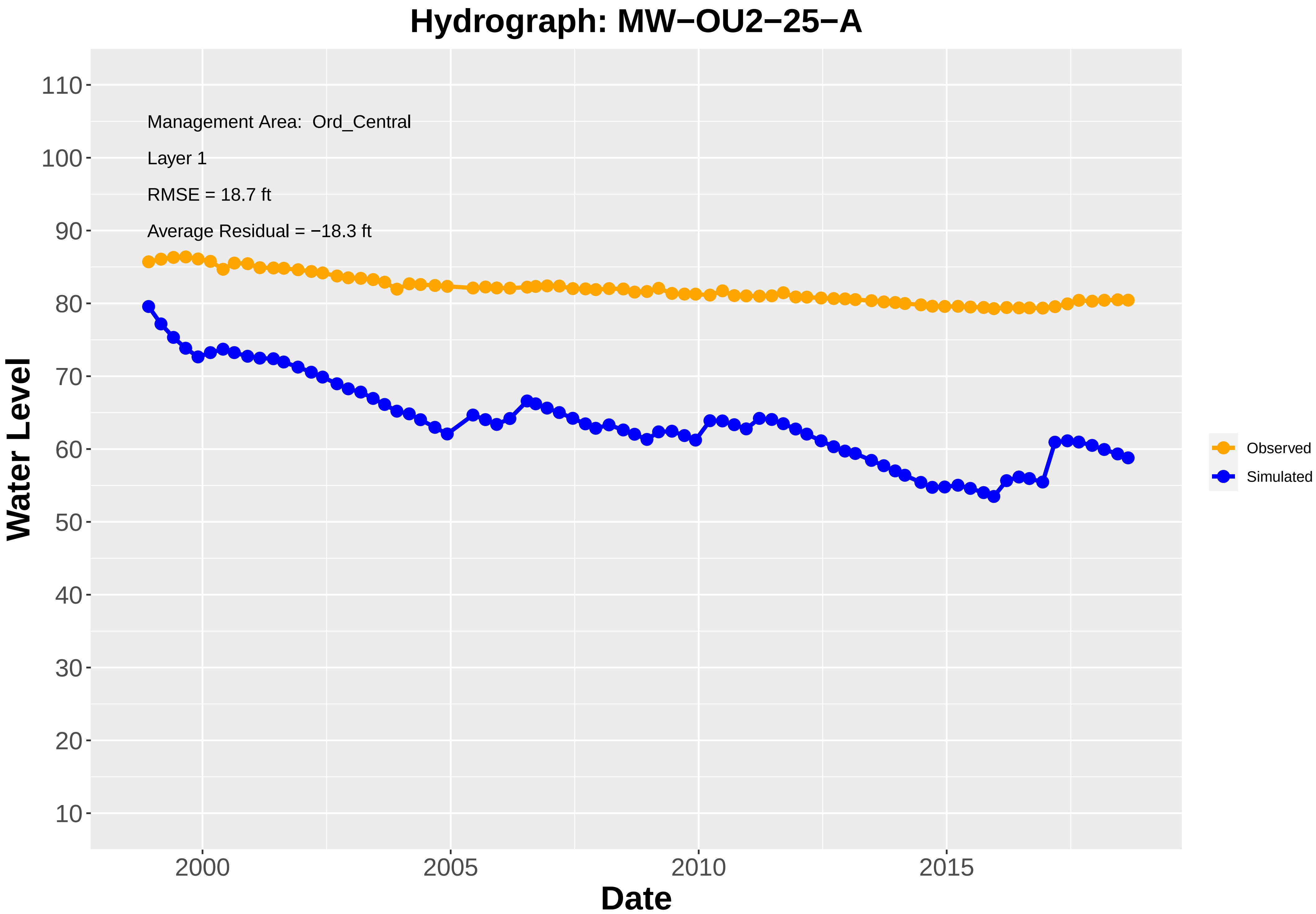
Hydrograph: MW−OU2−22−400
Management Area: Ord_Coast
Layer 5
RMSE = 7.5 ft
Average Residual = −4.2 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−23−180
Management Area: Ord_Coast
Layer 3
RMSE = 3.1 ft
Average Residual = 2.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

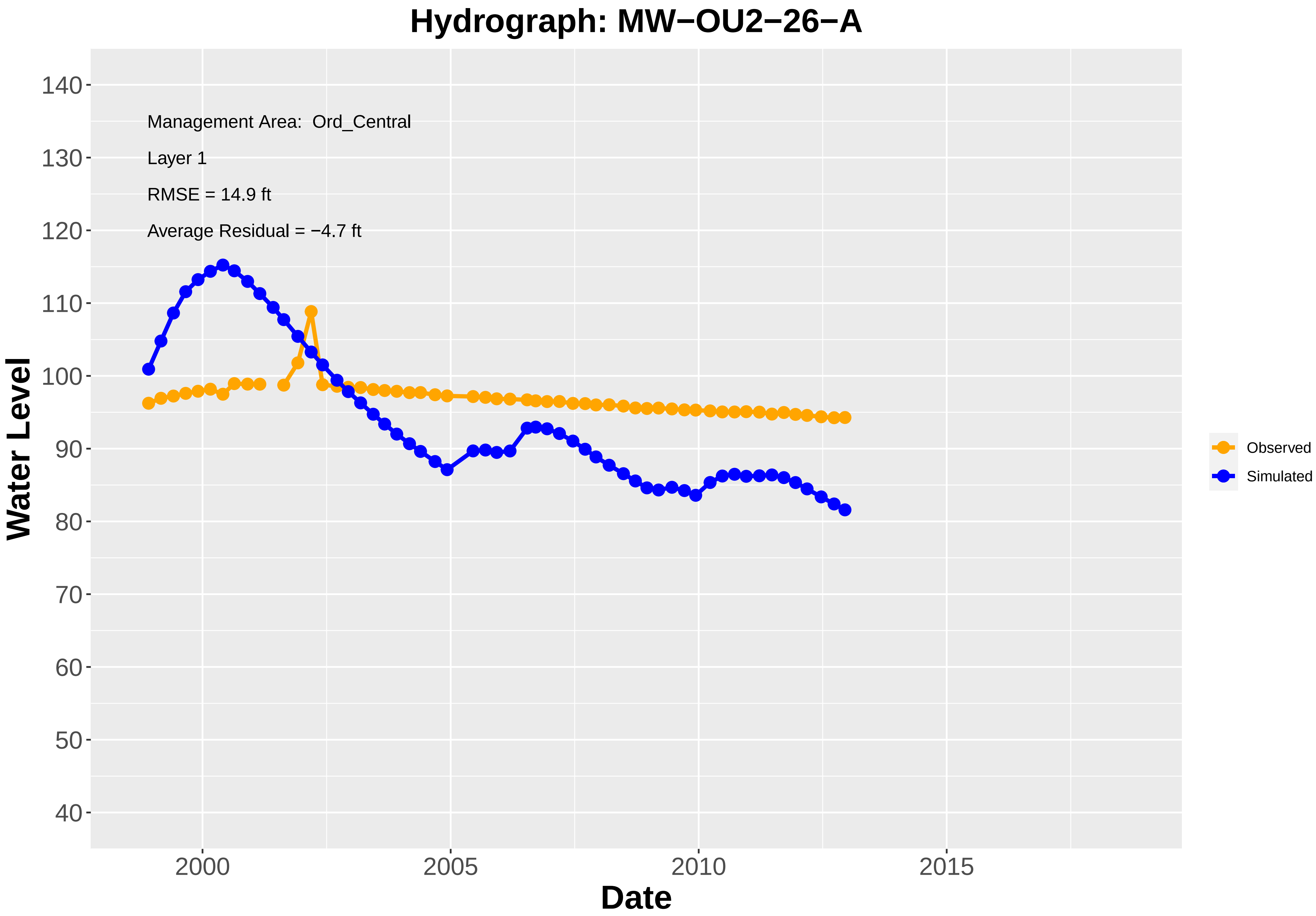

Hydrograph: MW−OU2−23−A
Management Area: Ord_Coast
Layer 1
RMSE = 4.9 ft
Average Residual = 4.3 ft
Water Level
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Date
Observed
Simulated

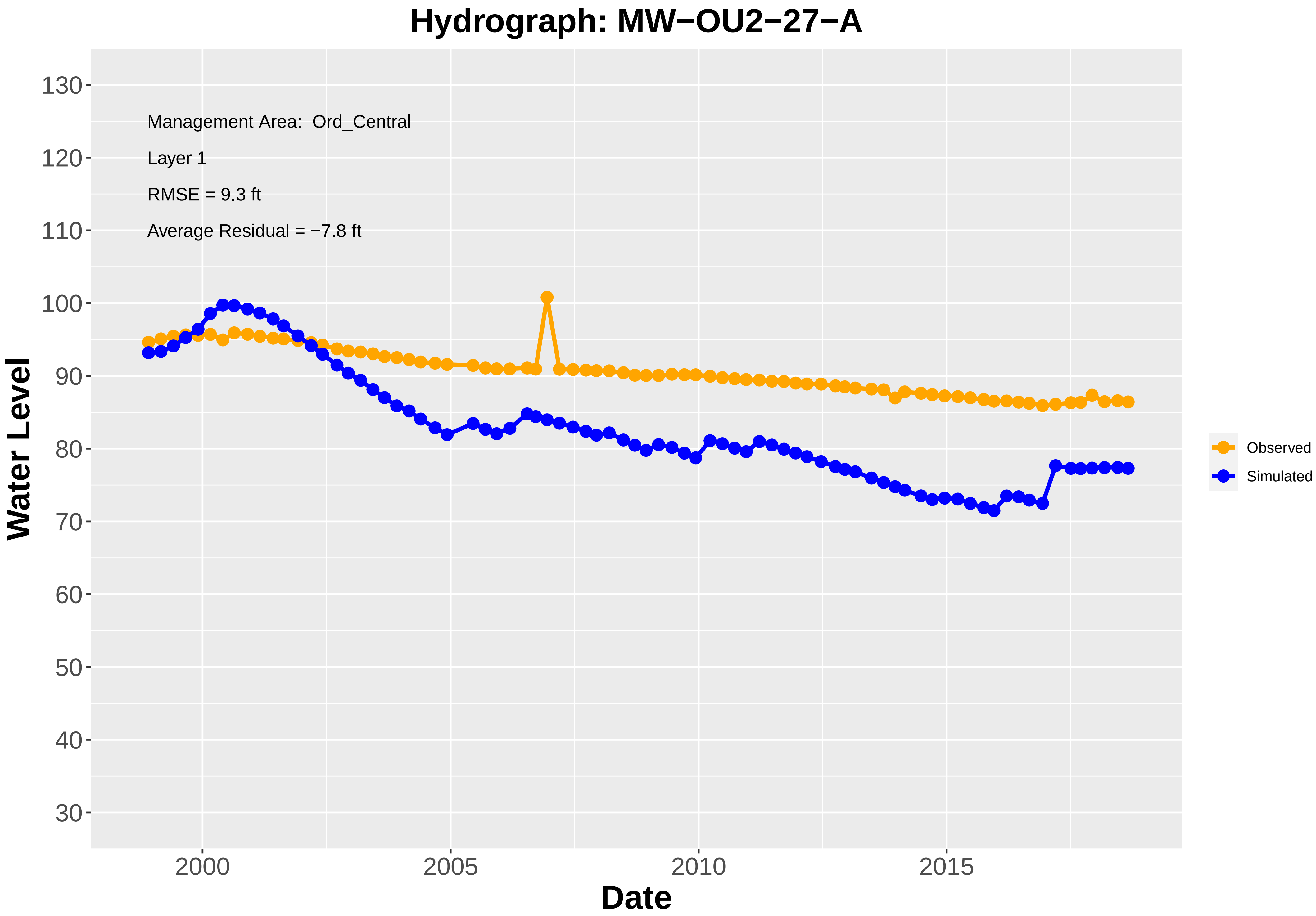


Hydrograph: MW−OU2−24−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.9 ft
Average Residual = 2.2 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

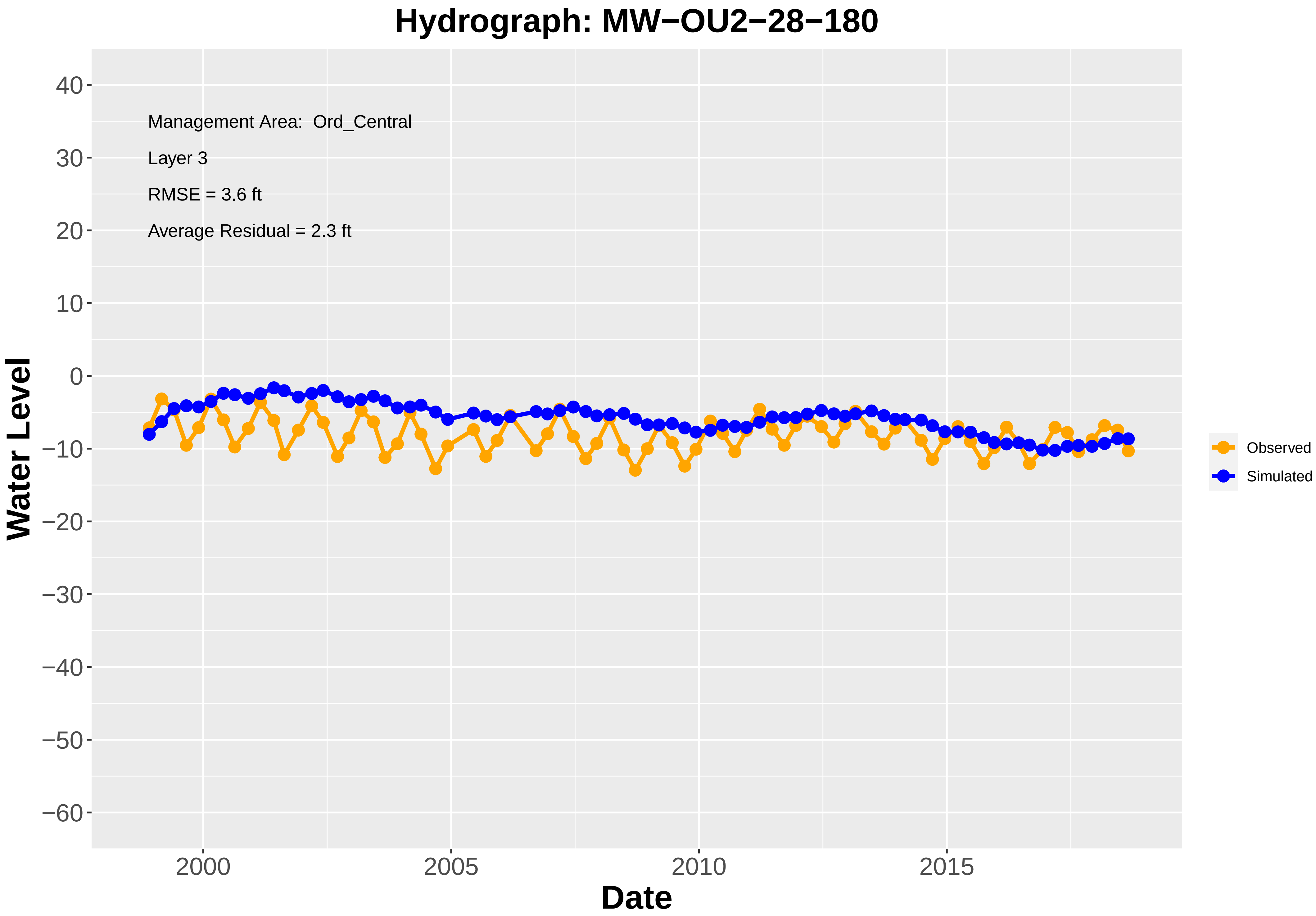


Hydrograph: MW−OU2−25−A
Management Area: Ord_Central
Layer 1
RMSE = 18.7 ft
Average Residual = −18.3 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

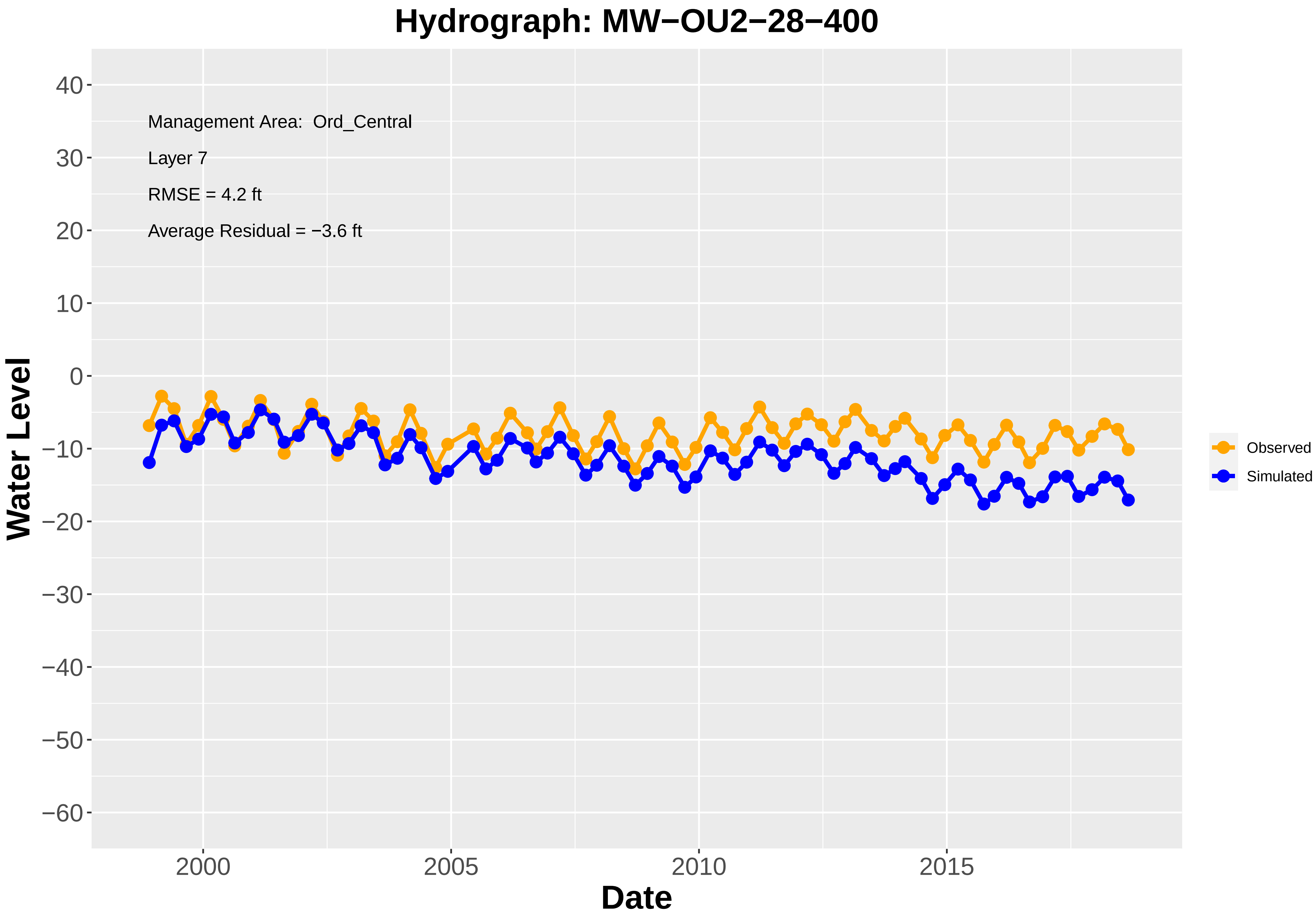

Hydrograph: MW−OU2−26−A
Management Area: Ord_Central
Layer 1
RMSE = 14.9 ft
Average Residual = −4.7 ft
Water Level
140
130
120
110
100
90
80
70
60
50
40
Date
2000
2005
2010
2015
Observed
Simulated



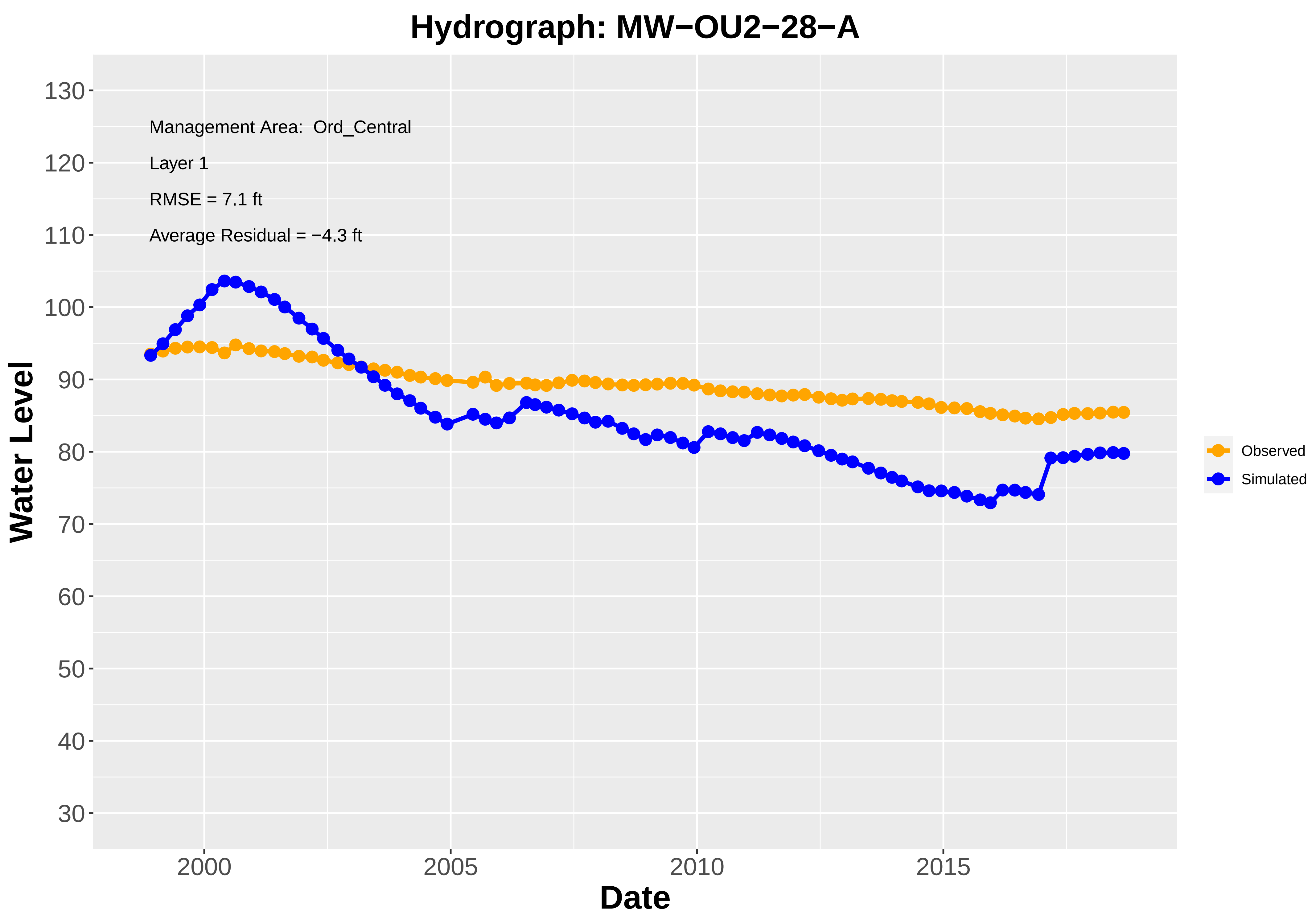
Hydrograph: MW−OU2−27−A
Management Area: Ord_Central
Layer 1
RMSE = 9.3 ft
Average Residual = −7.8 ft
Water Level
Date
Observed
Simulated
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015



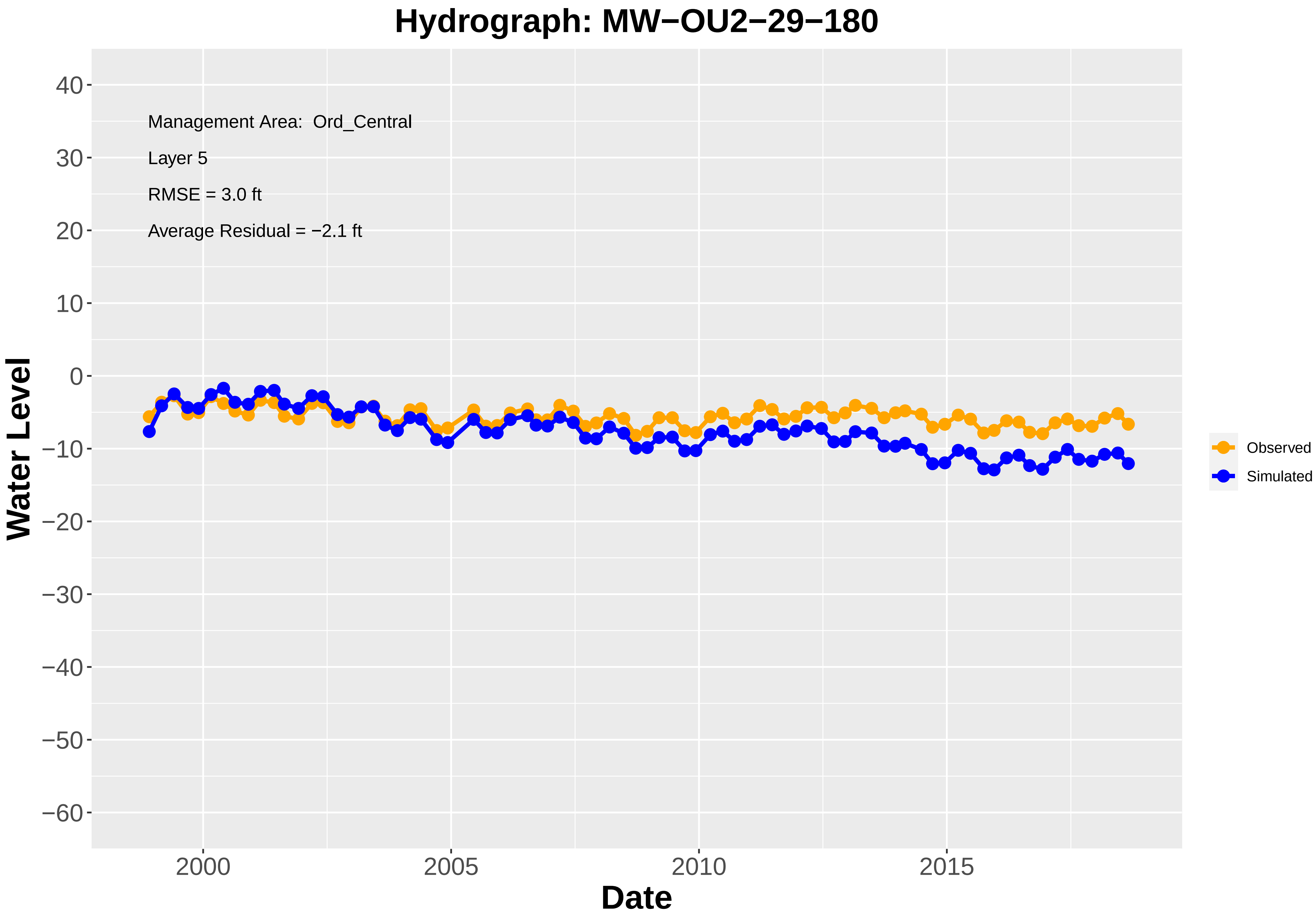
Hydrograph: MW−OU2−28−180
Management Area: Ord_Central
Layer 3
RMSE = 3.6 ft
Average Residual = 2.3 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

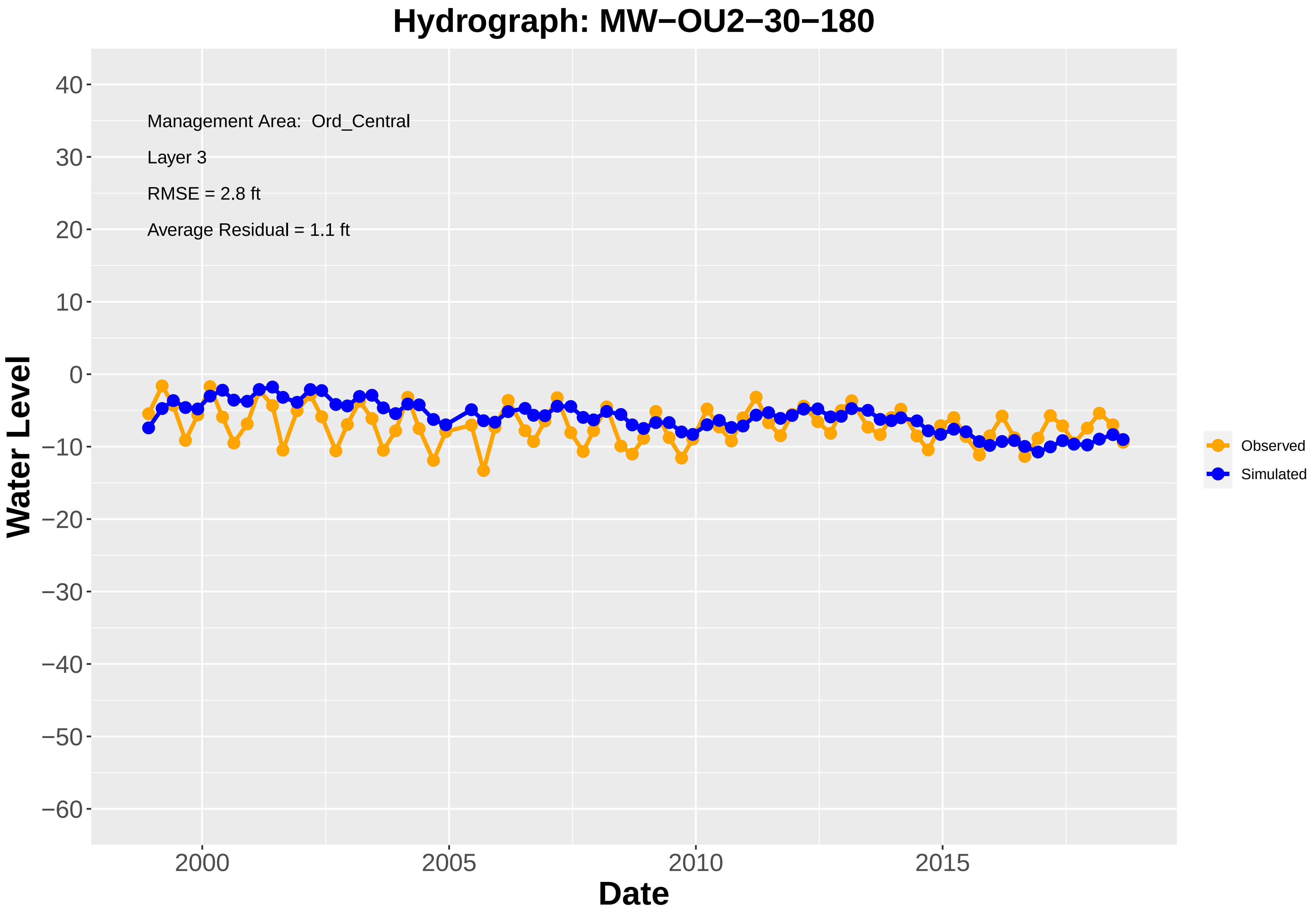


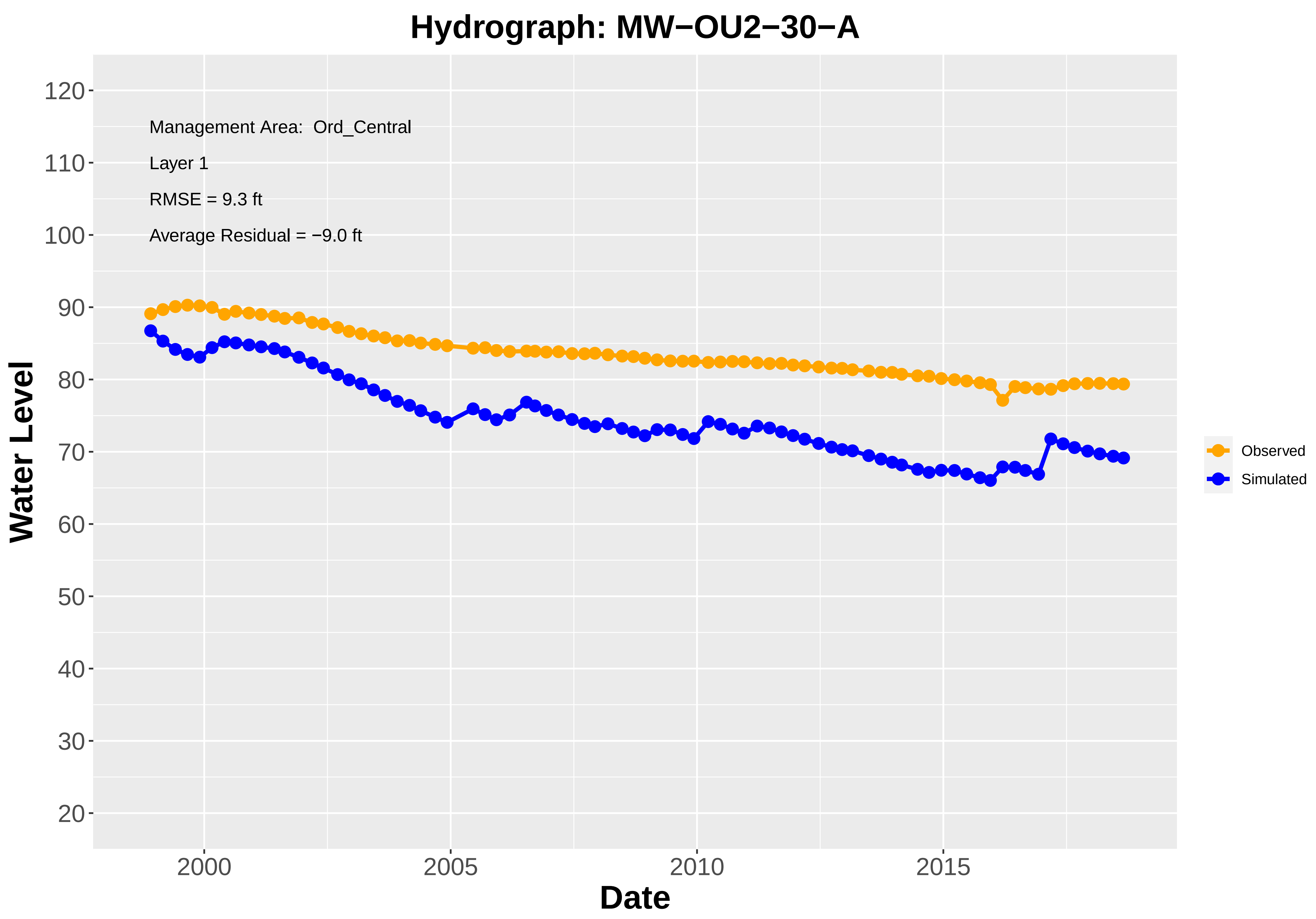
Hydrograph: MW−OU2−28−400
Management Area: Ord_Central
Layer 7
RMSE = 4.2 ft
Average Residual = −3.6 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated



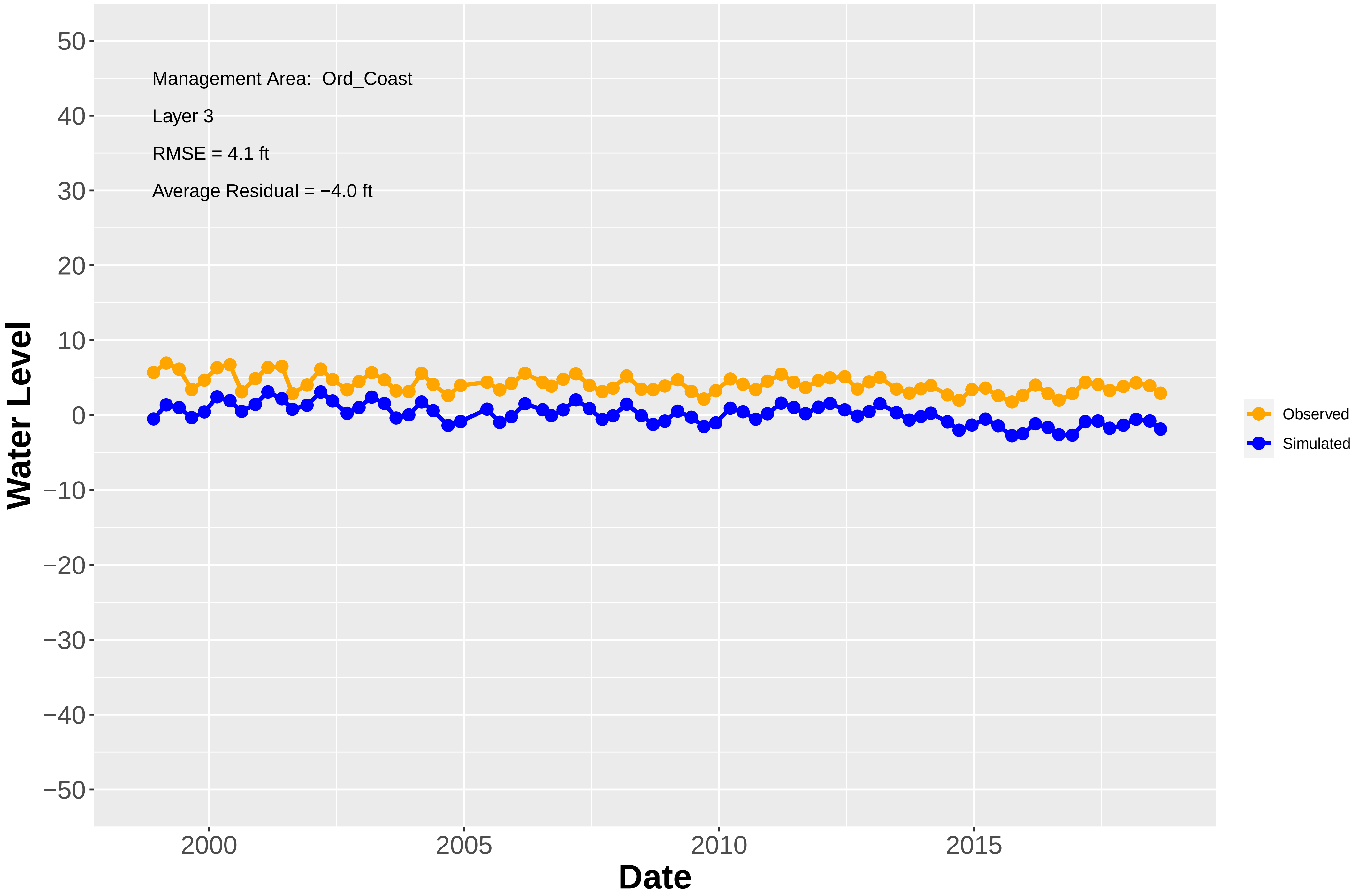
Hydrograph: MW−OU2−28−A
Management Area: Ord_Central
Layer 1
RMSE = 7.1 ft
Average Residual = −4.3 ft
Water Level
Date
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Observed
Simulated

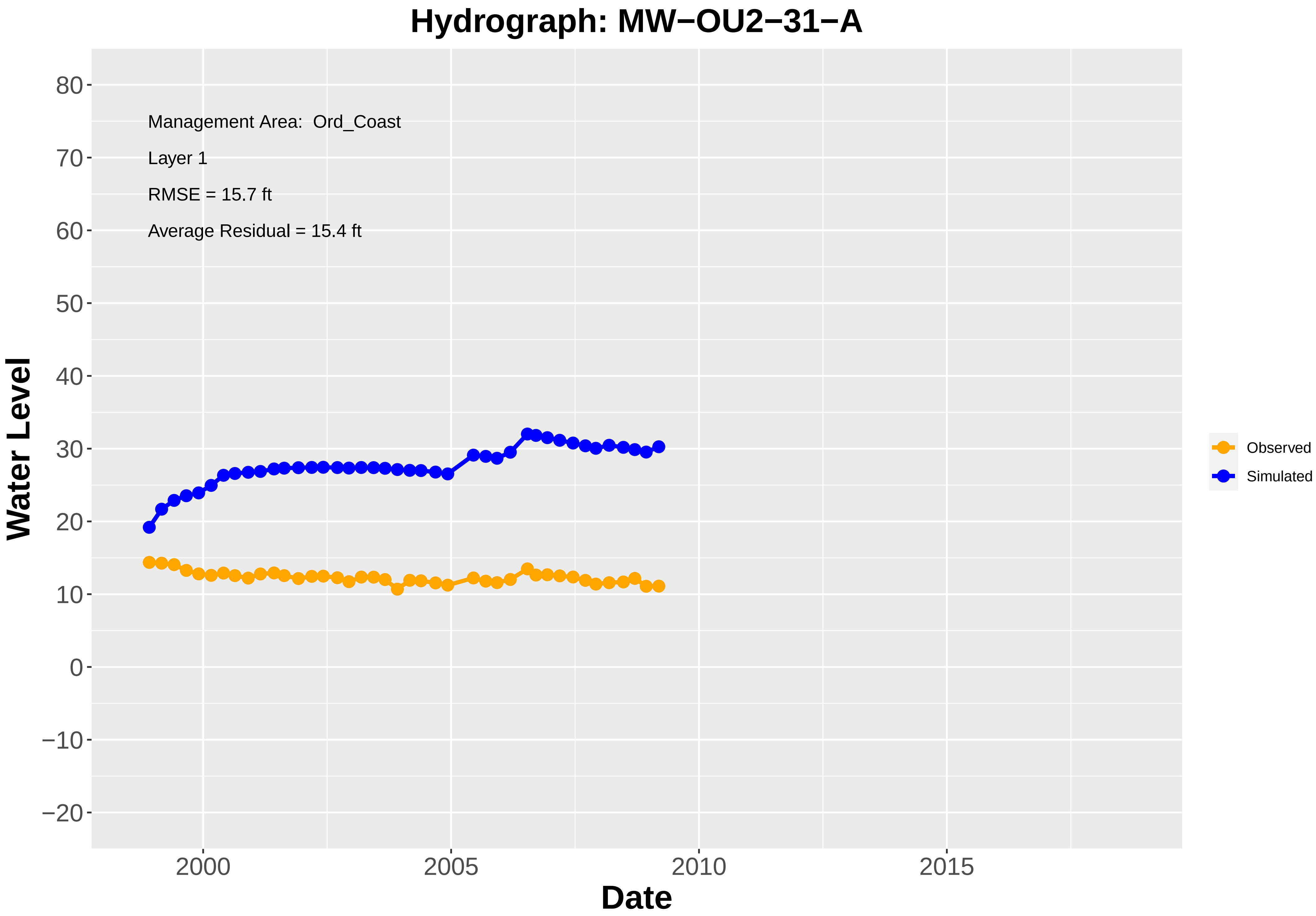

Hydrograph: MW−OU2−29−180
Management Area: Ord_Central
Layer 5
RMSE = 3.0 ft
Average Residual = −2.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−30−180
Management Area: Ord_Central
Layer 3
RMSE = 2.8 ft
Average Residual = 1.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

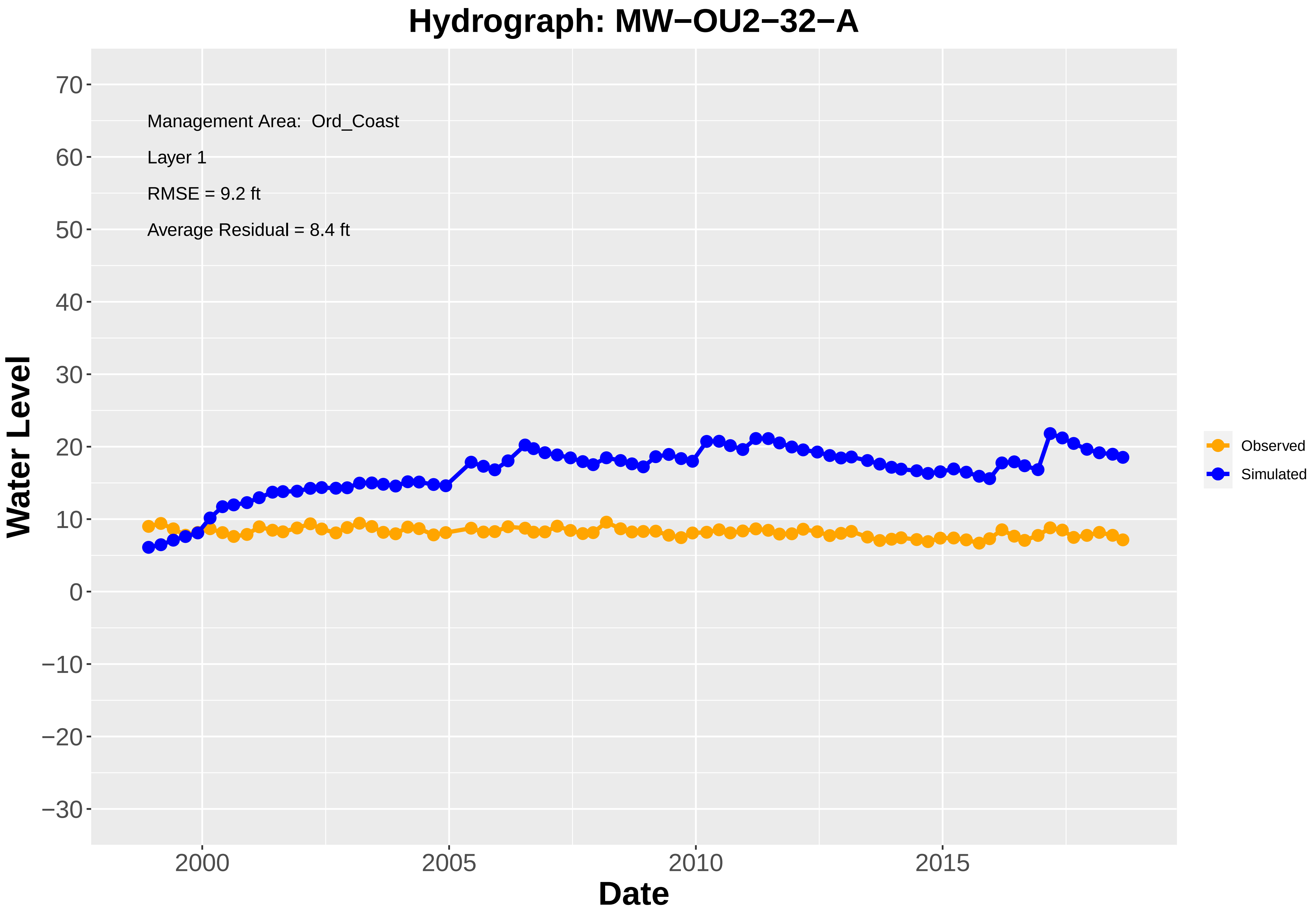

Hydrograph: MW−OU2−30−A
Management Area: Ord_Central
Layer 1
RMSE = 9.3 ft
Average Residual = −9.0 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

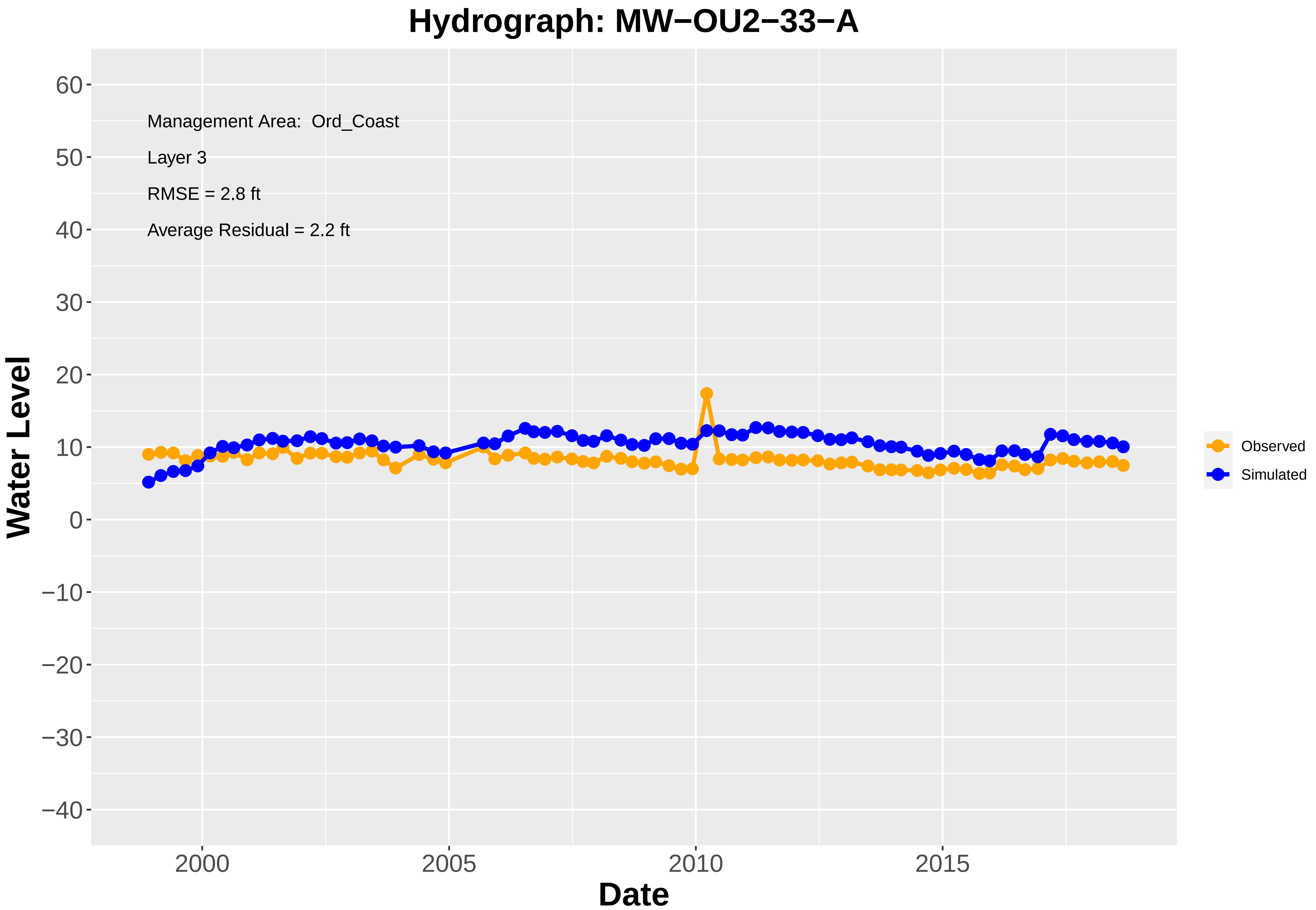
Hydrograph: MW−OU2−31−180R

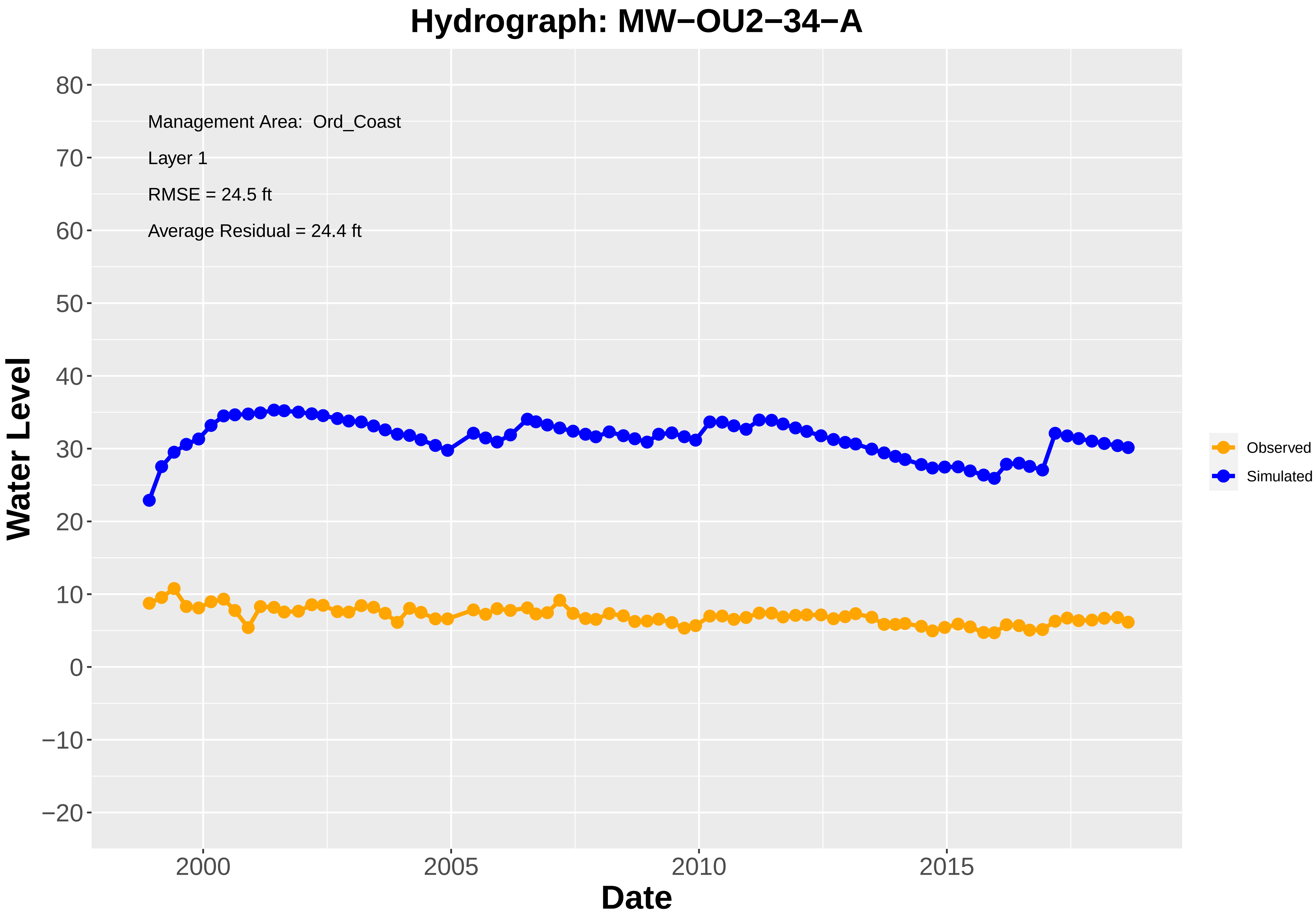




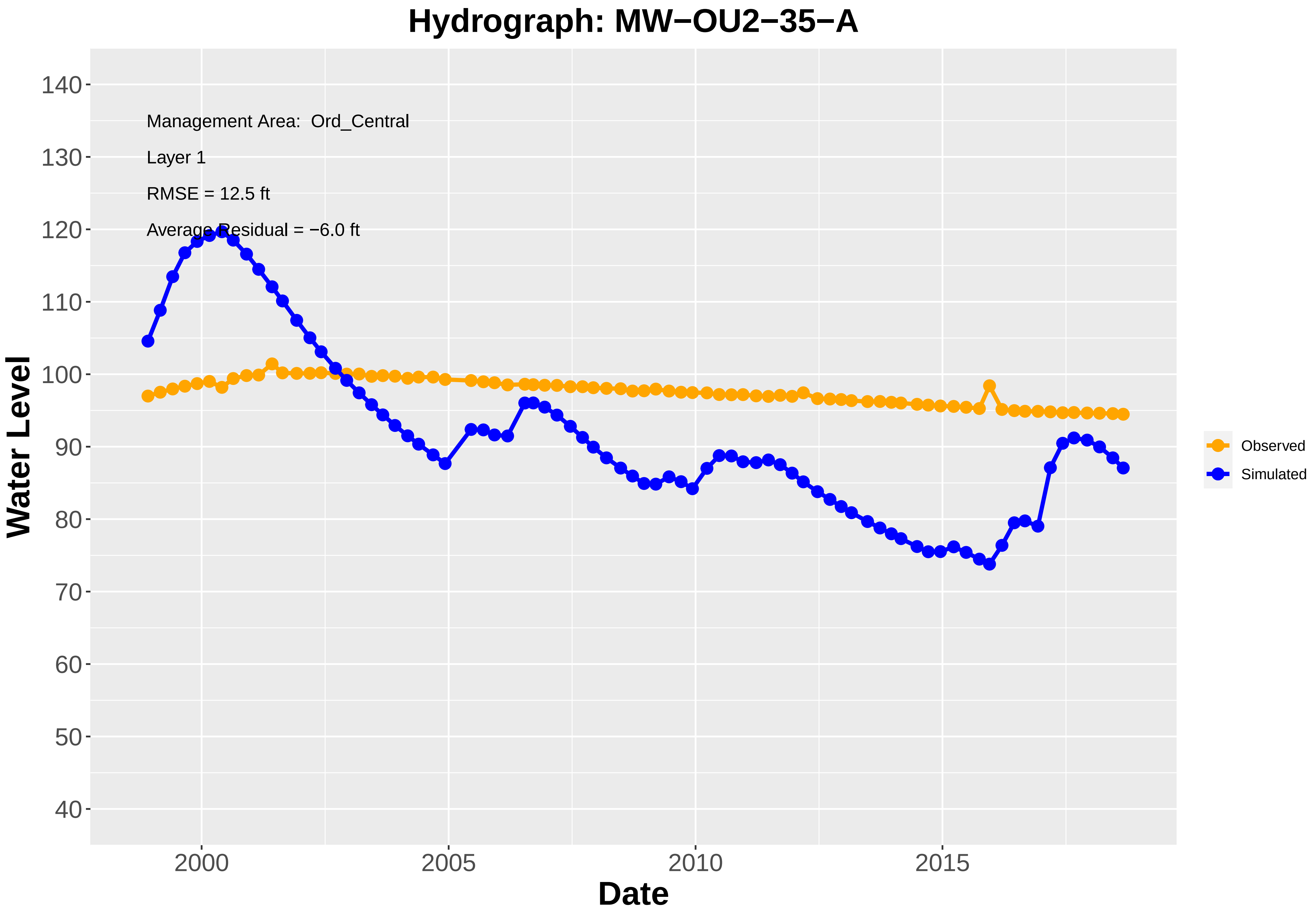
Hydrograph: MW−OU2−31−A
Management Area: Ord_Coast
Layer 1
RMSE = 15.7 ft
Average Residual = 15.4 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−32−A
Management Area: Ord_Coast
Layer 1
RMSE = 9.2 ft
Average Residual = 8.4 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Date
Observed
Simulated

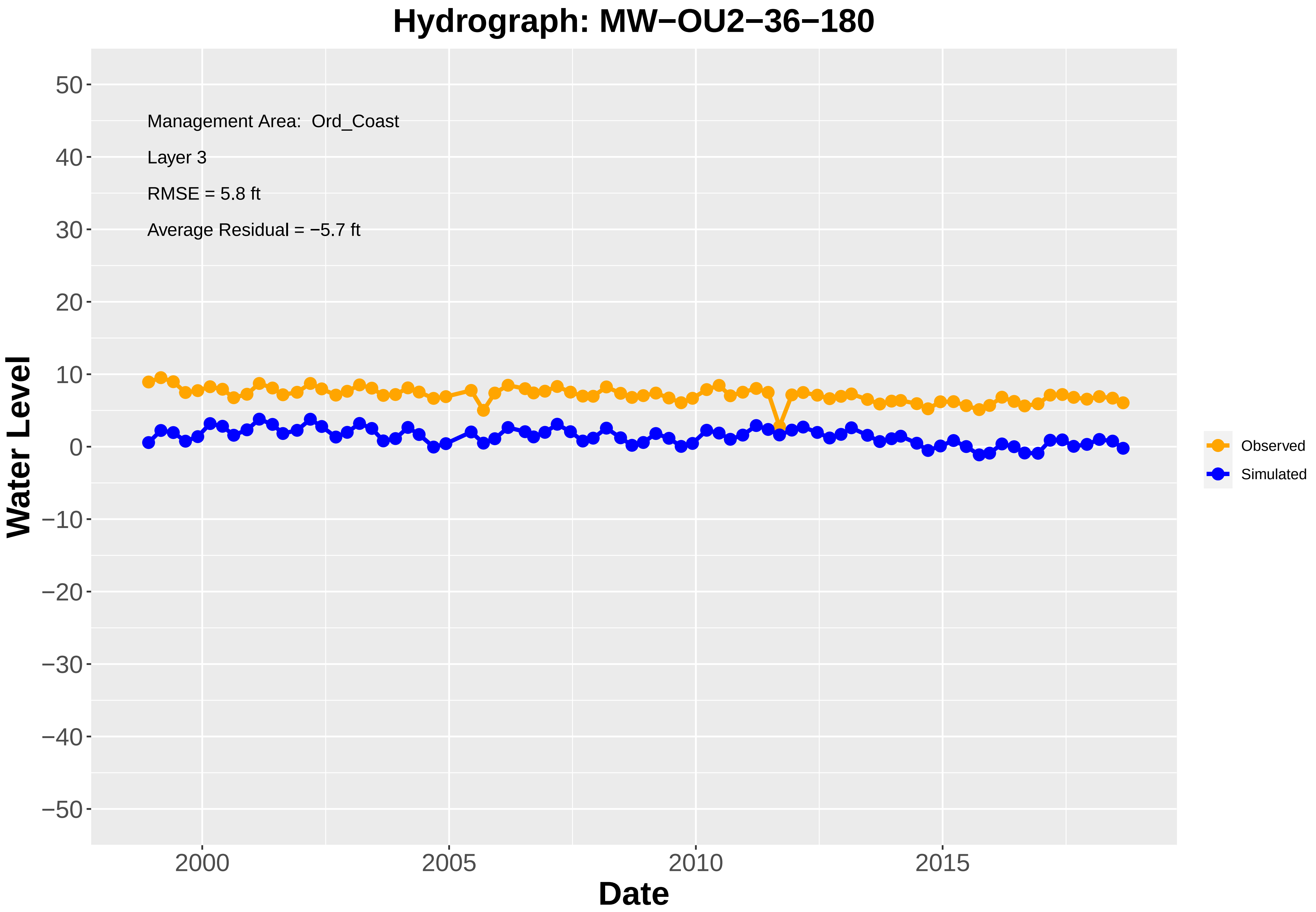

Hydrograph: MW−OU2−33−A
Management Area: Ord_Coast
Layer 3
RMSE = 2.8 ft
Average Residual = 2.2 ft
Water Level
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Date
Observed
Simulated



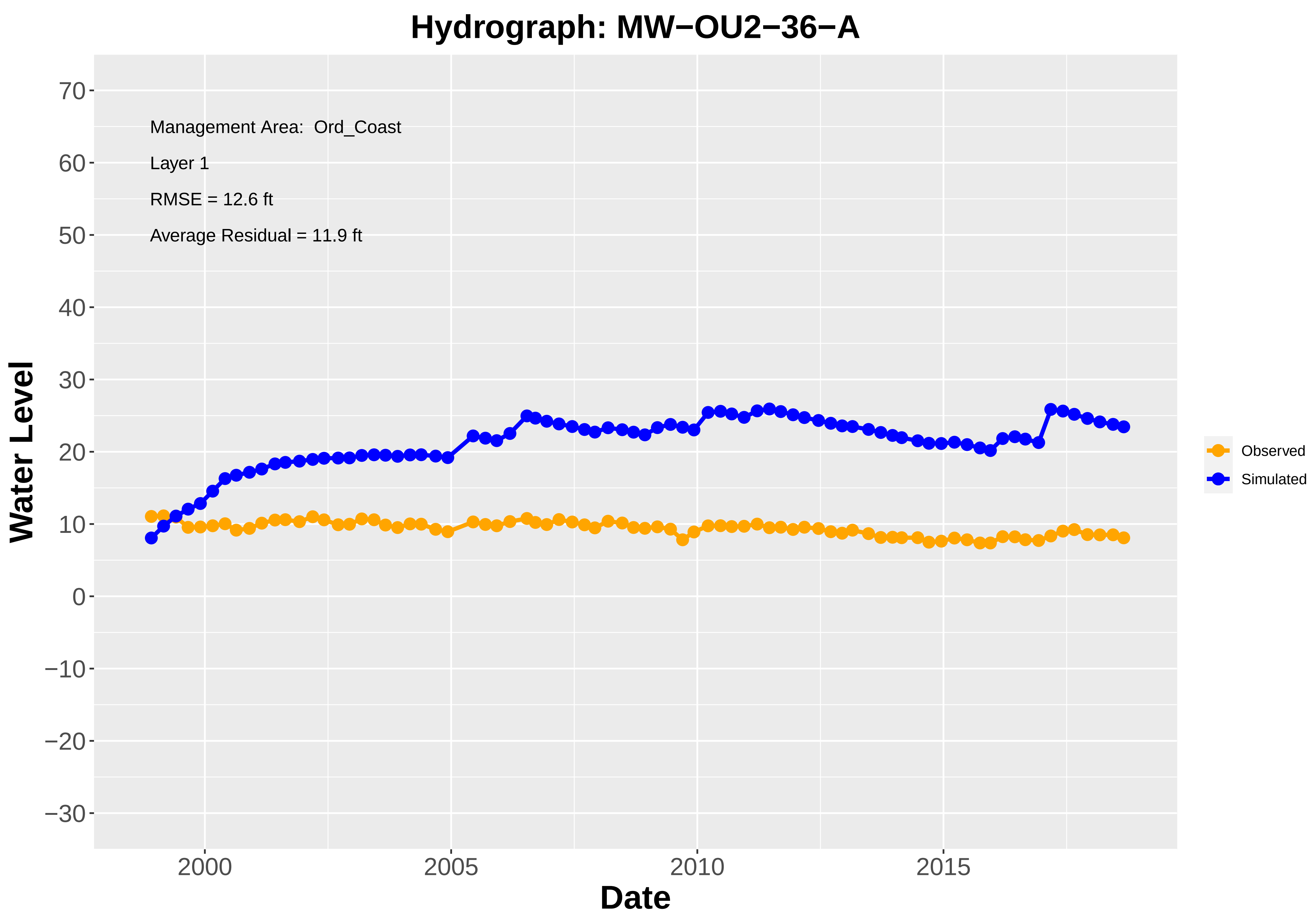
Hydrograph: MW−OU2−34−A
Management Area: Ord_Coast
Layer 1
RMSE = 24.5 ft
Average Residual = 24.4 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

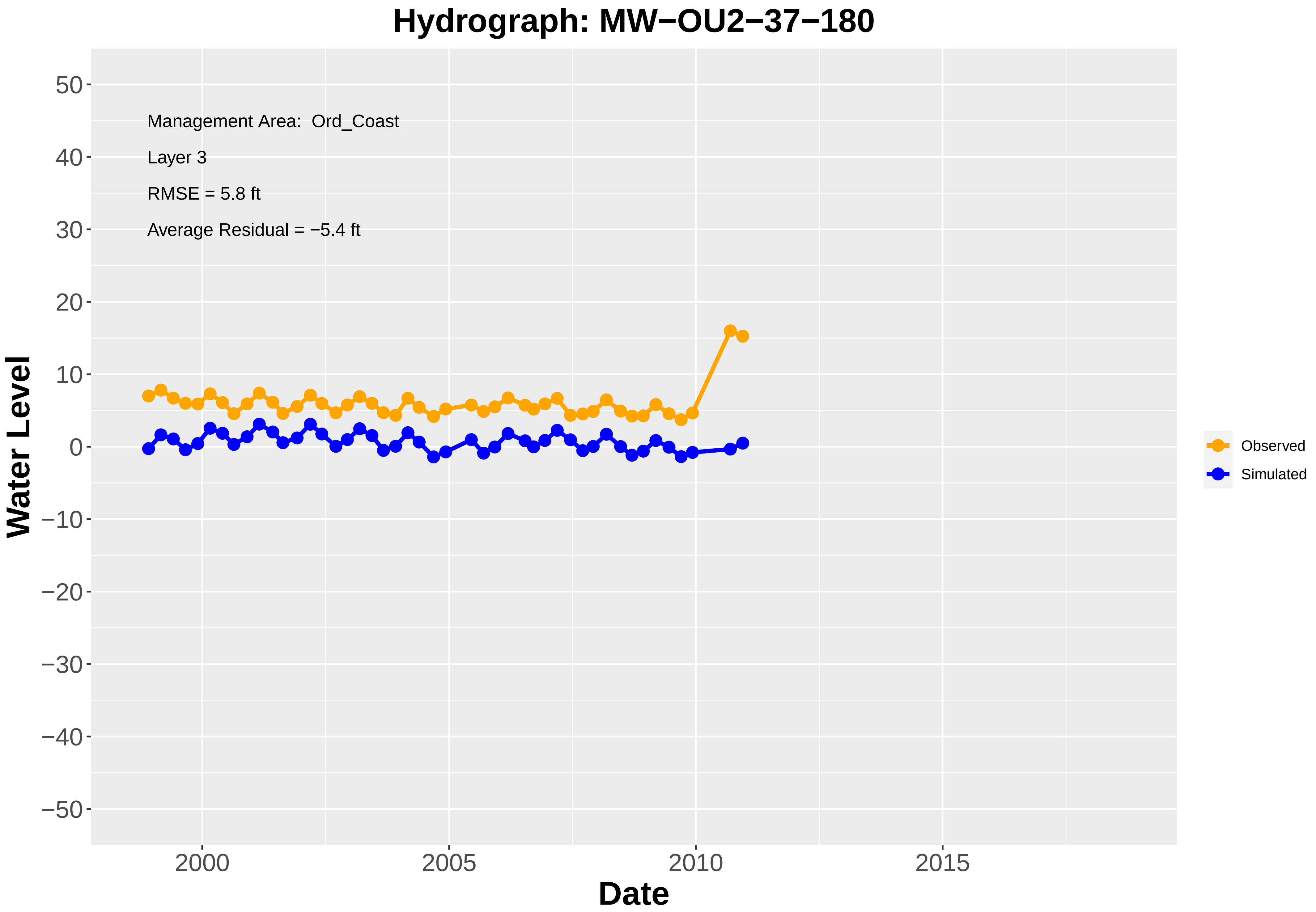


Hydrograph: MW−OU2−35−A
Management Area: Ord_Central
Layer 1
RMSE = 12.5 ft
Average Residual = −6.0 ft
Water Level
Date
140
130
120
110
100
90
80
70
60
50
40
2000
2005
2010
2015
Observed
Simulated

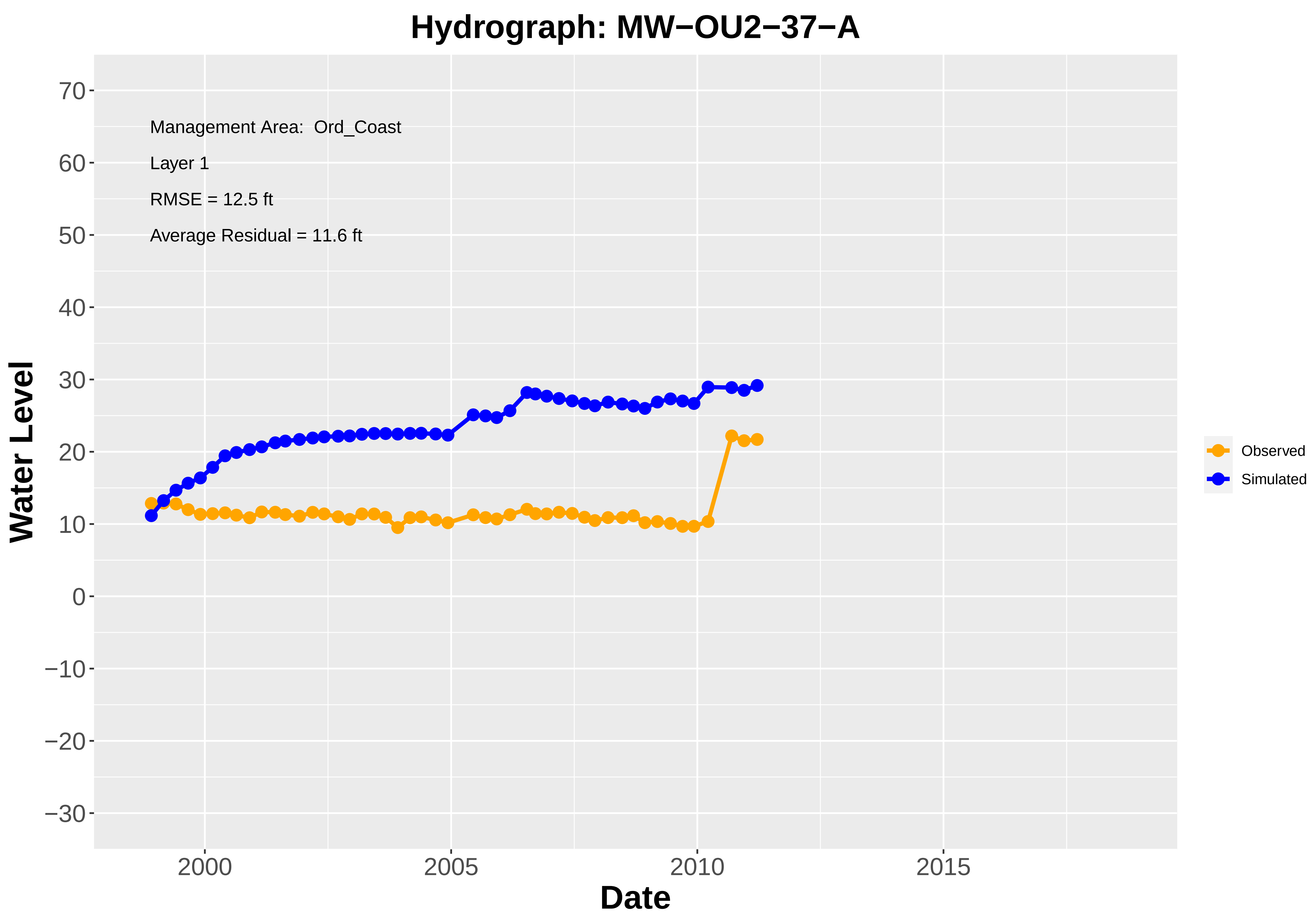


Hydrograph: MW−OU2−36−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.8 ft
Average Residual = −5.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

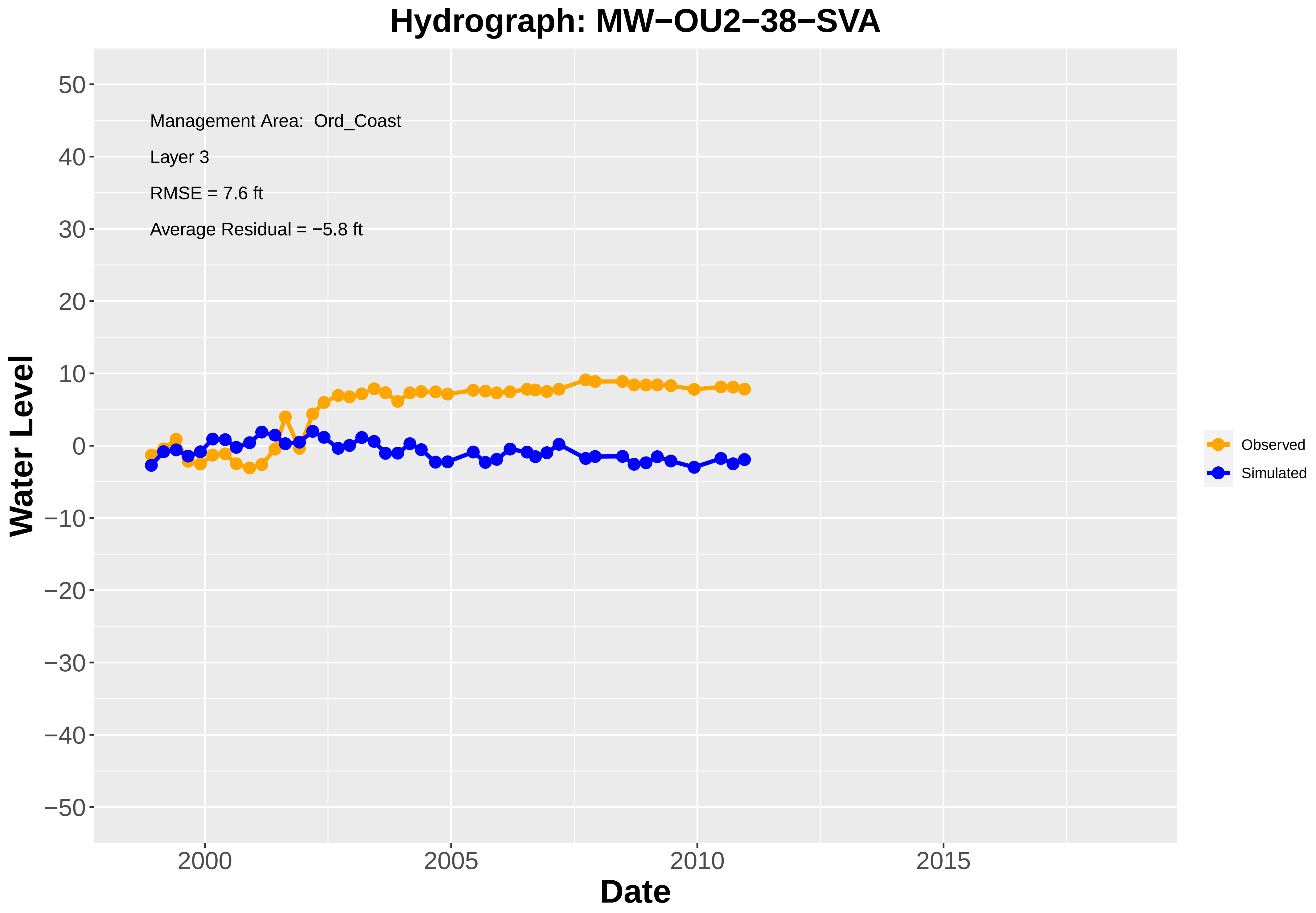

Hydrograph: MW−OU2−36−A
Management Area: Ord_Coast
Layer 1
RMSE = 12.6 ft
Average Residual = 11.9 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
Date
2000
2005
2010
2015
Observed
Simulated



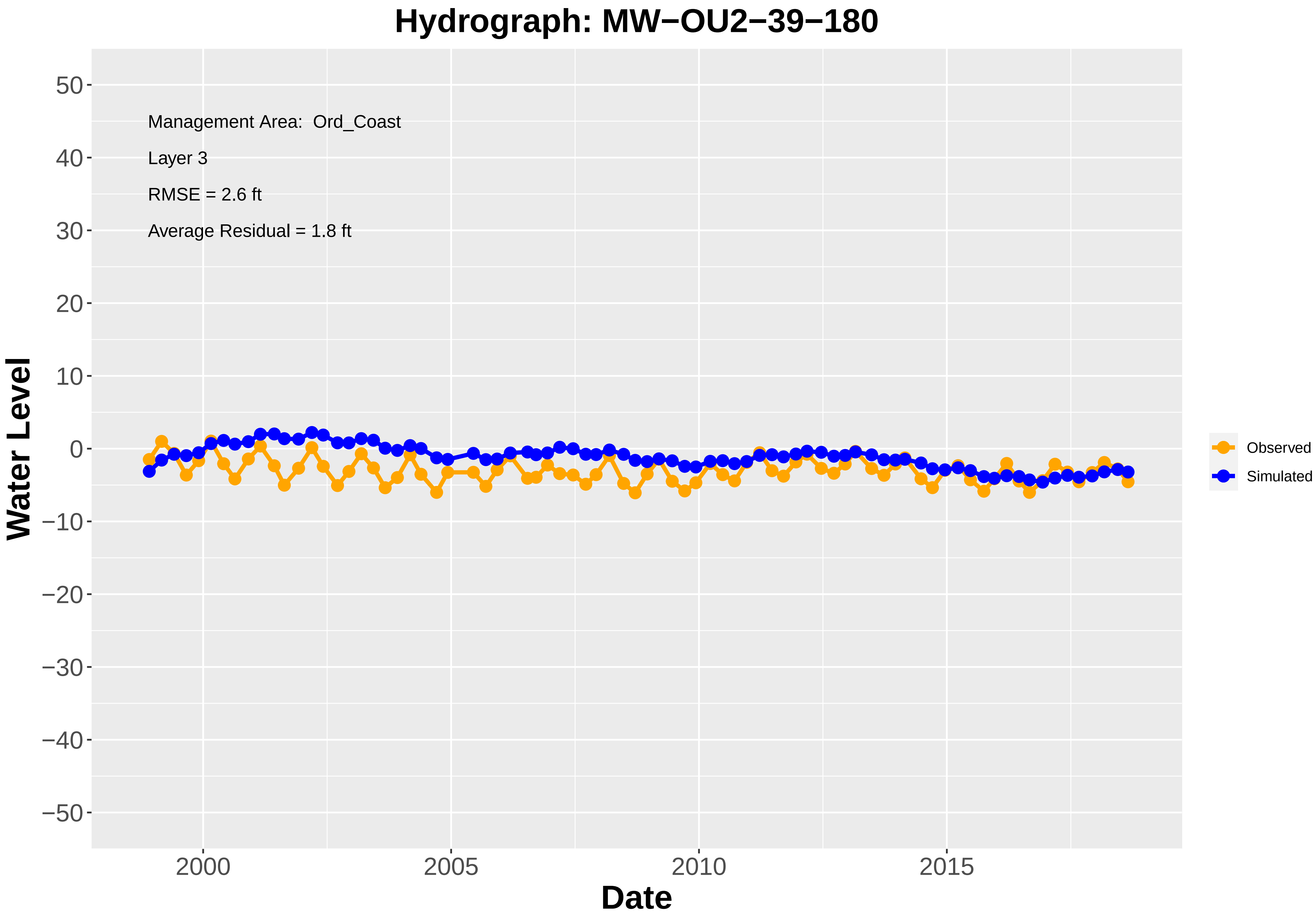
Hydrograph: MW−OU2−37−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.8 ft
Average Residual = −5.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



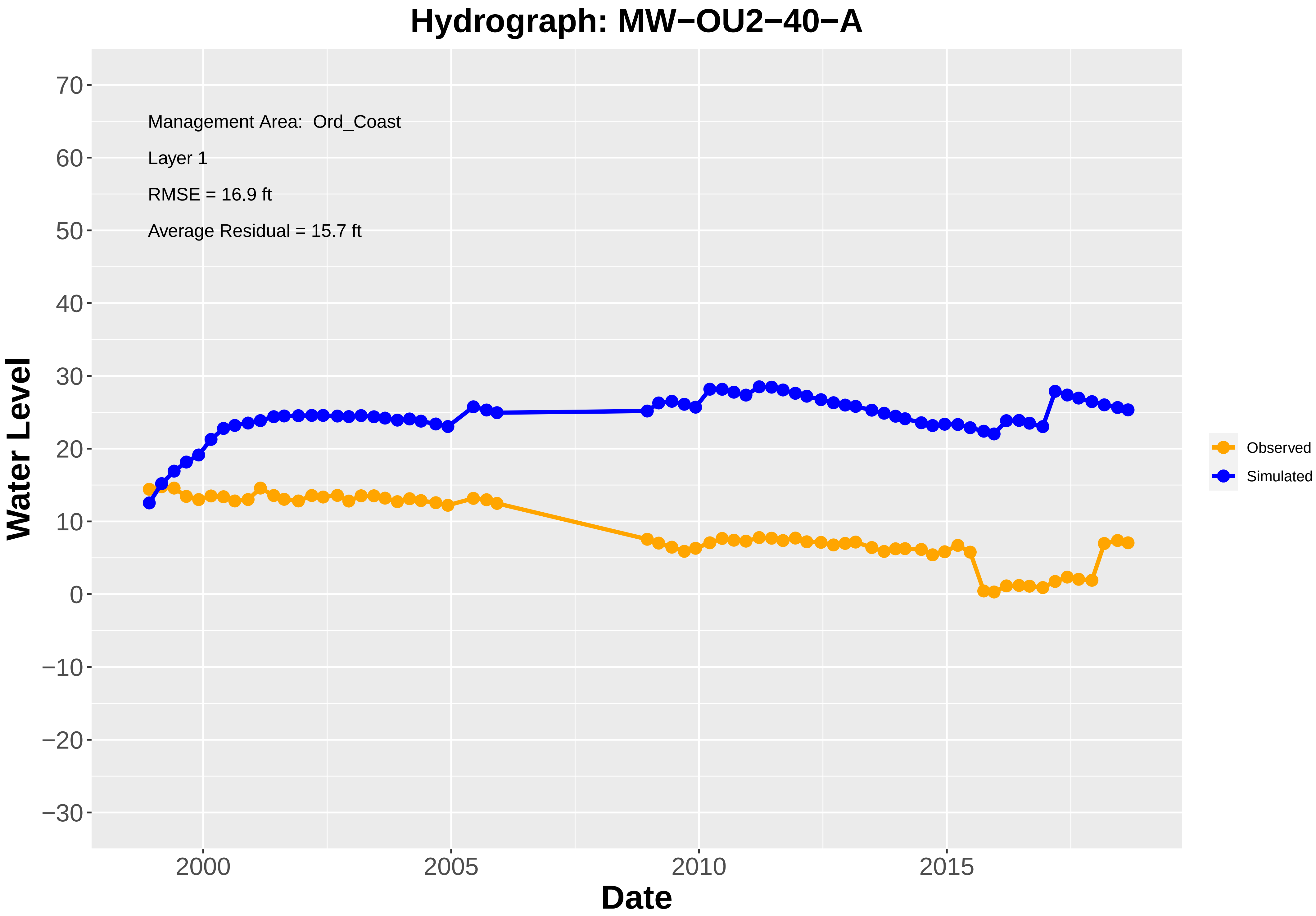
Hydrograph: MW−OU2−37−A
Management Area: Ord_Coast
Layer 1
RMSE = 12.5 ft
Average Residual = 11.6 ft
Water Level
Date
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Observed
Simulated



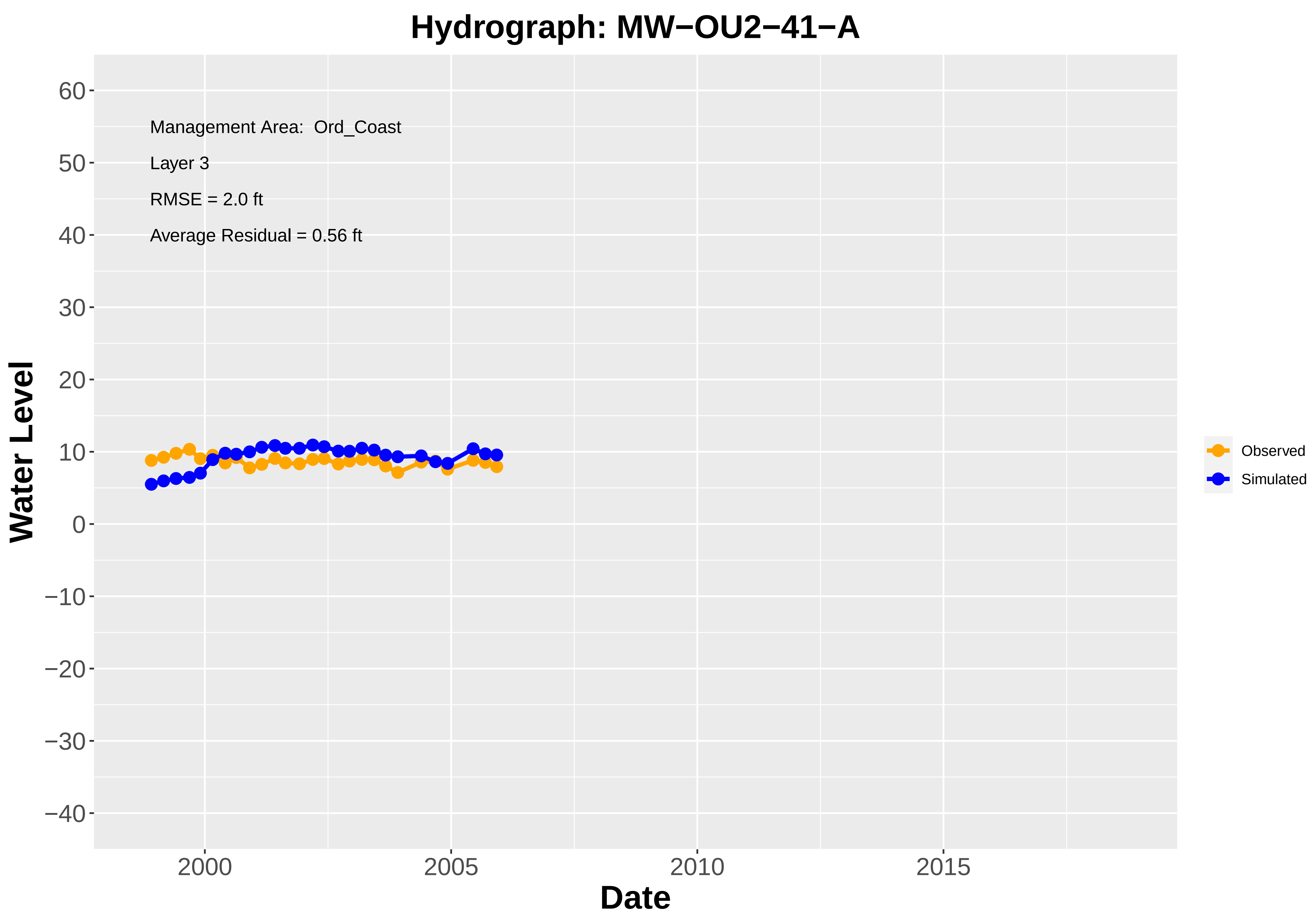
Hydrograph: MW−OU2−38−SVA
Management Area: Ord_Coast
Layer 3
RMSE = 7.6 ft
Average Residual = −5.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



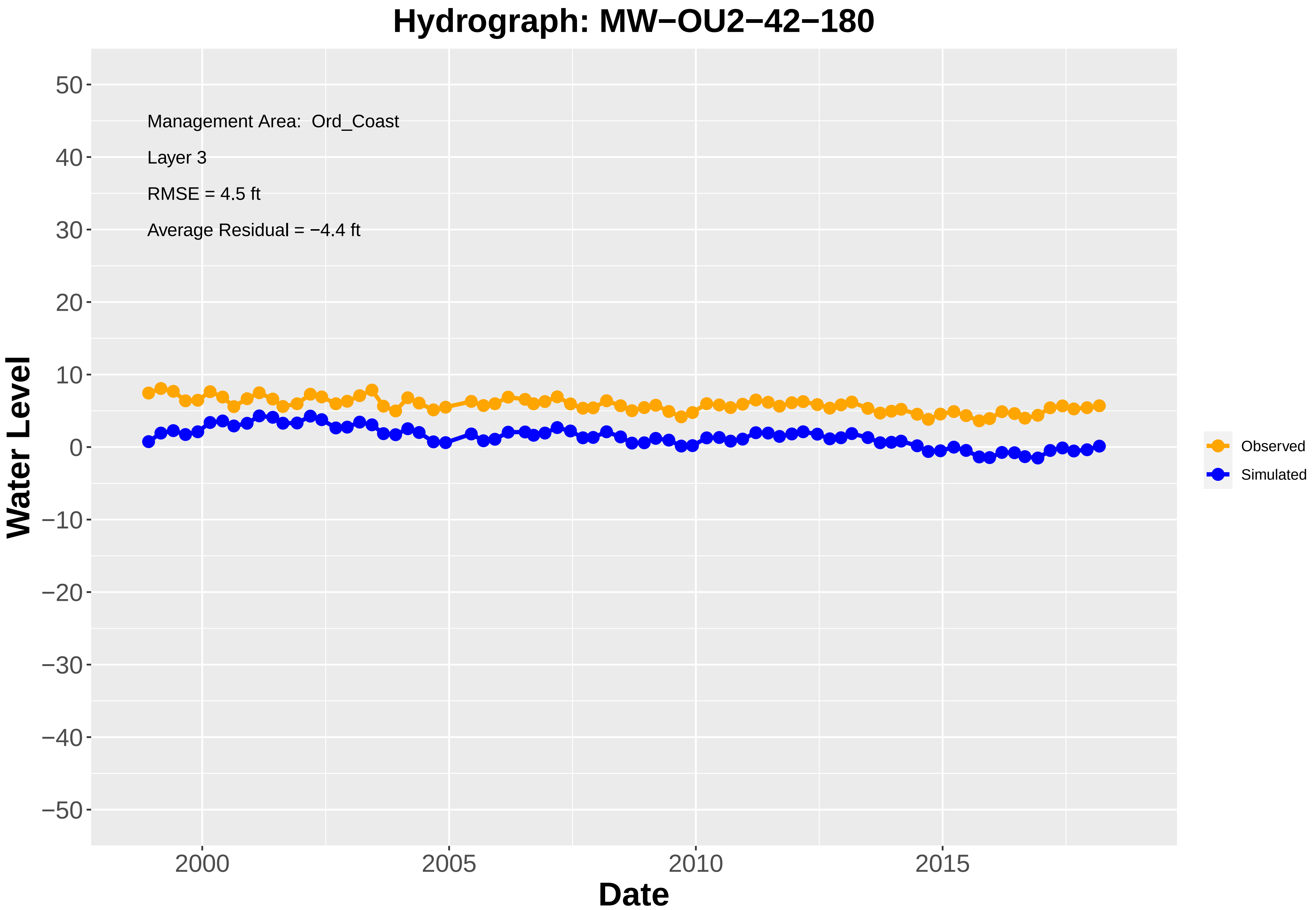
Hydrograph: MW−OU2−39−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.6 ft
Average Residual = 1.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



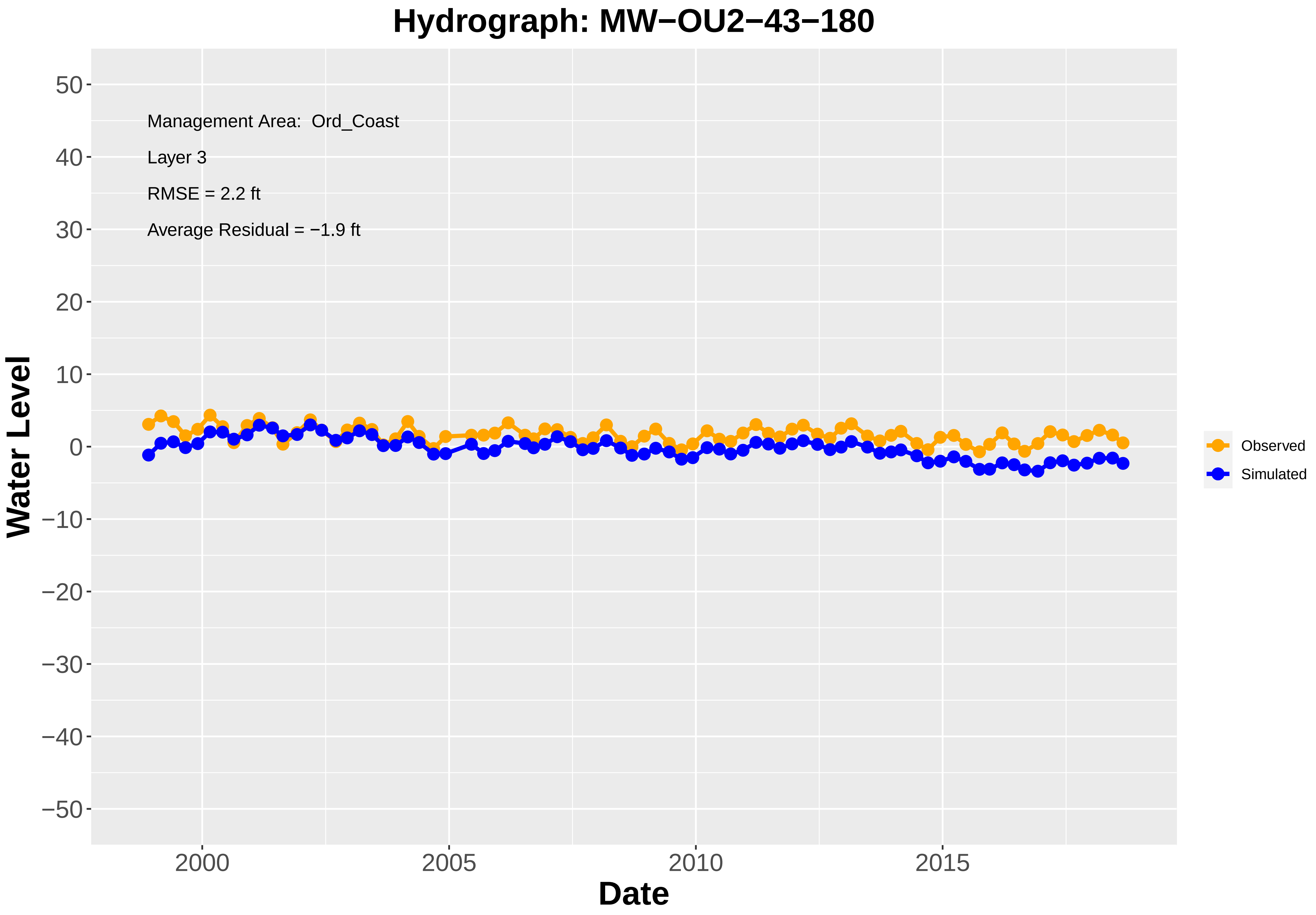
Hydrograph: MW−OU2−40−A
Management Area: Ord_Coast
Layer 1
RMSE = 16.9 ft
Average Residual = 15.7 ft
Water Level
70
60
50
40
30
20
10
0
−10
−20
−30
2000
2005
2010
2015
Date
Observed
Simulated

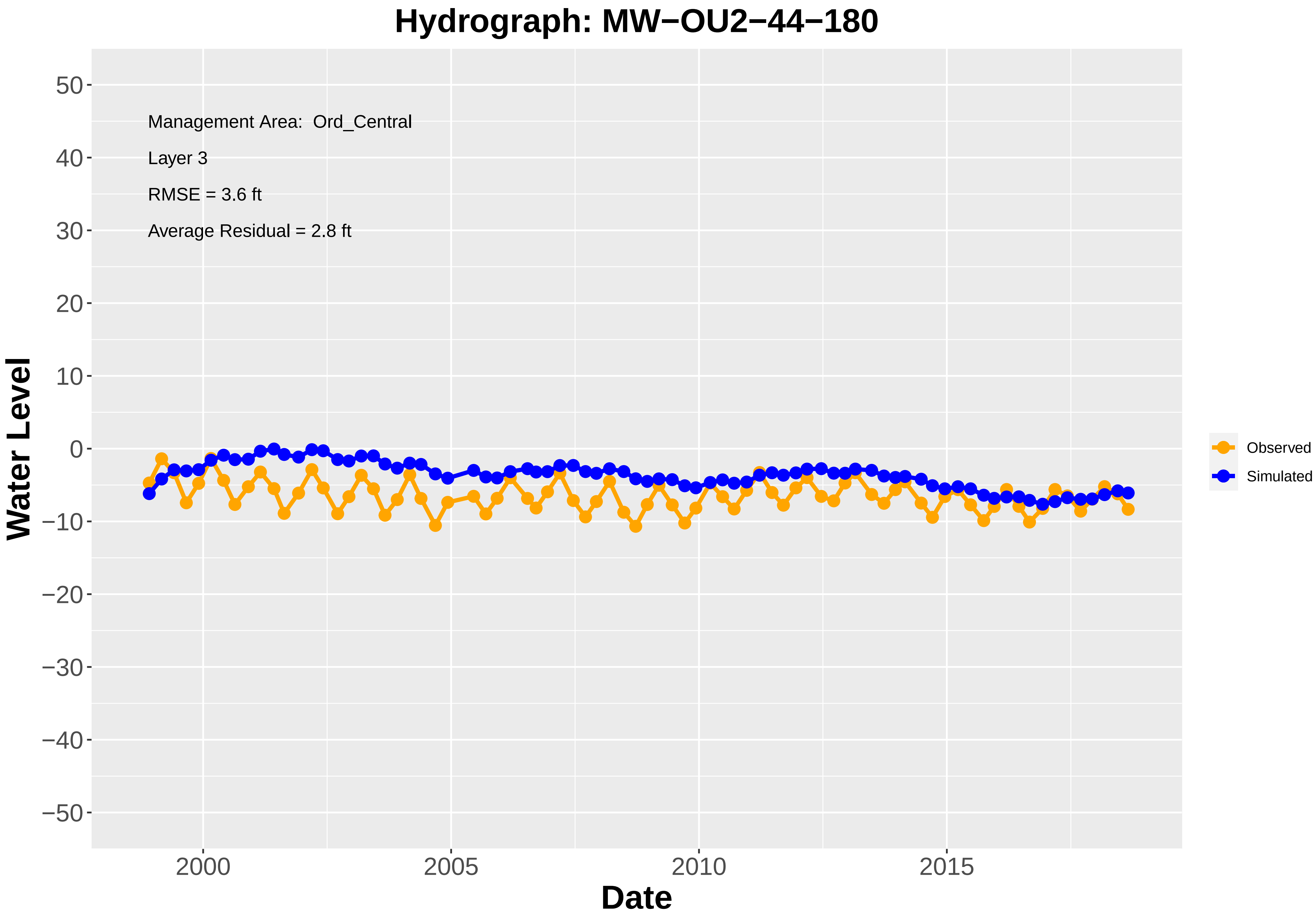


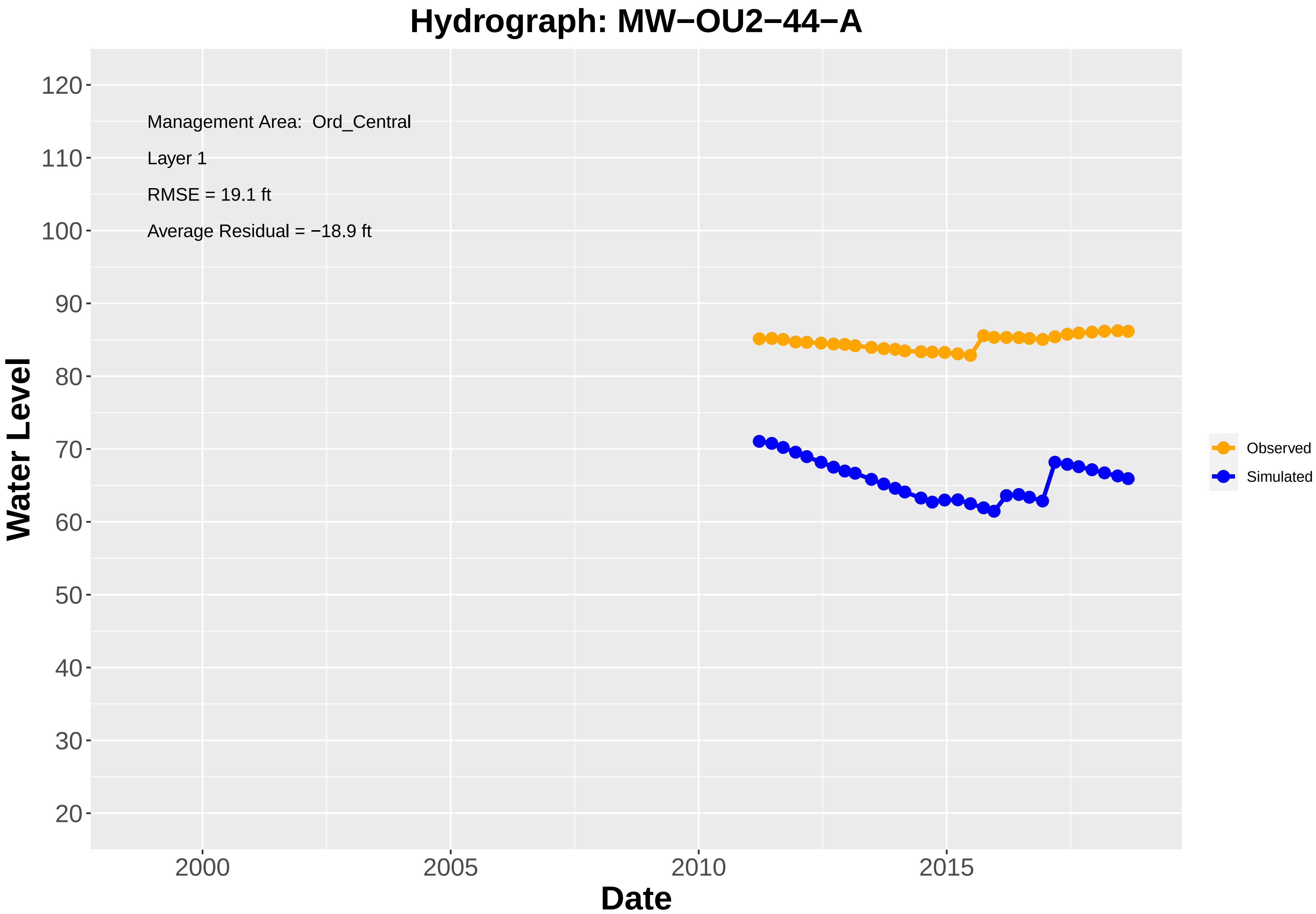
Hydrograph: MW−OU2−41−A
Management Area: Ord_Coast
Layer 3
RMSE = 2.0 ft
Average Residual = 0.56 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

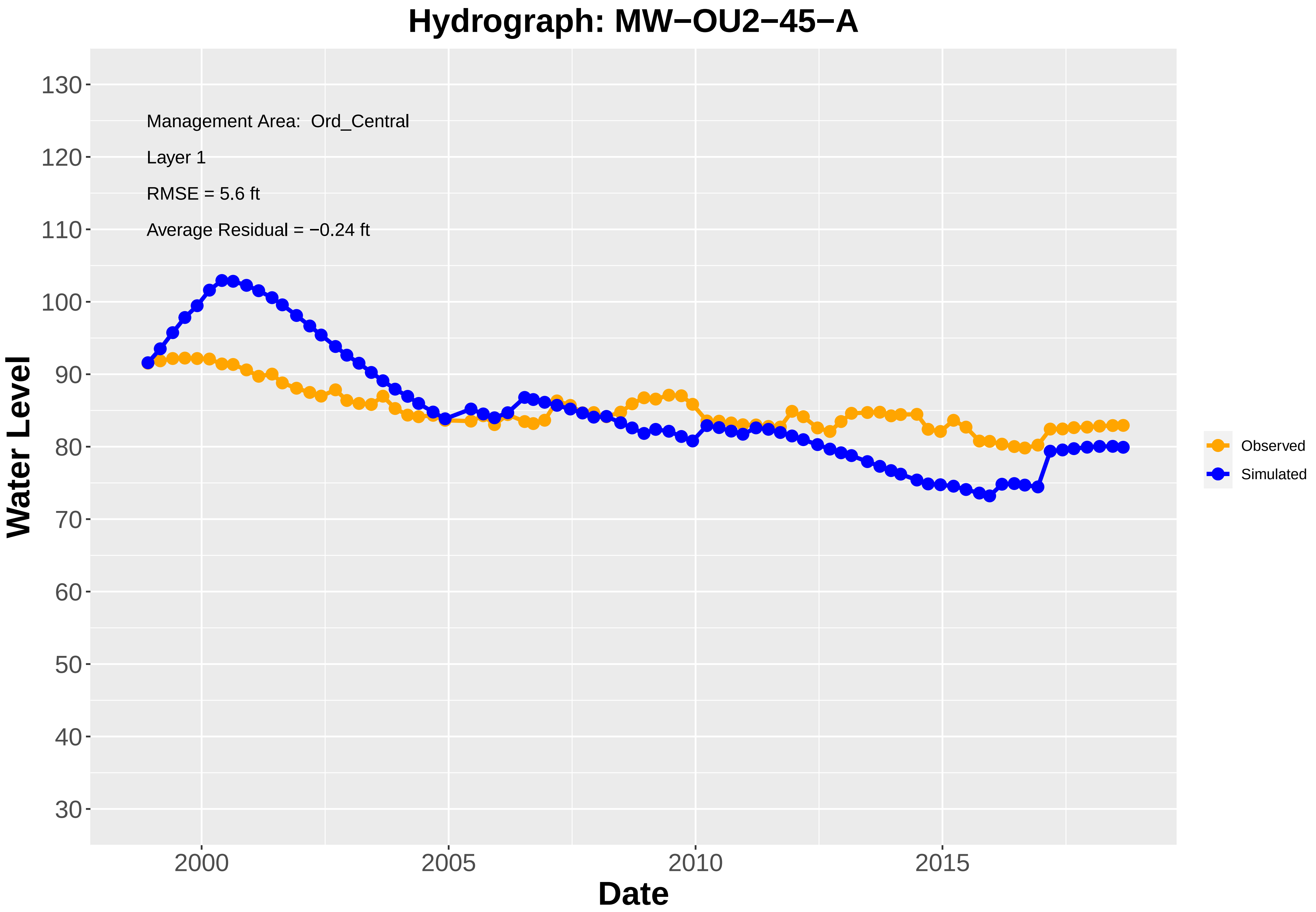


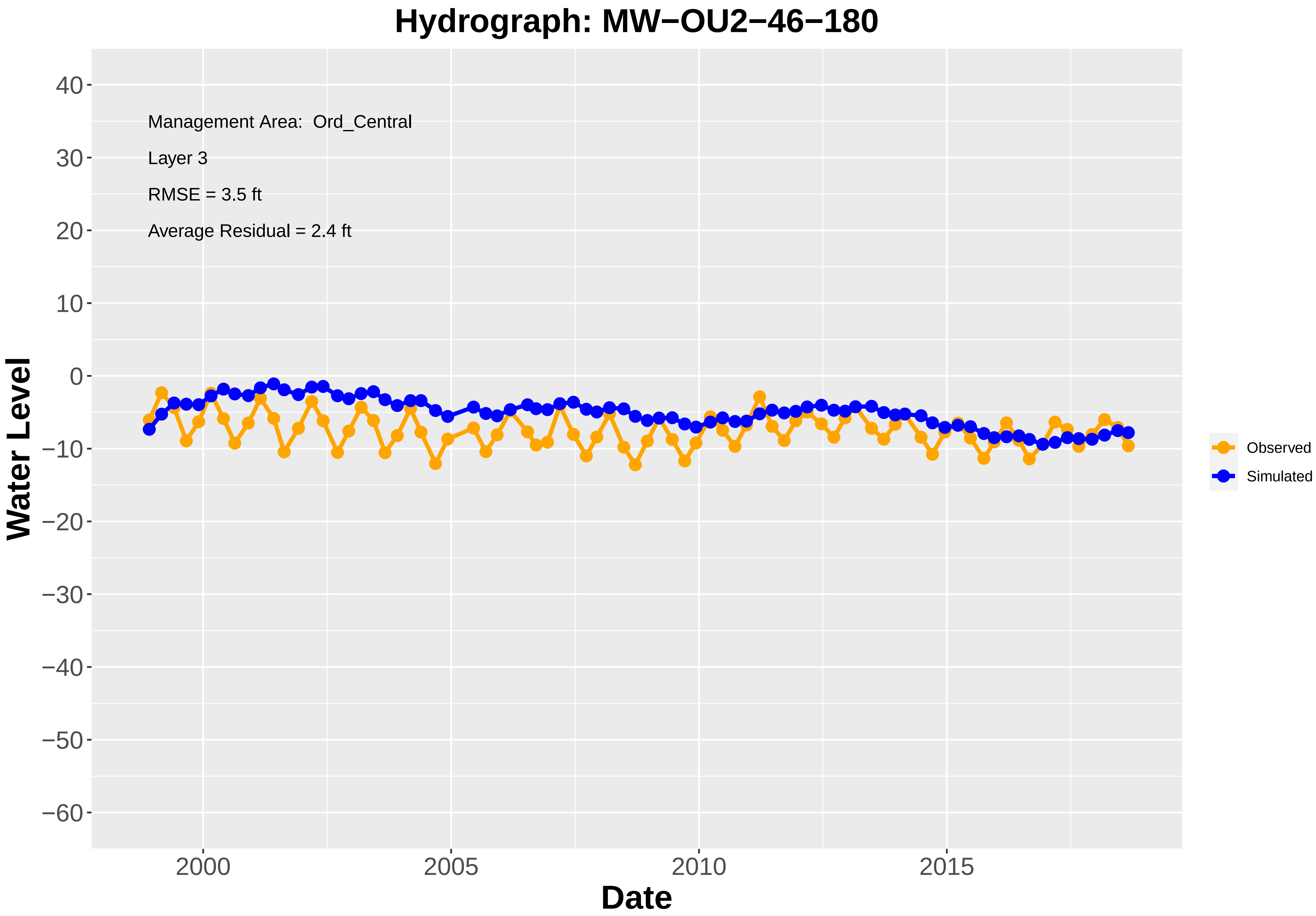
Hydrograph: MW−OU2−42−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.5 ft
Average Residual = −4.4 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−43−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.2 ft
Average Residual = −1.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

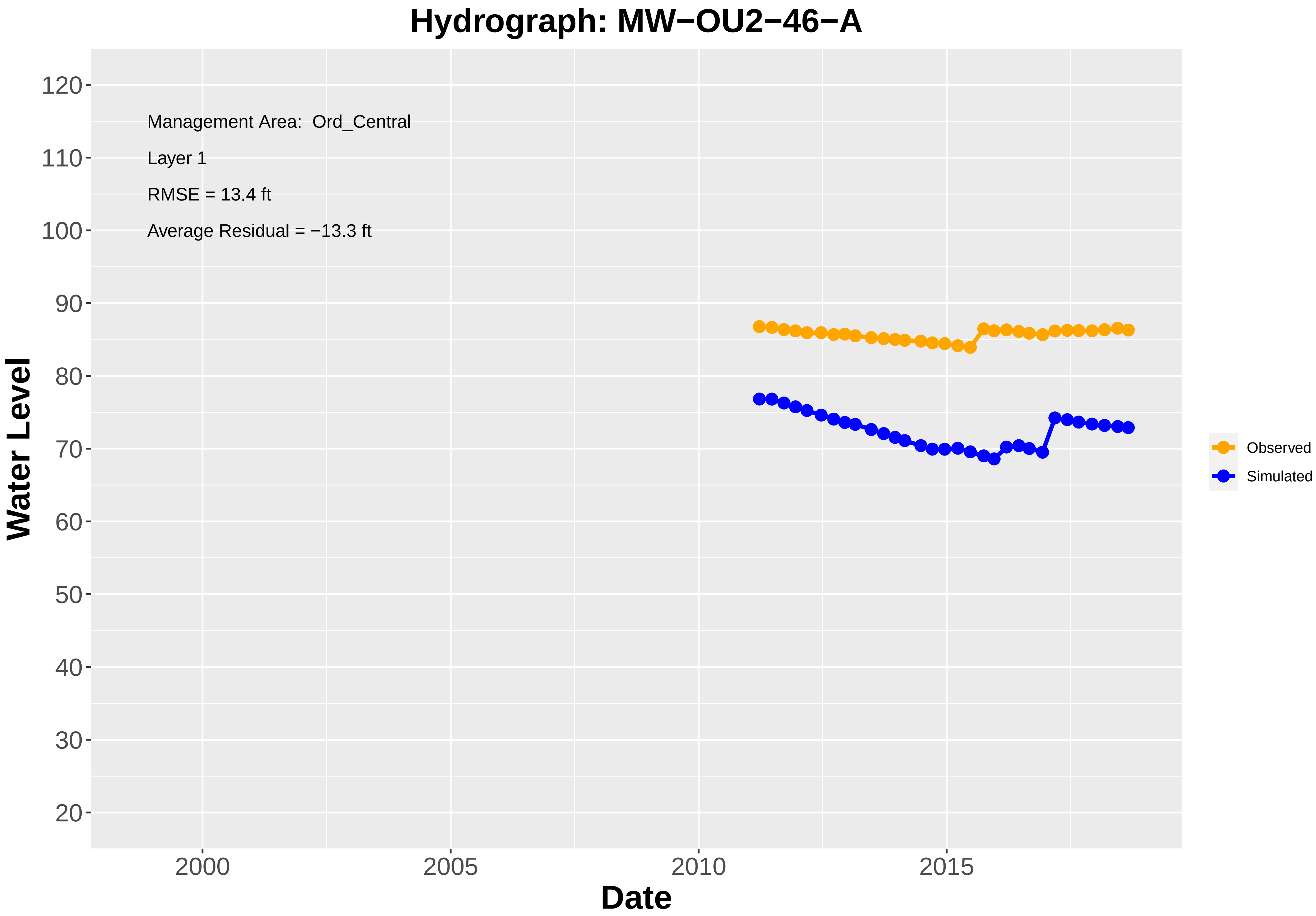

Hydrograph: MW−OU2−44−180
Management Area: Ord_Central
Layer 3
RMSE = 3.6 ft
Average Residual = 2.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−44−A
Management Area: Ord_Central
Layer 1
RMSE = 19.1 ft
Average Residual = −18.9 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

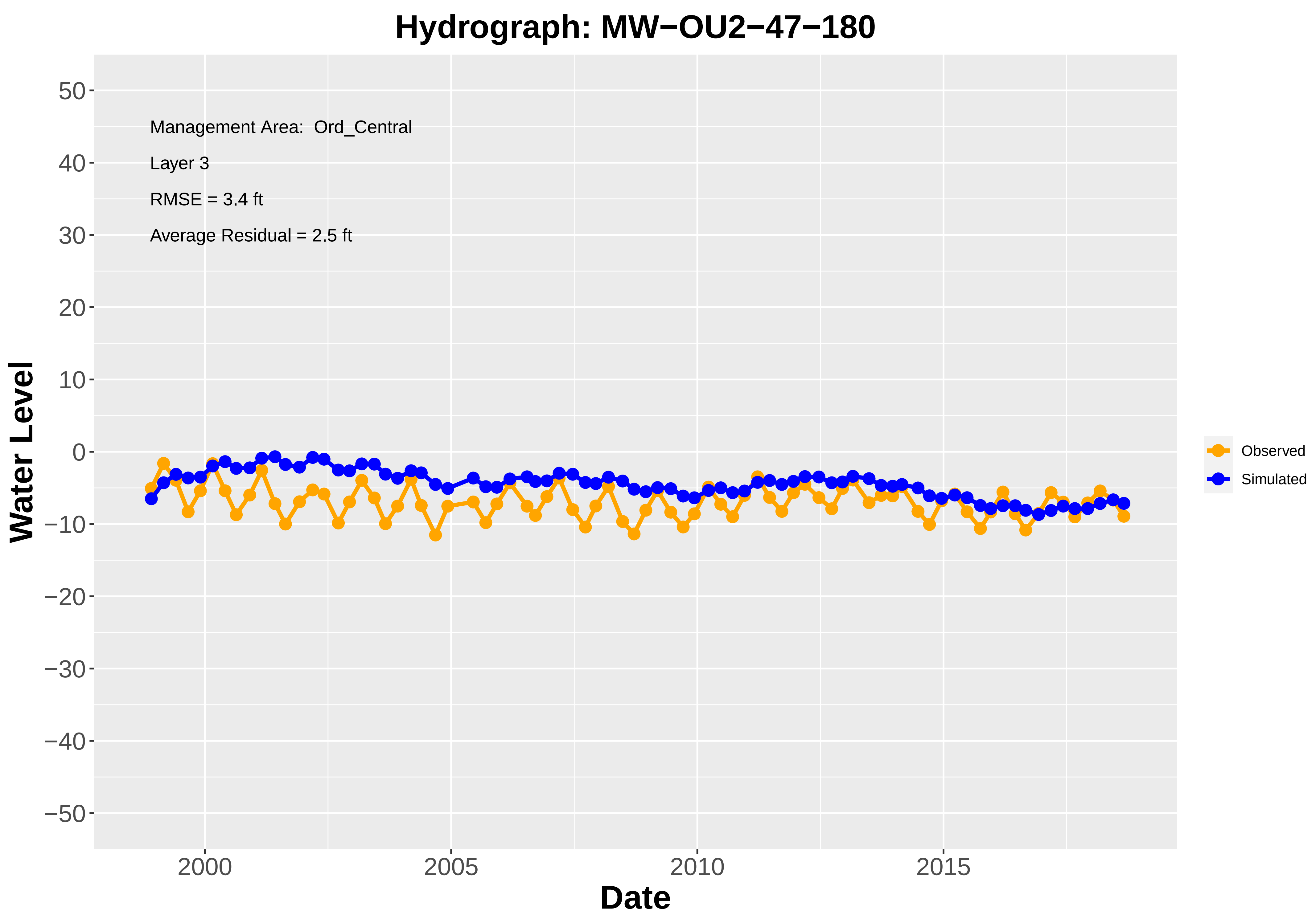

Hydrograph: MW−OU2−45−A
Management Area: Ord_Central
Layer 1
RMSE = 5.6 ft
Average Residual = −0.24 ft
Water Level
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Date
Observed
Simulated

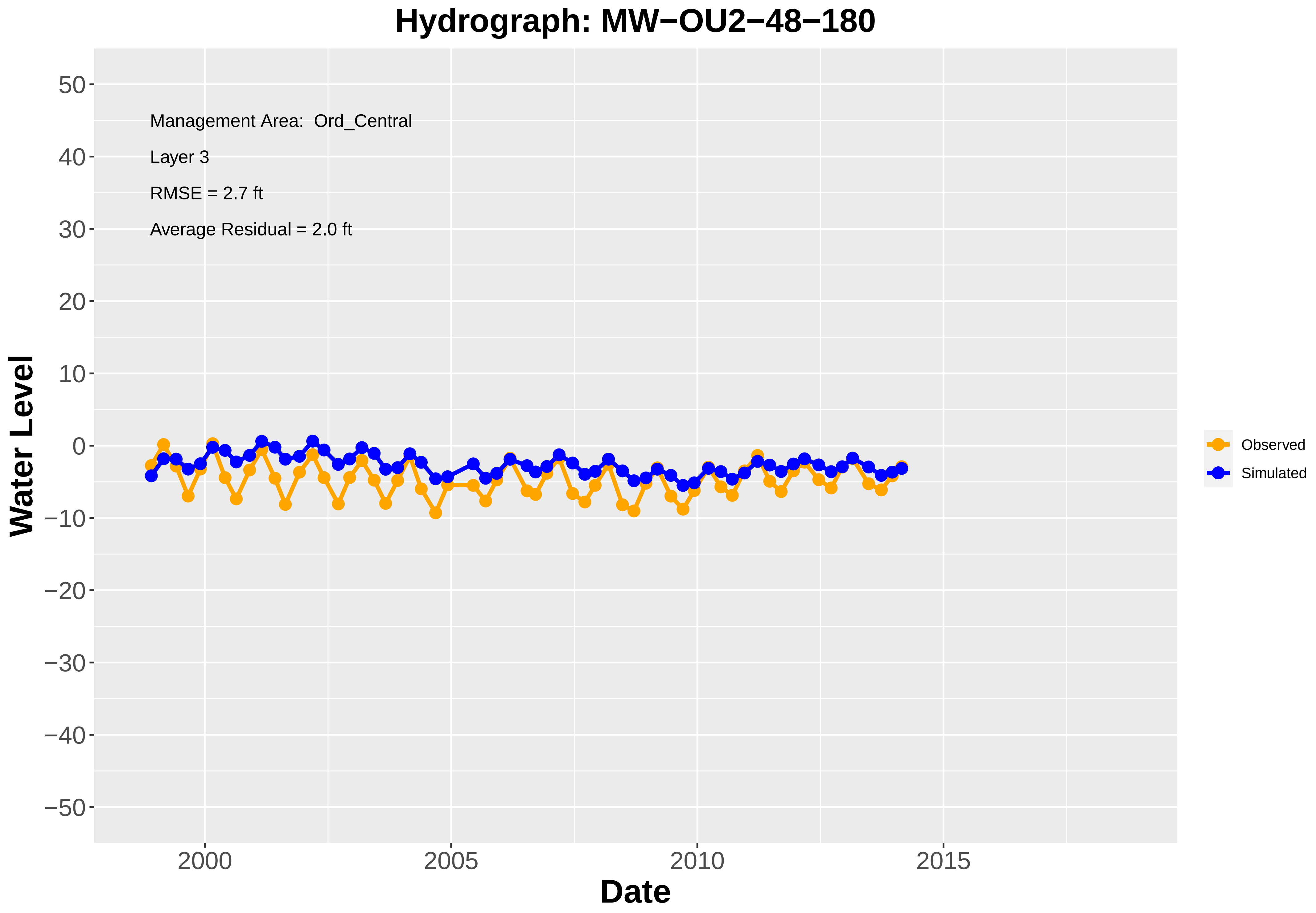


Hydrograph: MW−OU2−46−180
Management Area: Ord_Central
Layer 3
RMSE = 3.5 ft
Average Residual = 2.4 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

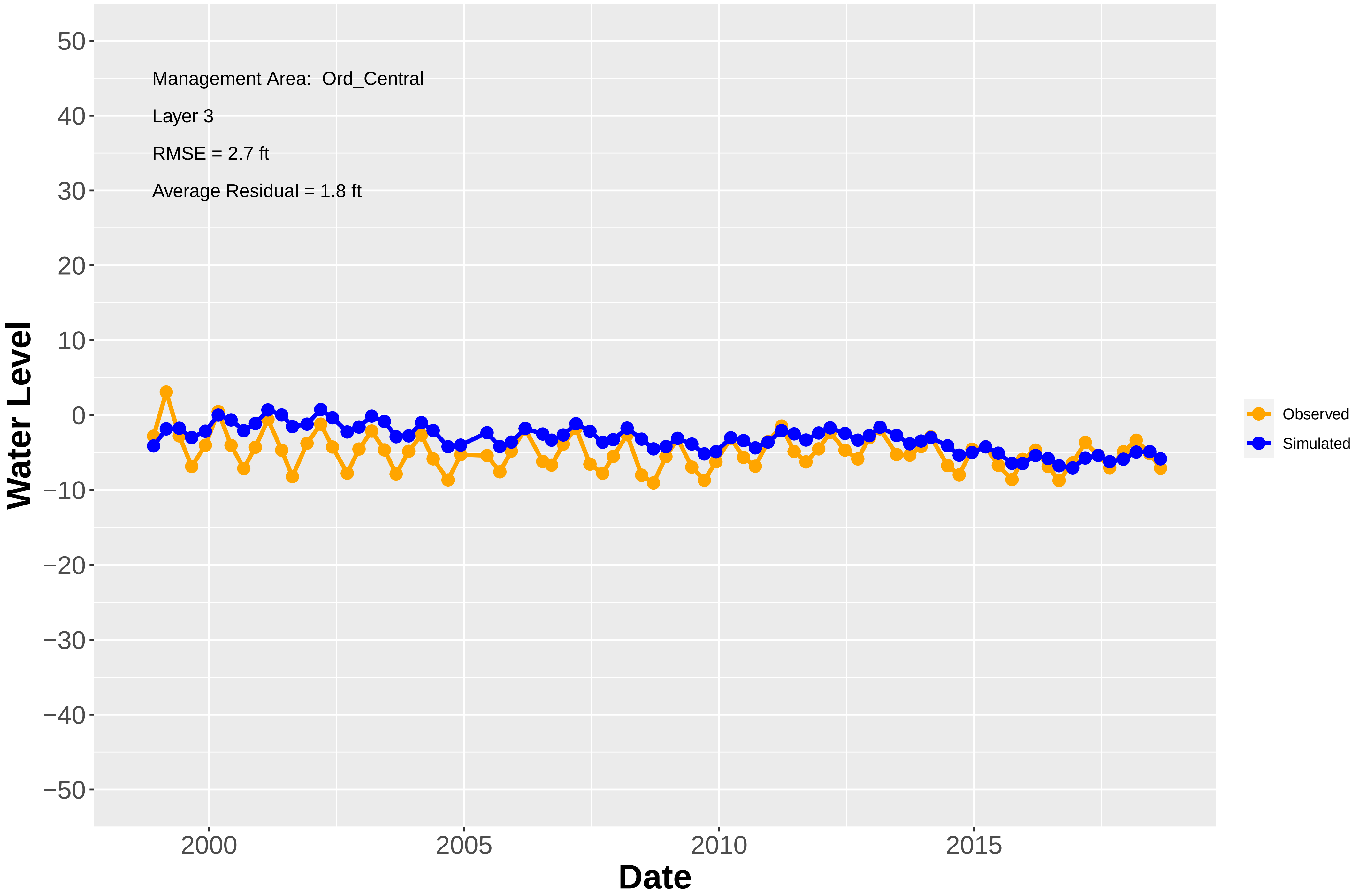


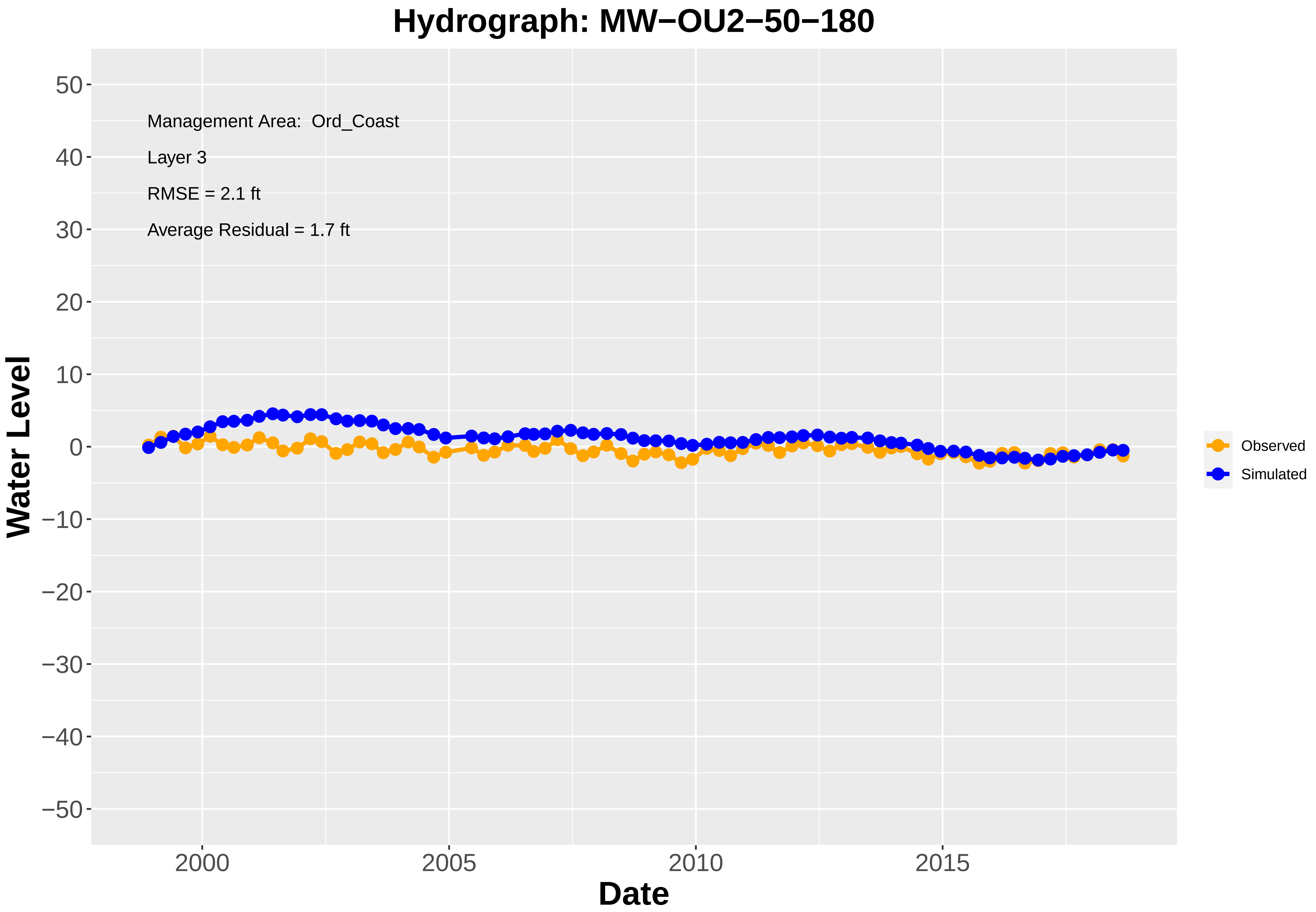
Hydrograph: MW−OU2−46−A
Management Area: Ord_Central
Layer 1
RMSE = 13.4 ft
Average Residual = −13.3 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

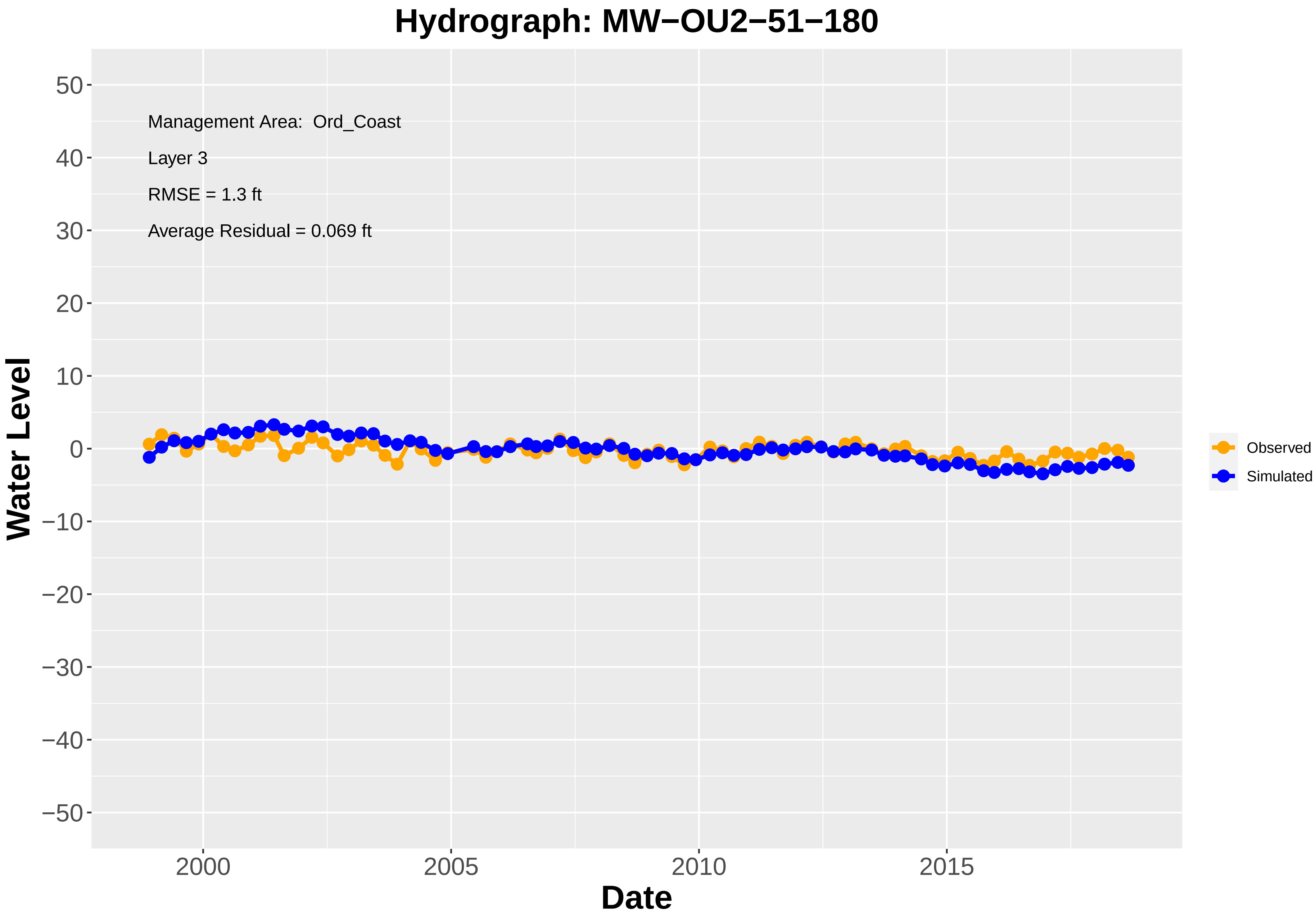

Hydrograph: MW−OU2−47−180
Management Area: Ord_Central
Layer 3
RMSE = 3.4 ft
Average Residual = 2.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−48−180
Management Area: Ord_Central
Layer 3
RMSE = 2.7 ft
Average Residual = 2.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

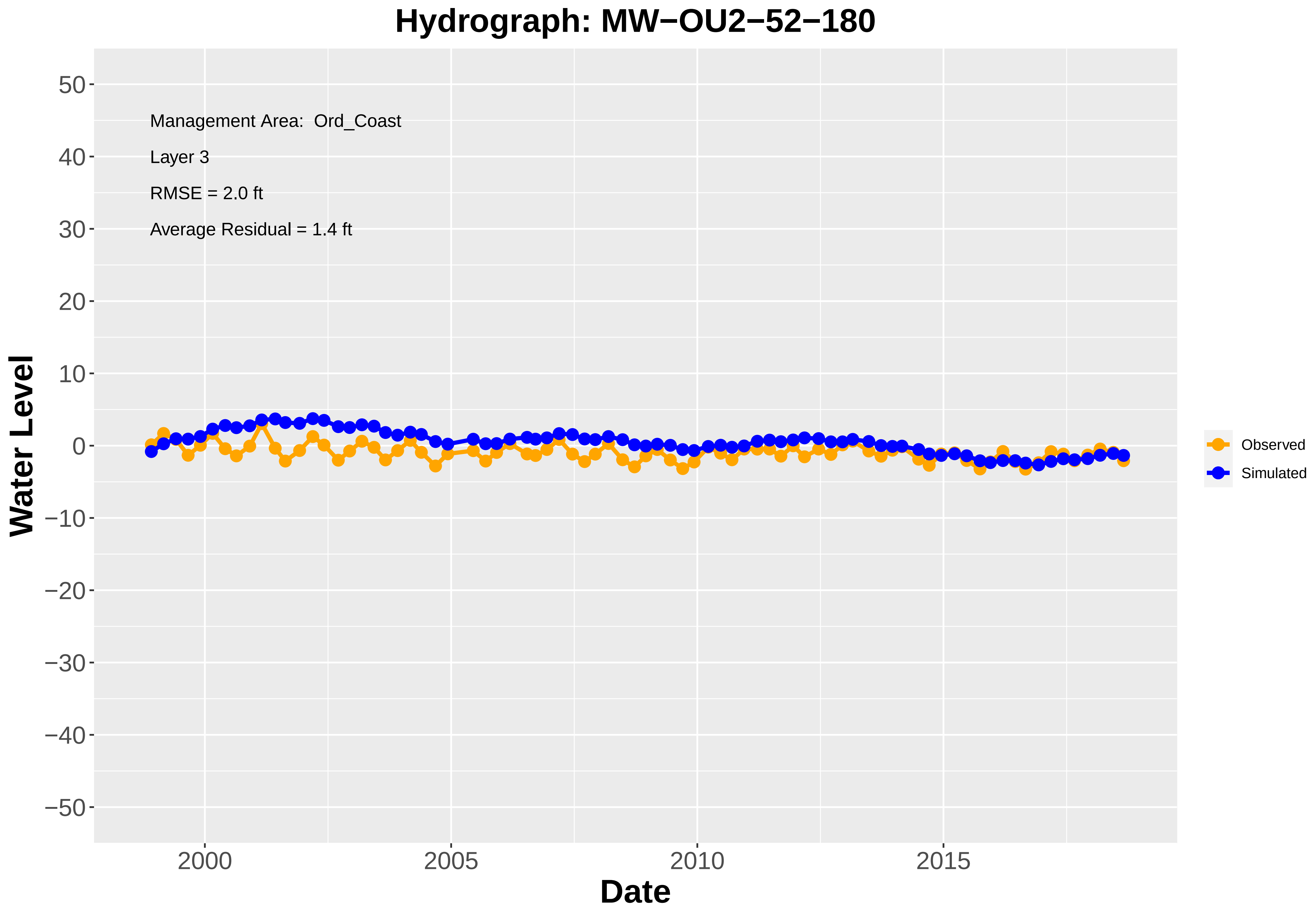
Hydrograph: MW−OU2−49−180



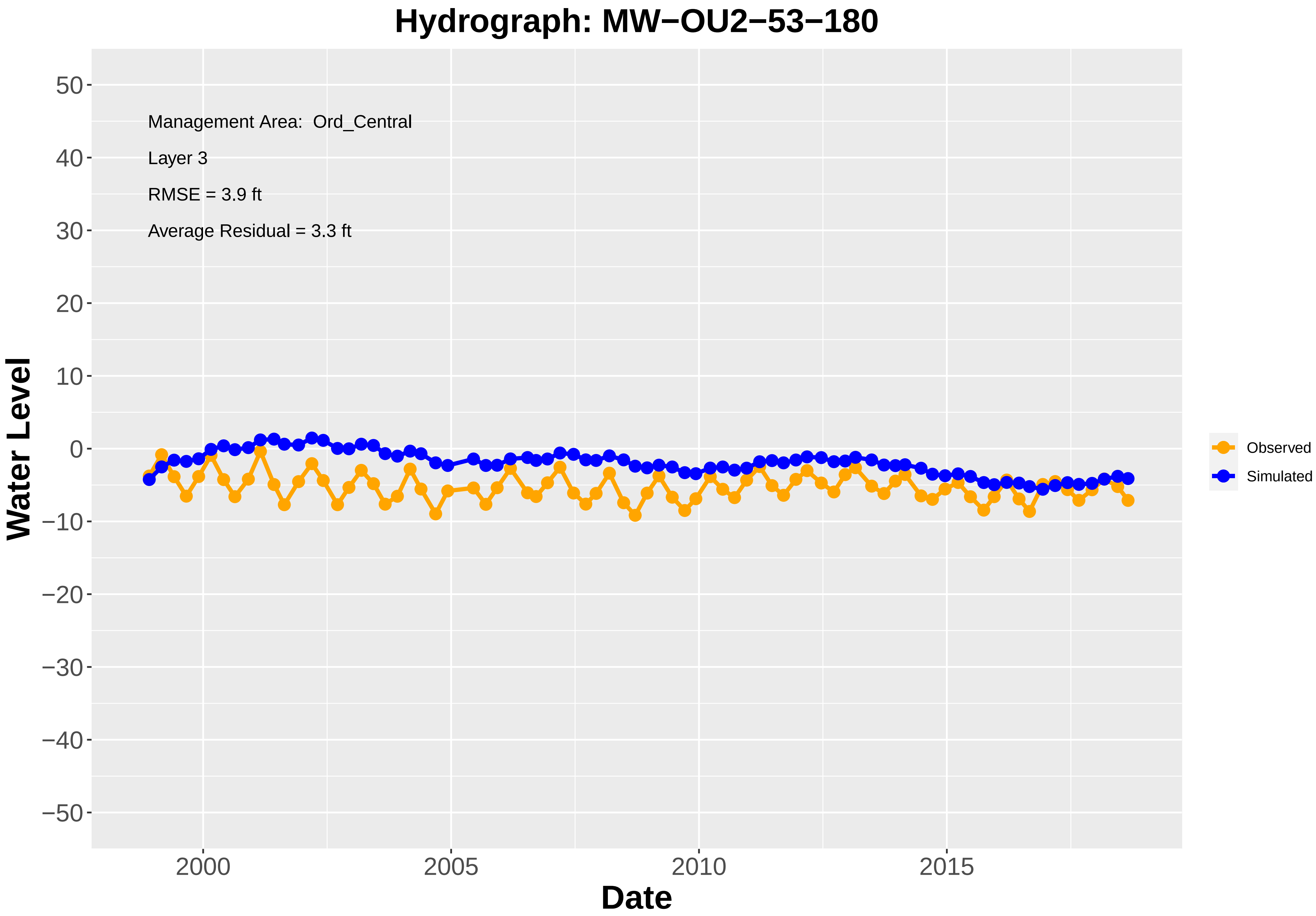

Hydrograph: MW−OU2−50−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.1 ft
Average Residual = 1.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



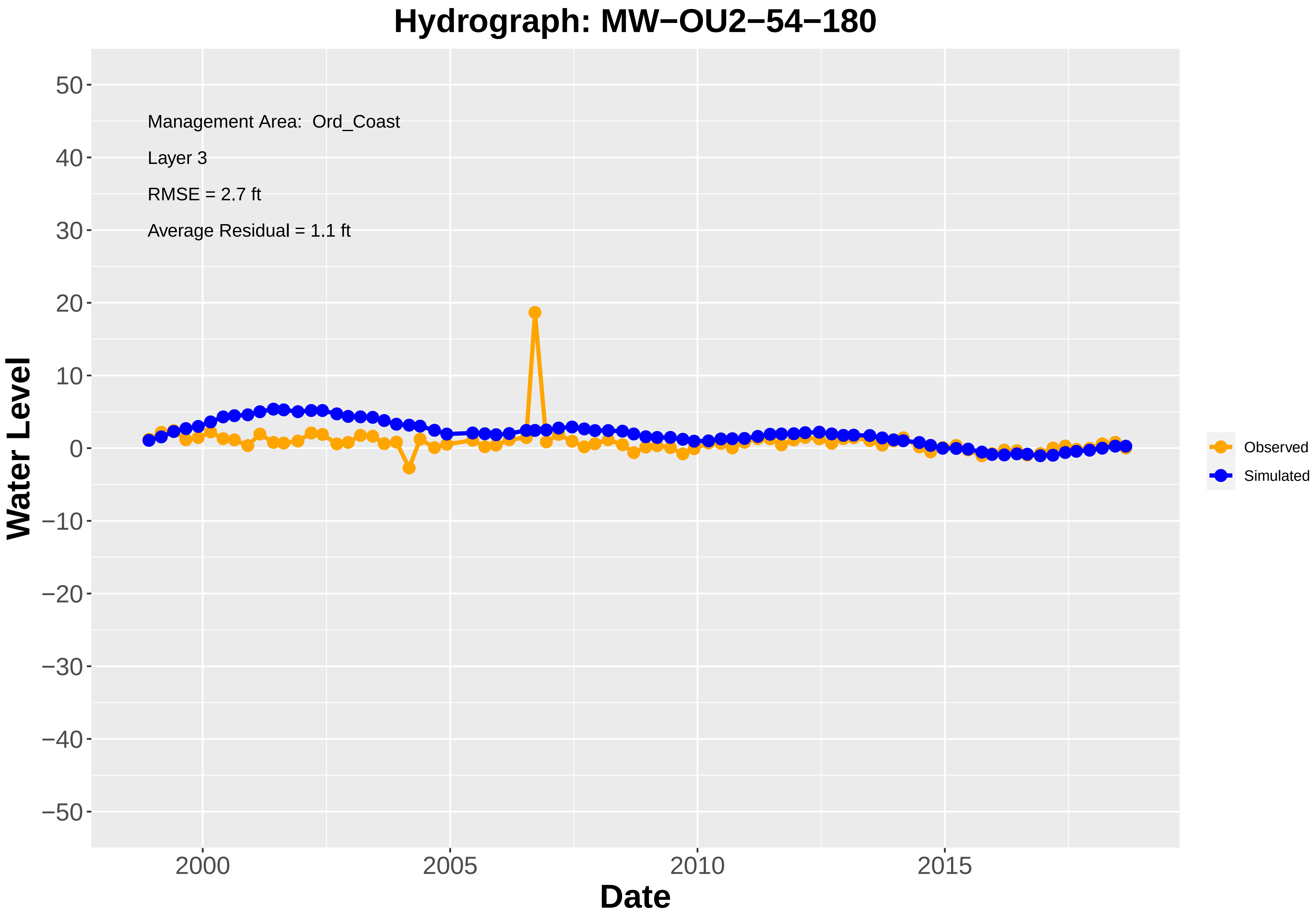
Hydrograph: MW−OU2−51−180
Management Area: Ord_Coast
Layer 3
RMSE = 1.3 ft
Average Residual = 0.069 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



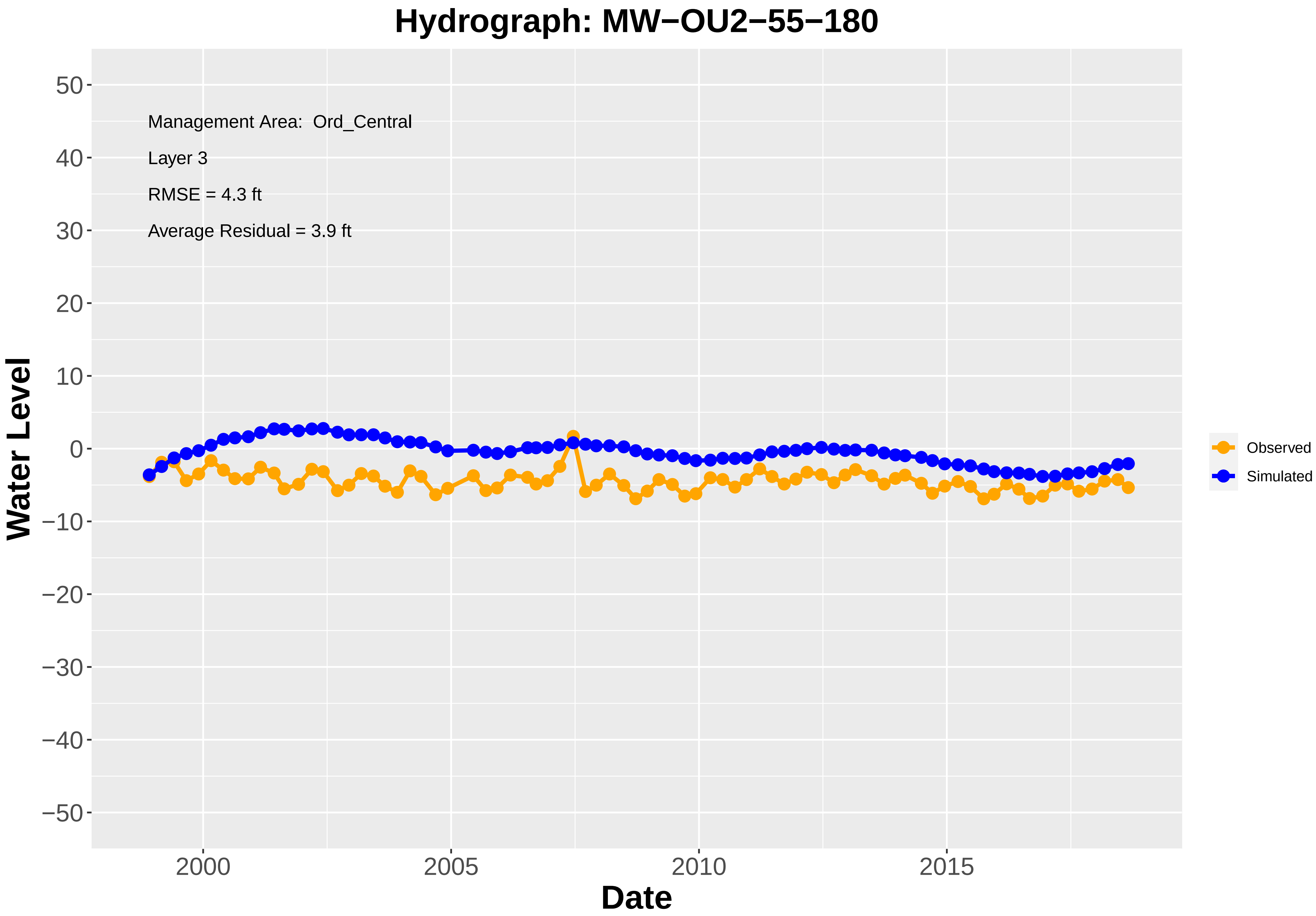
Hydrograph: MW−OU2−52−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.0 ft
Average Residual = 1.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

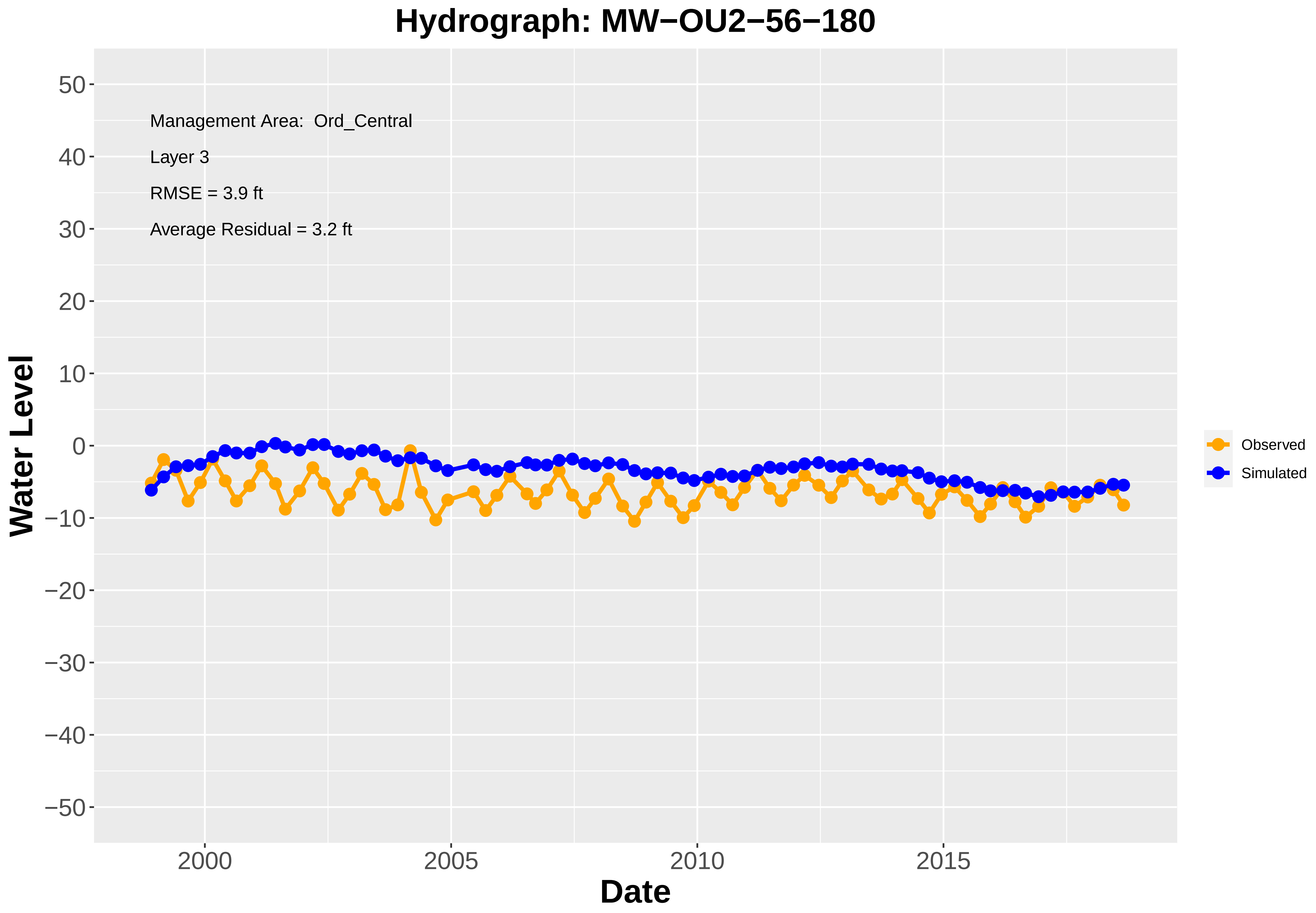


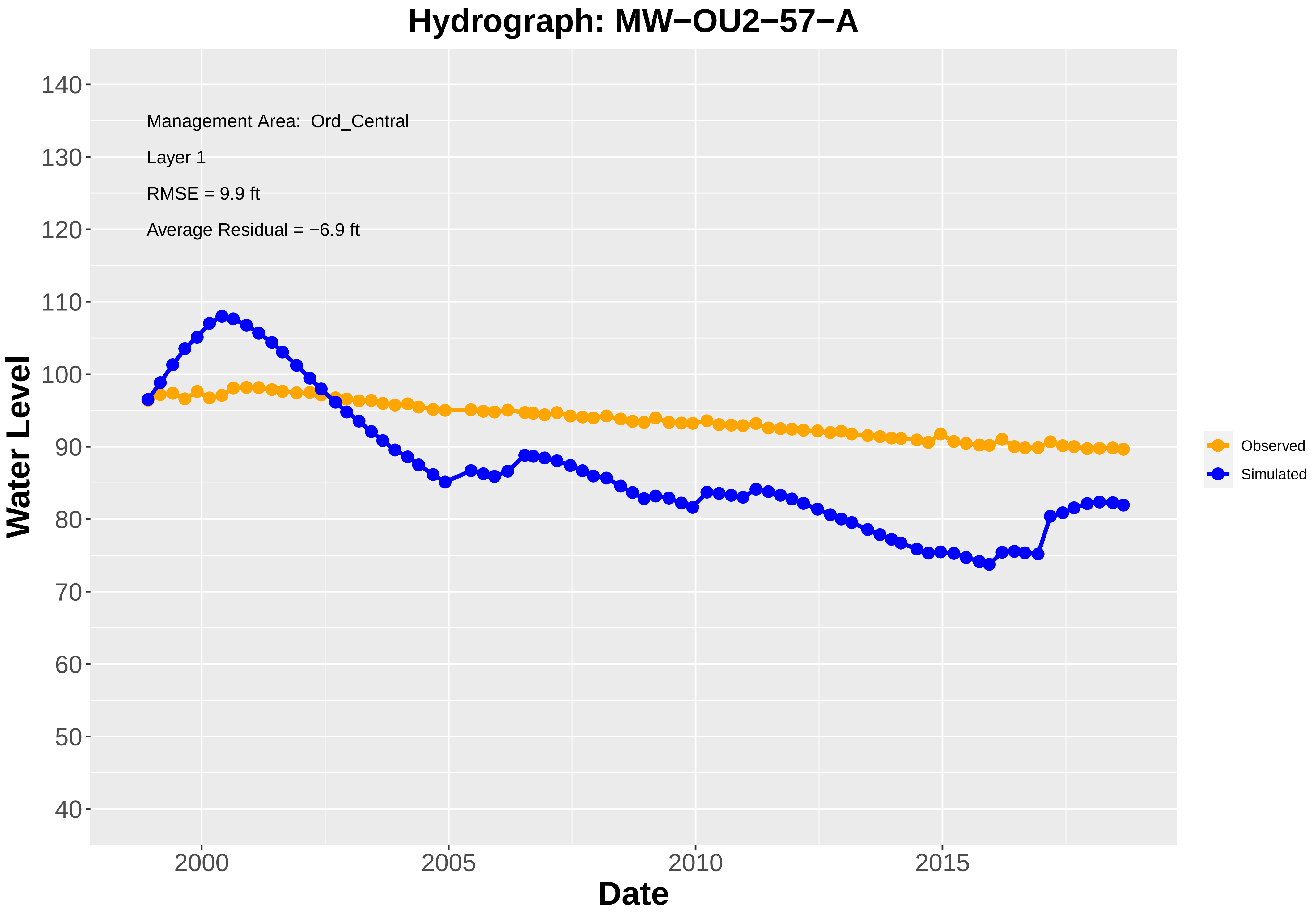
Hydrograph: MW−OU2−53−180
Management Area: Ord_Central
Layer 3
RMSE = 3.9 ft
Average Residual = 3.3 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

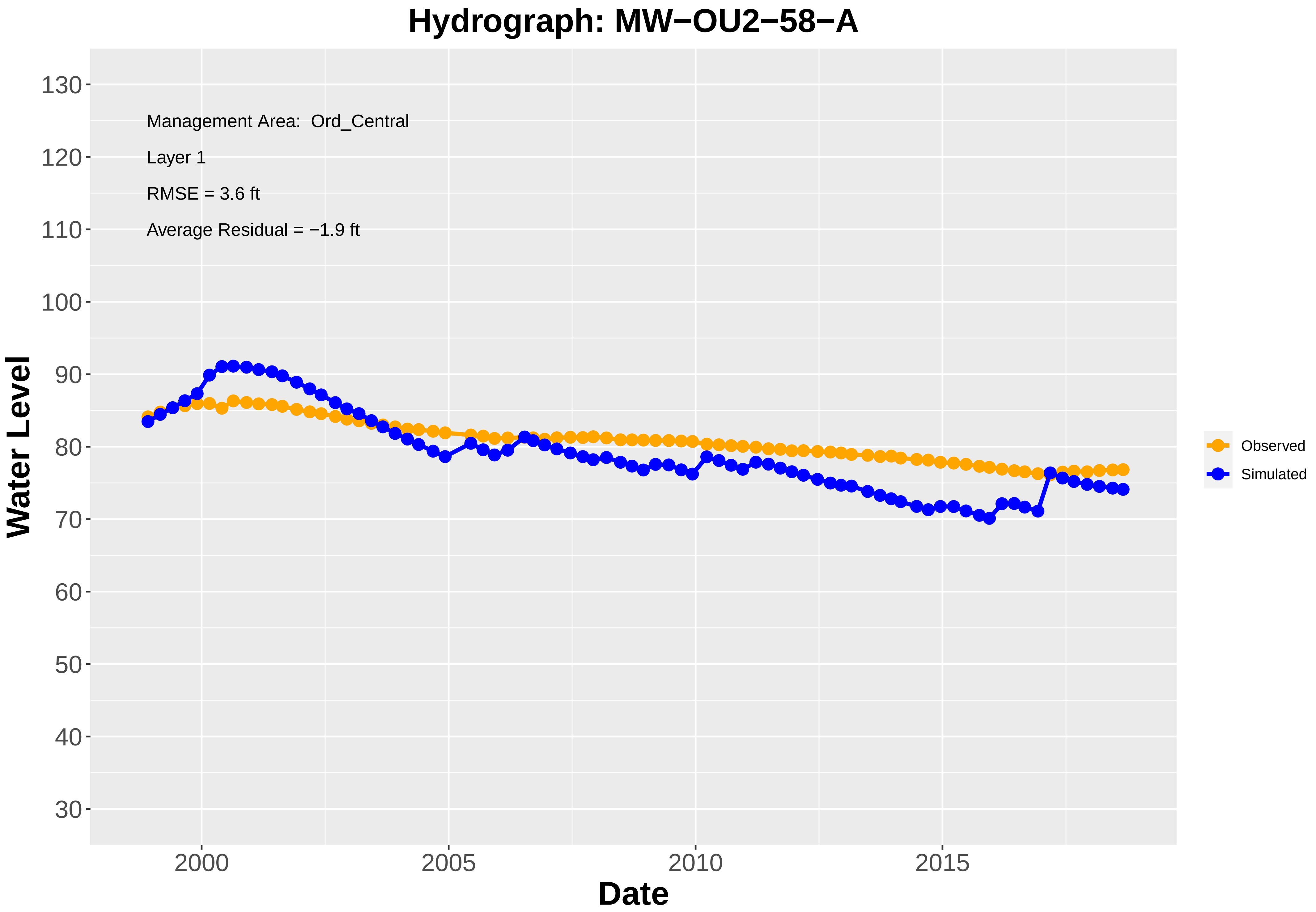


Hydrograph: MW−OU2−54−180
Management Area: Ord_Coast
Layer 3
RMSE = 2.7 ft
Average Residual = 1.1 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

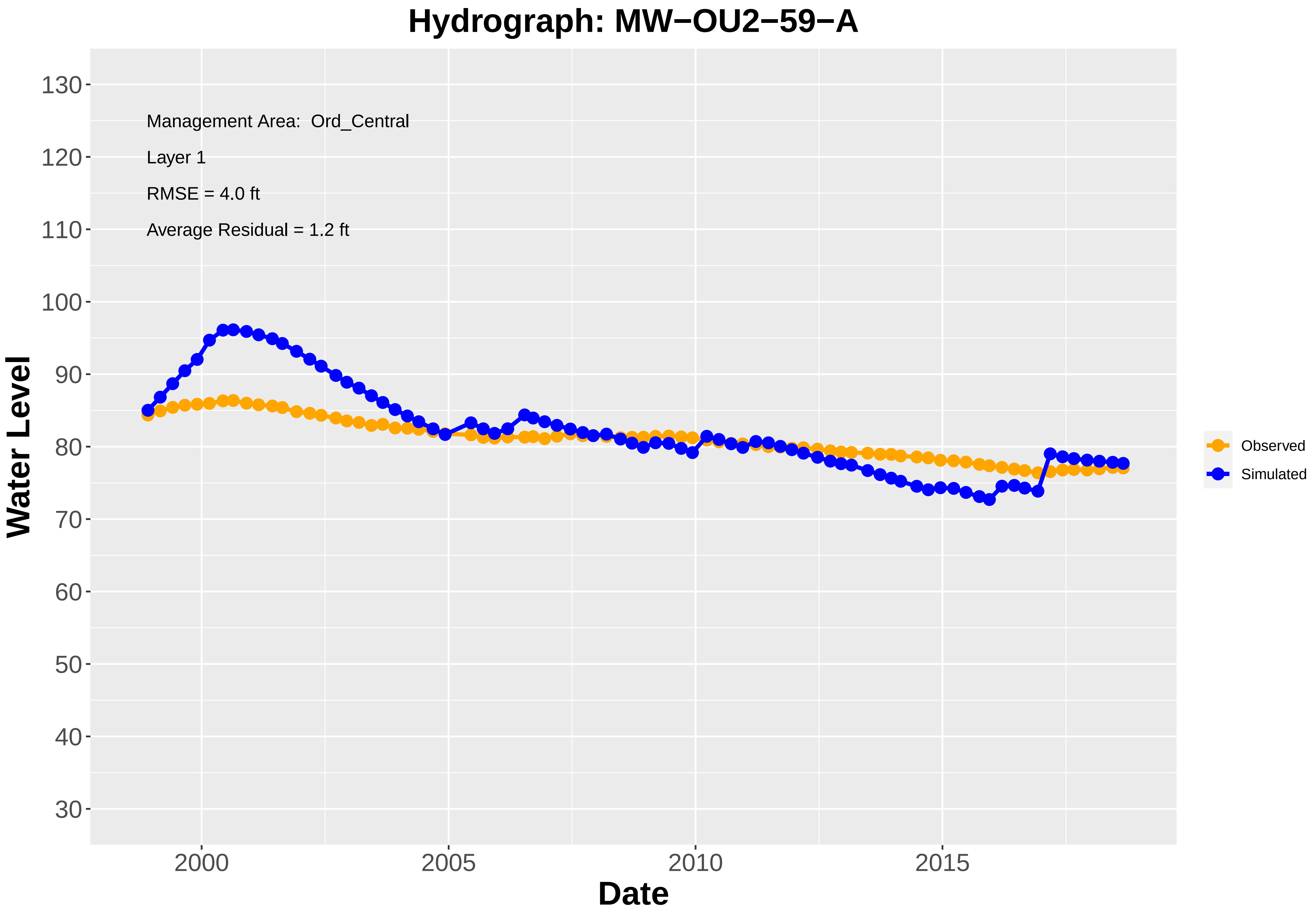

Hydrograph: MW−OU2−55−180
Management Area: Ord_Central
Layer 3
RMSE = 4.3 ft
Average Residual = 3.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

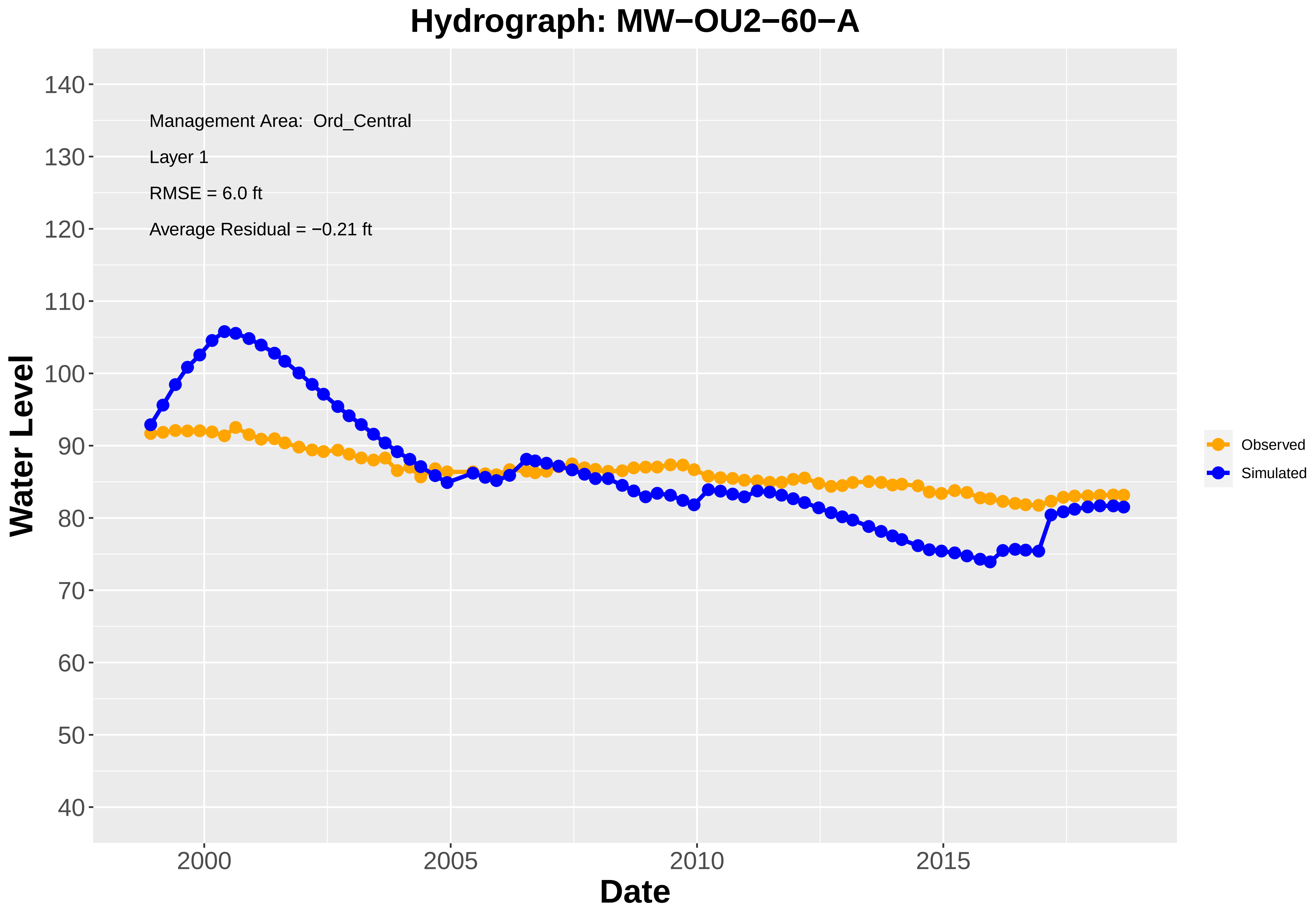

Hydrograph: MW−OU2−56−180
Management Area: Ord_Central
Layer 3
RMSE = 3.9 ft
Average Residual = 3.2 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

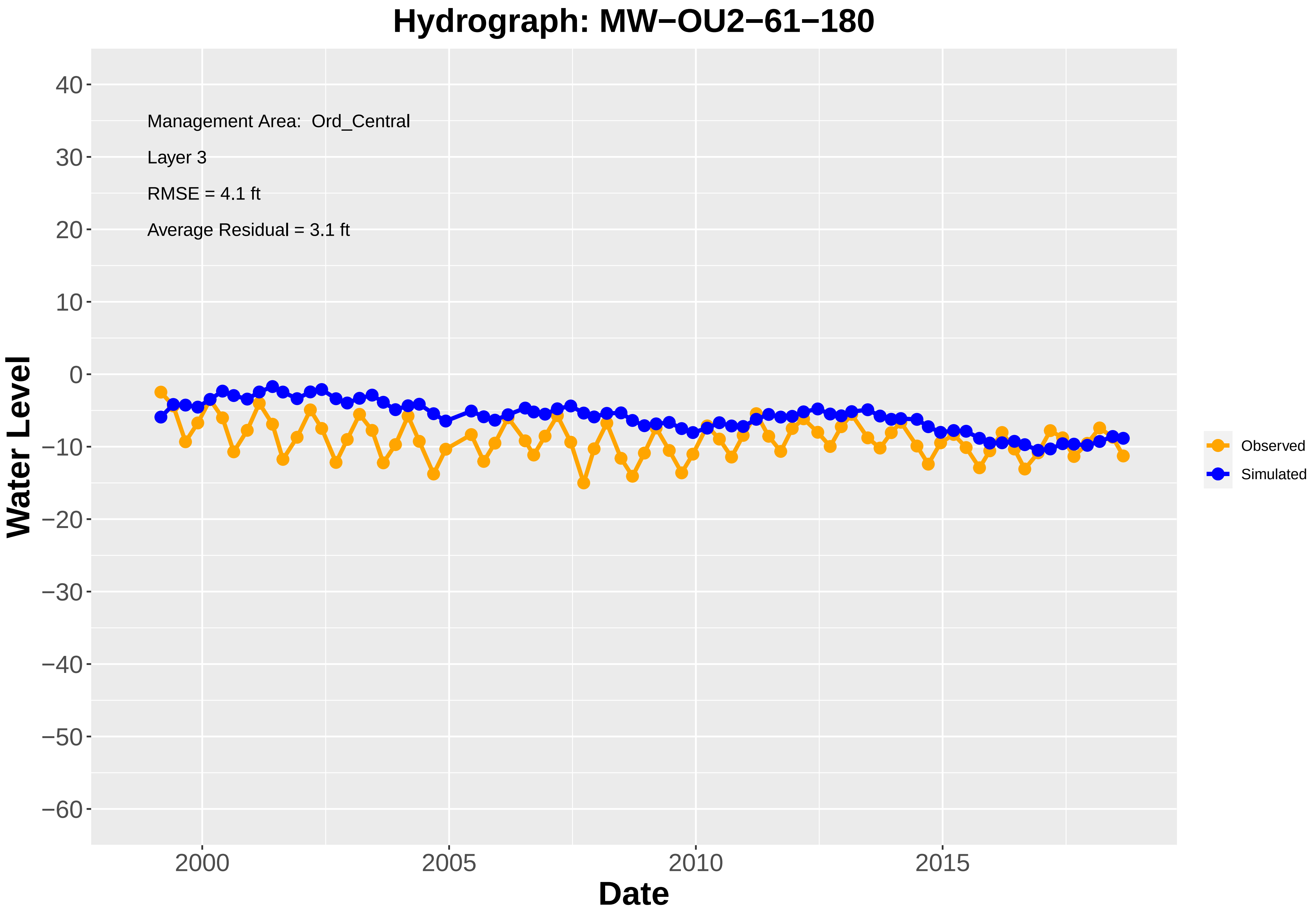

Hydrograph: MW−OU2−57−A
Management Area: Ord_Central
Layer 1
RMSE = 9.9 ft
Average Residual = −6.9 ft
Water Level
140
130
120
110
100
90
80
70
60
50
40
Date
2000
2005
2010
2015
Observed
Simulated



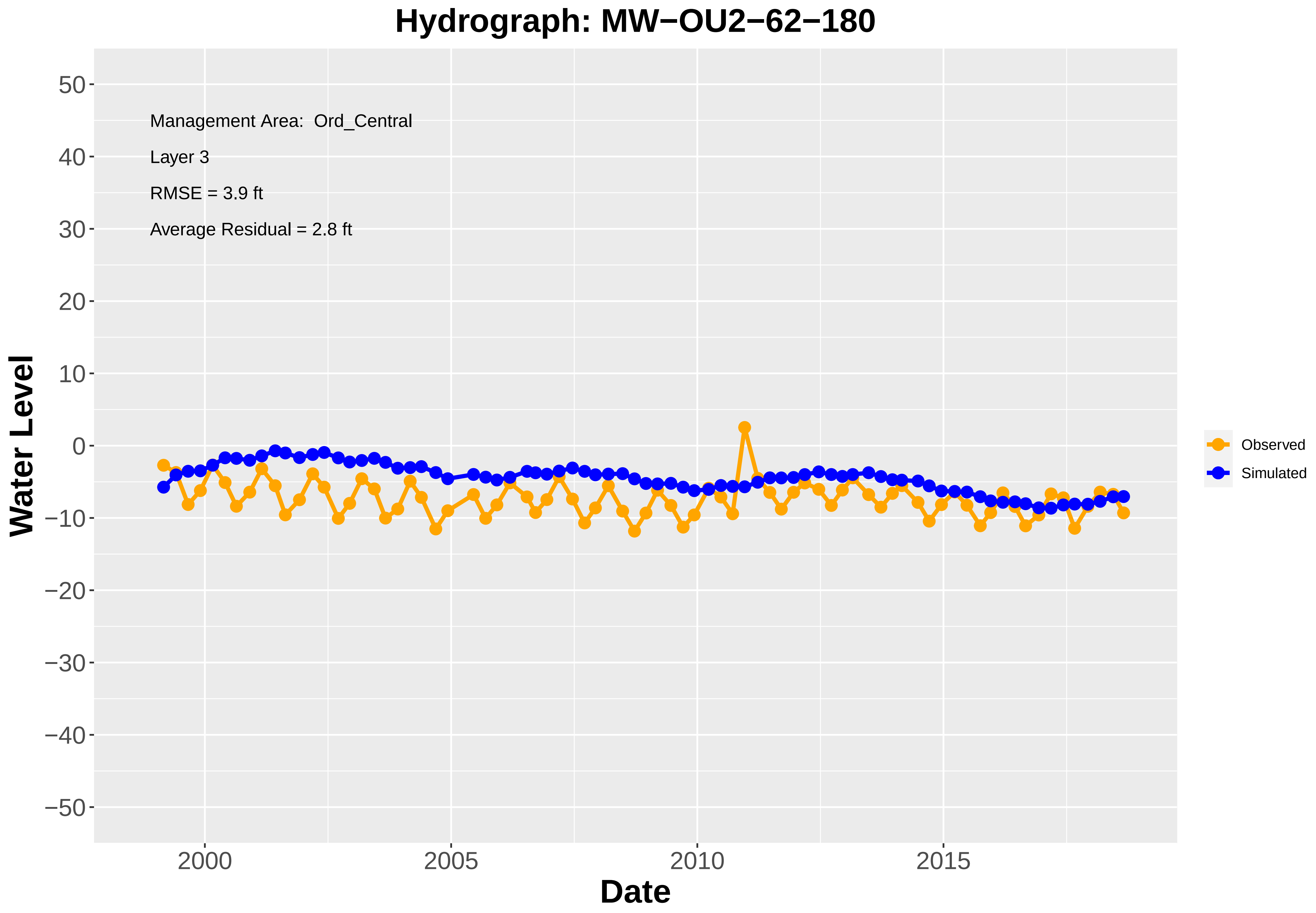
Hydrograph: MW−OU2−58−A
Management Area: Ord_Central
Layer 1
RMSE = 3.6 ft
Average Residual = −1.9 ft
Water Level
Date
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−59−A
Management Area: Ord_Central
Layer 1
RMSE = 4.0 ft
Average Residual = 1.2 ft
Water Level
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Date
Observed
Simulated

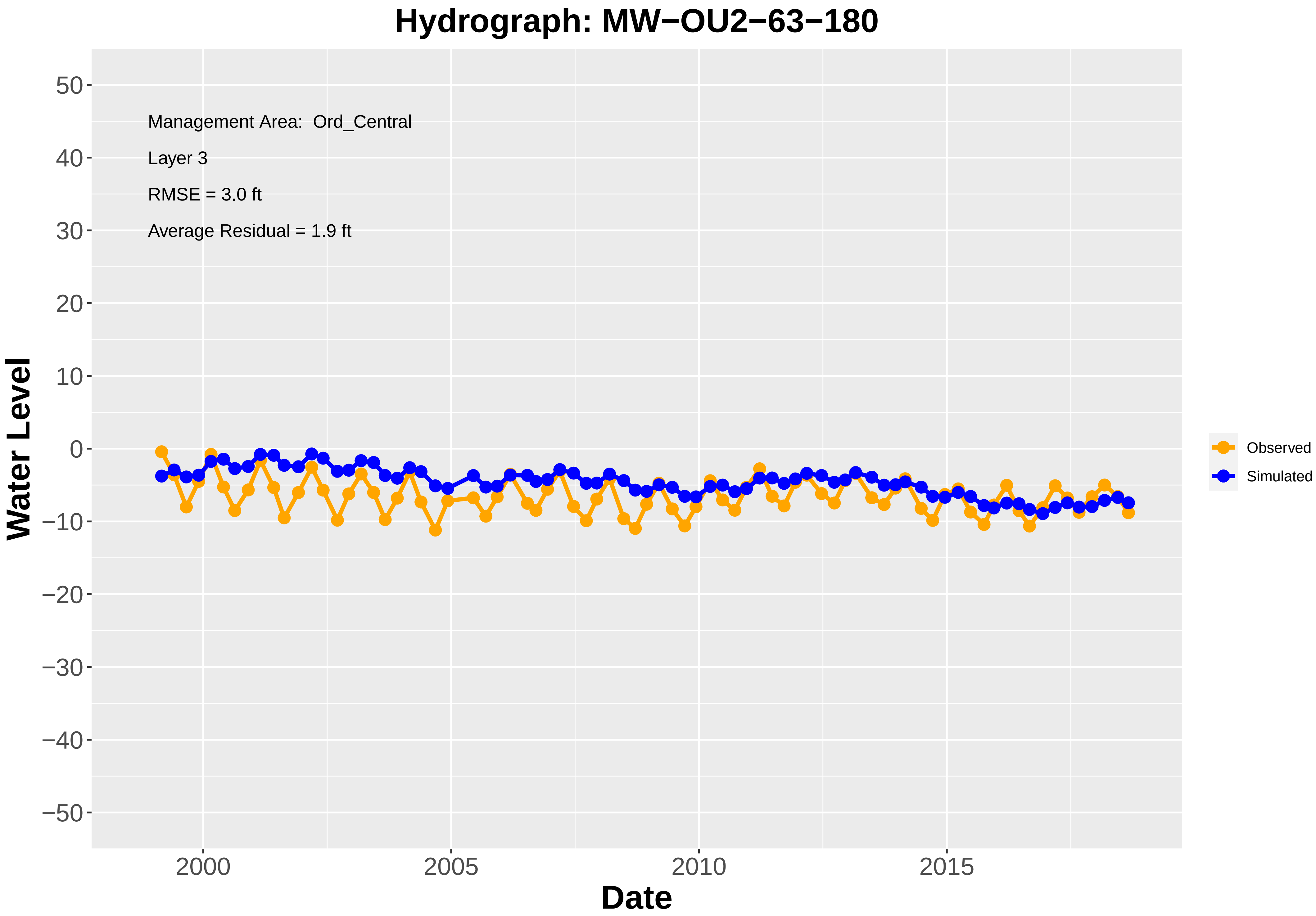

Hydrograph: MW−OU2−60−A
Management Area: Ord_Central
Layer 1
RMSE = 6.0 ft
Average Residual = −0.21 ft
Water Level
140
130
120
110
100
90
80
70
60
50
40
2000
2005
2010
2015
Date
Observed
Simulated



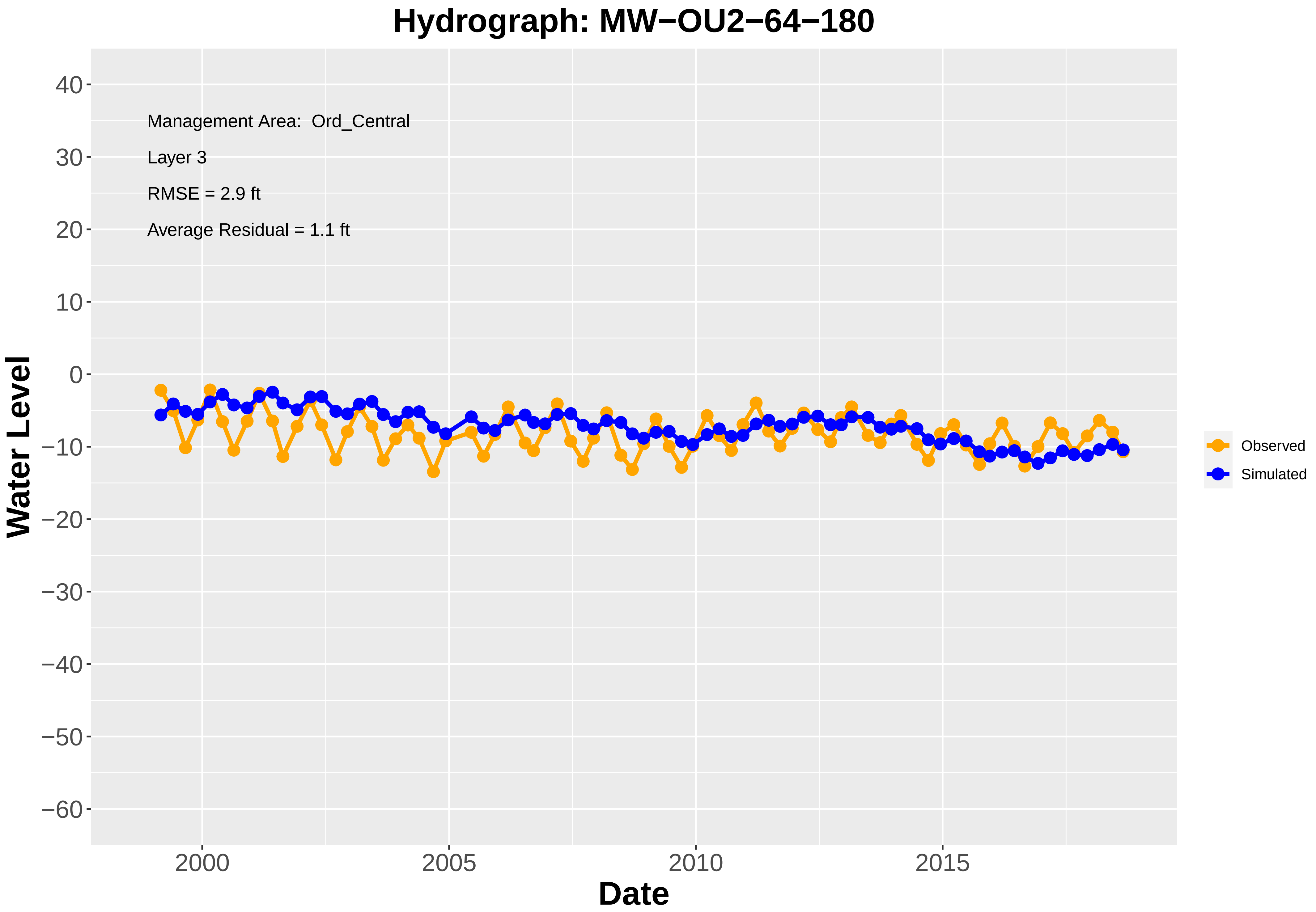
Hydrograph: MW−OU2−61−180
Management Area: Ord_Central
Layer 3
RMSE = 4.1 ft
Average Residual = 3.1 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated



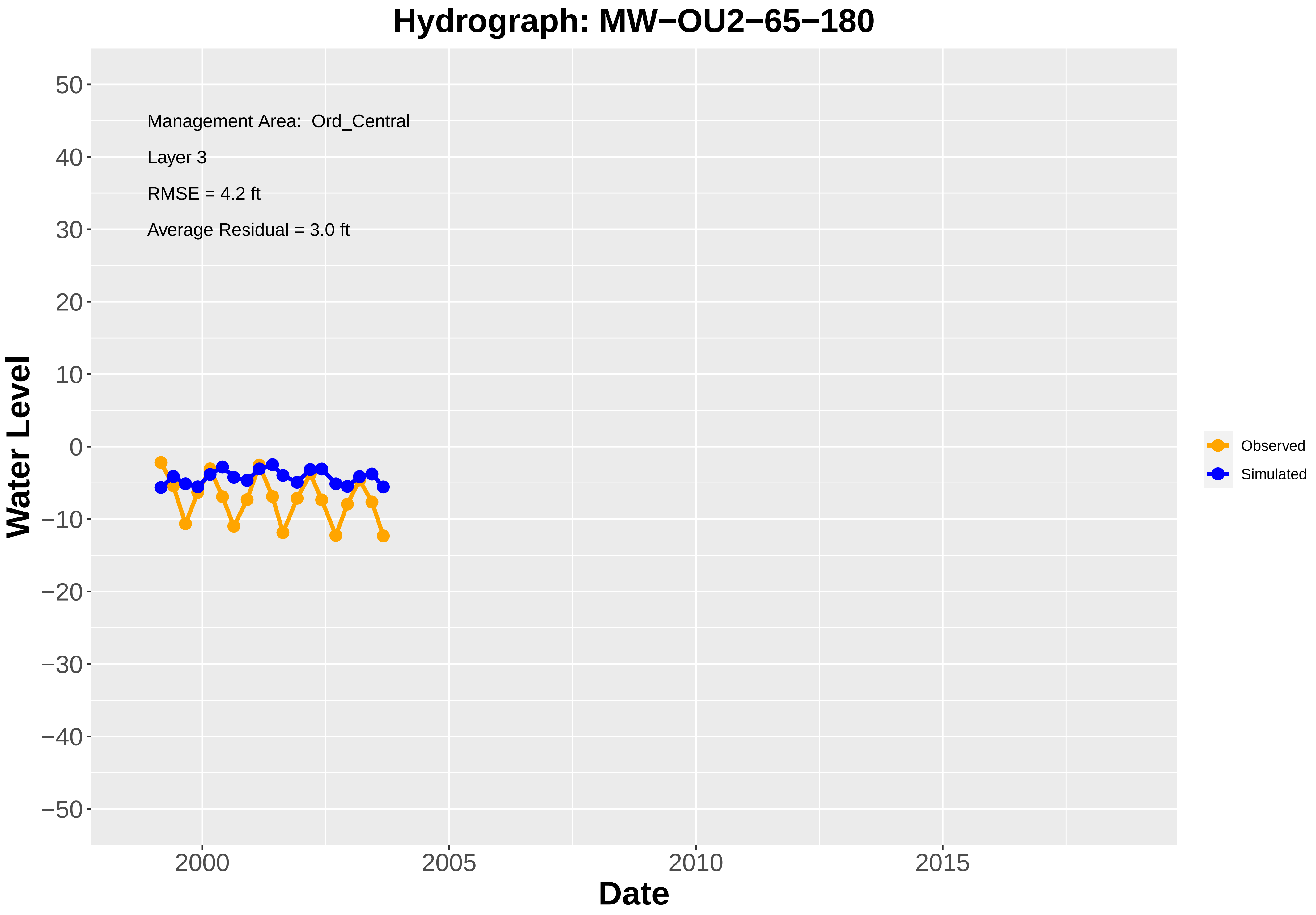
Hydrograph: MW−OU2−62−180
Management Area: Ord_Central
Layer 3
RMSE = 3.9 ft
Average Residual = 2.8 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

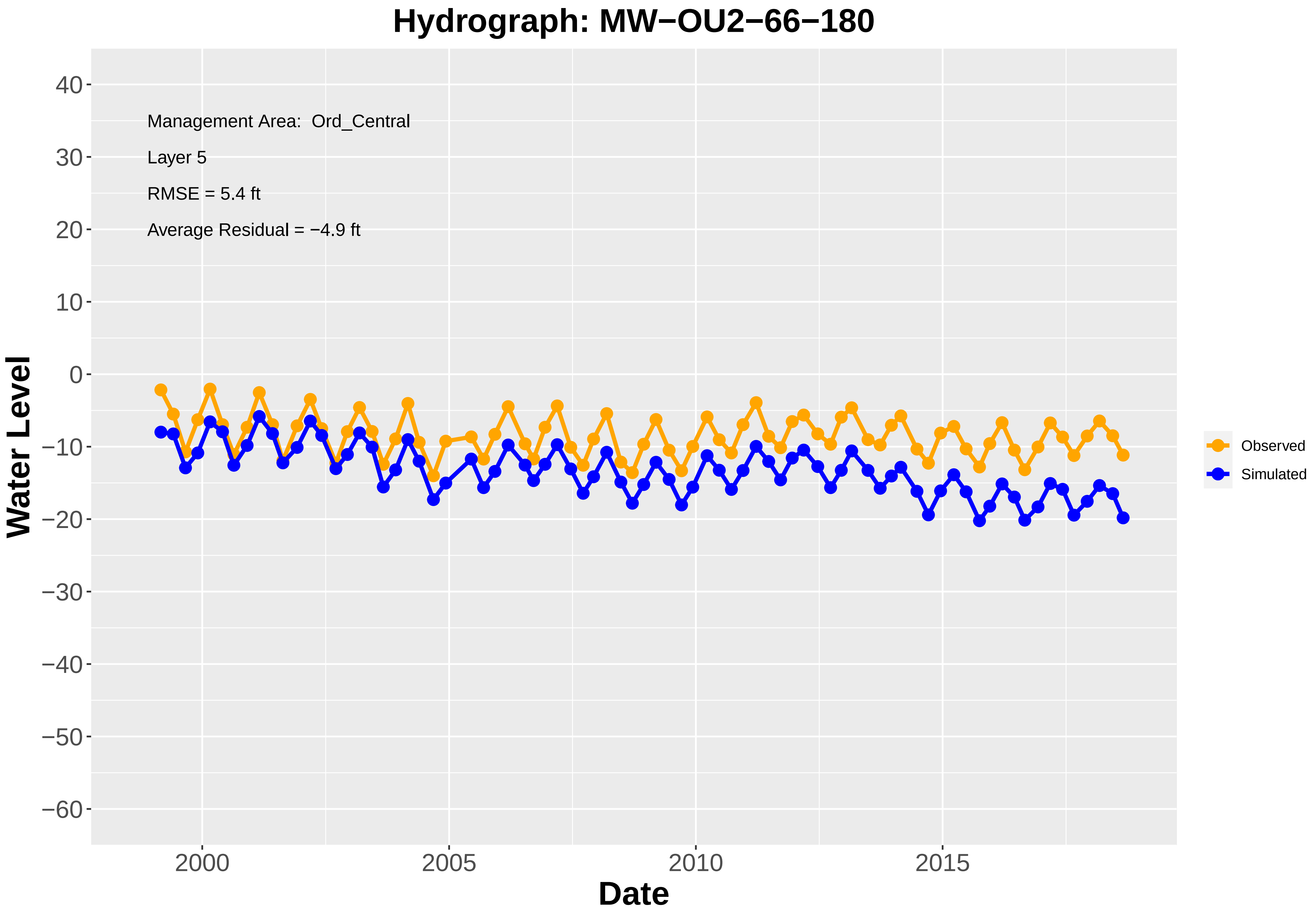


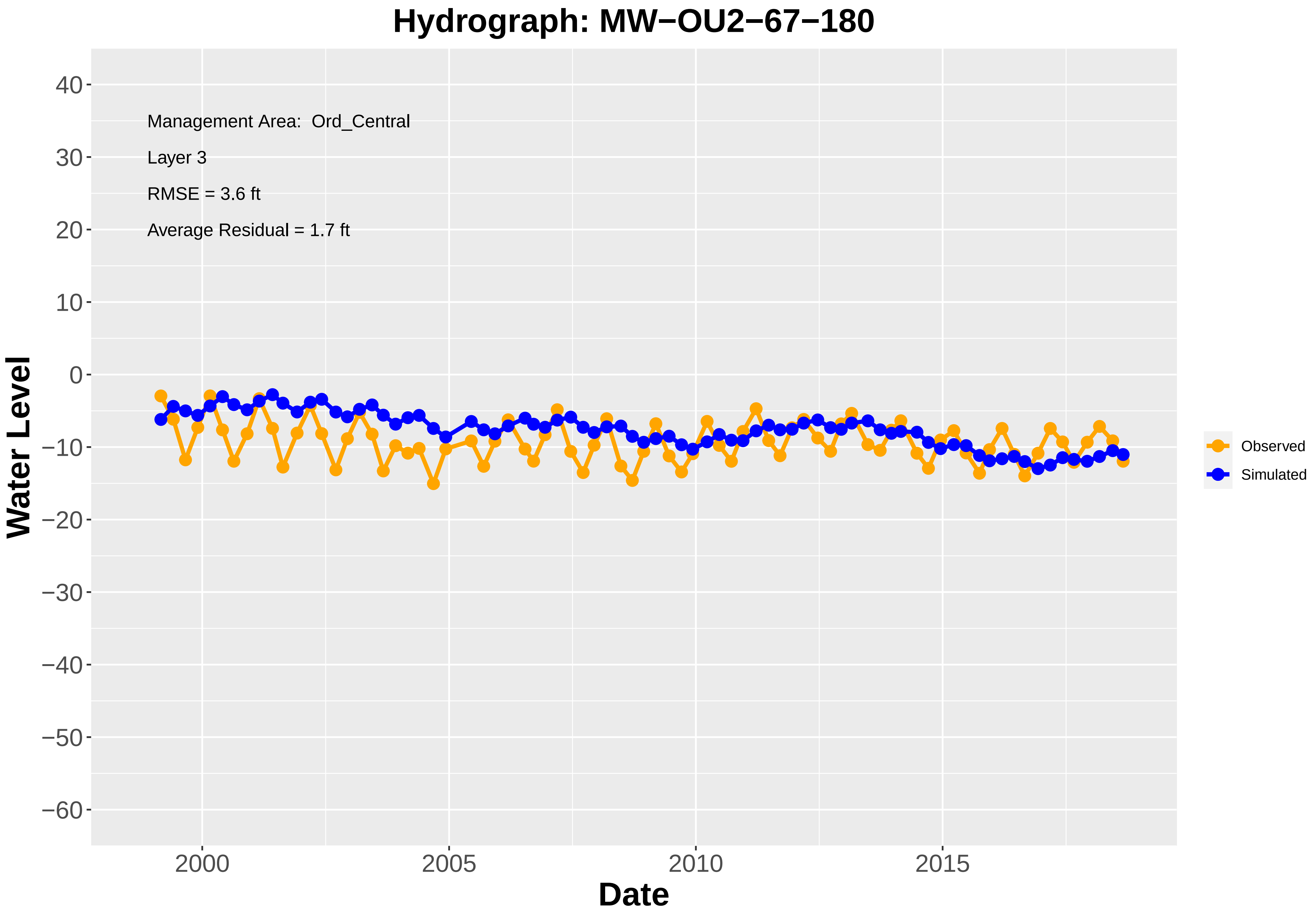
Hydrograph: MW−OU2−63−180
Management Area: Ord_Central
Layer 3
RMSE = 3.0 ft
Average Residual = 1.9 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

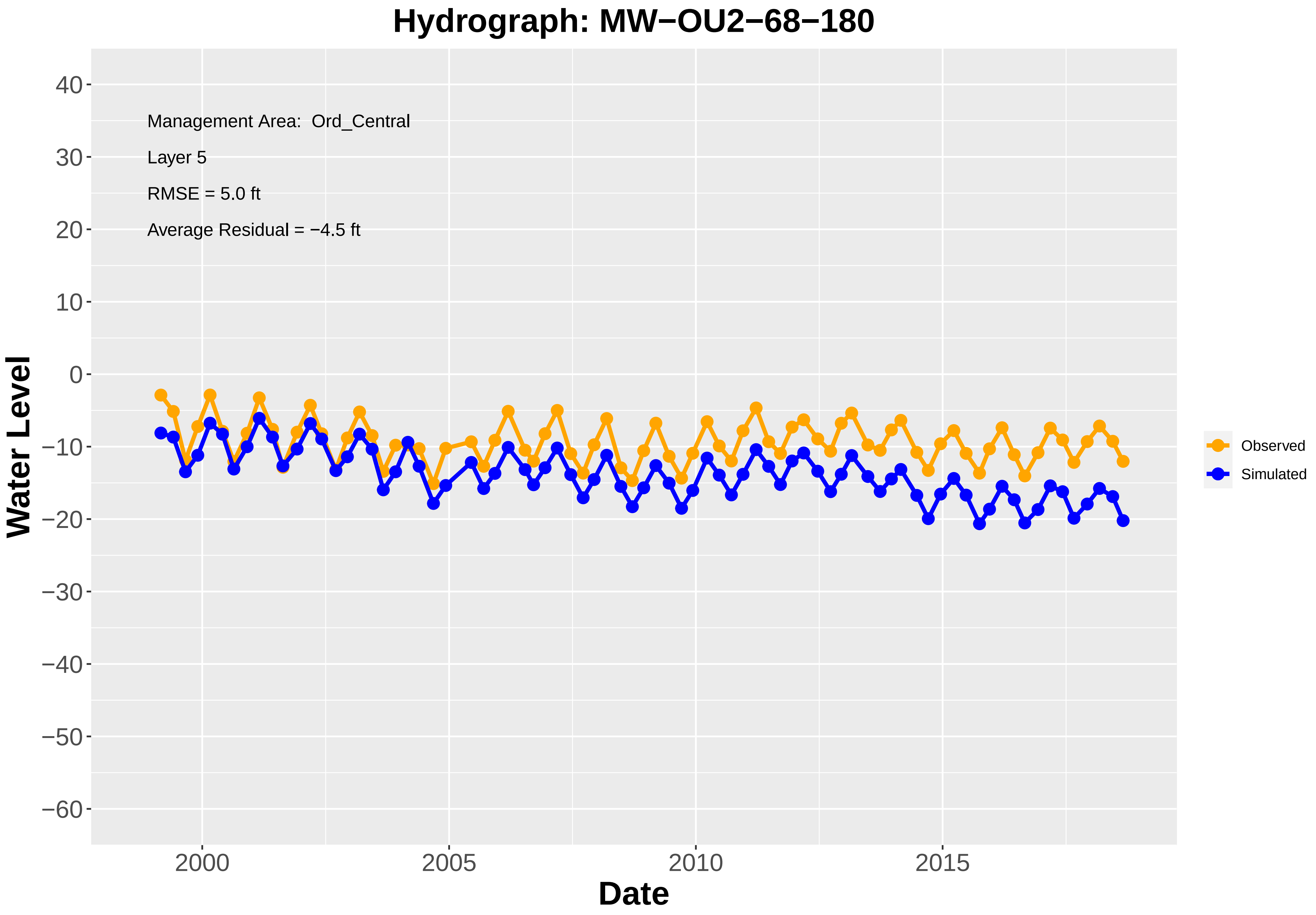


Hydrograph: MW−OU2−64−180
Management Area: Ord_Central
Layer 3
RMSE = 2.9 ft
Average Residual = 1.1 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated

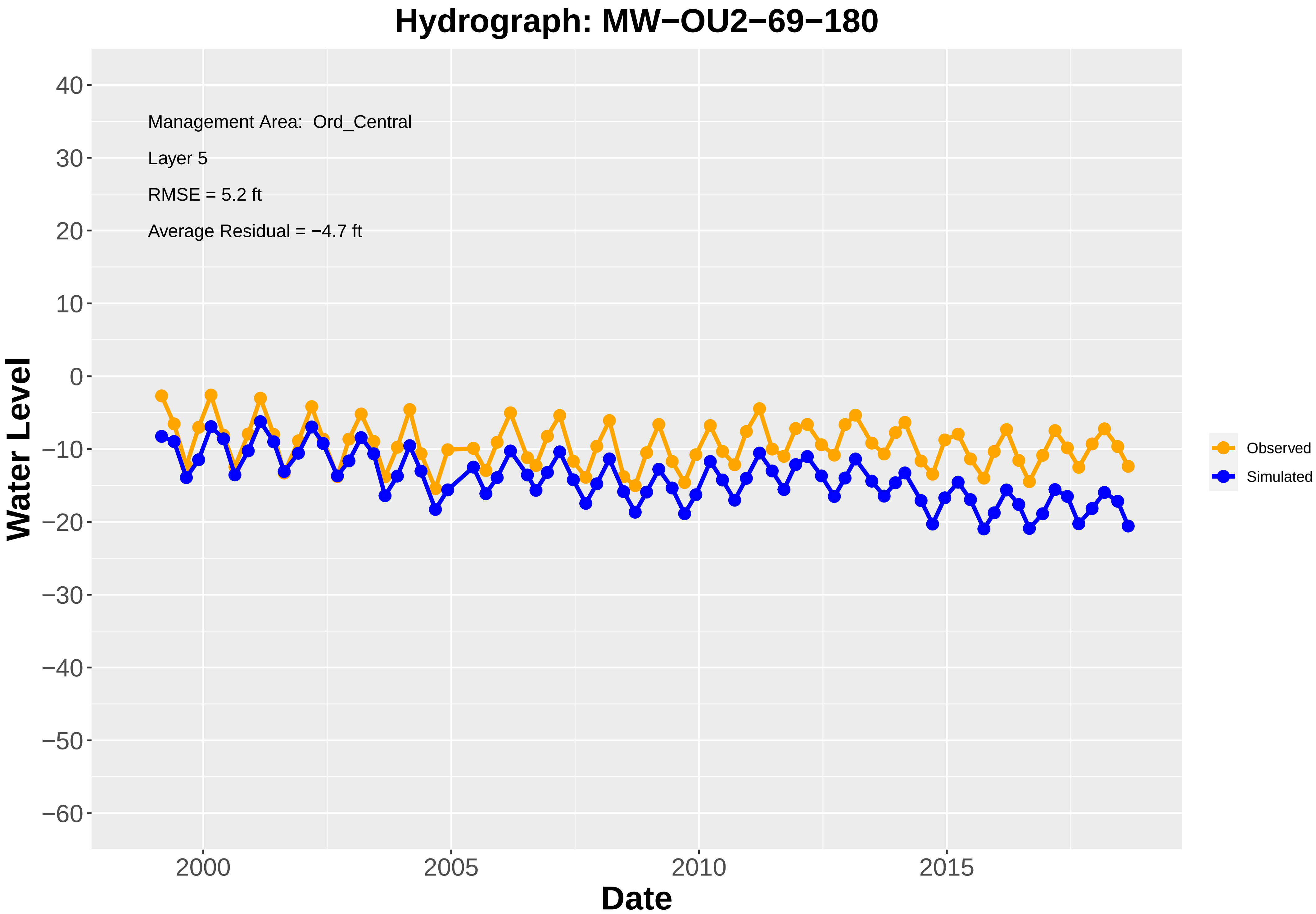

Hydrograph: MW−OU2−65−180
Management Area: Ord_Central
Layer 3
RMSE = 4.2 ft
Average Residual = 3.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

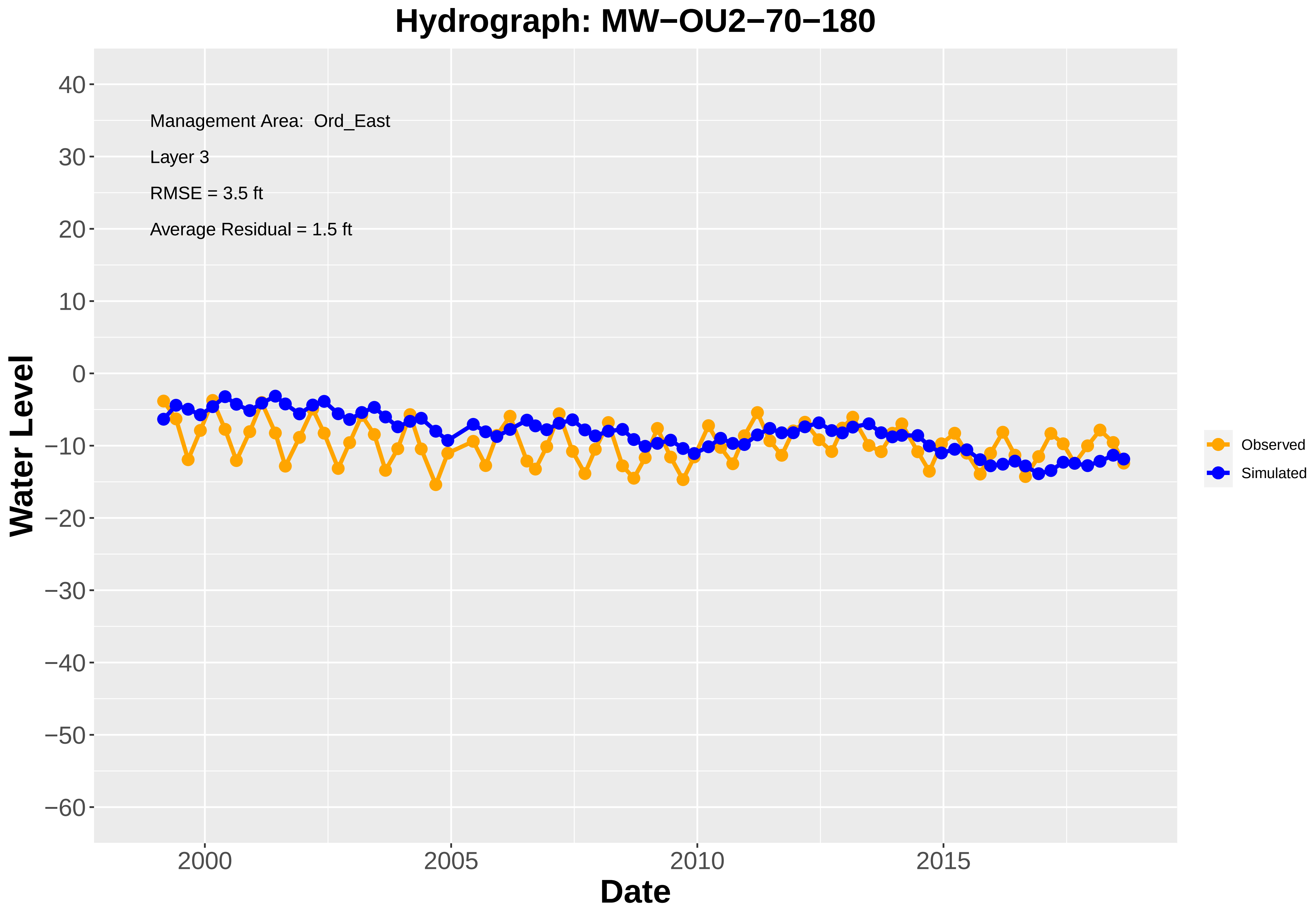

Hydrograph: MW−OU2−66−180
Management Area: Ord_Central
Layer 5
RMSE = 5.4 ft
Average Residual = −4.9 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−67−180
Management Area: Ord_Central
Layer 3
RMSE = 3.6 ft
Average Residual = 1.7 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

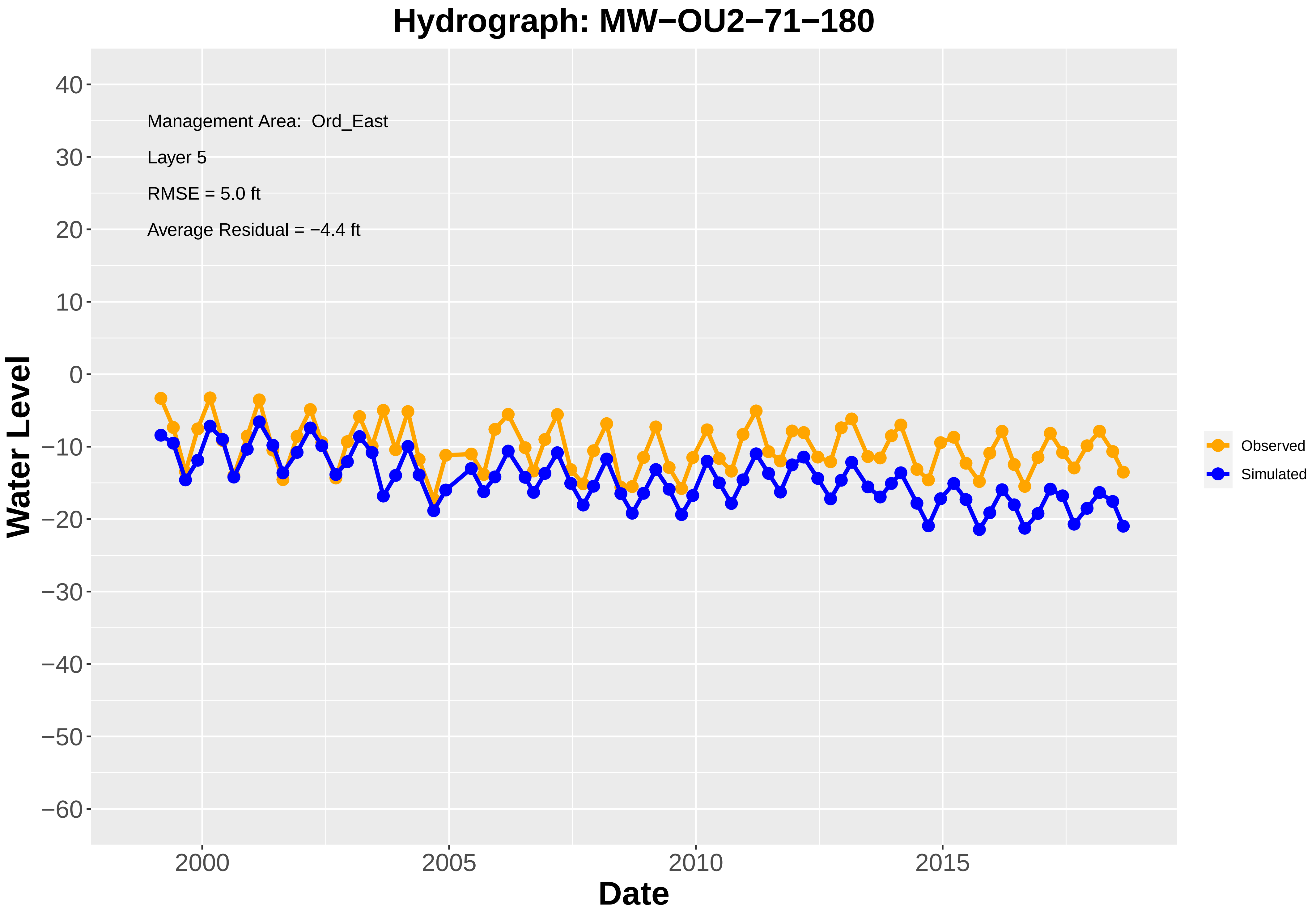


Hydrograph: MW−OU2−68−180
Management Area: Ord_Central
Layer 5
RMSE = 5.0 ft
Average Residual = −4.5 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

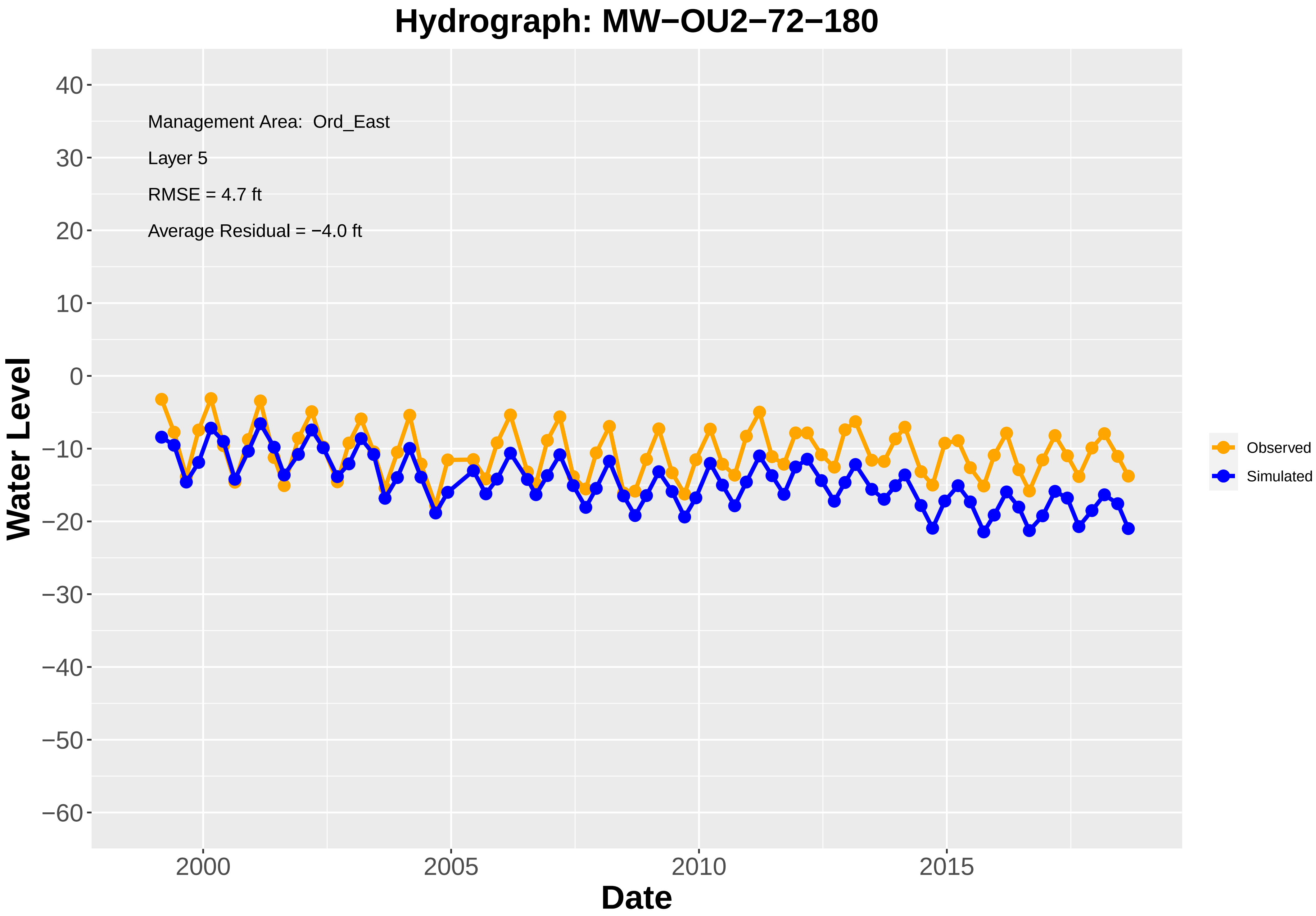

Hydrograph: MW−OU2−69−180
Management Area: Ord_Central
Layer 5
RMSE = 5.2 ft
Average Residual = −4.7 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated



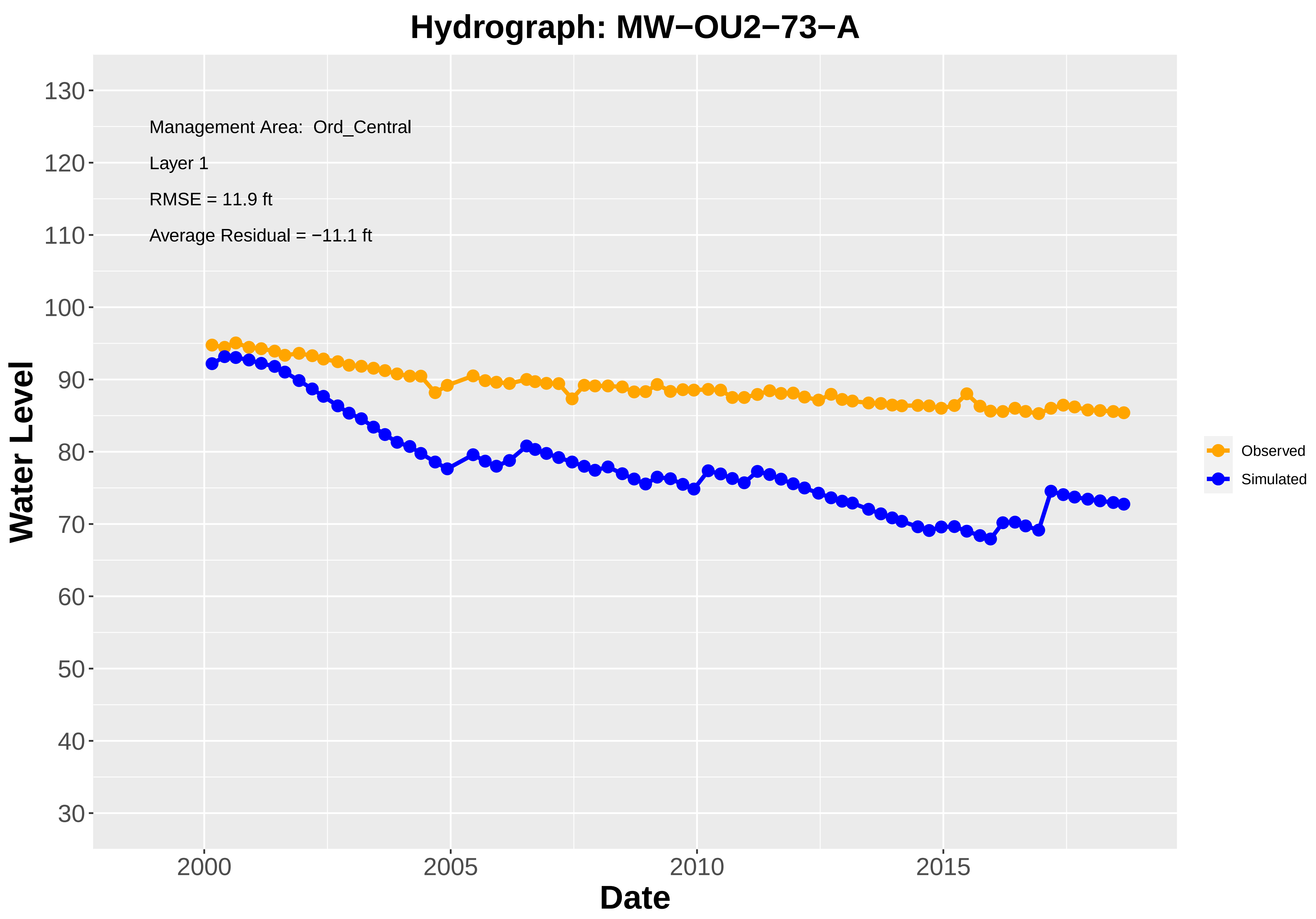
Hydrograph: MW−OU2−70−180
Management Area: Ord_East
Layer 3
RMSE = 3.5 ft
Average Residual = 1.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

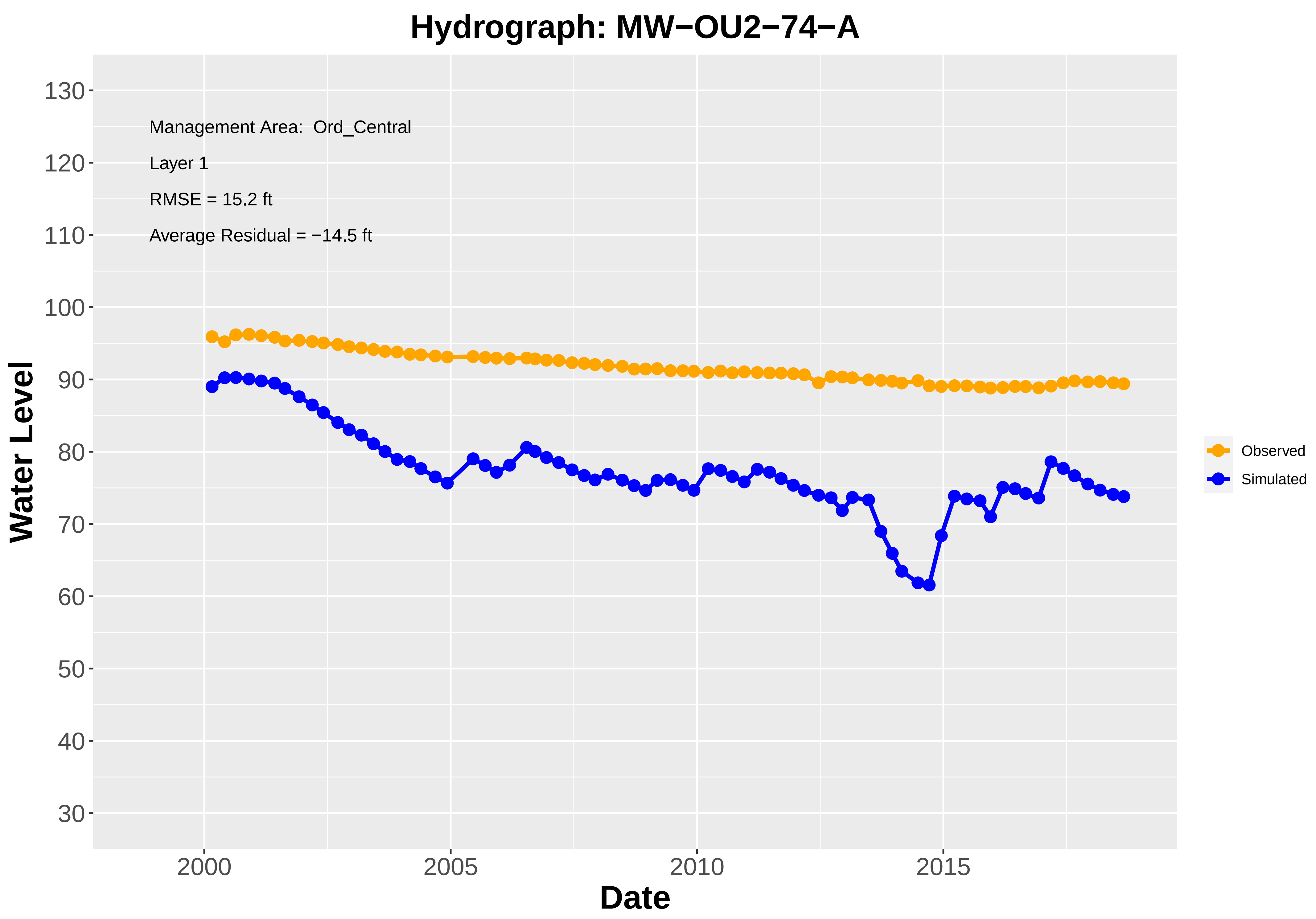


Hydrograph: MW−OU2−71−180
Management Area: Ord_East
Layer 5
RMSE = 5.0 ft
Average Residual = −4.4 ft
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

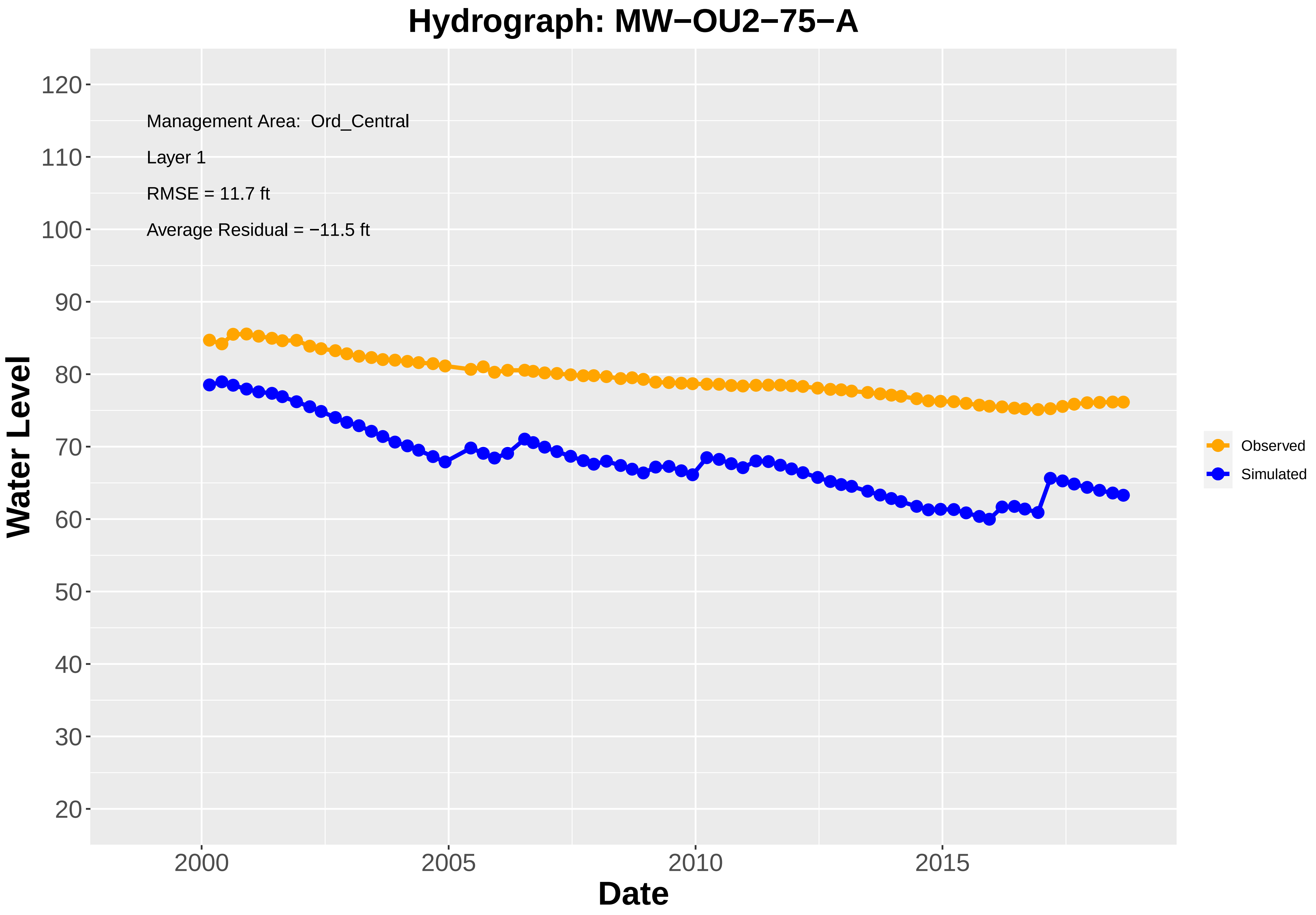


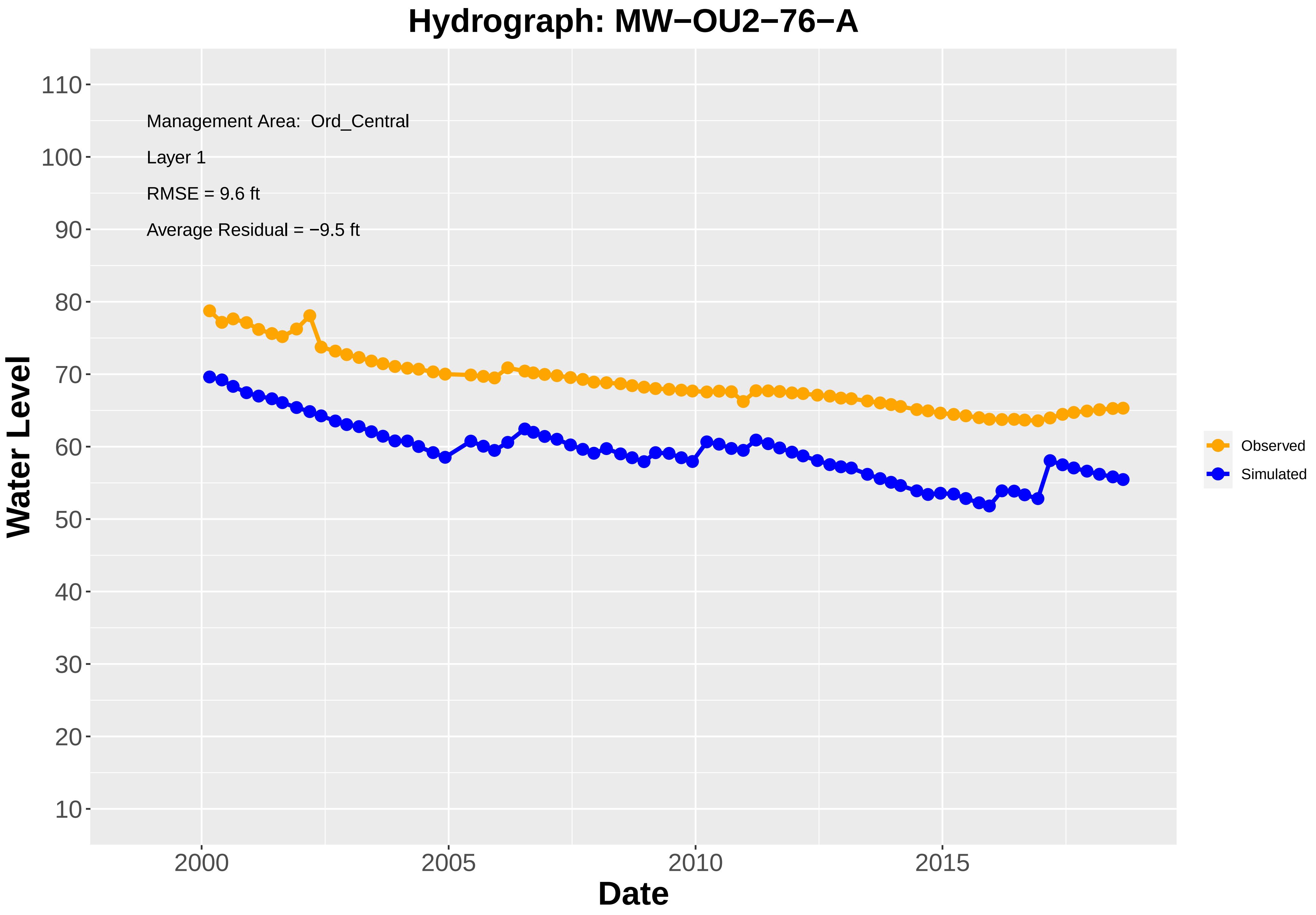
Hydrograph: MW−OU2−72−180
Management Area: Ord_East
Layer 5
RMSE = 4.7 ft
Average Residual = −4.0 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: MW−OU2−73−A
Management Area: Ord_Central
Layer 1
RMSE = 11.9 ft
Average Residual = −11.1 ft
Water Level
Date
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Observed
Simulated

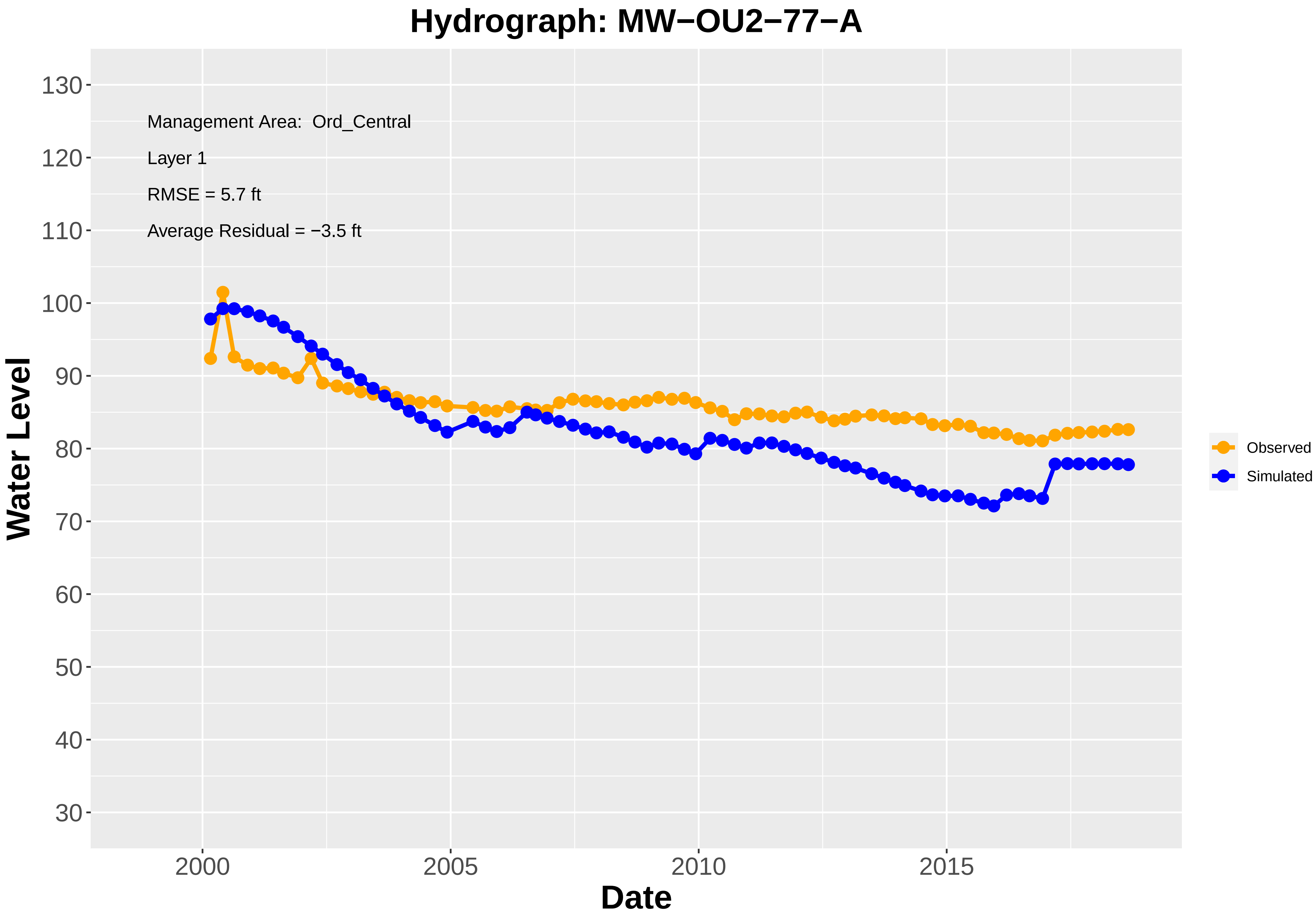


Hydrograph: MW−OU2−74−A
Management Area: Ord_Central
Layer 1
RMSE = 15.2 ft
Average Residual = −14.5 ft
Water Level
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Date
Observed
Simulated

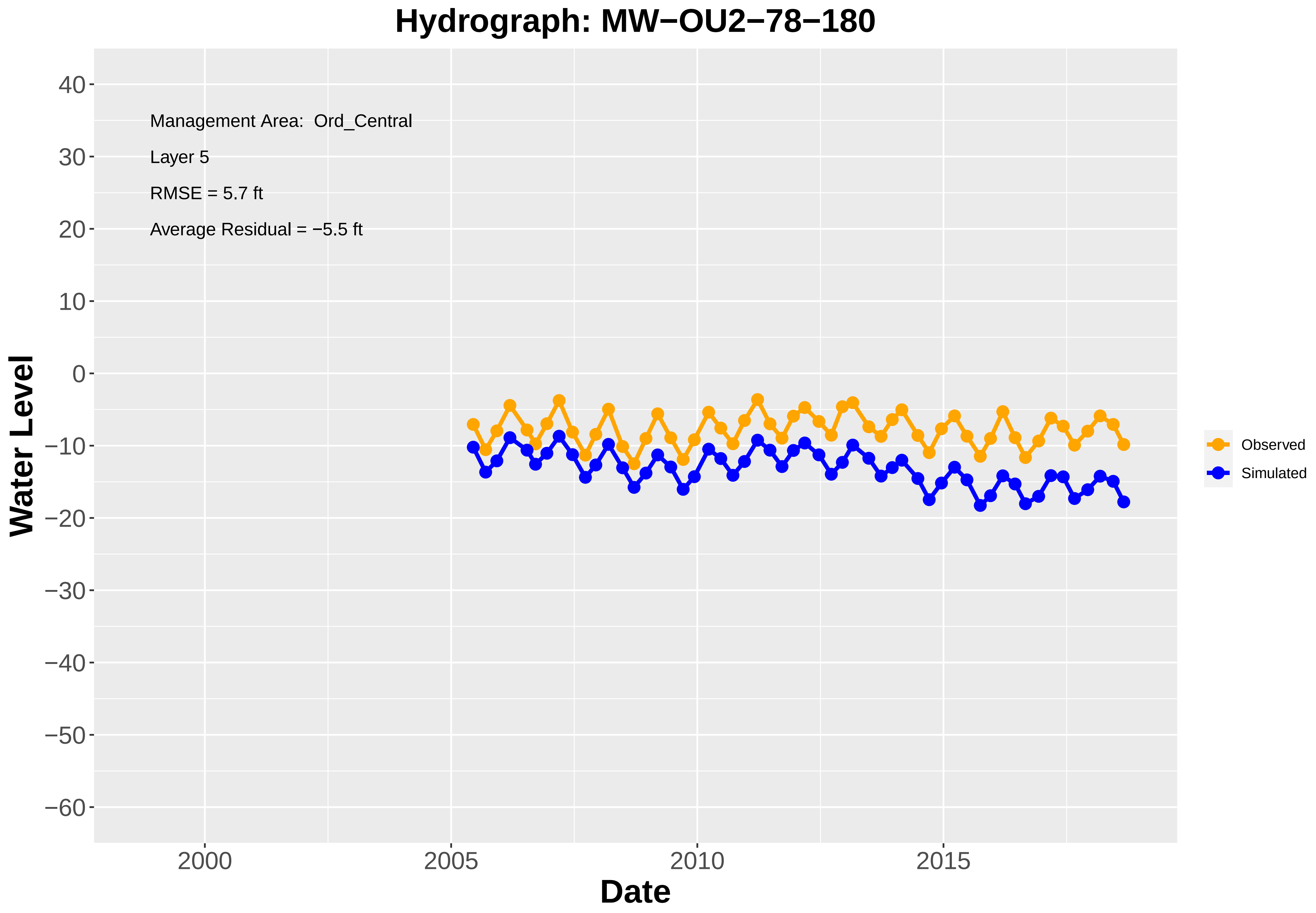

Hydrograph: MW−OU2−75−A
Management Area: Ord_Central
Layer 1
RMSE = 11.7 ft
Average Residual = −11.5 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

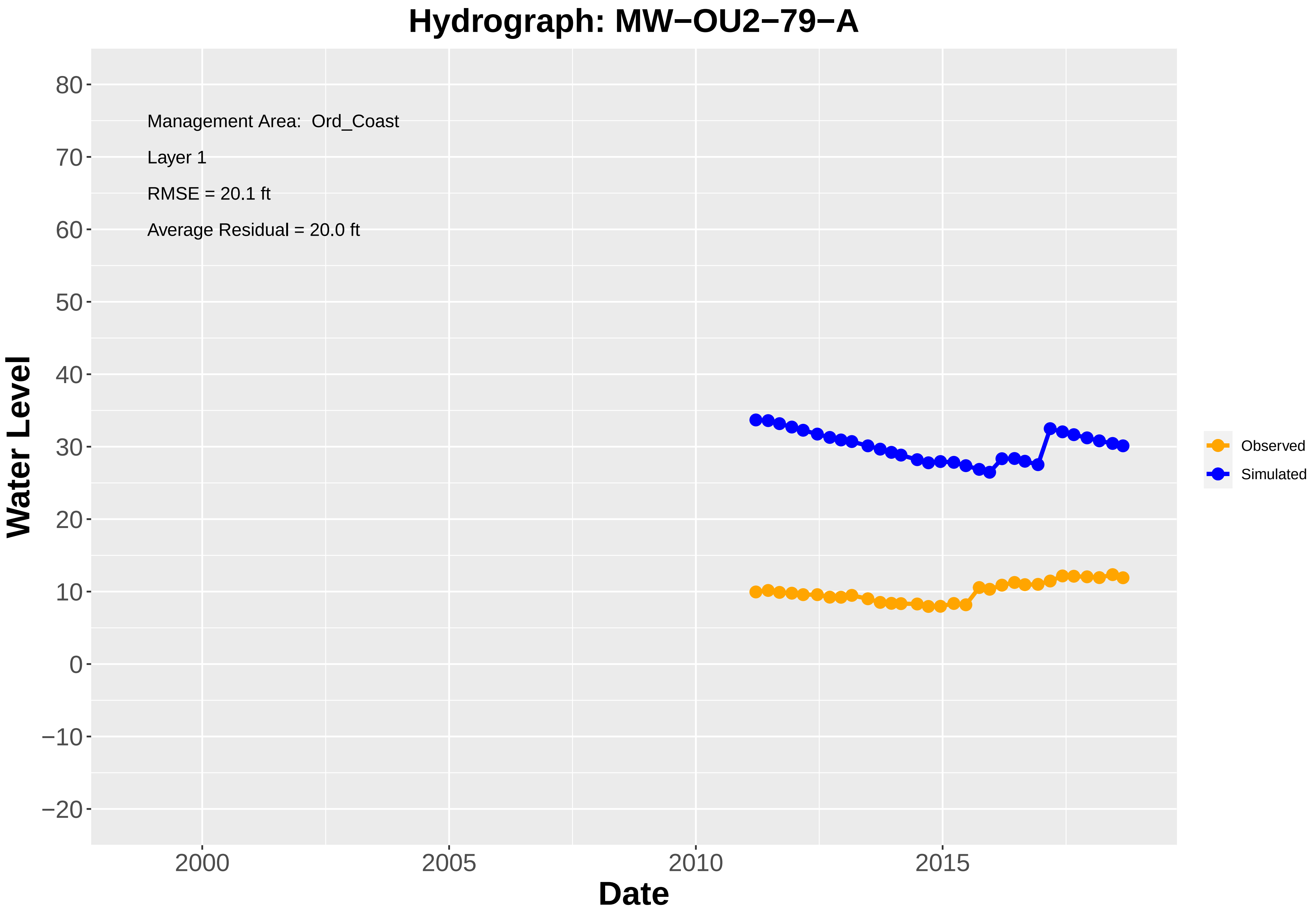


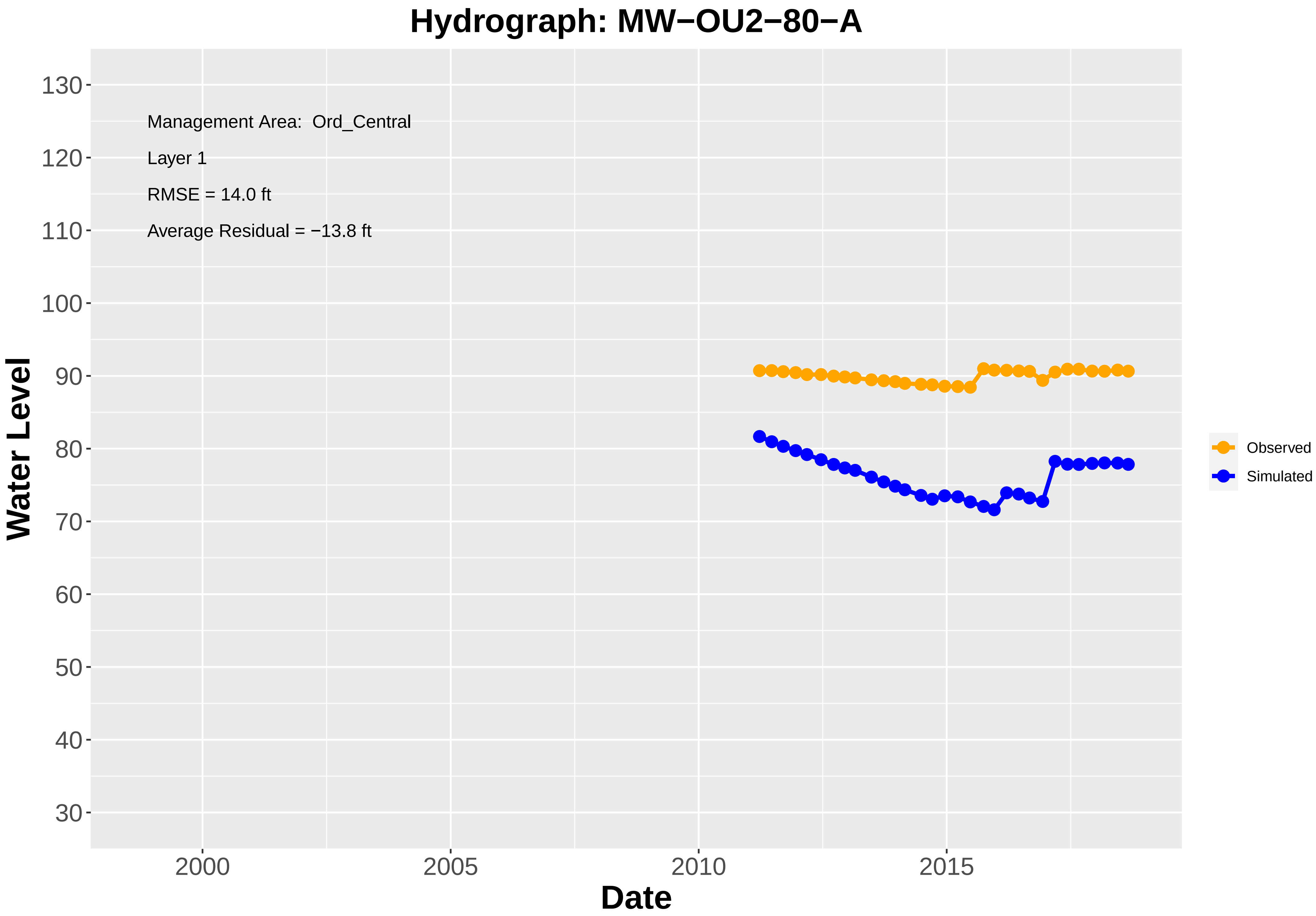
Hydrograph: MW−OU2−76−A
Management Area: Ord_Central
Layer 1
RMSE = 9.6 ft
Average Residual = −9.5 ft
Water Level
Date
Observed
Simulated
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015

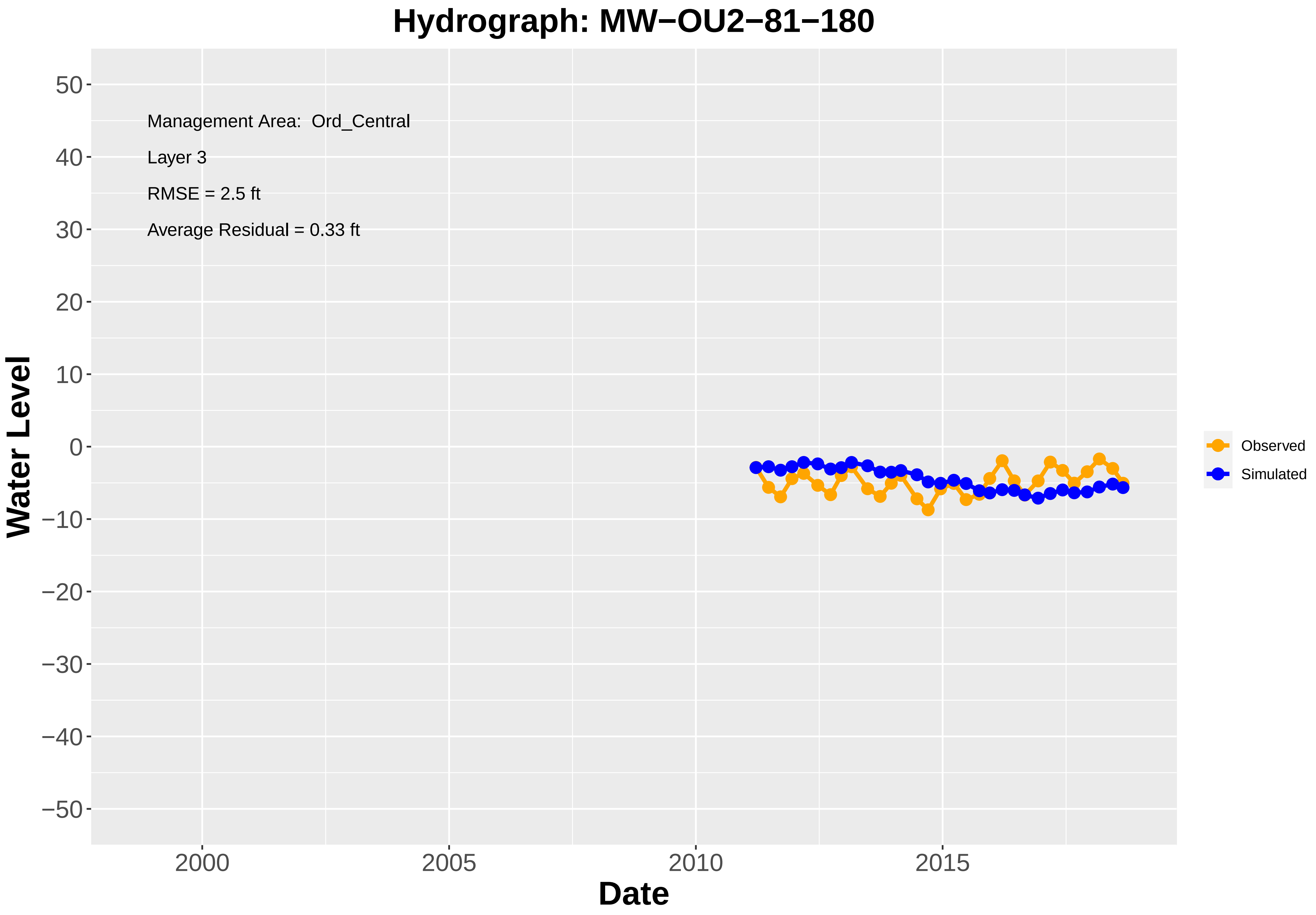


Hydrograph: MW−OU2−77−A
Management Area: Ord_Central
Layer 1
RMSE = 5.7 ft
Average Residual = −3.5 ft
Water Level
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Date
Observed
Simulated

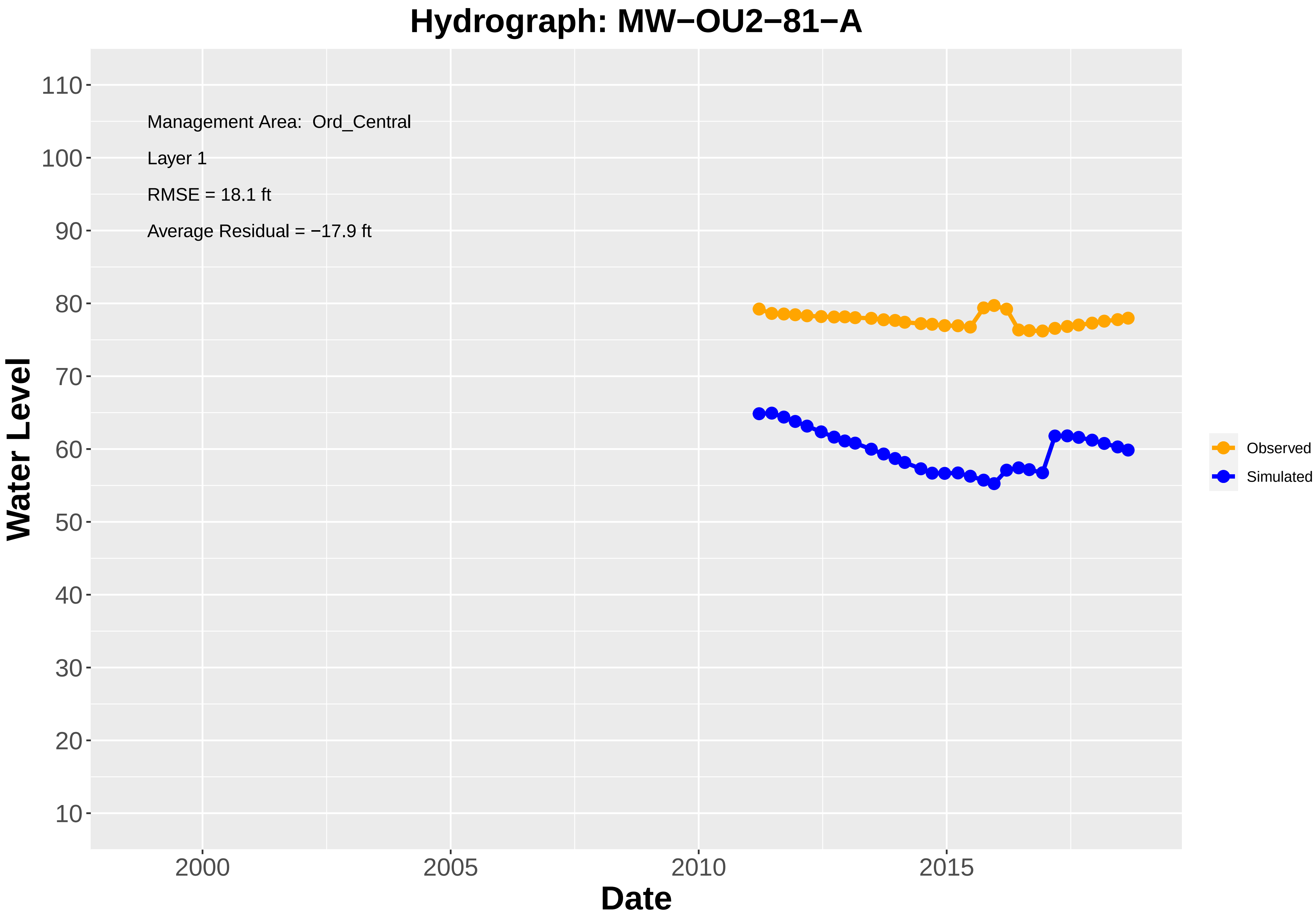

Hydrograph: MW−OU2−78−180
Management Area: Ord_Central
Layer 5
RMSE = 5.7 ft
Average Residual = −5.5 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: MW−OU2−79−A
Management Area: Ord_Coast
Layer 1
RMSE = 20.1 ft
Average Residual = 20.0 ft
Water Level
Date
80
70
60
50
40
30
20
10
0
−10
−20
2000
2005
2010
2015
Observed
Simulated

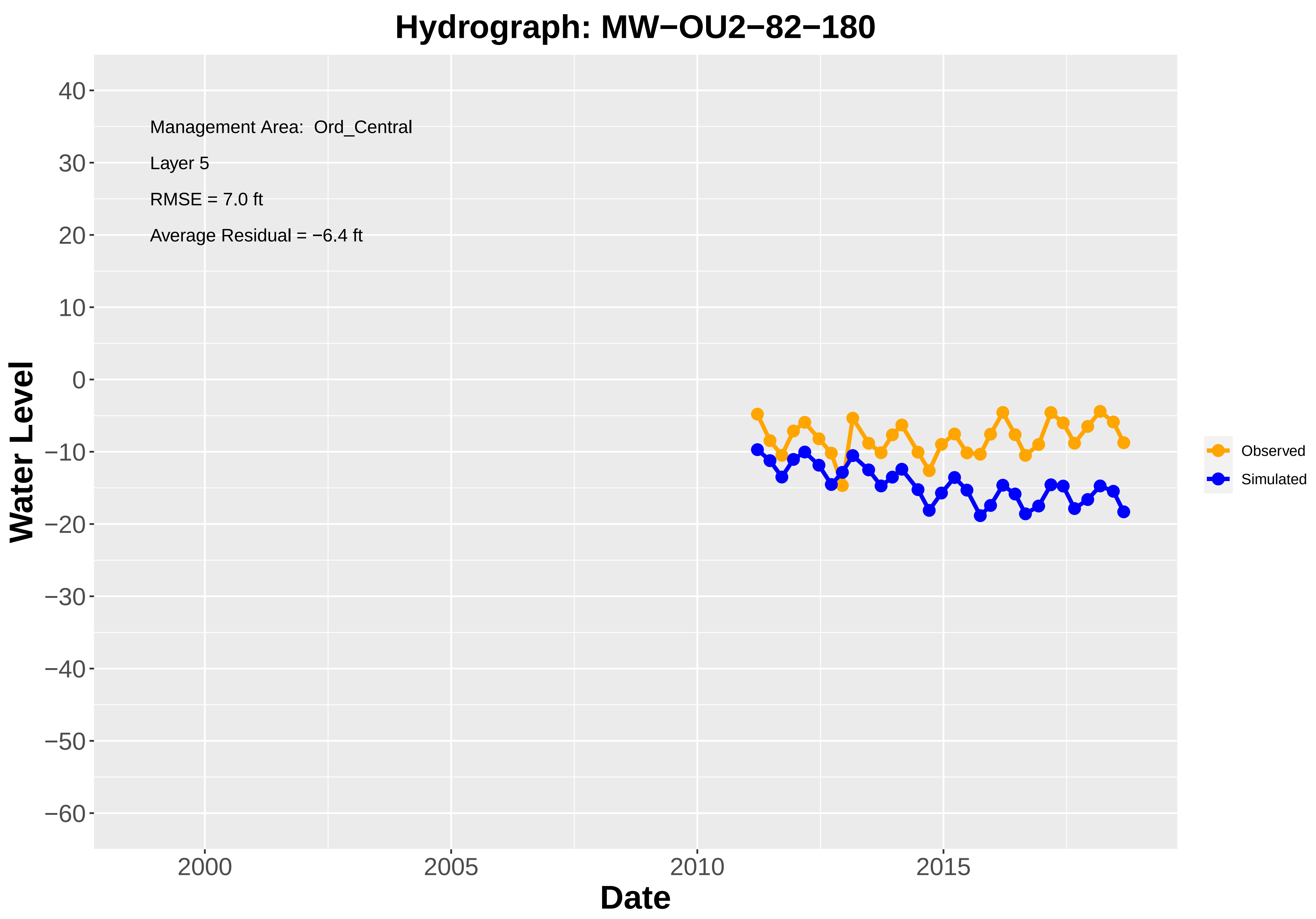

Hydrograph: MW−OU2−80−A
Management Area: Ord_Central
Layer 1
RMSE = 14.0 ft
Average Residual = −13.8 ft
Water Level
Date
130
120
110
100
90
80
70
60
50
40
30
2000
2005
2010
2015
Observed
Simulated

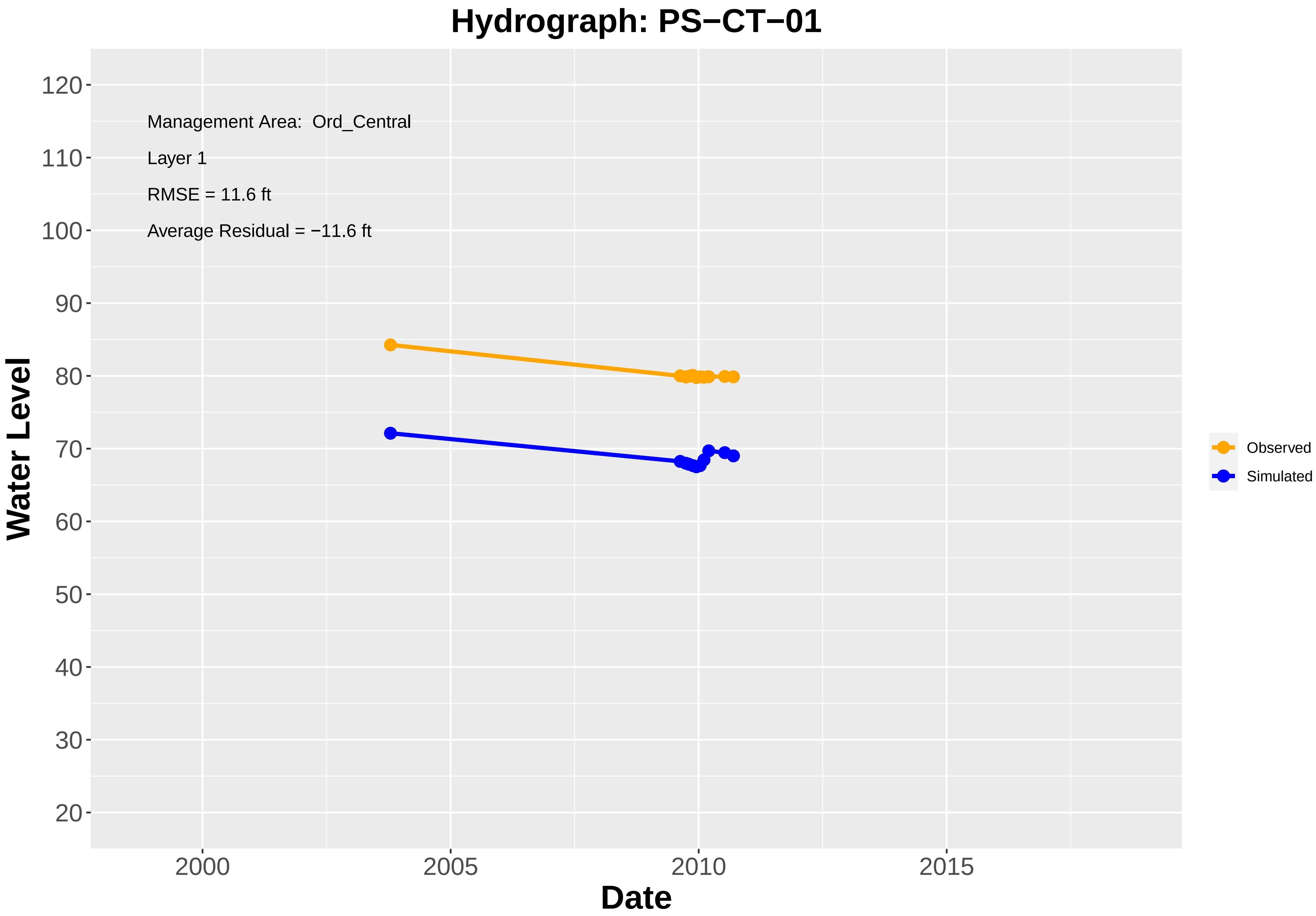


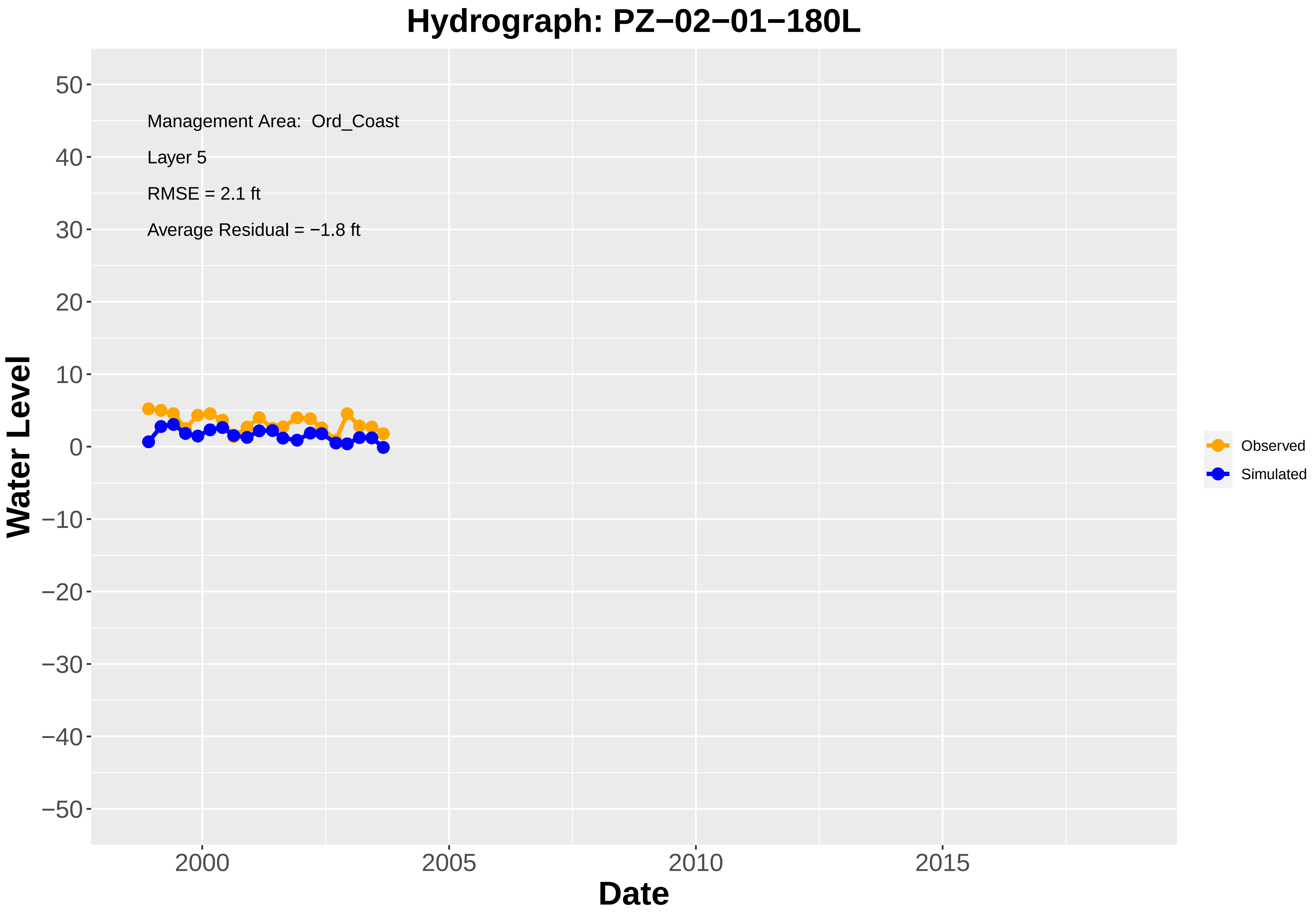
Hydrograph: MW−OU2−81−180
Management Area: Ord_Central
Layer 3
RMSE = 2.5 ft
Average Residual = 0.33 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



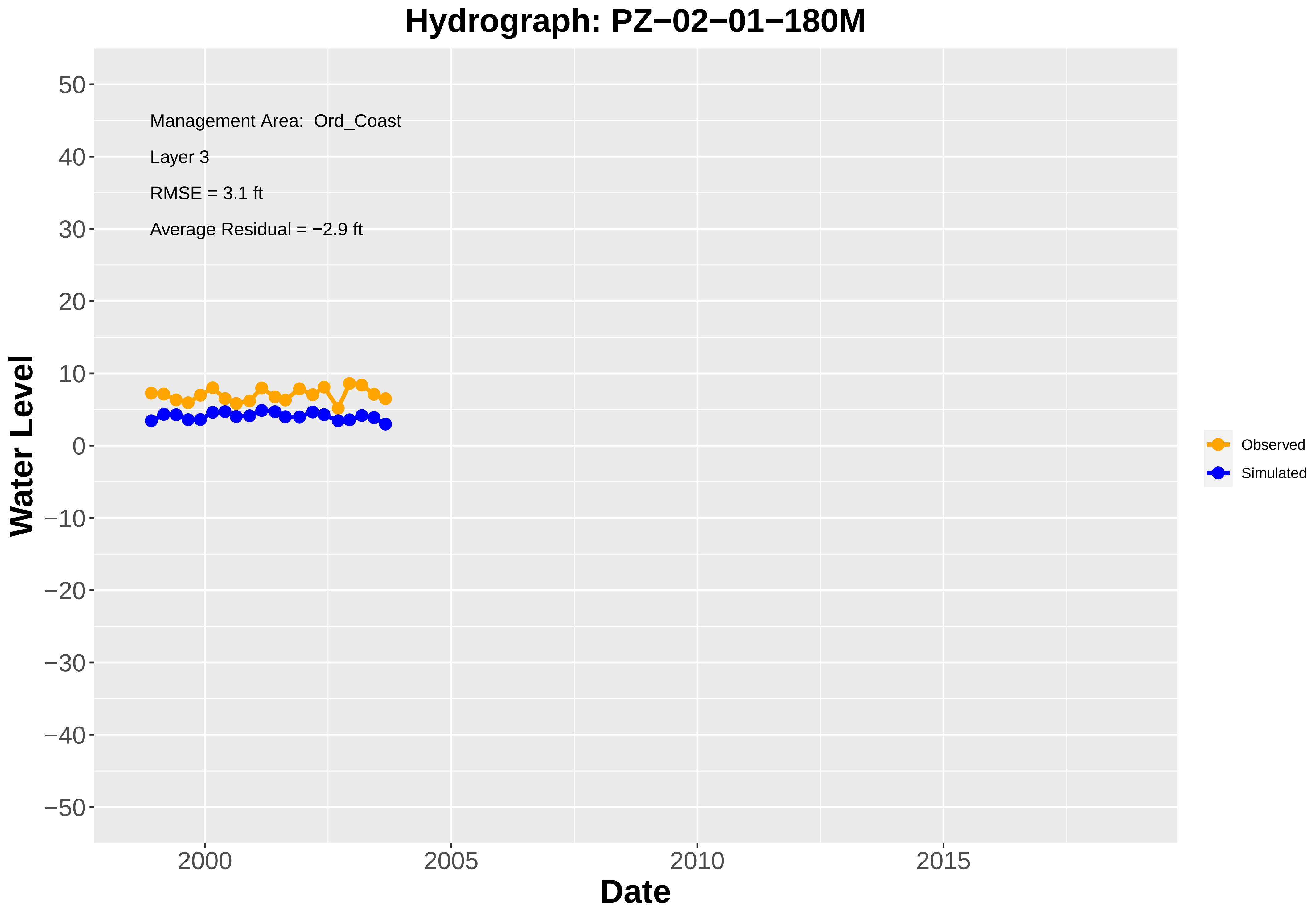
Hydrograph: MW−OU2−81−A
Management Area: Ord_Central
Layer 1
RMSE = 18.1 ft
Average Residual = −17.9 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

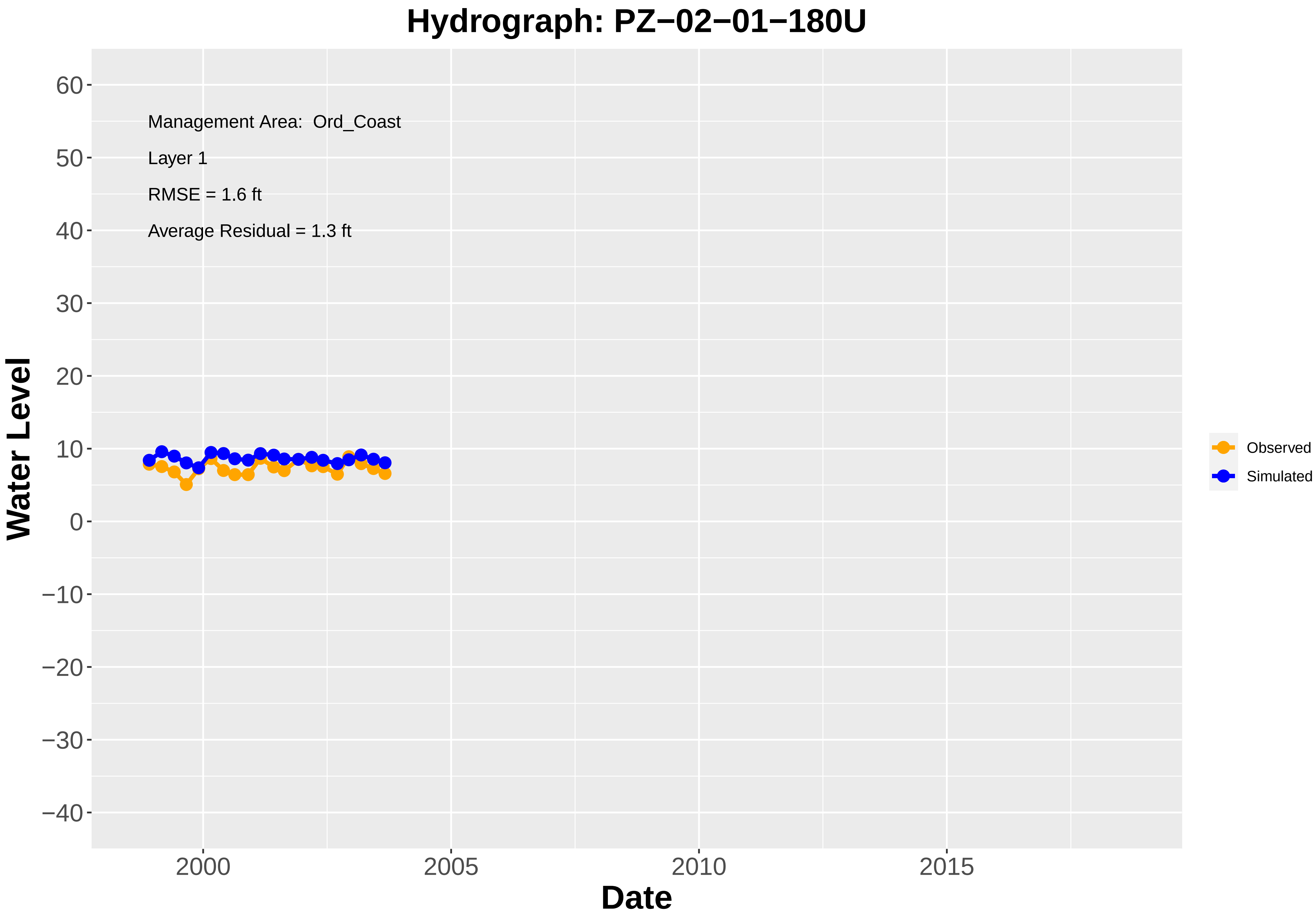

Hydrograph: MW−OU2−82−180
Management Area: Ord_Central
Layer 5
RMSE = 7.0 ft
Average Residual = −6.4 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated


Hydrograph: PS−CT−01
Management Area: Ord_Central
Layer 1
RMSE = 11.6 ft
Average Residual = −11.6 ft
Water Level
Date
120
110
100
90
80
70
60
50
40
30
20
2000
2005
2010
2015
Observed
Simulated

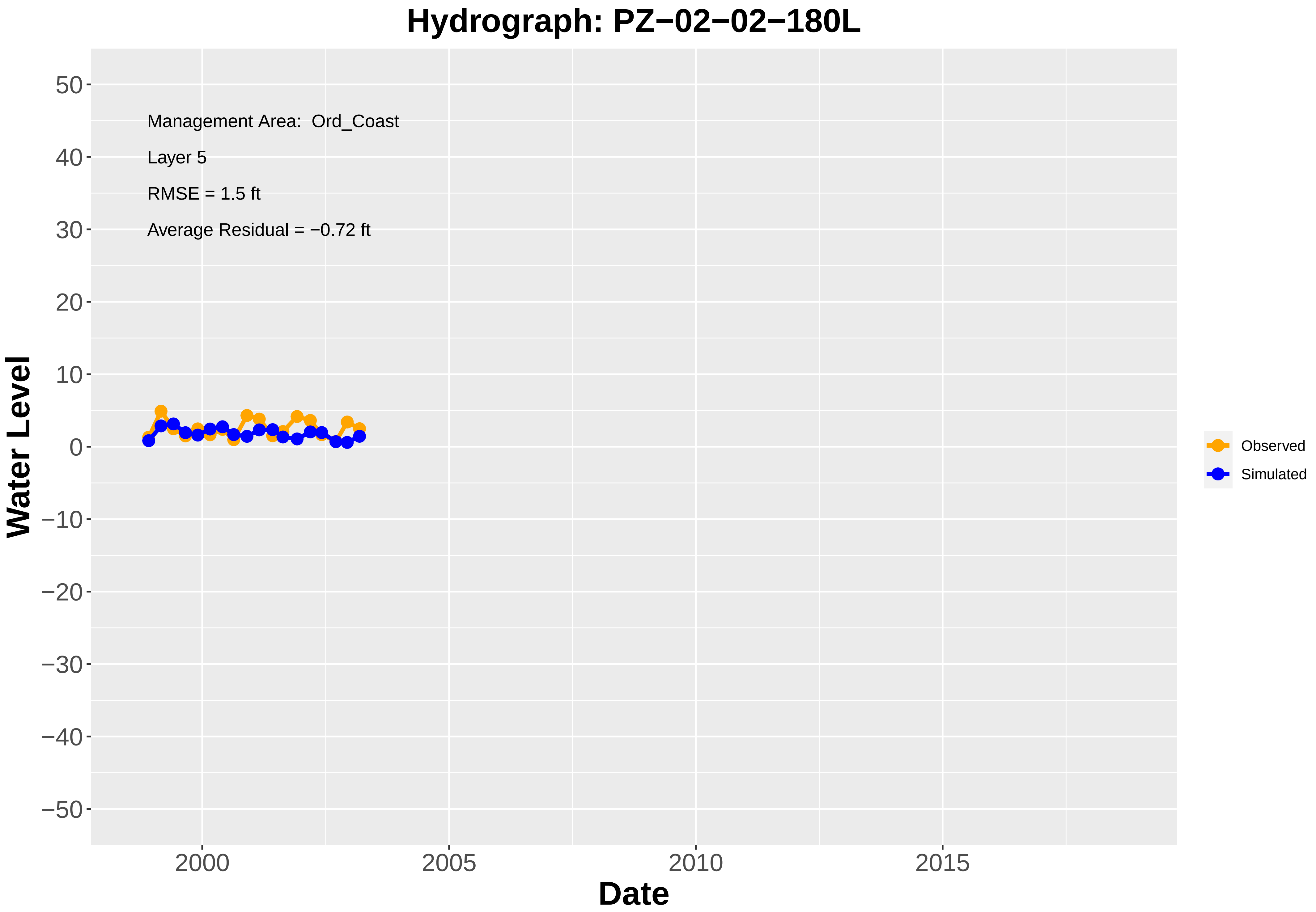


Hydrograph: PZ−02−01−180L
Management Area: Ord_Coast
Layer 5
RMSE = 2.1 ft
Average Residual = −1.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

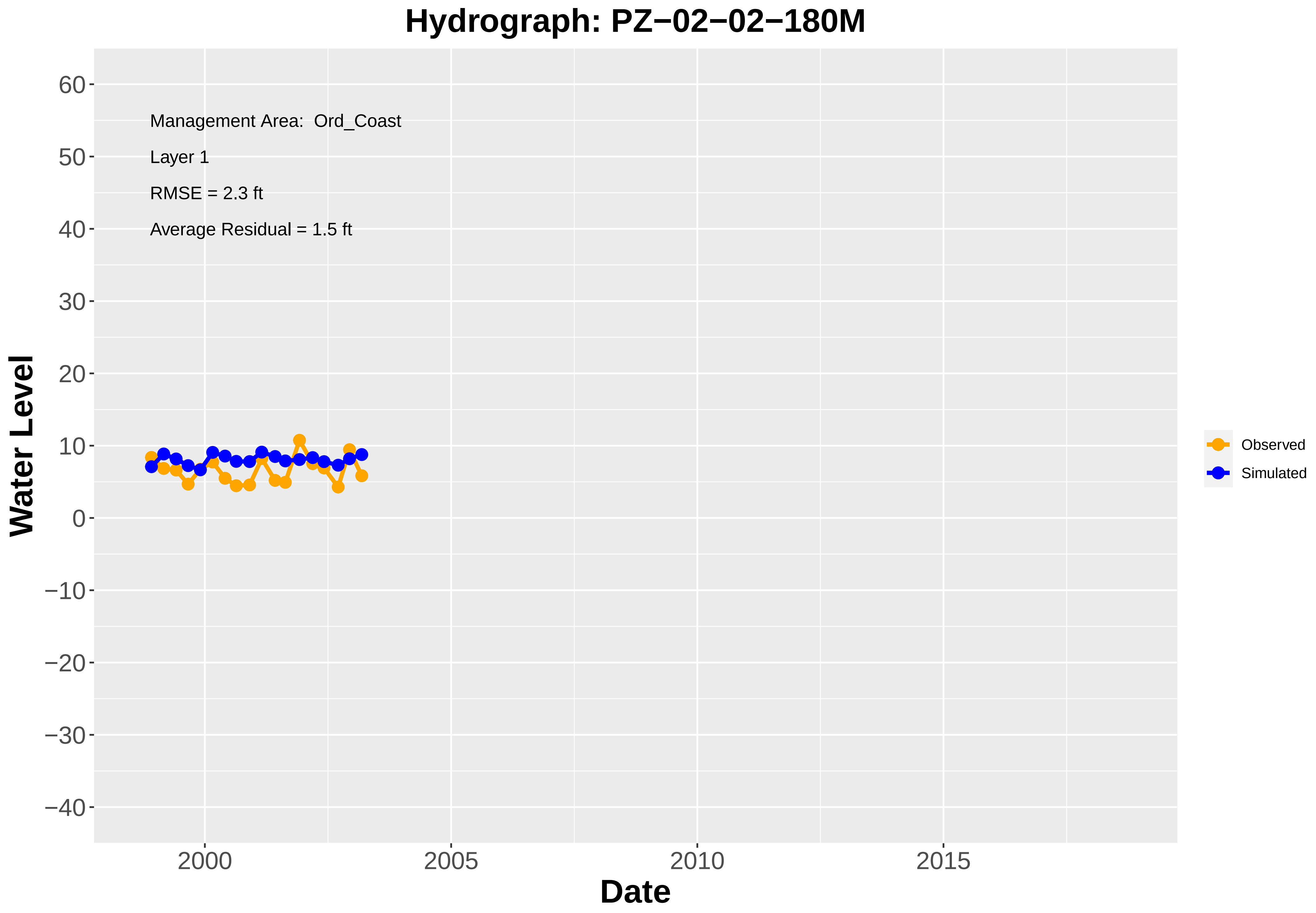

Hydrograph: PZ−02−01−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.1 ft
Average Residual = −2.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



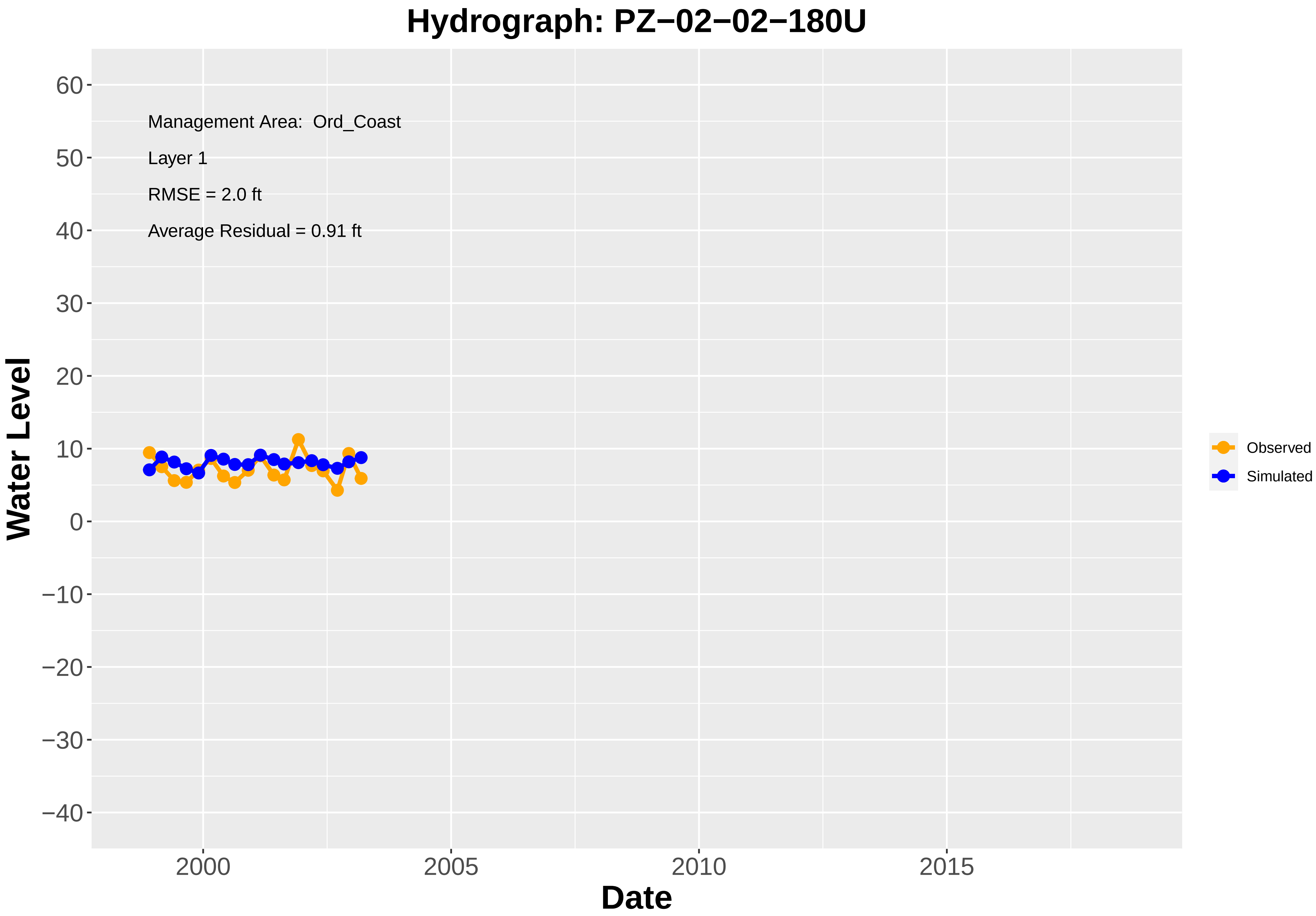
Hydrograph: PZ−02−01−180U
Management Area: Ord_Coast
Layer 1
RMSE = 1.6 ft
Average Residual = 1.3 ft
60
50
40
30
20
10
0
−10
−20
−30
−40
Water Level
2000
2005
2010
2015
Date
Observed
Simulated

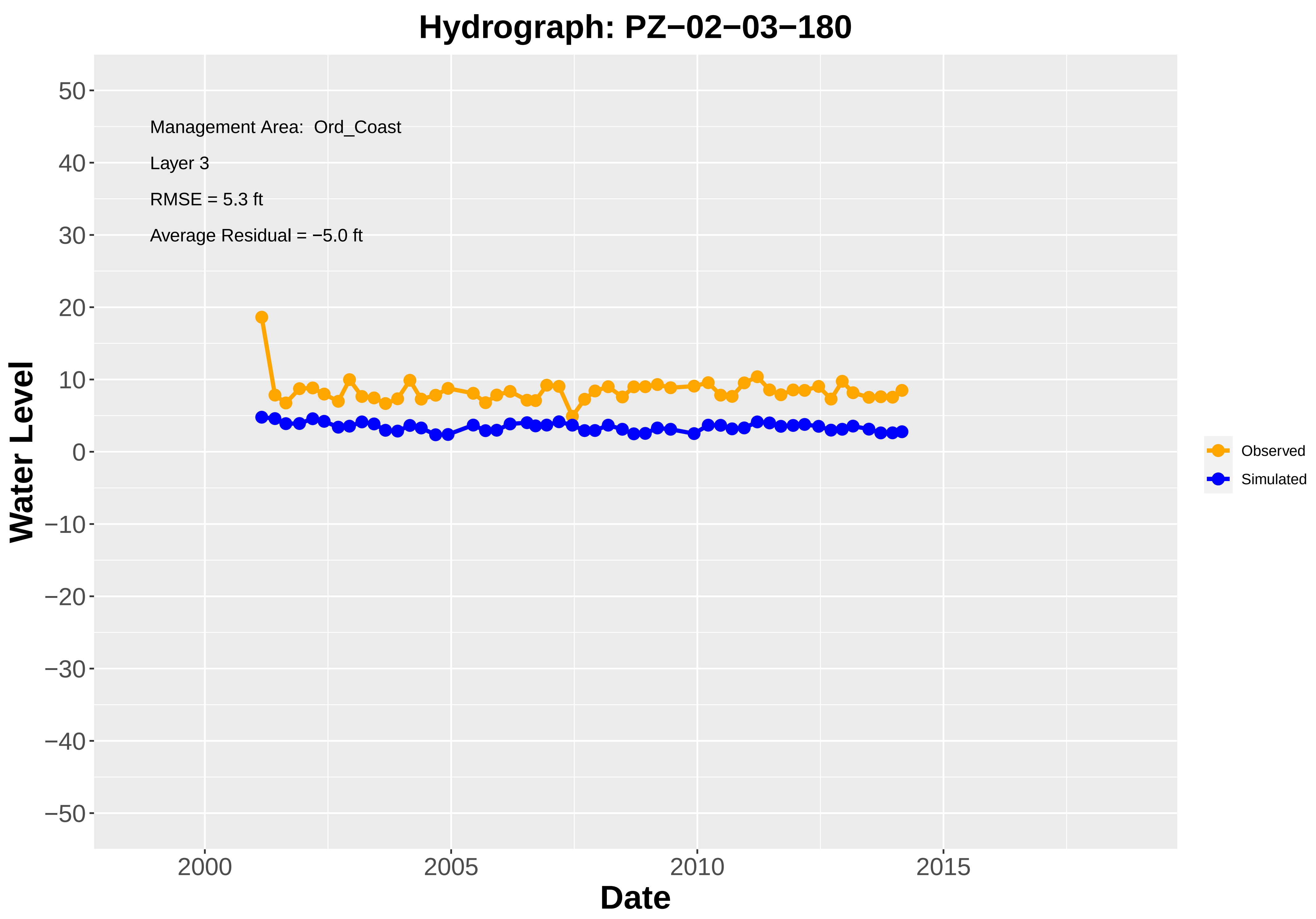


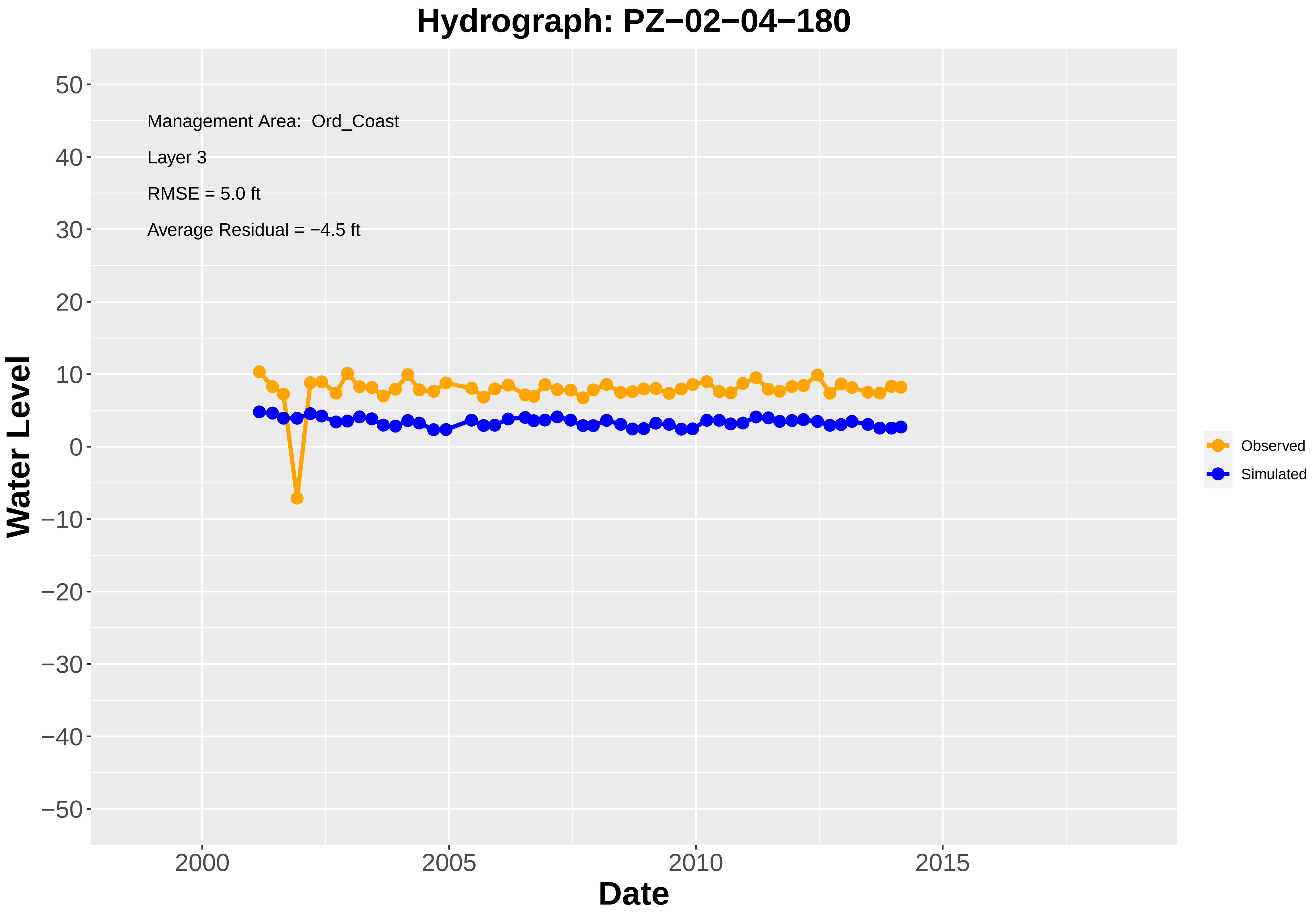
Hydrograph: PZ−02−02−180L
Management Area: Ord_Coast
Layer 5
RMSE = 1.5 ft
Average Residual = −0.72 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated



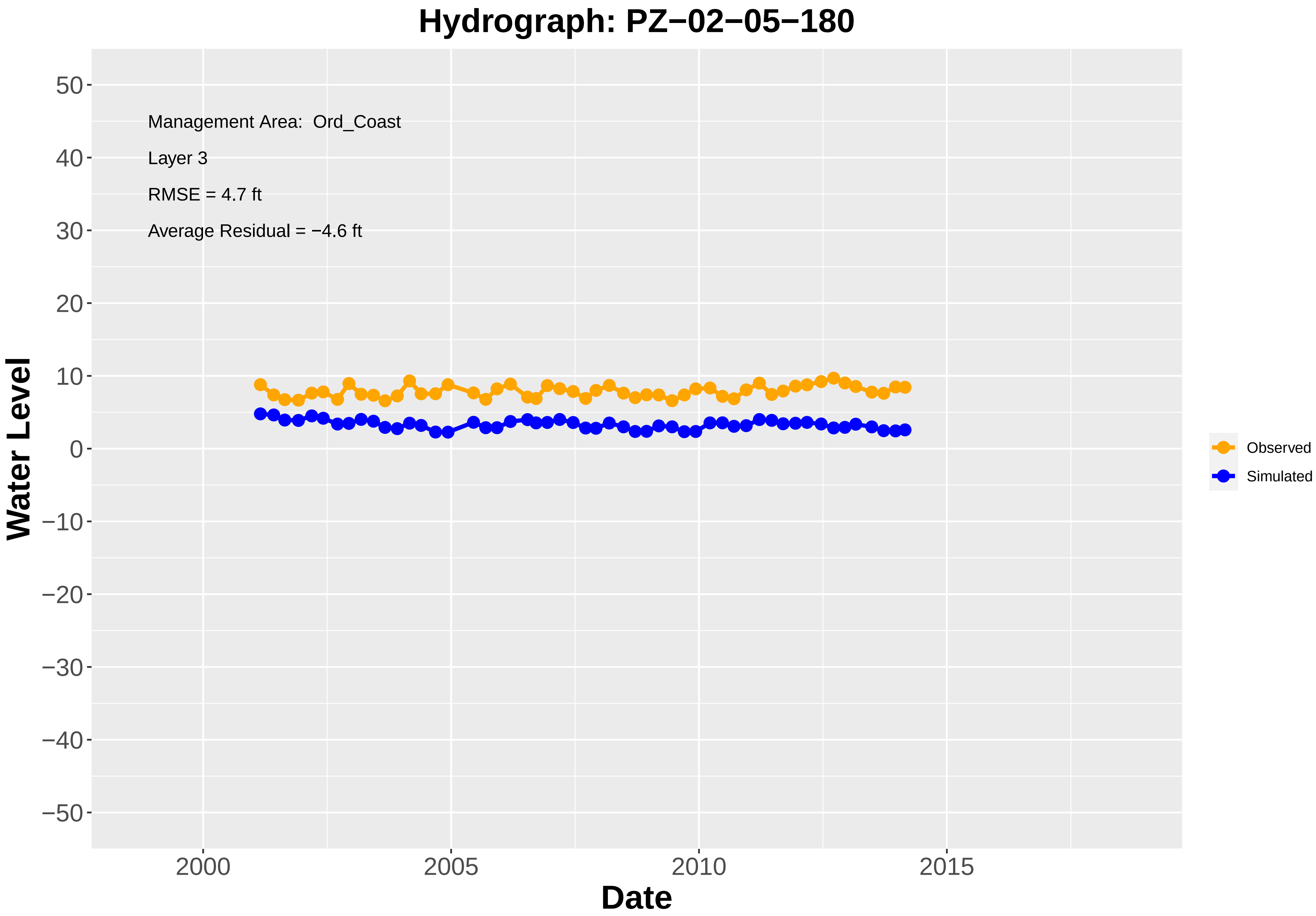
Hydrograph: PZ−02−02−180M
Management Area: Ord_Coast
Layer 1
RMSE = 2.3 ft
Average Residual = 1.5 ft
Water Level
60
50
40
30
20
10
0
−10
−20
−30
−40
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: PZ−02−02−180U
Management Area: Ord_Coast
Layer 1
RMSE = 2.0 ft
Average Residual = 0.91 ft
Water Level
Date
60
50
40
30
20
10
0
−10
−20
−30
−40
2000
2005
2010
2015
Observed
Simulated

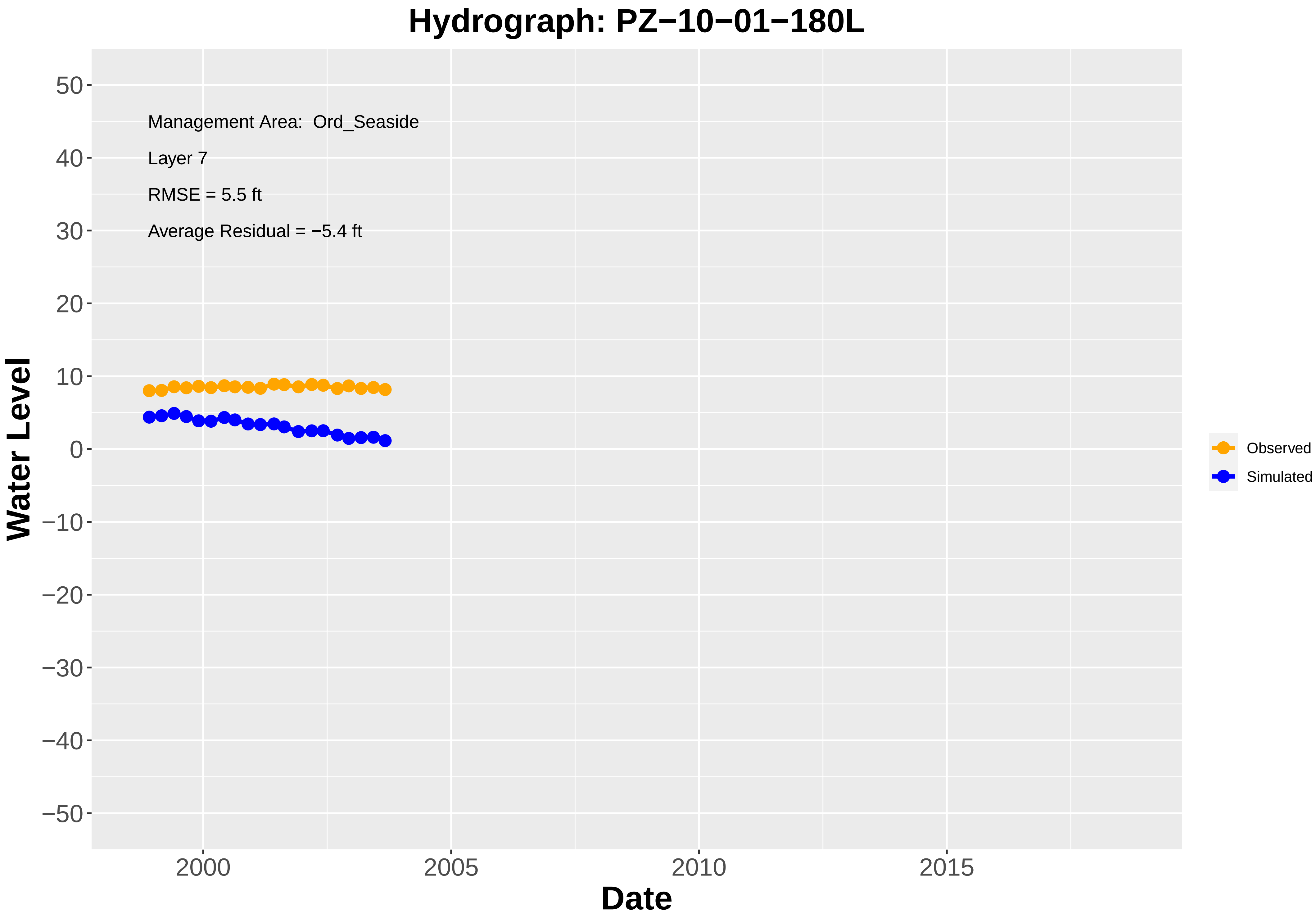

Hydrograph: PZ−02−03−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.3 ft
Average Residual = −5.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

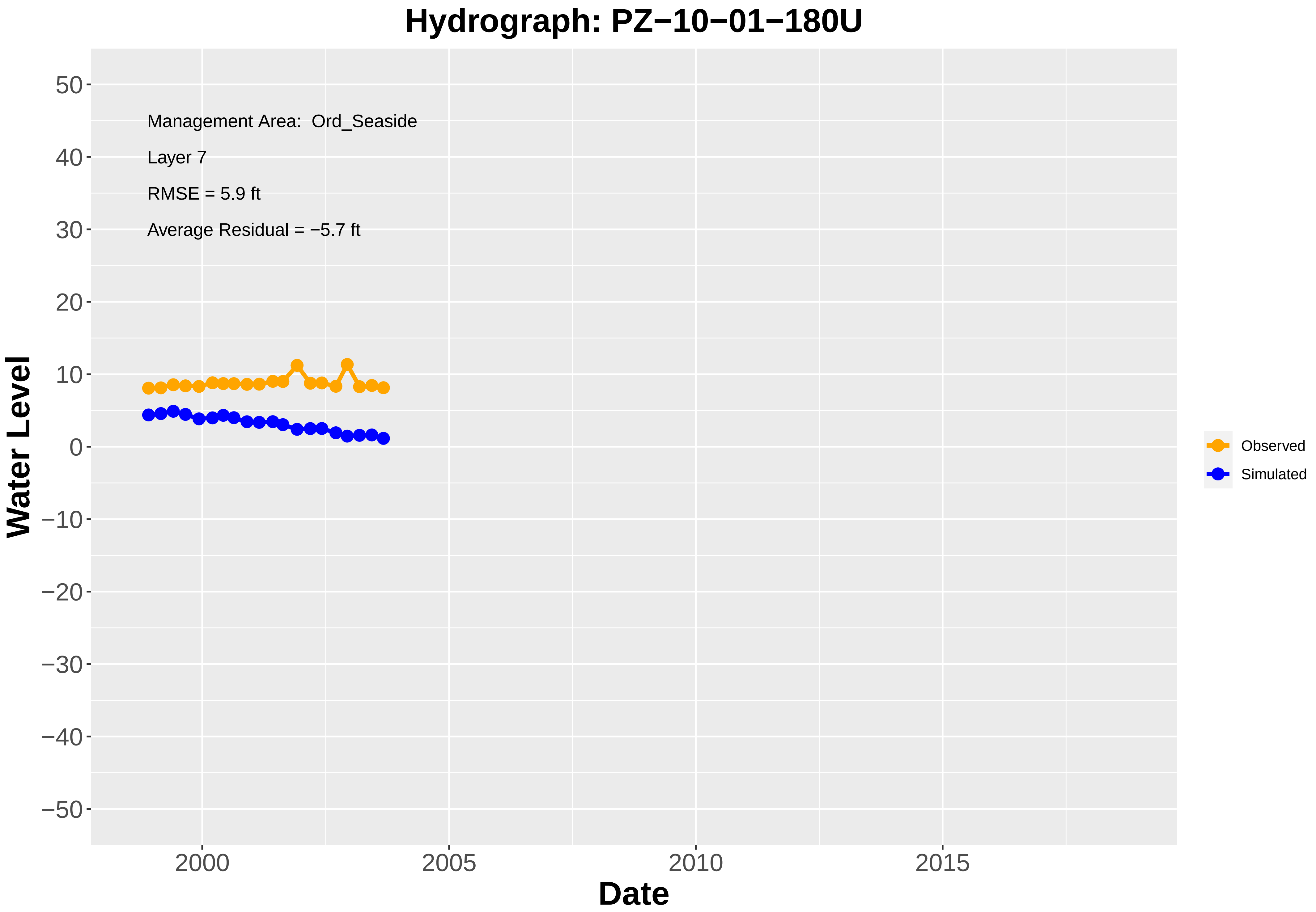


Hydrograph: PZ−02−04−180
Management Area: Ord_Coast
Layer 3
RMSE = 5.0 ft
Average Residual = −4.5 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

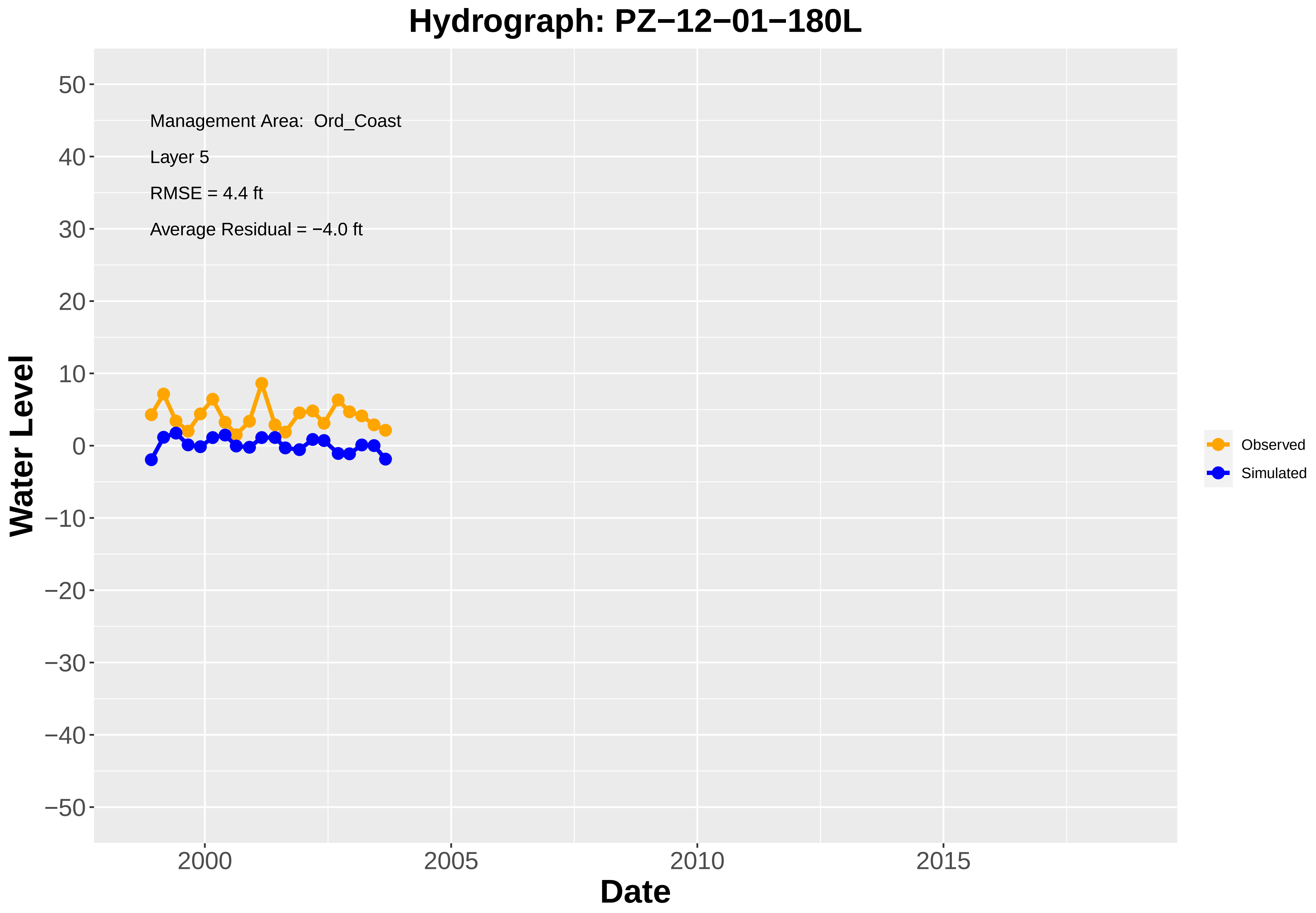


Hydrograph: PZ−02−05−180
Management Area: Ord_Coast
Layer 3
RMSE = 4.7 ft
Average Residual = −4.6 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

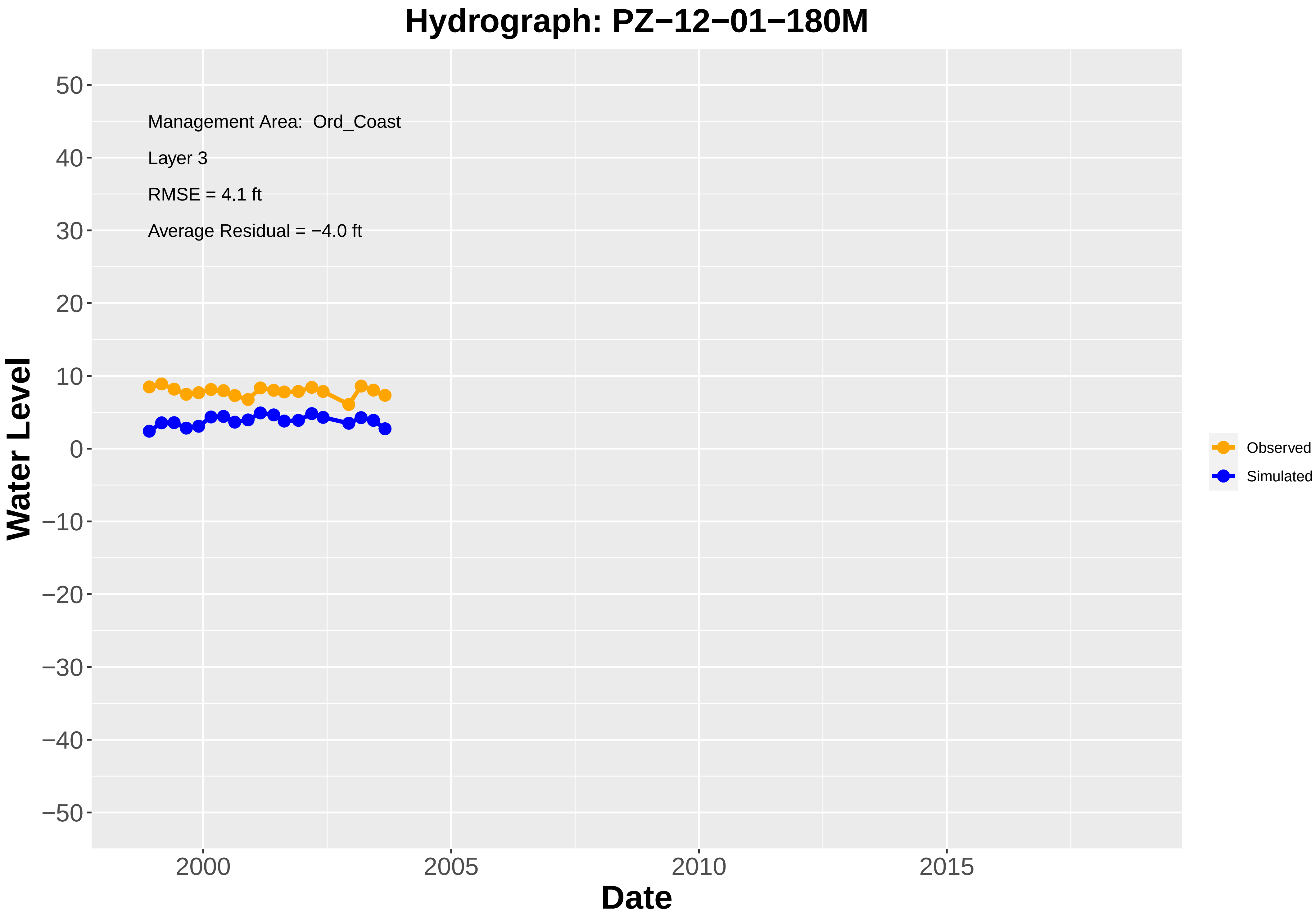

Hydrograph: PZ−10−01−180L
Management Area: Ord_Seaside
Layer 7
RMSE = 5.5 ft
Average Residual = −5.4 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

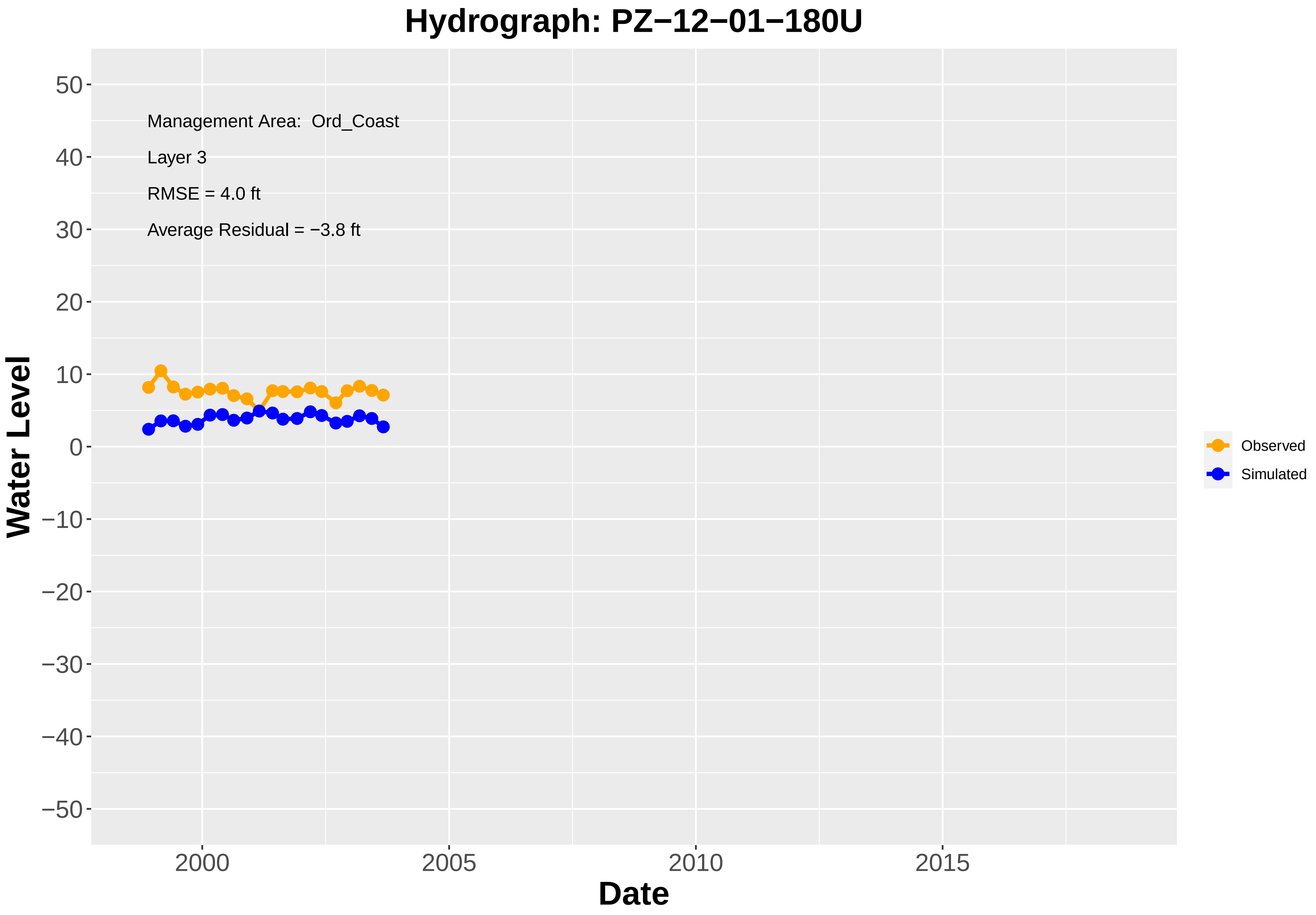


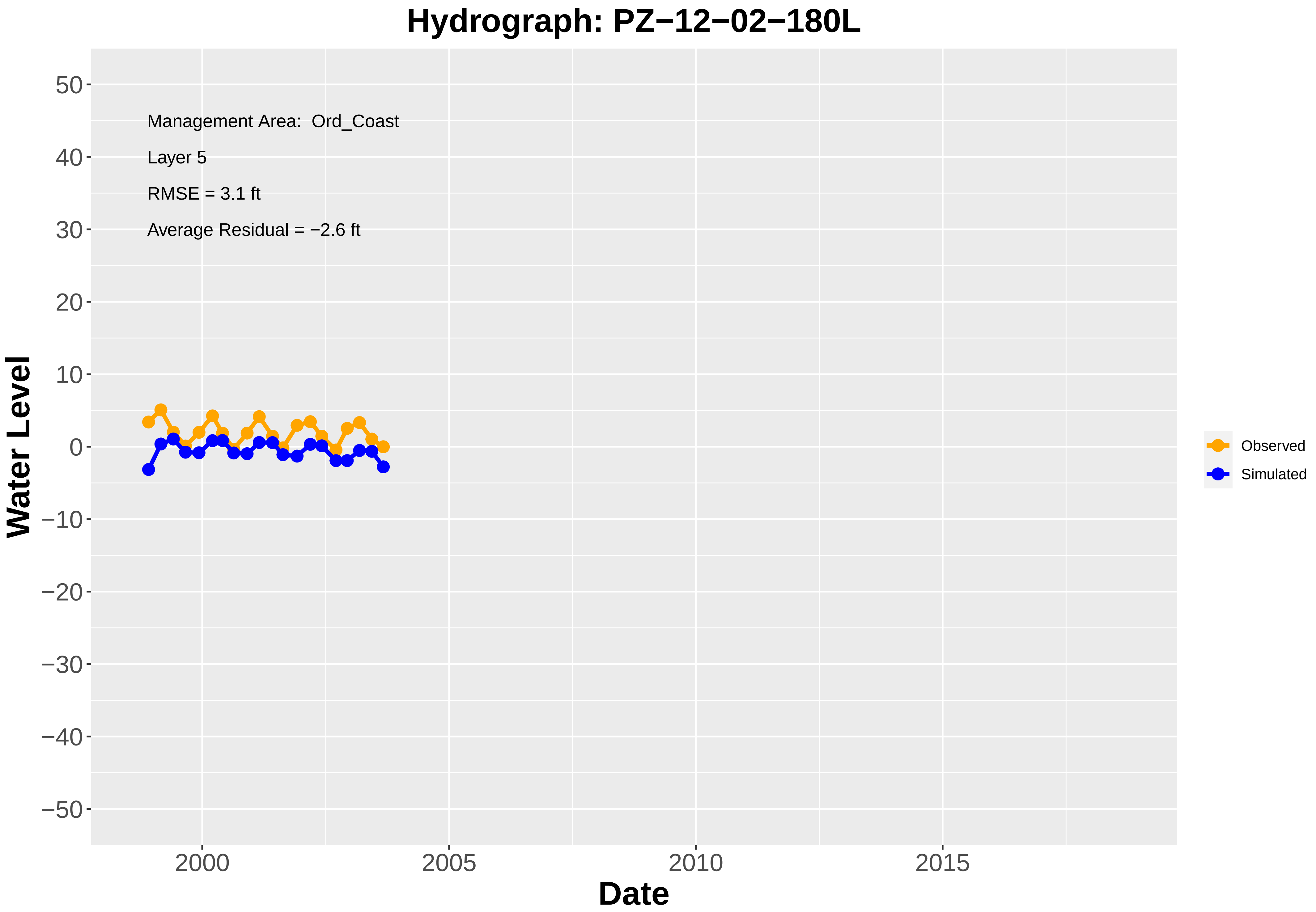
Hydrograph: PZ−10−01−180U
Management Area: Ord_Seaside
Layer 7
RMSE = 5.9 ft
Average Residual = −5.7 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

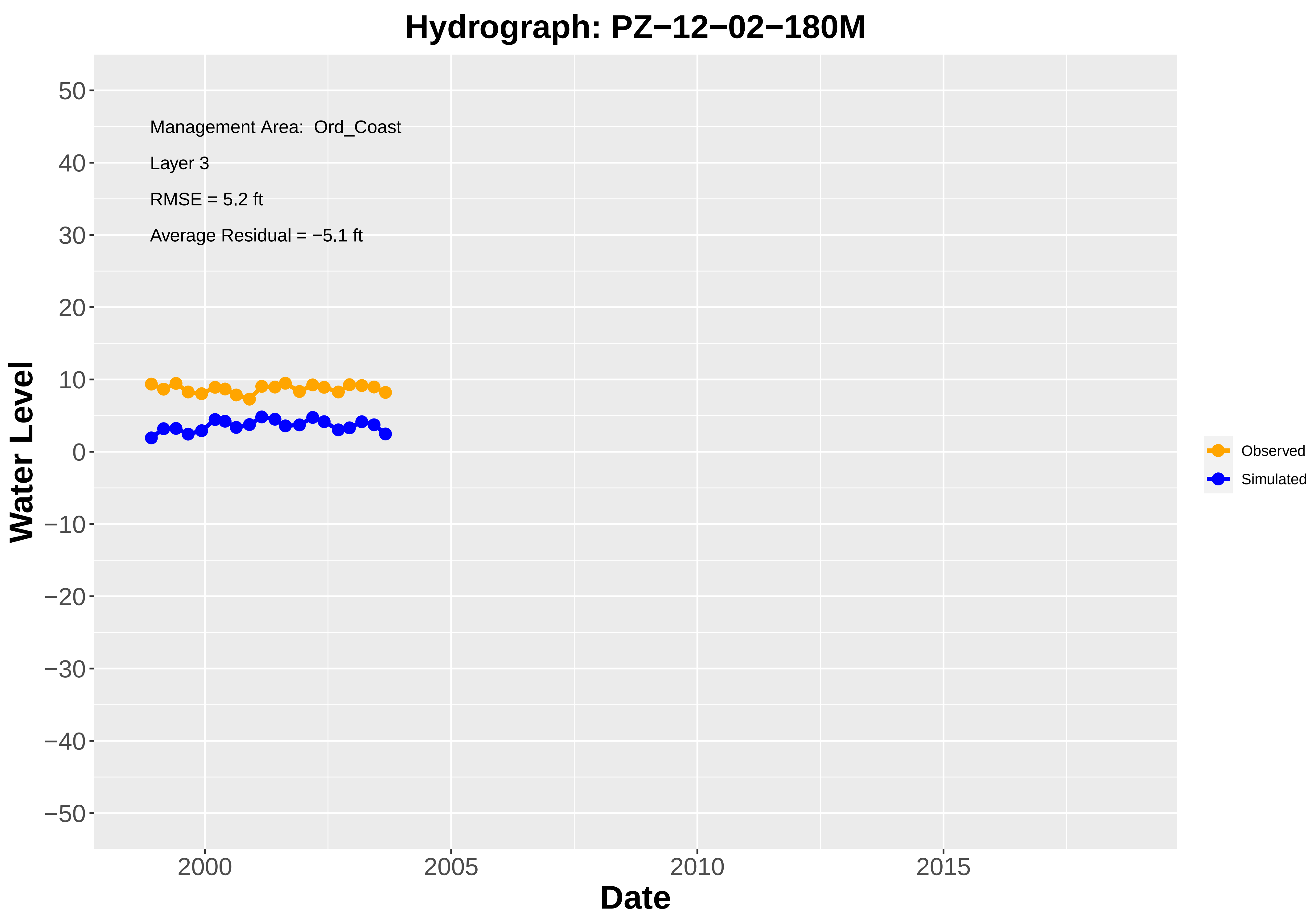


Hydrograph: PZ−12−01−180L
Management Area: Ord_Coast
Layer 5
RMSE = 4.4 ft
Average Residual = −4.0 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

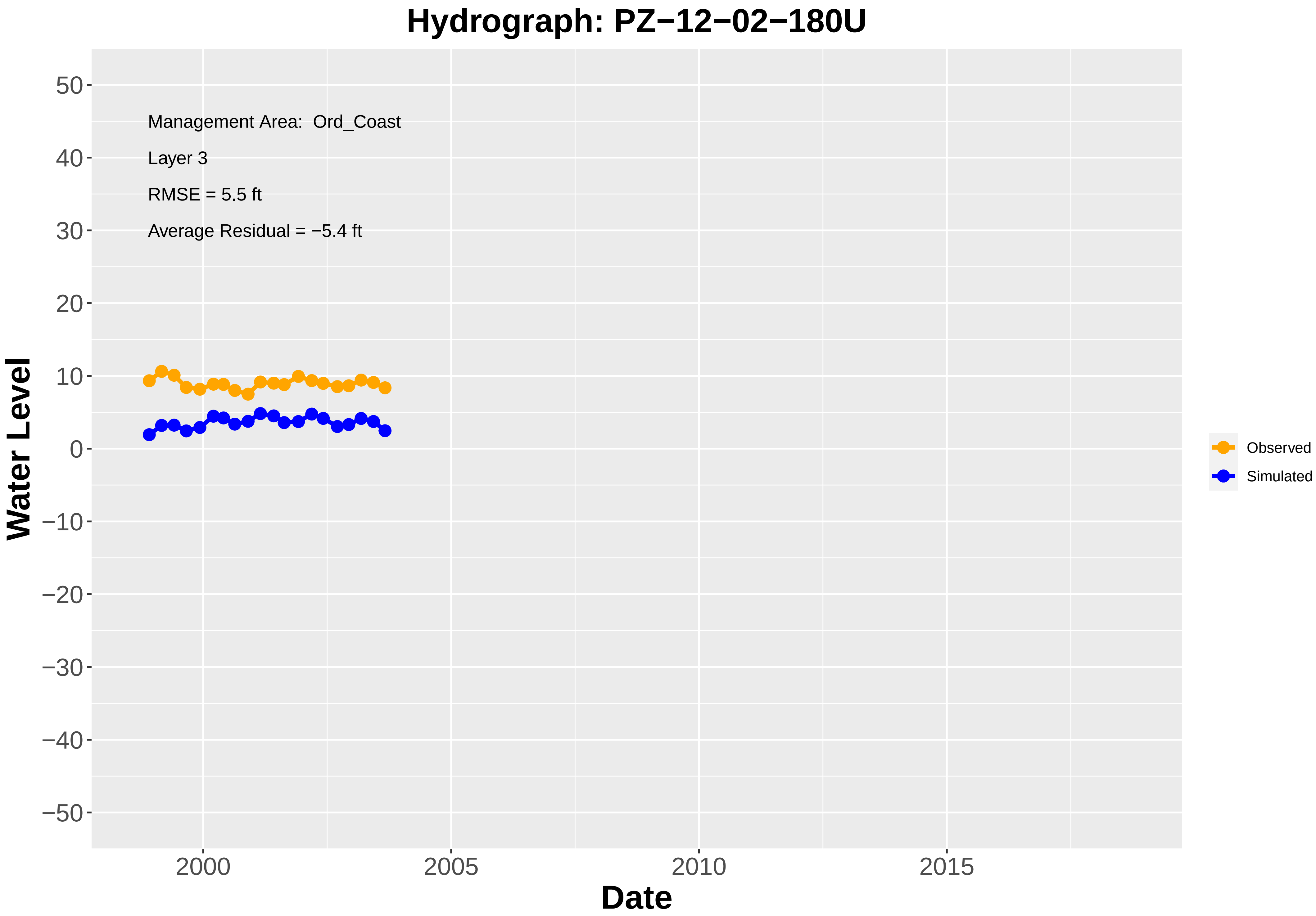

Hydrograph: PZ−12−01−180M
Management Area: Ord_Coast
Layer 3
RMSE = 4.1 ft
Average Residual = −4.0 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: PZ−12−01−180U
Management Area: Ord_Coast
Layer 3
RMSE = 4.0 ft
Average Residual = −3.8 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated


Hydrograph: PZ−12−02−180L
Management Area: Ord_Coast
Layer 5
RMSE = 3.1 ft
Average Residual = −2.6 ft
Water Level
Date
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Observed
Simulated

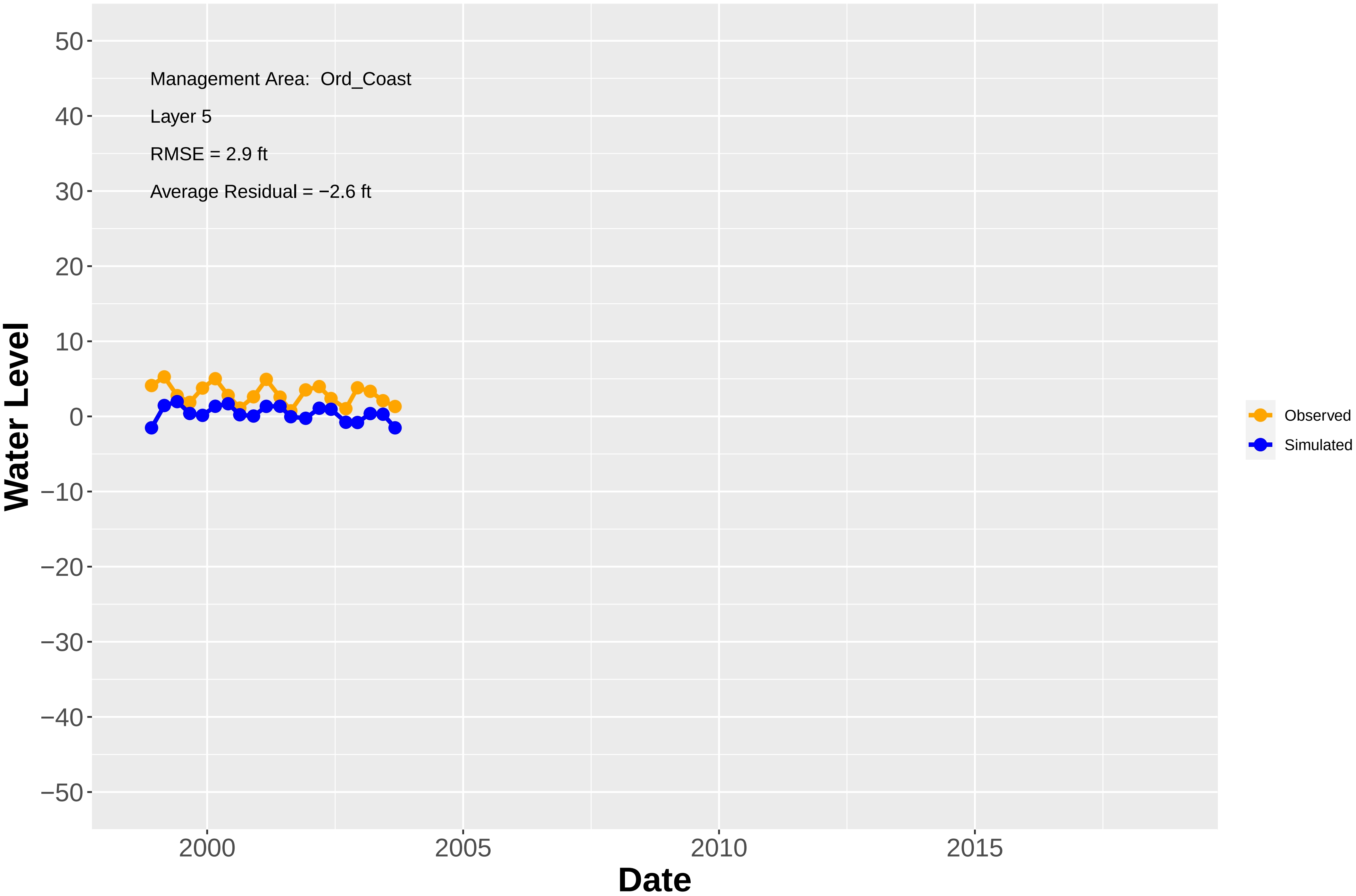


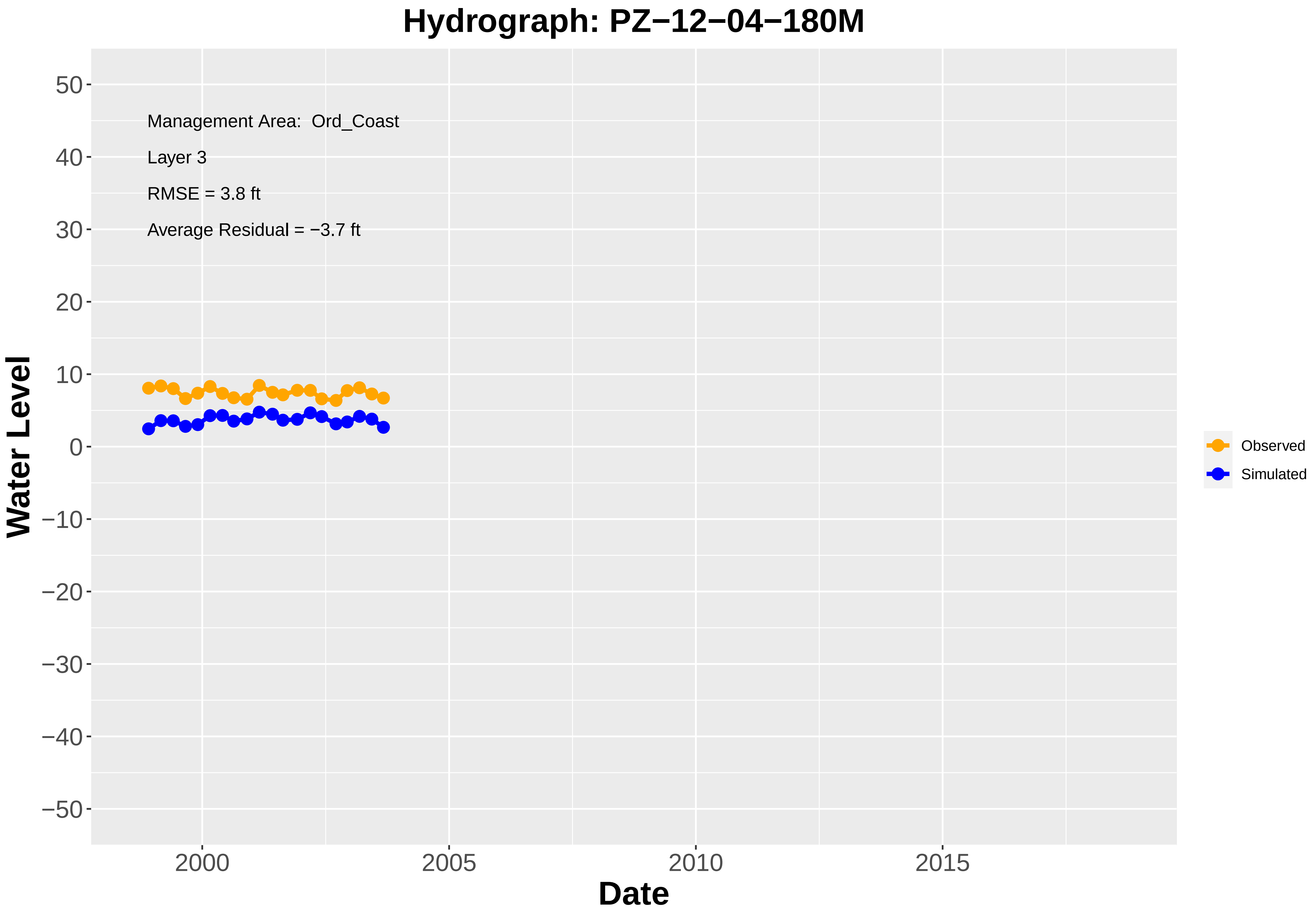
Hydrograph: PZ−12−02−180M
Management Area: Ord_Coast
Layer 3
RMSE = 5.2 ft
Average Residual = −5.1 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated



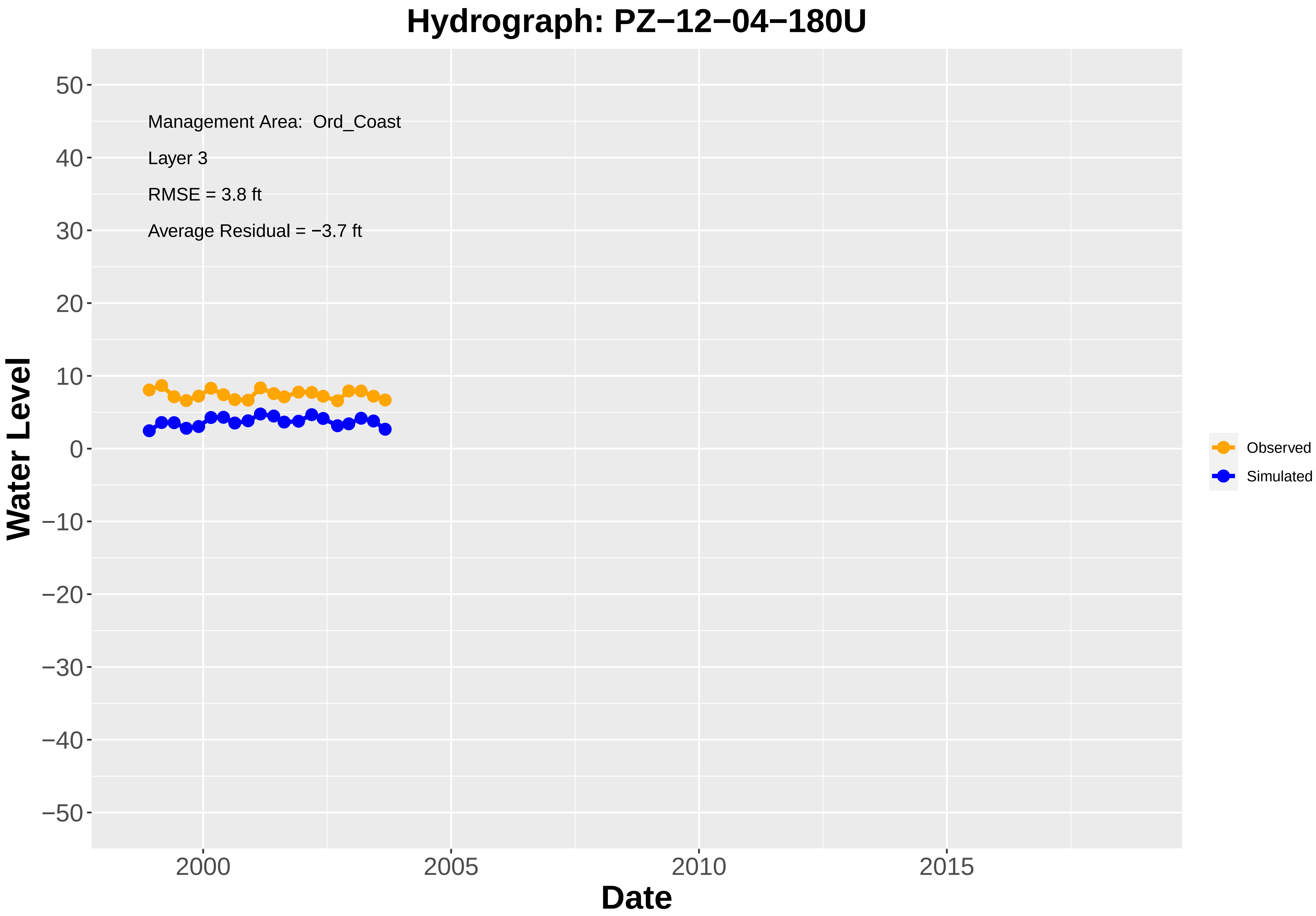
Hydrograph: PZ−12−02−180U
Management Area: Ord_Coast
Layer 3
RMSE = 5.5 ft
Average Residual = −5.4 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

Hydrograph: PZ−12−04−180L

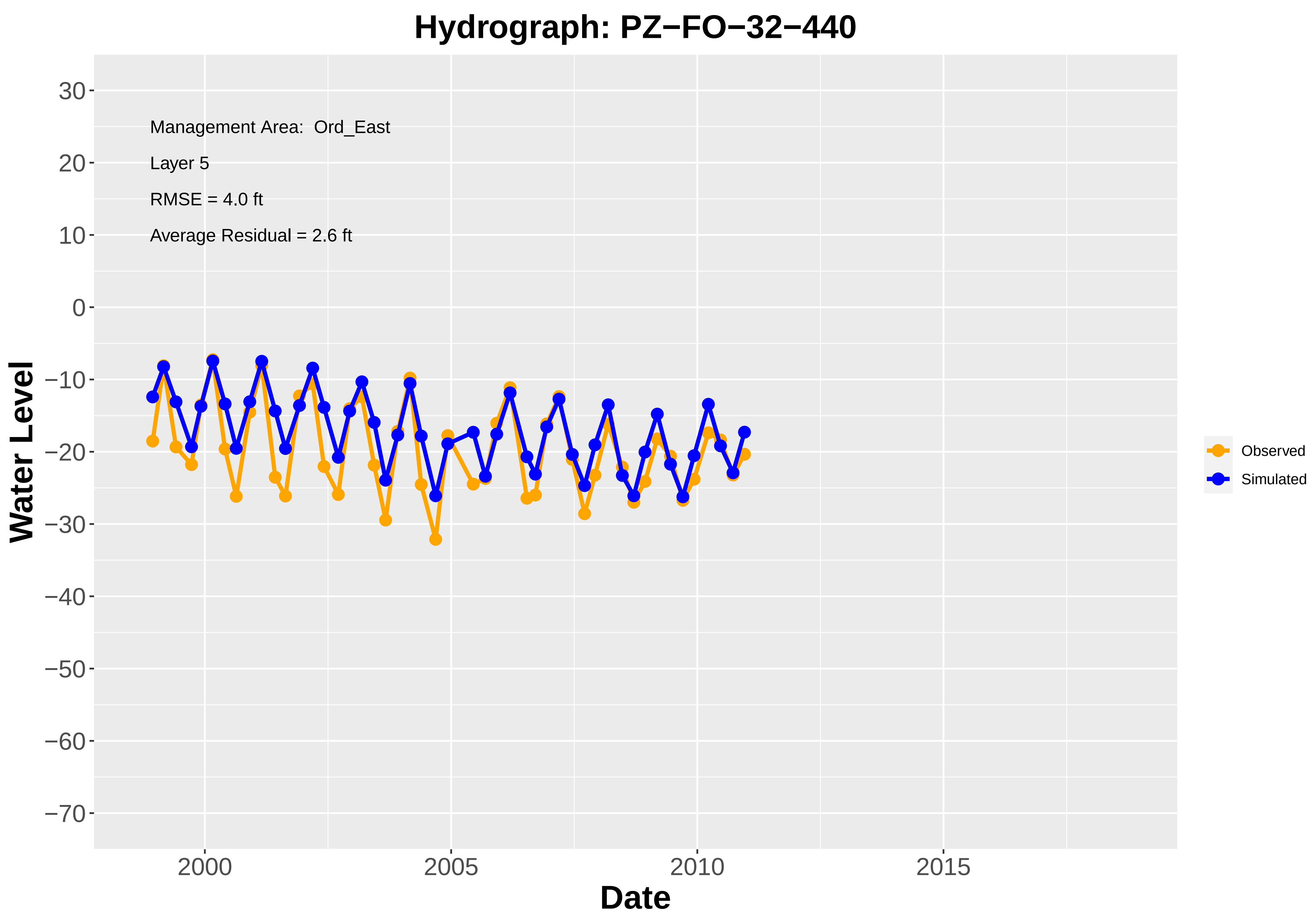


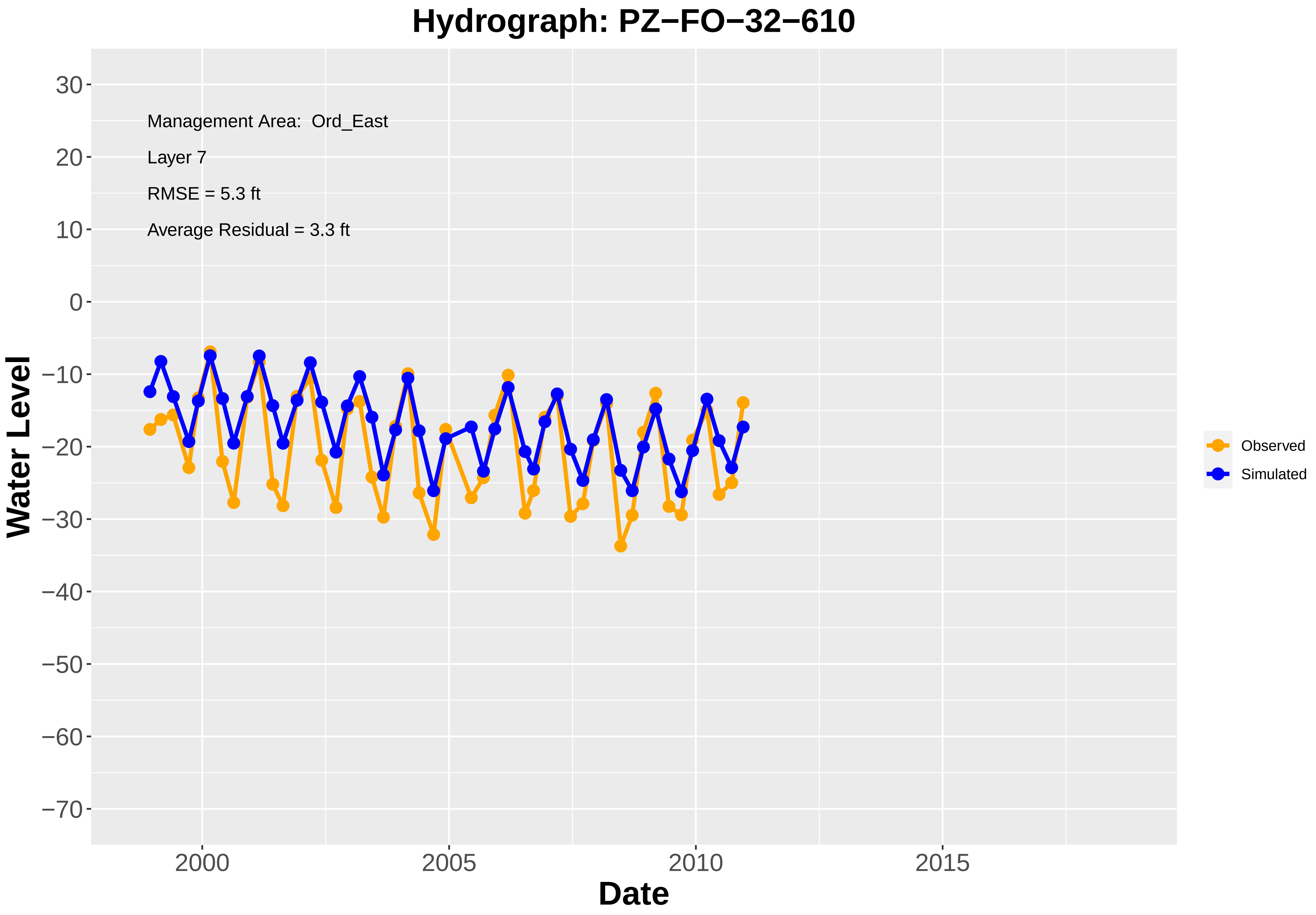


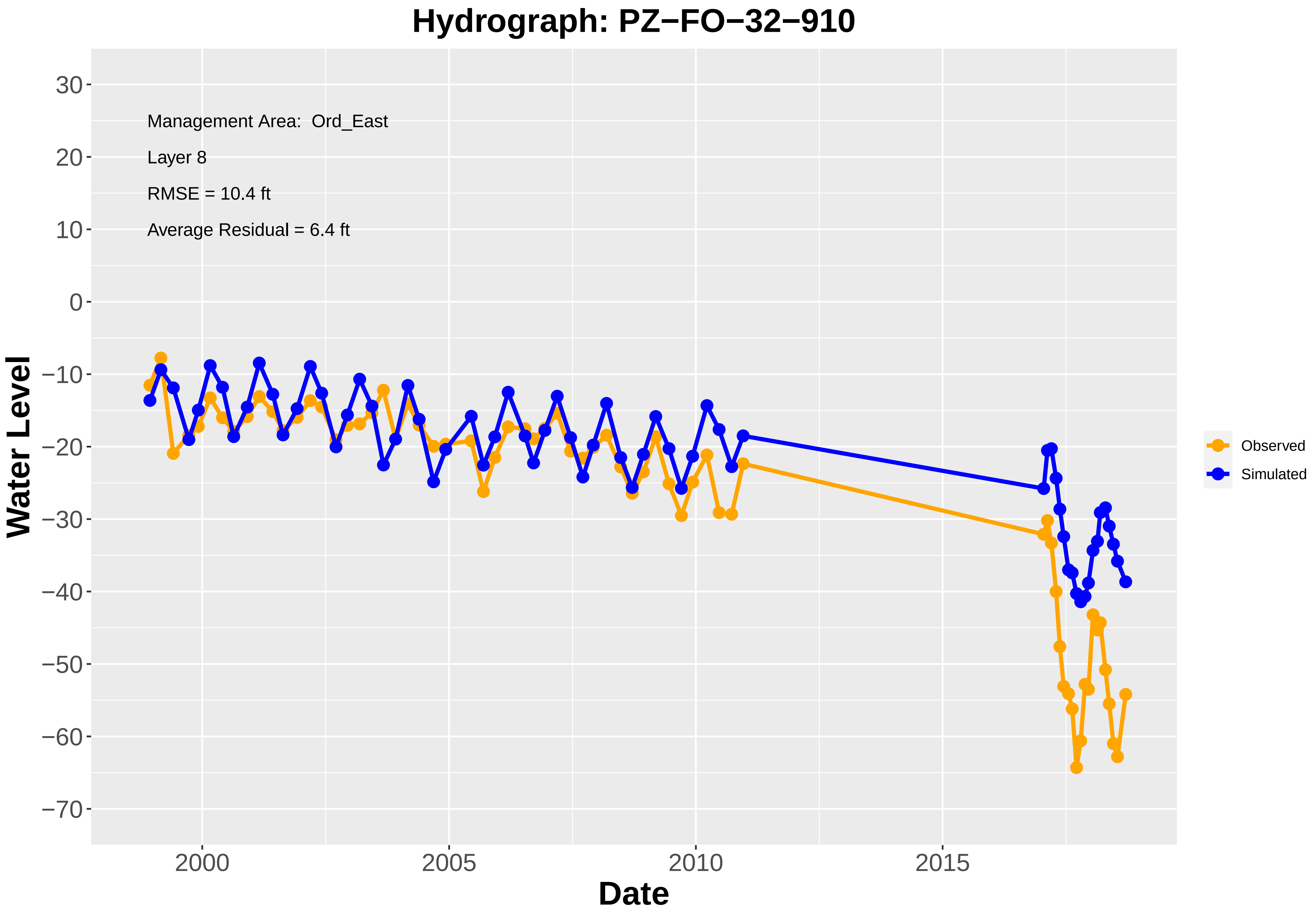
Hydrograph: PZ−12−04−180M
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

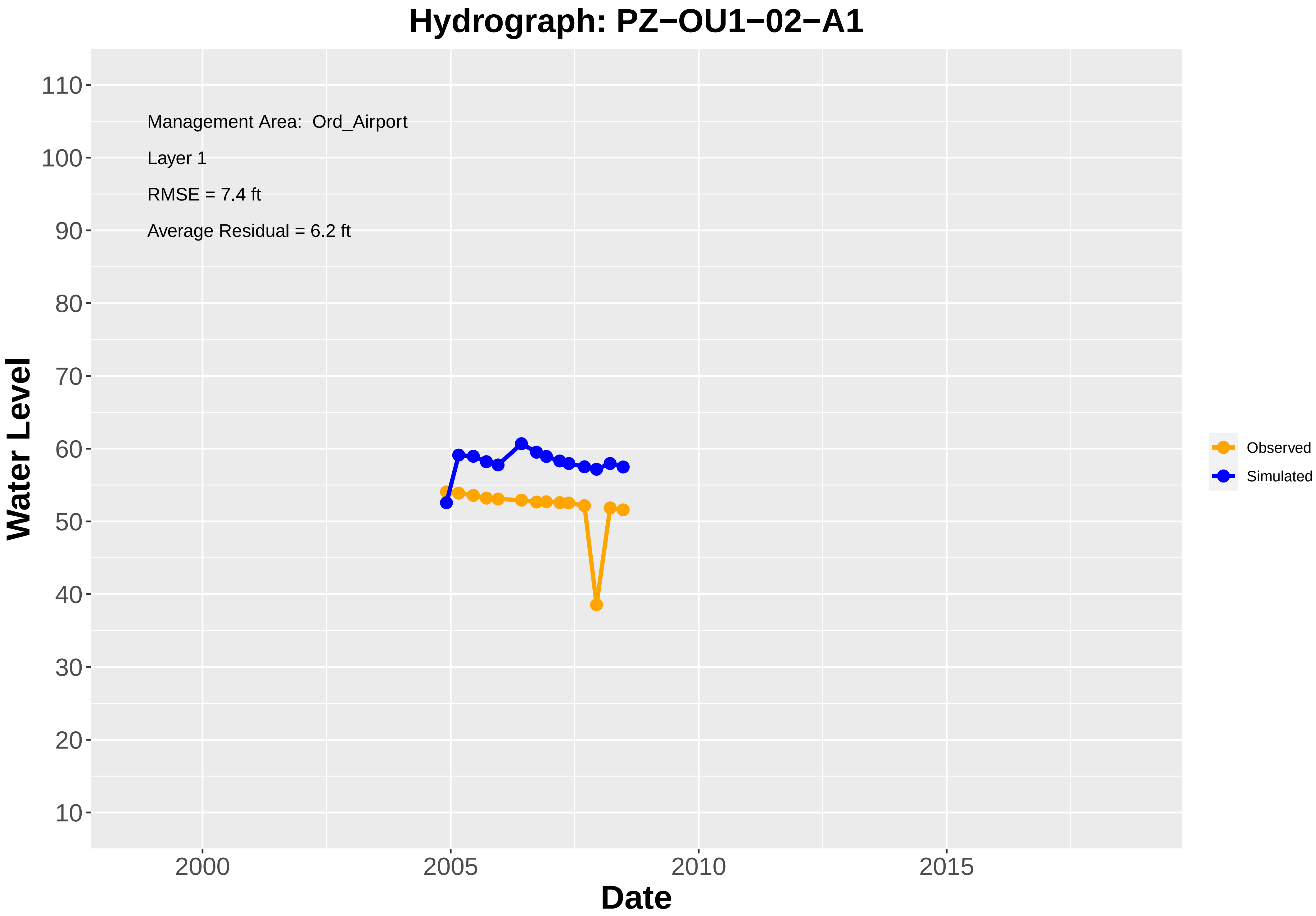


Hydrograph: PZ−12−04−180U
Management Area: Ord_Coast
Layer 3
RMSE = 3.8 ft
Average Residual = −3.7 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
2000
2005
2010
2015
Date
Observed
Simulated

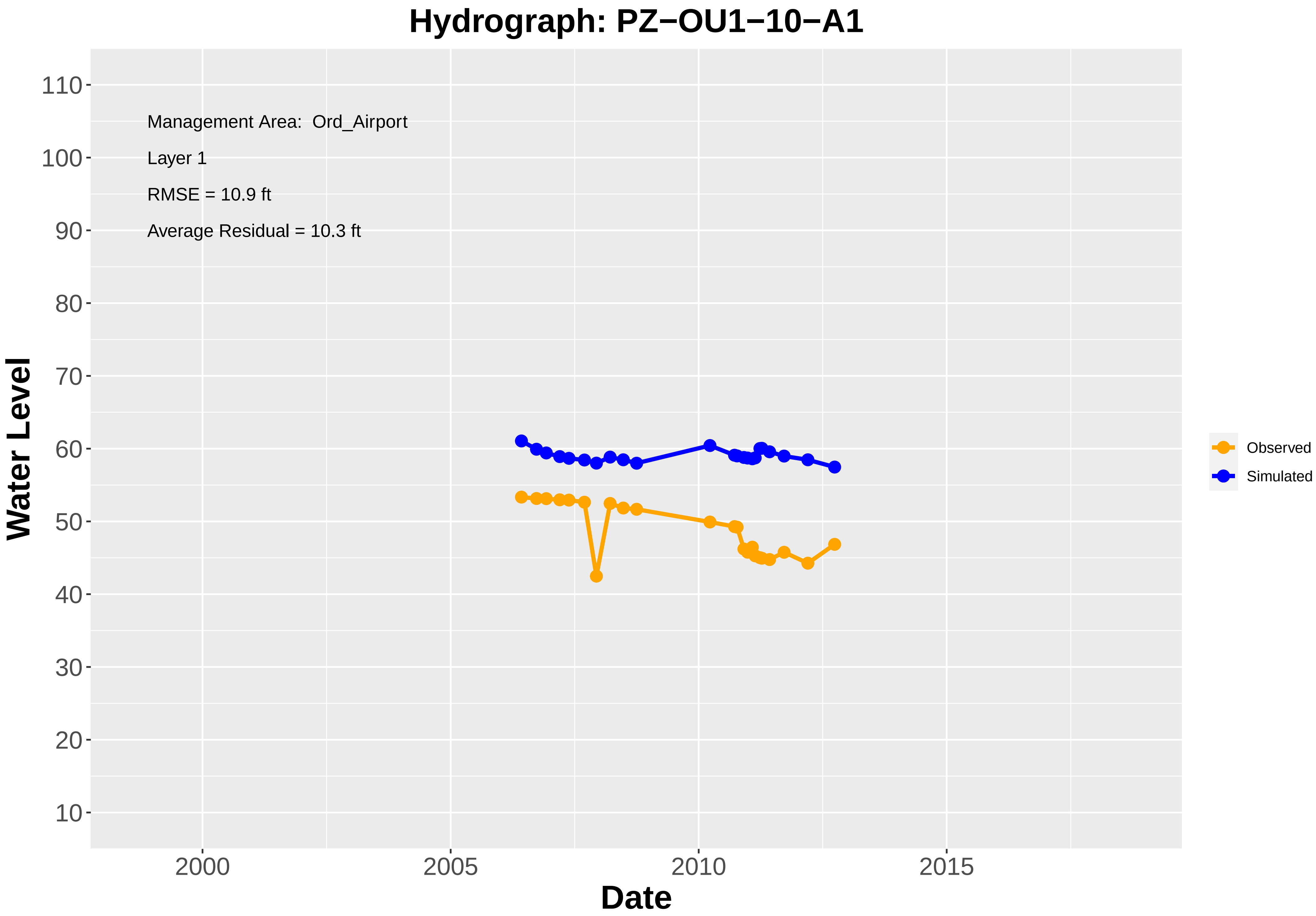

Hydrograph: PZ−FO−32−440
Management Area: Ord_East
Layer 5
RMSE = 4.0 ft
Average Residual = 2.6 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated


Hydrograph: PZ−FO−32−610
Management Area: Ord_East
Layer 7
RMSE = 5.3 ft
Average Residual = 3.3 ft
Water Level
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Date
Observed
Simulated

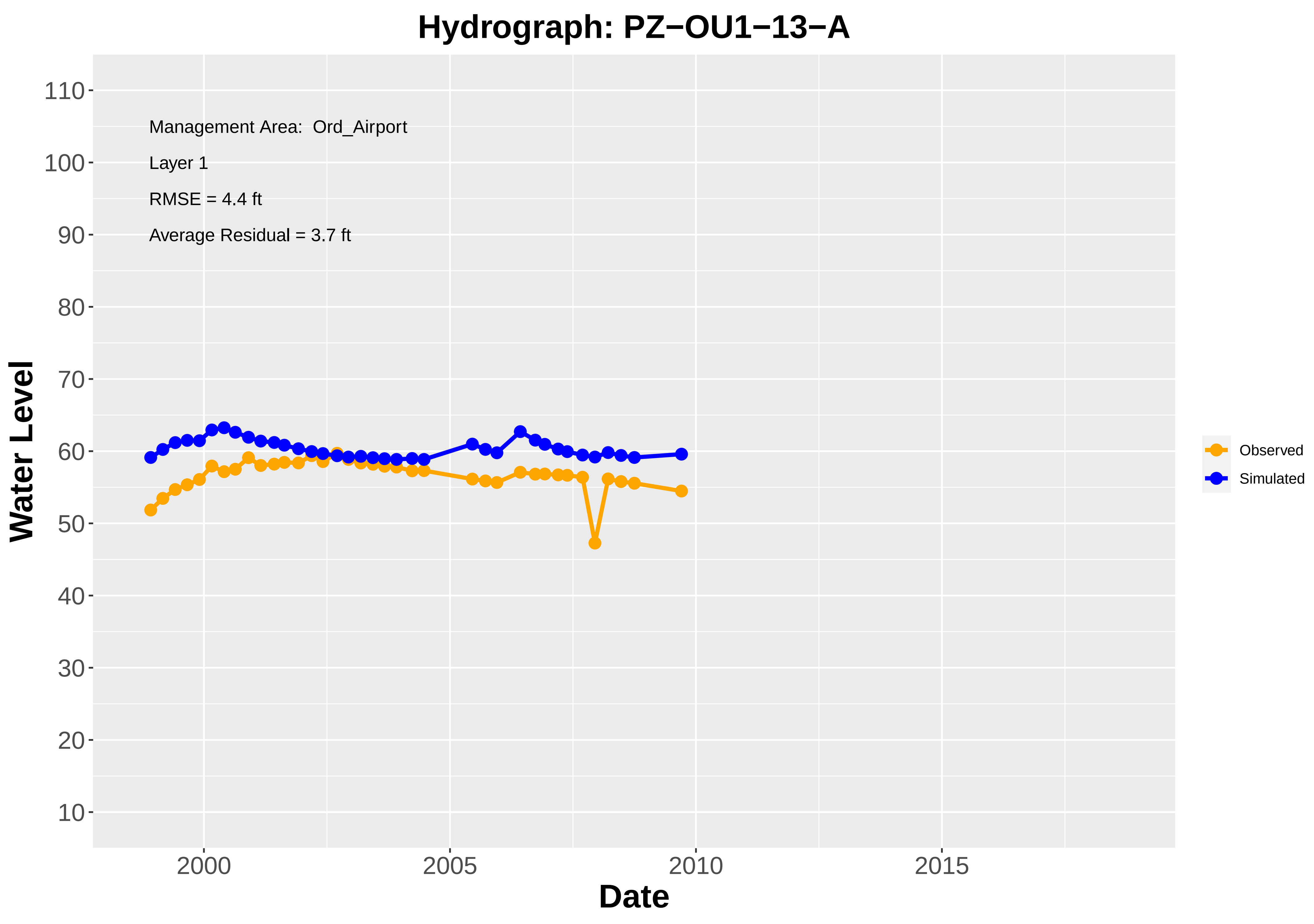

Hydrograph: PZ−FO−32−910
Management Area: Ord_East
Layer 8
RMSE = 10.4 ft
Average Residual = 6.4 ft
Water Level
Date
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
2000
2005
2010
2015
Observed
Simulated



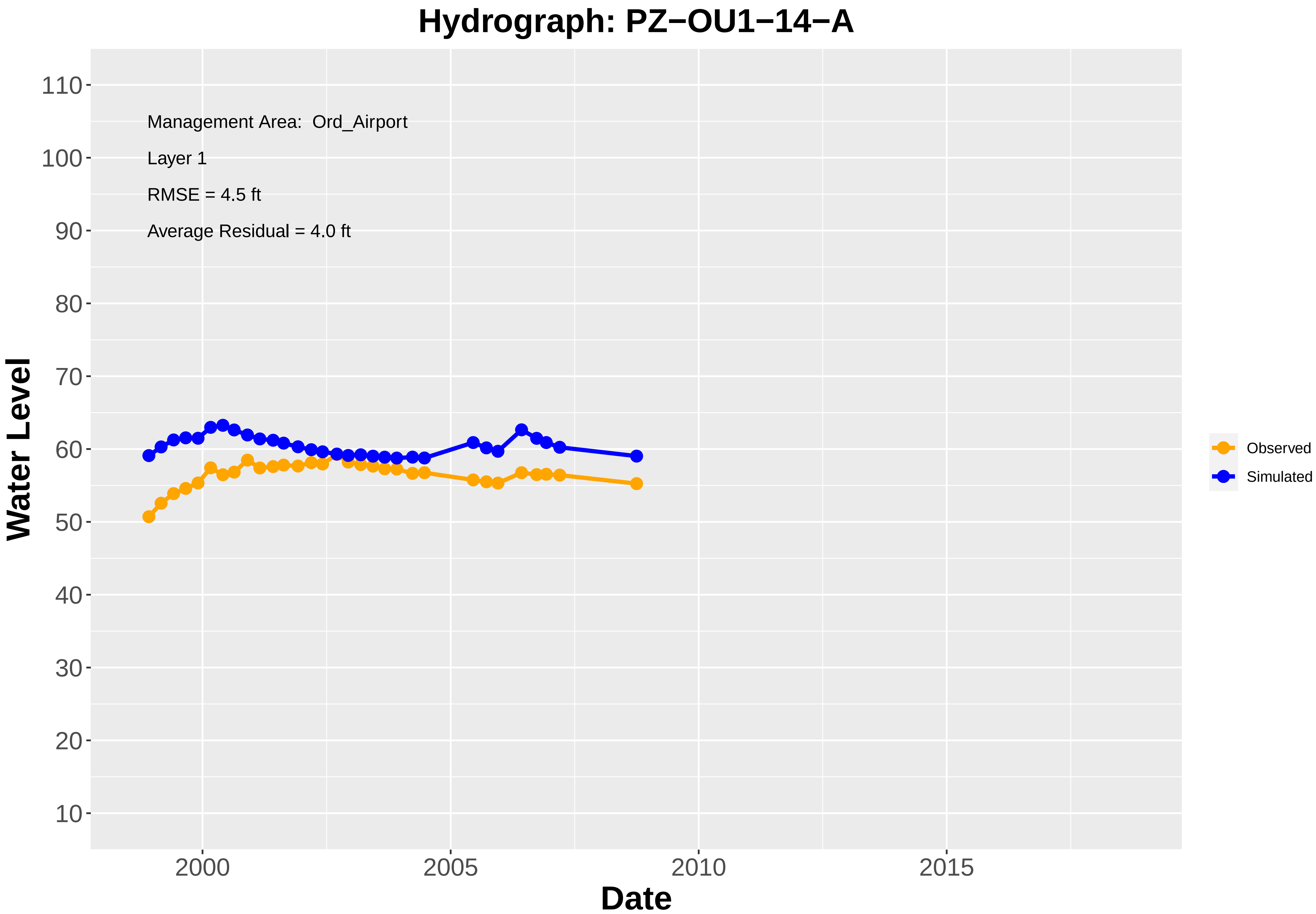
Hydrograph: PZ−OU1−02−A1
Management Area: Ord_Airport
Layer 1
RMSE = 7.4 ft
Average Residual = 6.2 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



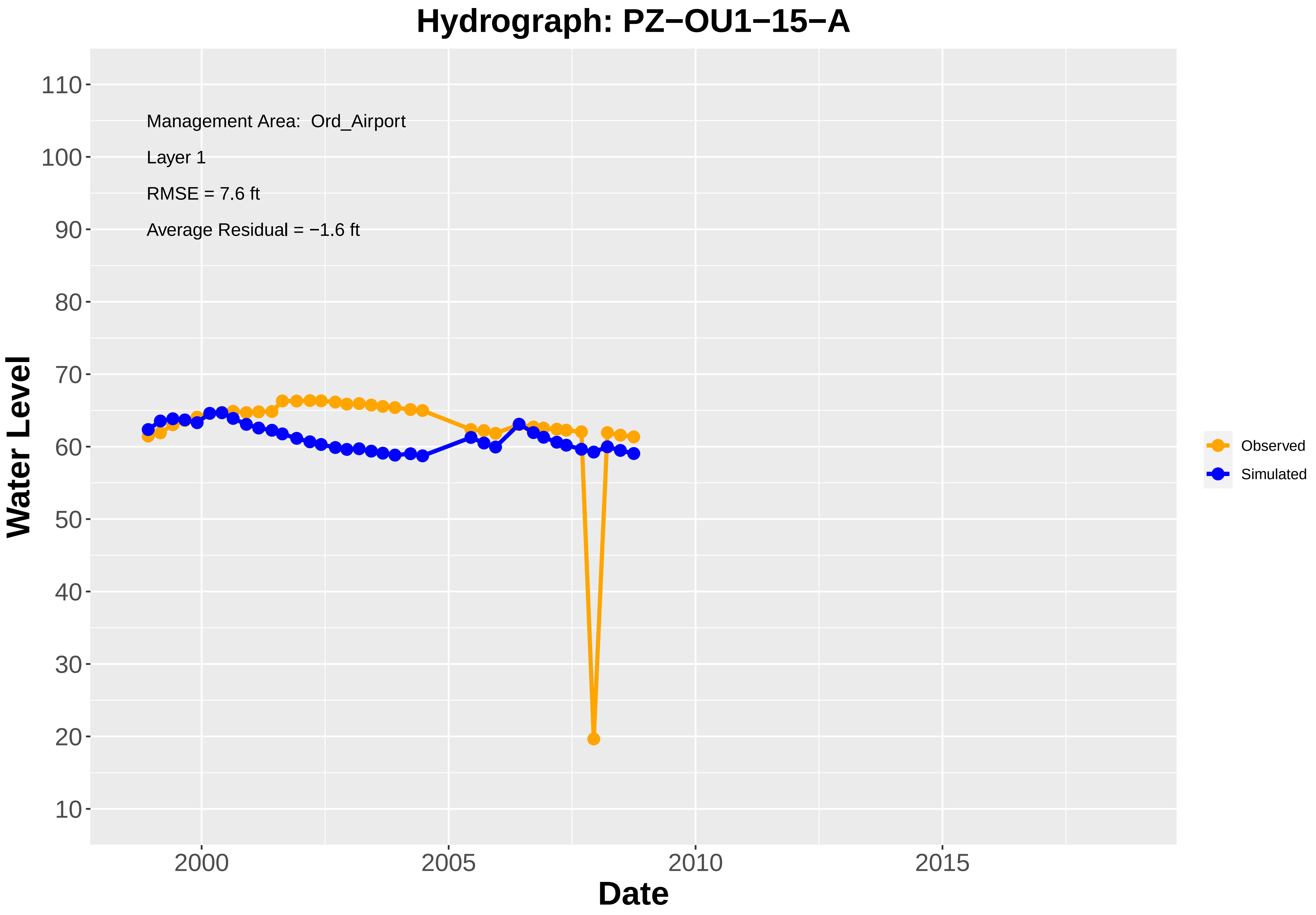
Hydrograph: PZ−OU1−10−A1
Management Area: Ord_Airport
Layer 1
RMSE = 10.9 ft
Average Residual = 10.3 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



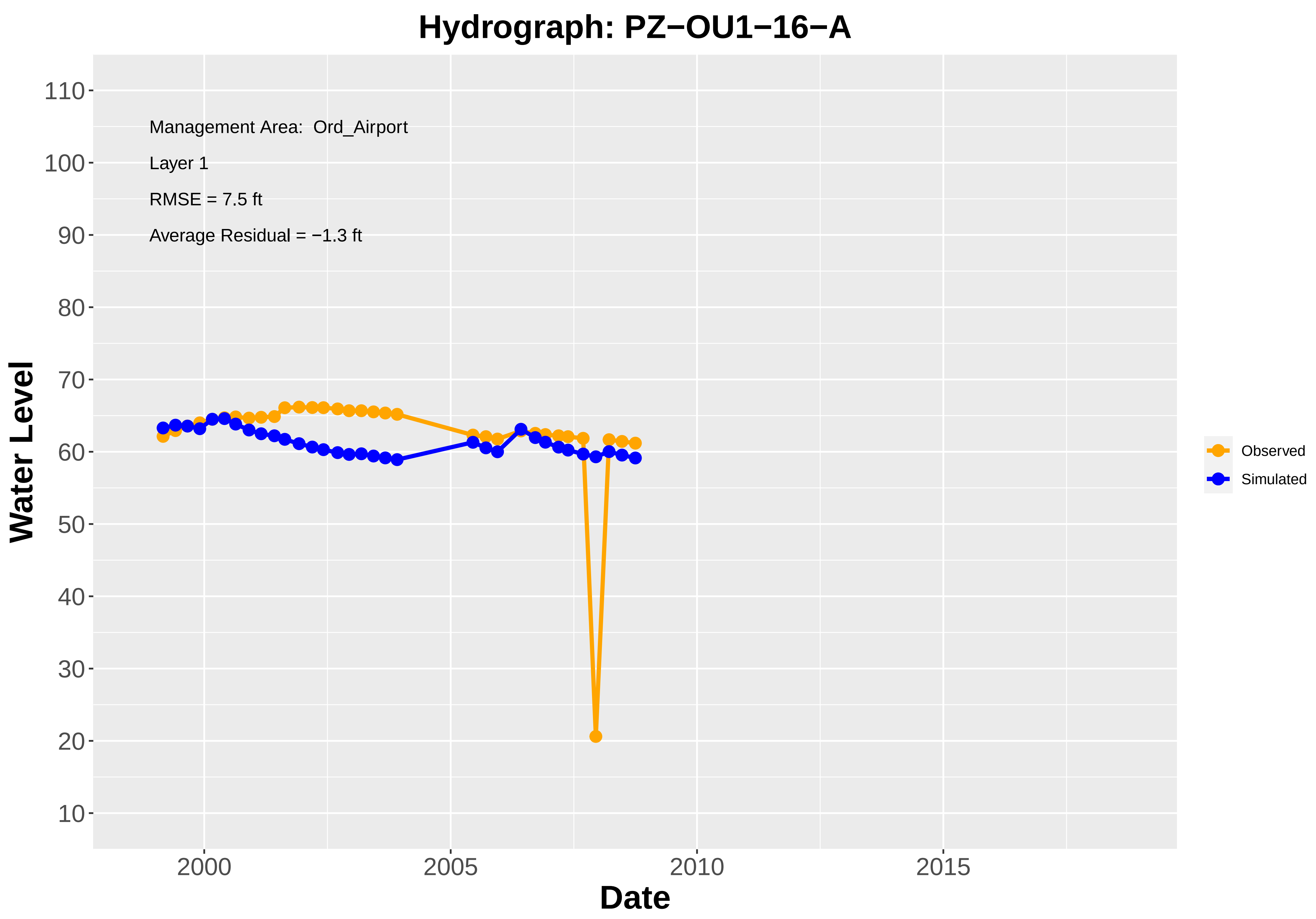
Hydrograph: PZ−OU1−13−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.4 ft
Average Residual = 3.7 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated

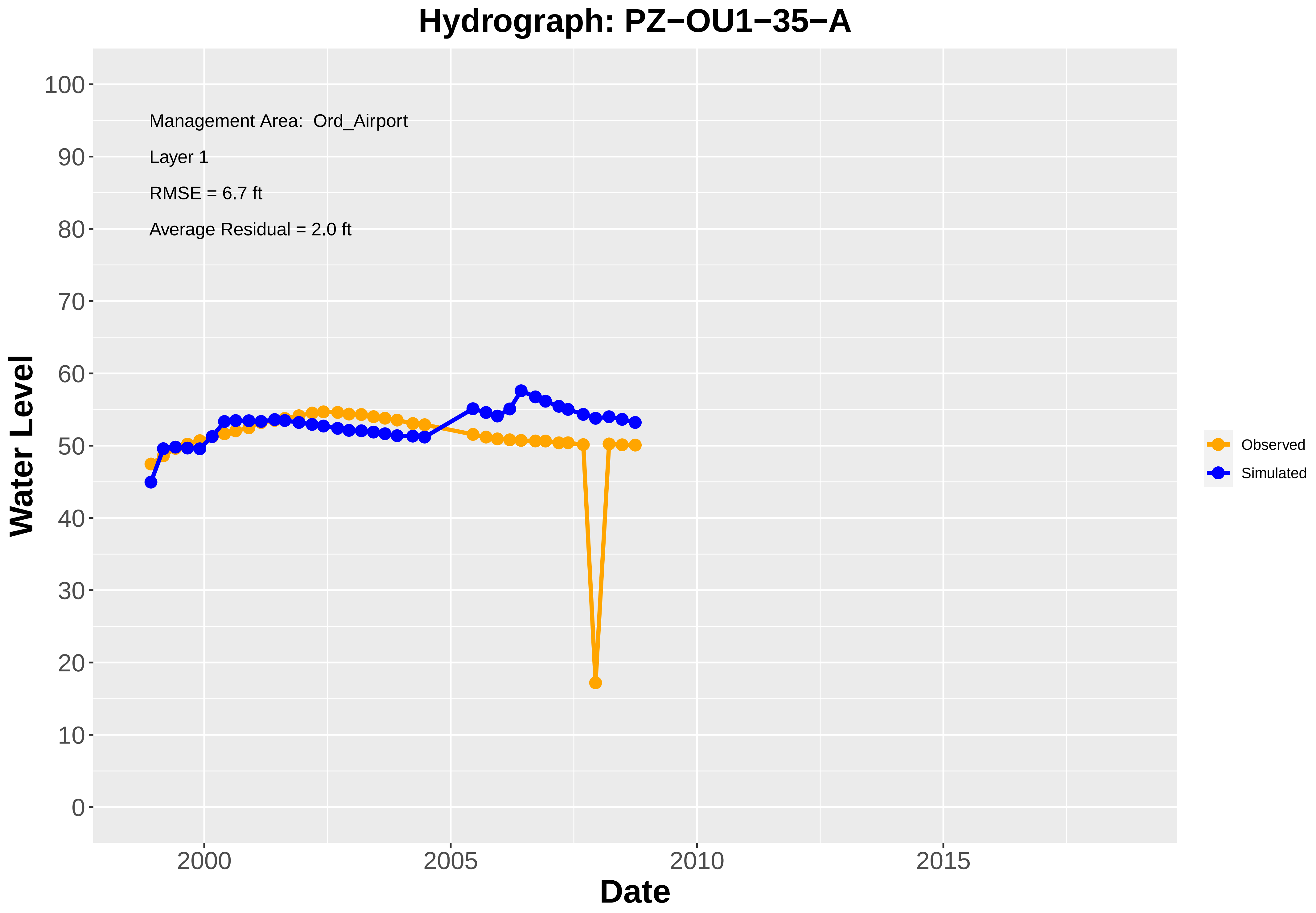


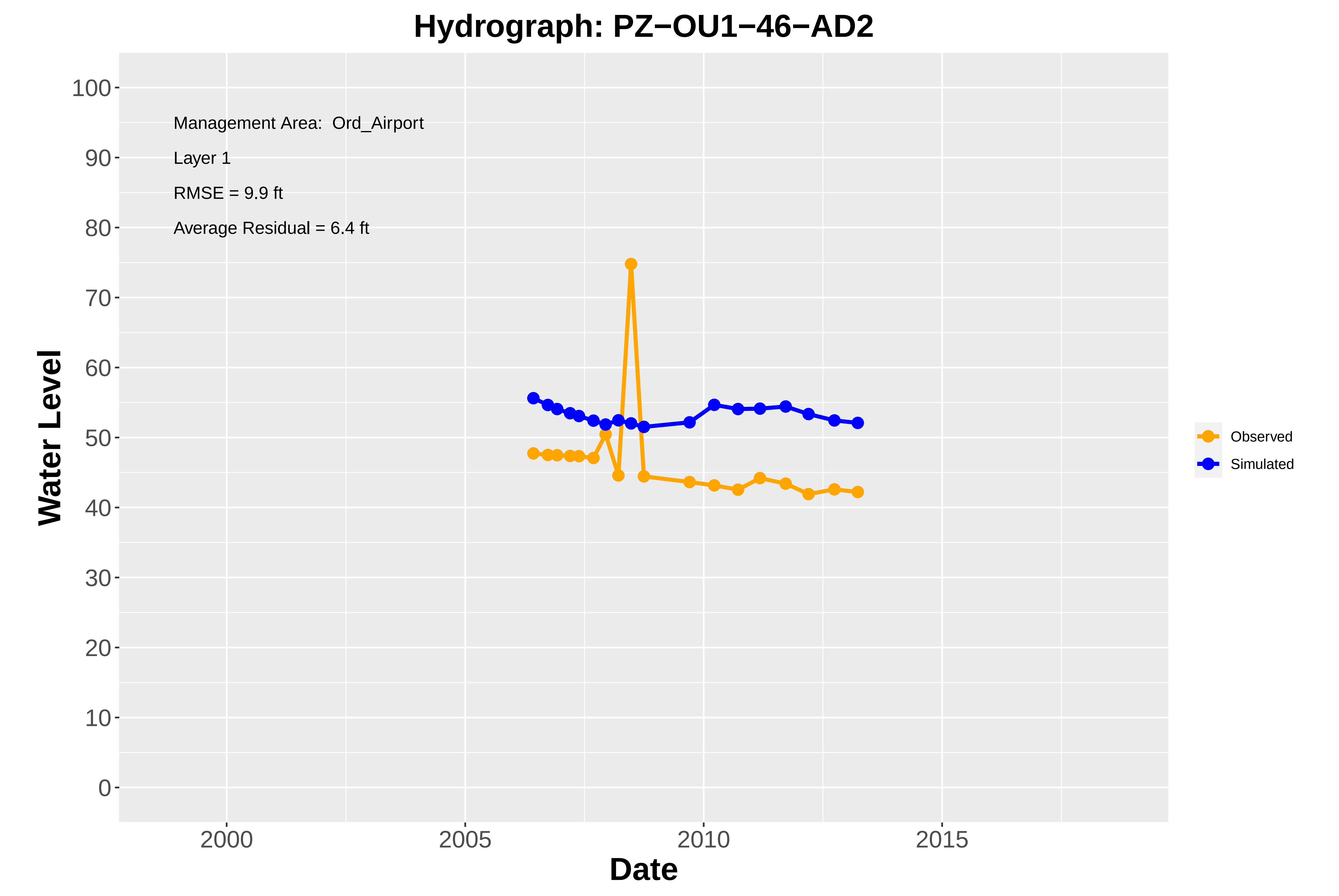
Hydrograph: PZ−OU1−14−A
Management Area: Ord_Airport
Layer 1
RMSE = 4.5 ft
Average Residual = 4.0 ft
Water Level
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Date
Observed
Simulated



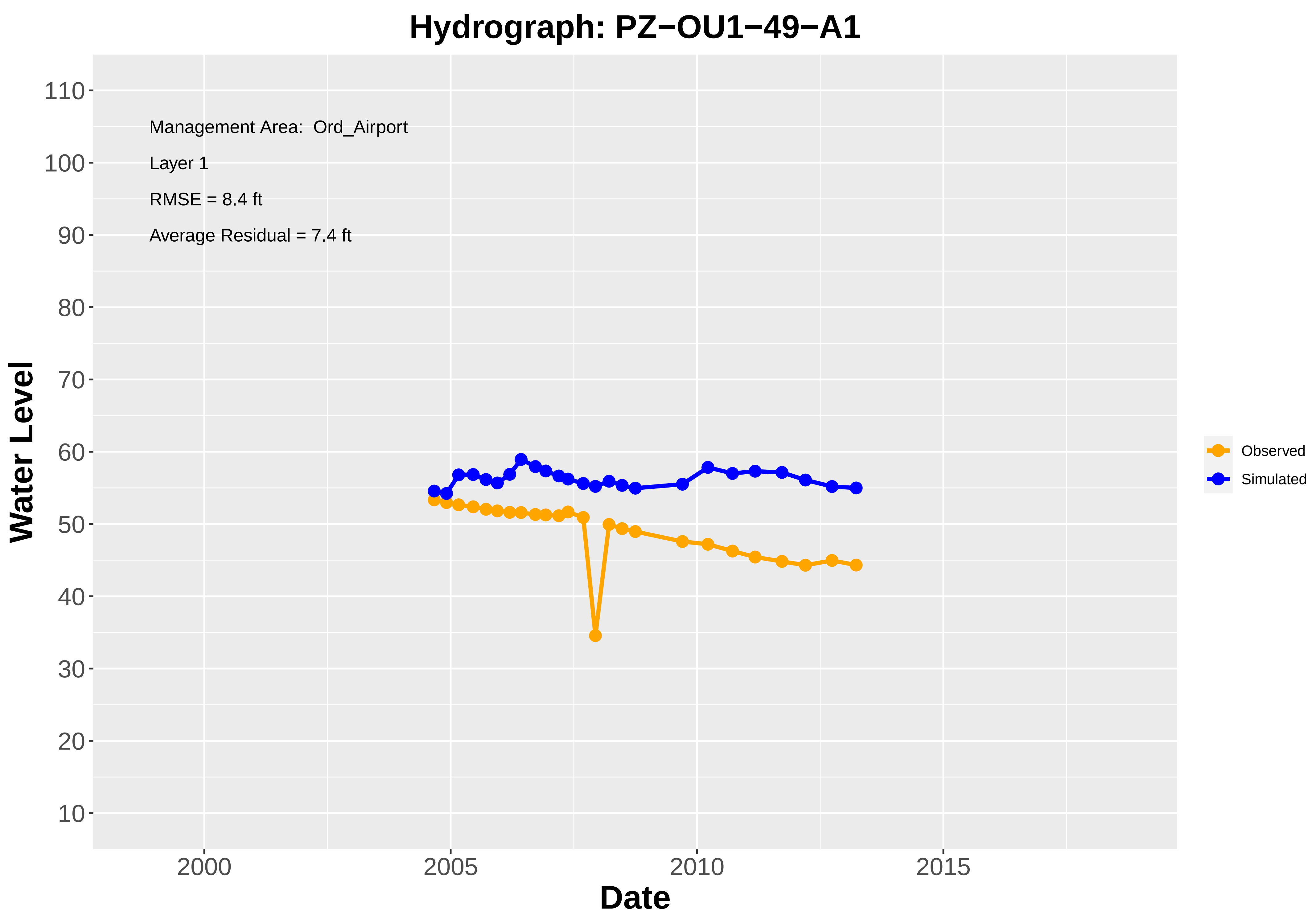
Hydrograph: PZ−OU1−15−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.6 ft
Average Residual = −1.6 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

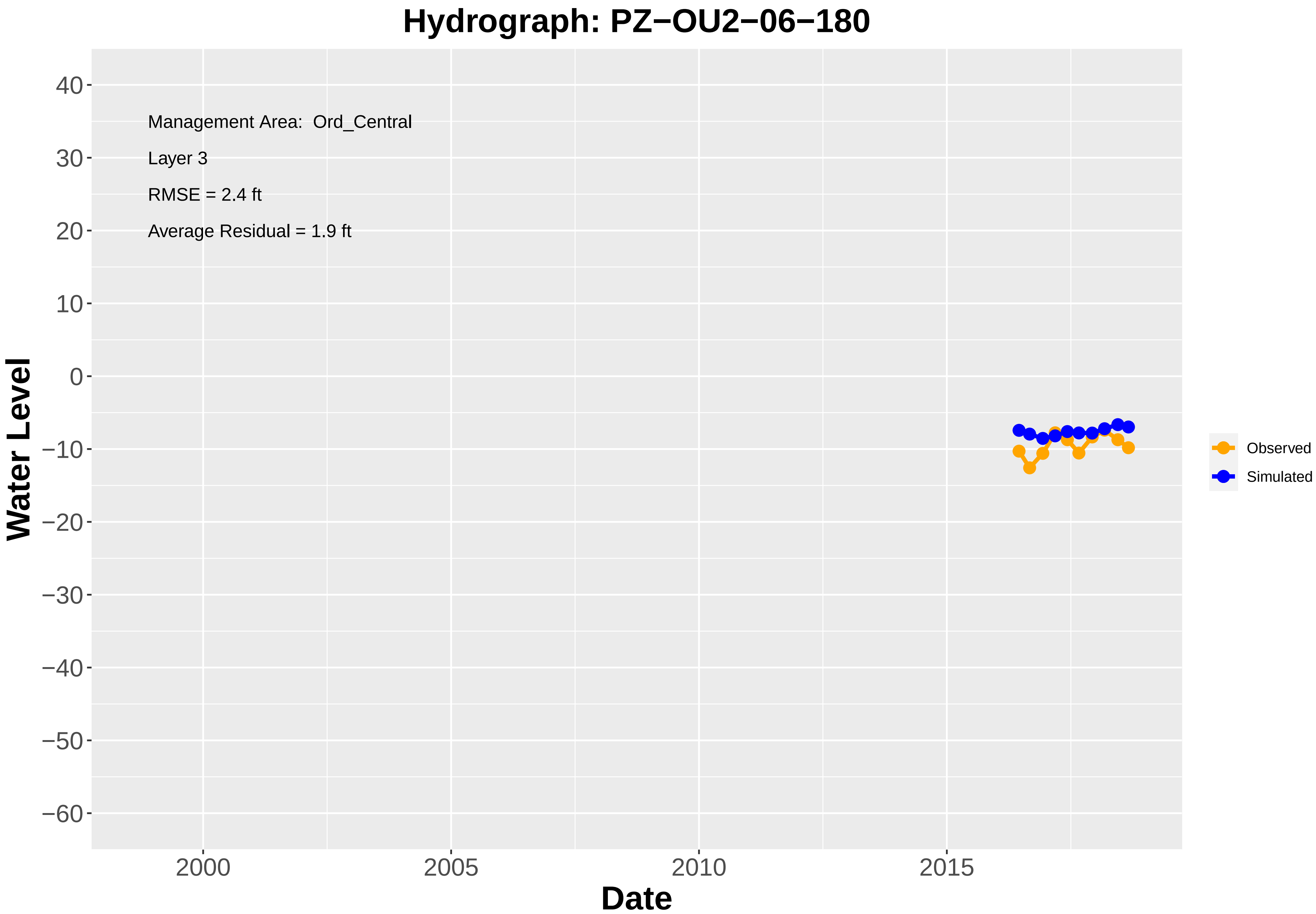

Hydrograph: PZ−OU1−16−A
Management Area: Ord_Airport
Layer 1
RMSE = 7.5 ft
Average Residual = −1.3 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated


Hydrograph: PZ−OU1−35−A
Management Area: Ord_Airport
Layer 1
RMSE = 6.7 ft
Average Residual = 2.0 ft
Water Level
Date
0
10
20
30
40
50
60
70
80
90
100
2000
2005
2010
2015
Observed
Simulated

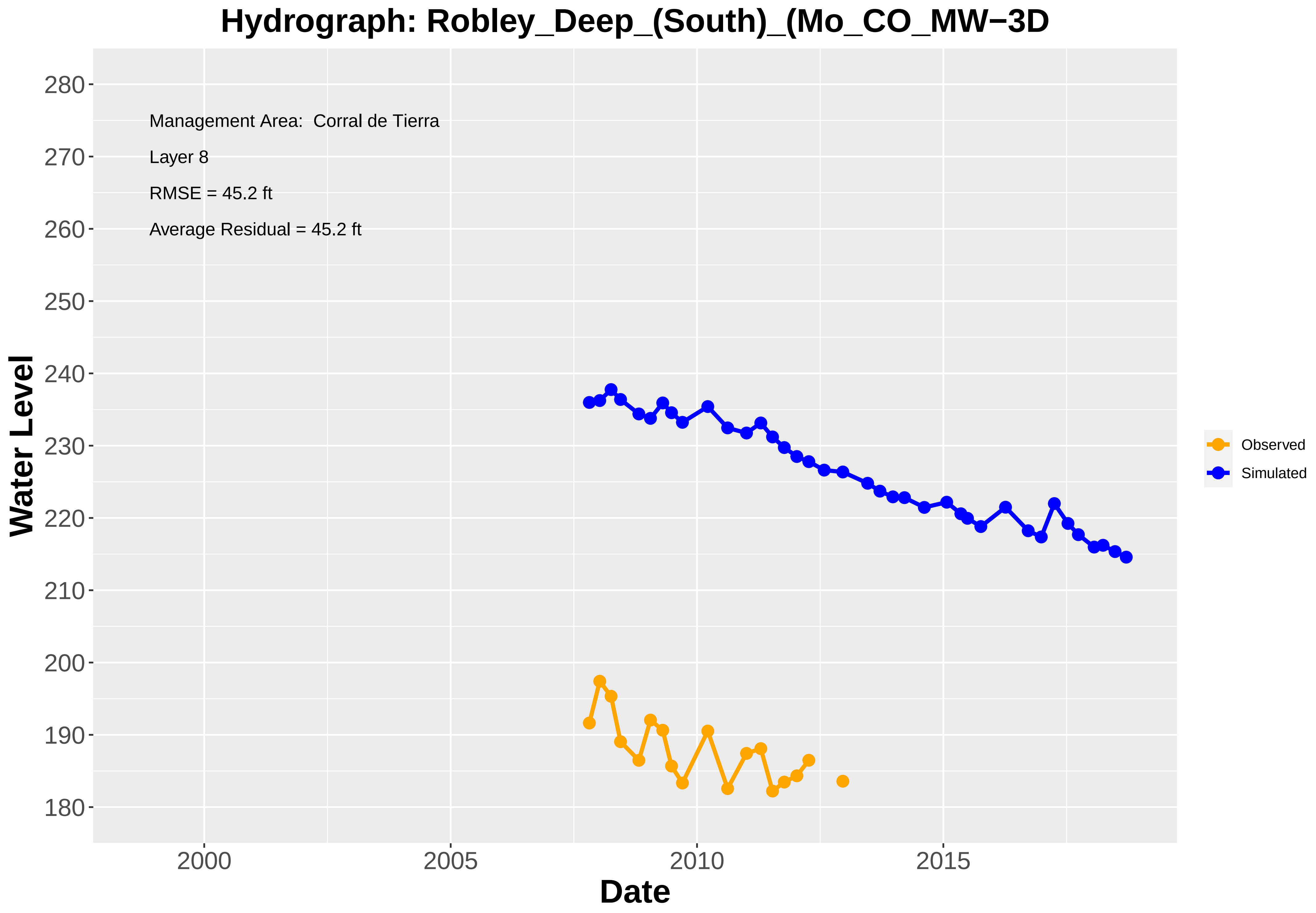


Hydrograph: PZ−OU1−46−AD2
Management Area: Ord_Airport
Layer 1
RMSE = 9.9 ft
Average Residual = 6.4 ft
Water Level
Date
100
90
80
70
60
50
40
30
20
10
0
2000
2005
2010
2015
Observed
Simulated

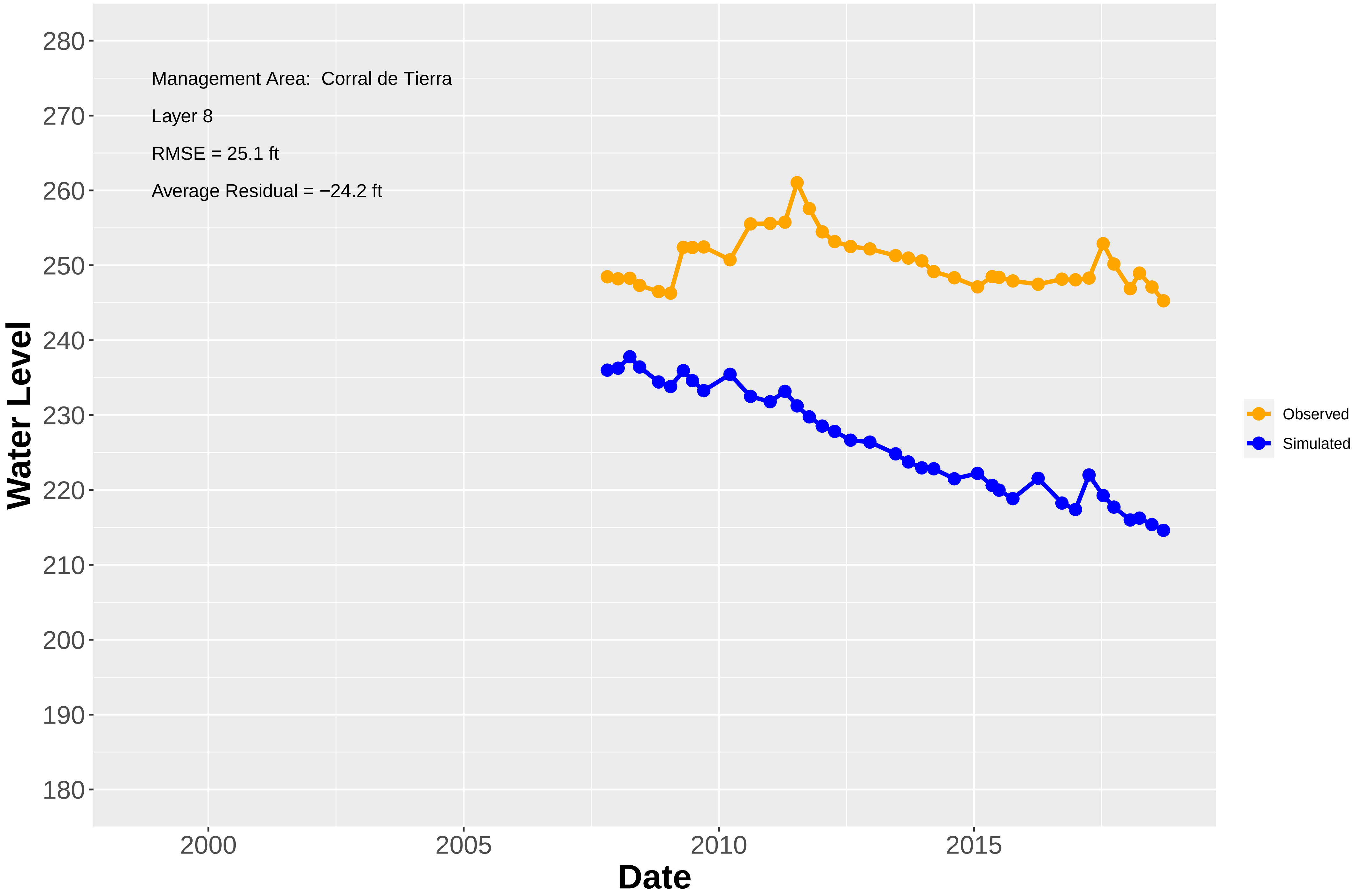

Hydrograph: PZ−OU1−49−A1
Management Area: Ord_Airport
Layer 1
RMSE = 8.4 ft
Average Residual = 7.4 ft
Water Level
Date
110
100
90
80
70
60
50
40
30
20
10
2000
2005
2010
2015
Observed
Simulated

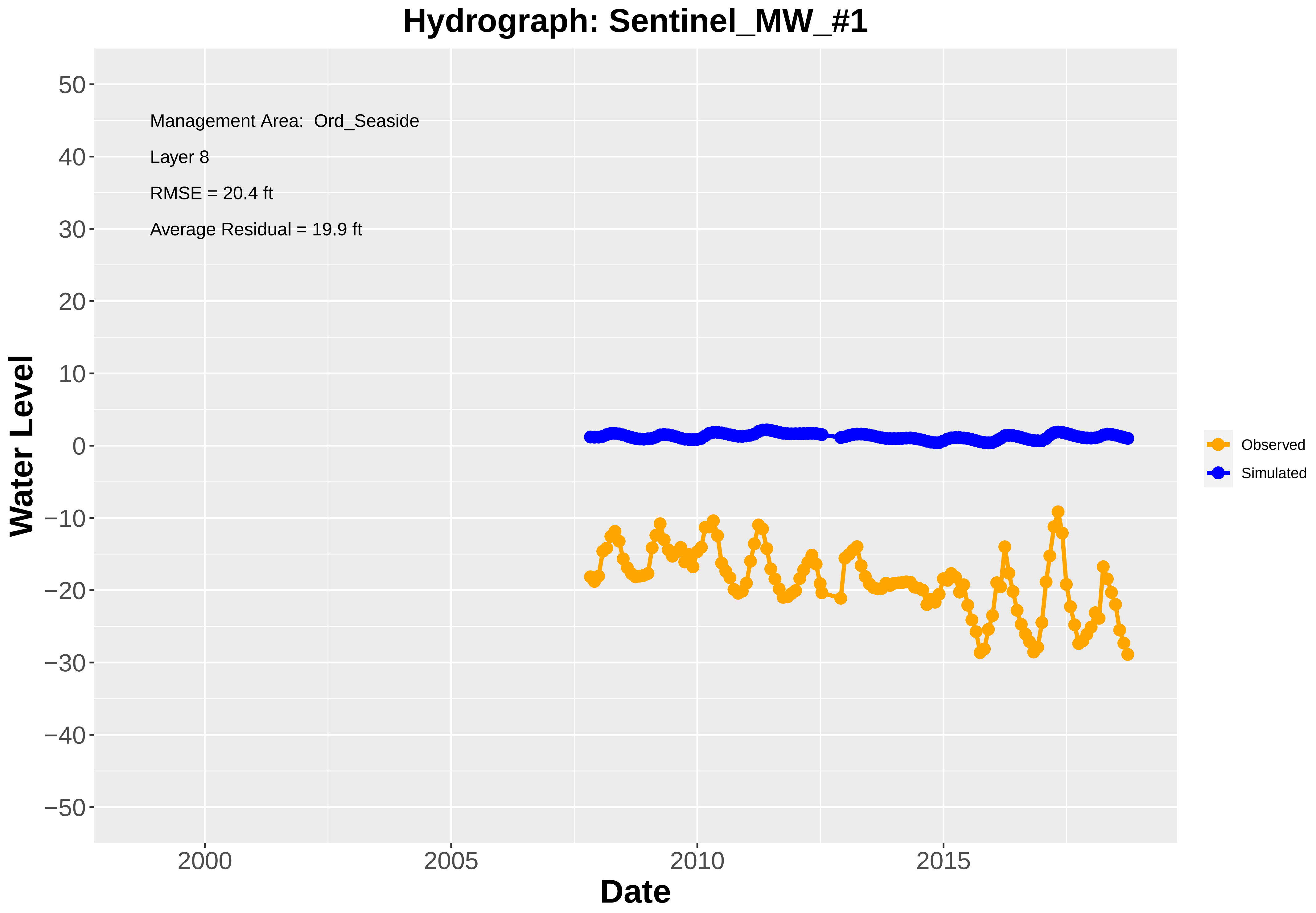


Hydrograph: PZ−OU2−06−180
Management Area: Ord_Central
Layer 3
RMSE = 2.4 ft
Average Residual = 1.9 ft
Water Level
Date
40
30
20
10
0
−10
−20
−30
−40
−50
−60
2000
2005
2010
2015
Observed
Simulated

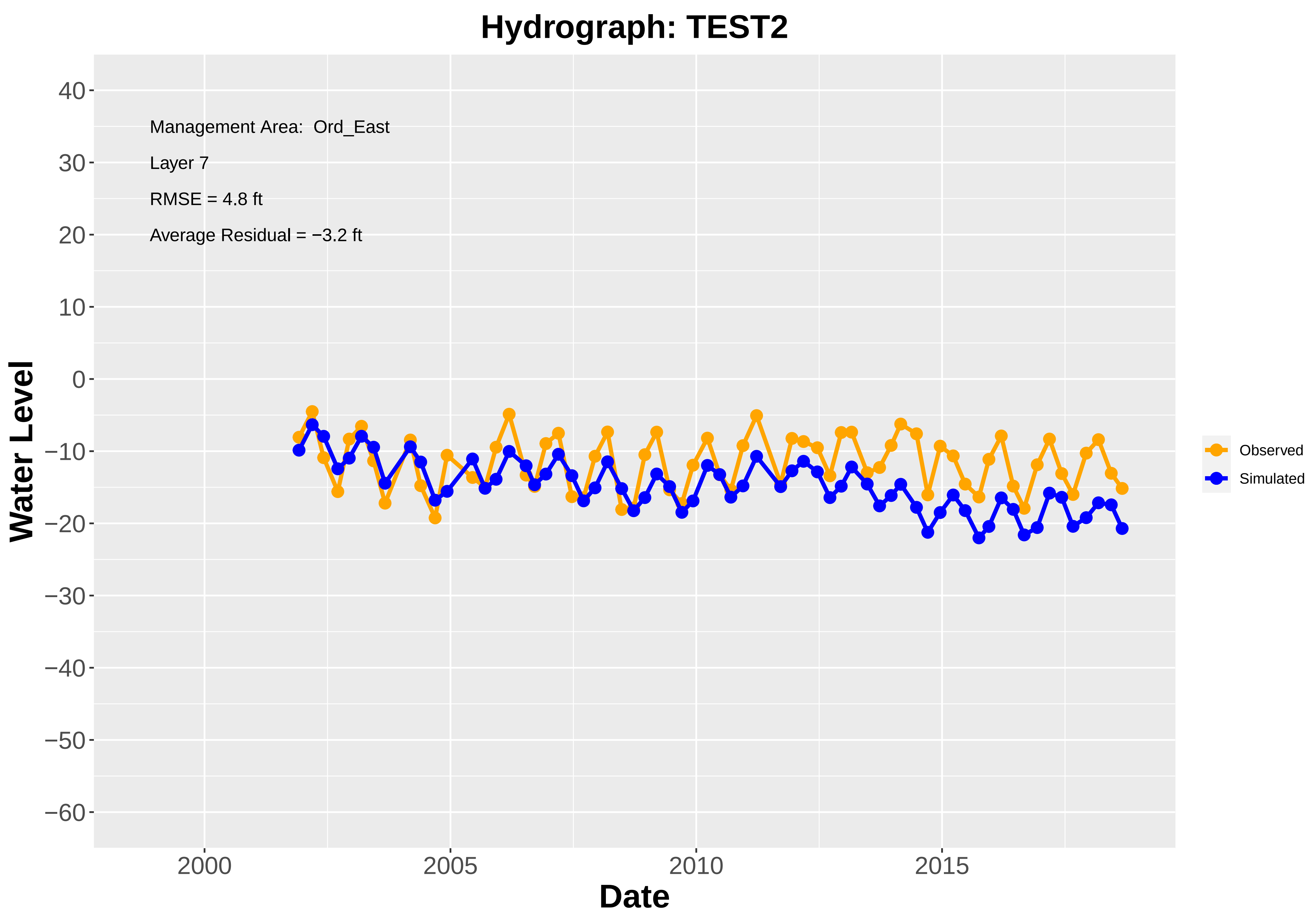

Hydrograph: Robley_Deep_(South)_(Mo_CO_MW−3D
Management Area: Corral de Tierra
Layer 8
RMSE = 45.2 ft
Average Residual = 45.2 ft
Water Level
280
270
260
250
240
230
220
210
200
190
180
2000
2005
2010
2015
Date
Observed
Simulated

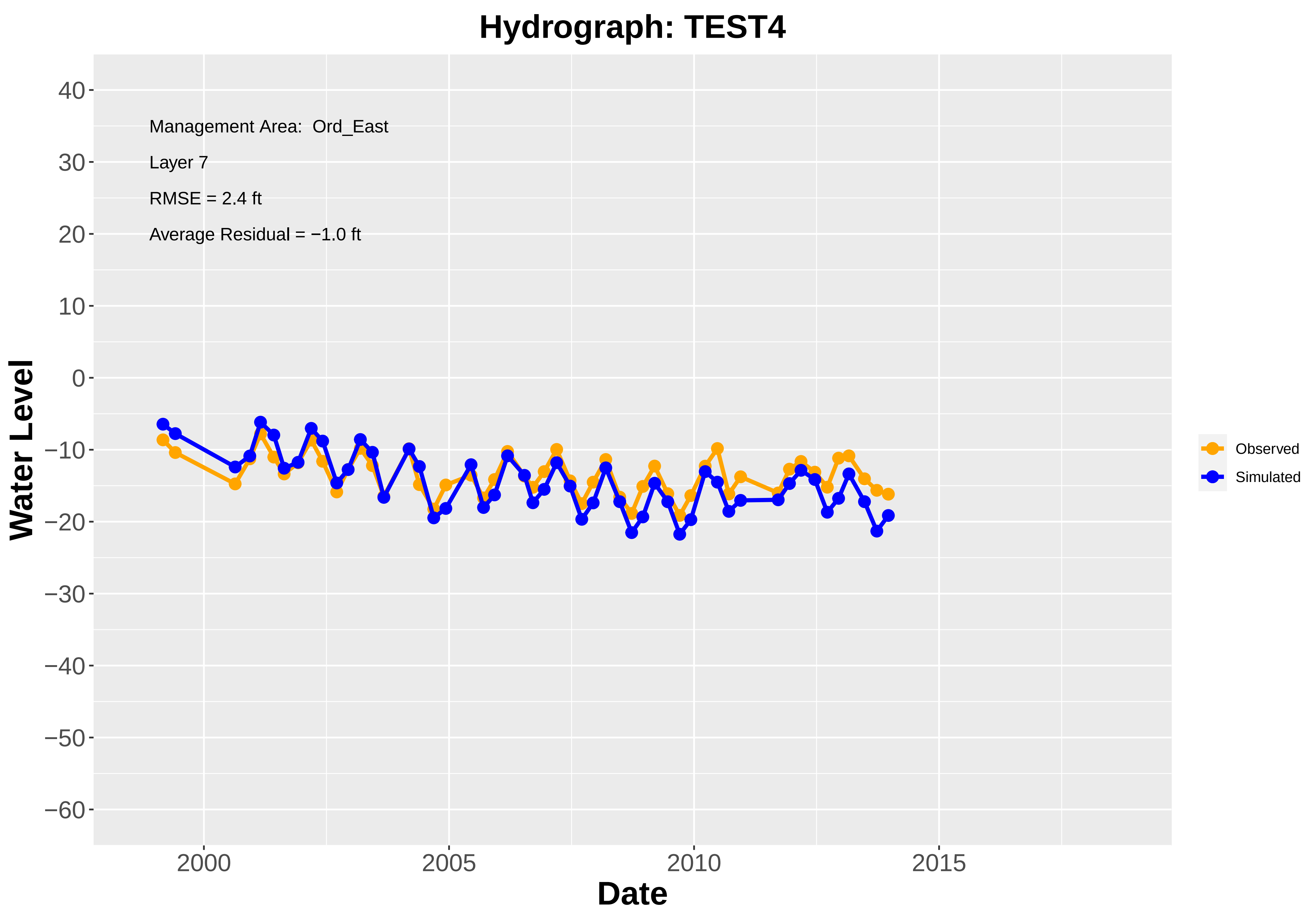
Hydrograph: Robley_Shallow_(North)_(Mo_Co_MW−3S)





Hydrograph: Sentinel_MW_#1
Management Area: Ord_Seaside
Layer 8
RMSE = 20.4 ft
Average Residual = 19.9 ft
Water Level
50
40
30
20
10
0
−10
−20
−30
−40
−50
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: TEST2
Management Area: Ord_East
Layer 7
RMSE = 4.8 ft
Average Residual = −3.2 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated


Hydrograph: TEST4
Management Area: Ord_East
Layer 7
RMSE = 2.4 ft
Average Residual = −1.0 ft
Water Level
40
30
20
10
0
−10
−20
−30
−40
−50
−60
Date
2000
2005
2010
2015
Observed
Simulated

Attachment 2. Soil Moisture Budget Accounting Model Documentation

SOIL MOISTURE BUDGET ACCOUNTING MODEL DOCUMENTATION

TABLE OF CONTENTS

1. INTRODUCTION

A Soil Moisture Budget (SMB) accounting model (SMB model) was developed to provide groundwater recharge estimates for use as input to the Monterey Subbasin Groundwater Flow Model (MBGWFM). This documentation presents a description of the hydrologic processes included in the SMB model along with the associated calculations/equations, the data requirements, the model calculations/equations, and the model execution process.

1.1 Purpose and Objectives of the Soil Moisture Budget Accounting Model

As described in detail in *Appendix 6-B* of the 2022 Monterey Subbasin Groundwater Sustainability Plan (GSP or Plan), the MBGWFM is a numerical model that calculates the movement of groundwater and surface water into, within, and out of the Monterey Subbasin (Basin) by discretizing the three-dimensional model domain horizontally into a grid of cells and vertically into eight layers. Like all groundwater models, the MBGWFM relies on various user-specified inputs related to aquifer hydraulic properties, initial conditions, and boundary conditions to represent the Basin and its transient hydrologic functioning. One of the main boundary condition inputs required for the MBGWFM is the aerial recharge rate to the Basin as a function of space (location) and time. The purpose of the SMB model described herein is to estimate spatiotemporal recharge rates and generate the associated input datasets for use in the MBGWFM.

1.2 SMB Model Background

1.2.1 Conceptual Approach

The SMB model uses mass-balance principles to quantify and track the movement of water that arrives at the land surface from either precipitation or irrigation into the subsurface or back into the atmosphere, based on the processes and spatially- and temporally variable factors that control recharge and groundwater pumping. The order of calculations is generally consistent with the sequence of hydrologic processes that govern this movement of water, as discussed further in *Section 2* below. At each stage in the calculation for a given time step, the volume of water in the system (consisting of soil moisture in the soil/root zone and canopy/depression storage) is balanced in accordance with the various inflows or outflows associated with the hydrologic process at that stage.

1.2.2 Spatial Approach

The SMB model performs calculations on a grid cell basis using the same spatial grid as the MBGWFM. Within each time step, calculations are performed for all active model grid cells simultaneously using vector operations. As discussed in greater detail in *Section 3* below, spatial properties assigned to grid cells vary depending on location (e.g., within a water service area), land use, and soil type characteristics. The model therefore provides spatially-variable recharge estimates that reflect variable land use, soil conditions, and imported water availability throughout the Basin. The SMB model also calculates spatially-variable private agricultural groundwater pumping demands based on evapotranspiration (ET), surface water deliveries, and irrigation efficiency, for use in calculating residual irrigation requirements and associated total applied water and recharge rates on agricultural lands.

1.2.3 Temporal Approach

The SMB model runs using a daily time step. As discussed in greater detail in *Section 3* below, the various transient input datasets vary in their temporal resolution (e.g., precipitation and potential evapotranspiration data is daily, whereas water deliveries data is monthly, and land use is held constant). The outputs from the model are monthly to be consistent with the stress periods of the MBGWFM. The decision to use a daily time step in the SMB model is driven largely by the need to incorporate the rainfall-runoff process which functions at a relatively high temporal frequency; use of a longer time step would obscure the high frequency behavior of the system.

1.2.4 Code Setup and Execution

The SMB model is written and run in the Octave programming language. During model execution, the model first reads in a set of user-prepared input datasets (discussed further in *Section 3* below) and sets up various variables and parameters. The model then runs through soil moisture budget accounting calculations for each time step in the specified simulation period. The calculations associated with each relevant hydrologic (or water movement) process are presented in *Section 2* below. In addition to the hydrologic processes described below, a set of "bookkeeping" calculations are performed at the start of each time step related to updating the various grid cell properties as needed. After the last time step is completed, the model performs final calculations to sum daily values into monthly values and writes the output data to files.

2. PROCESSES INCLUDED IN THE SMB MODEL

The water movement processes included in the SMB model are (1) precipitation, (2) interception, (3) evaporation from canopy and depression storage,(4) rainfall excess runoff, (5) applied water from District deliveries, (6) applied water from private pumping (deficit pumping), (7) ET by vegetation, (8) recharge, (9) saturation excess runoff, and (10) dynamic soil moisture storage. Each of these processes is described below along with the associated calculations/equations.

2.1 Precipitation

Precipitation is an input to the SMB model rather than a calculated variable. The precipitation data used in the SMB model is gridded daily precipitation from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) dataset developed by the Northwest Alliance for Computational Science and Engineering (NACSE) based at Oregon State University. The spatial resolution of the gridded precipitation data is 4 kilometers (km).

2.2 Interception

Interception occurs when rainfall is caught by the vegetation canopy (leaves, stems, etc.) before reaching the ground. Intercepted rainfall accumulates within the canopy storage and is then subject to evaporation. The similar process of depression storage, where water accumulates in depressions on the soil surface, is treated the same way as interception in the SMB model. The model uses a running canopy storage budget for each grid cell to track the accumulation and evaporation of intercepted rainfall and depression storage, collectively referred to as interception.

$$interception = \max\left(0\middle|\min(rainfall|stor\ cap_{canopy} + stor\ cap_{depr} - CS_0)\right) \quad (1)$$

where *stor cap*$_{canopy}$ and *stor cap*$_{depr}$ are the canopy storage capacity and depression storage capacity, respectively.

$$CS_1 = CS_0 + interception \quad (2)$$

where CS is the volume (depth) of canopy and depression storage and the subscripts indicate an order of calculation.

2.3 Evaporation from Canopy and Depression Storage

Evaporation from canopy and depression storage is the removal of water from the vegetation canopy and soil surface through the meteorological process of evaporation. The evaporated water is lost to the atmosphere. This evaporation does not go towards satisfying the vegetation's transpiration demand but does use a portion of the potential evapotranspiration available from meteorological conditions (i.e., temperature, humidity, windspeed, etc.).

$$AET_c = \min(PET|CS_1) \quad (3)$$

where AET_c is the actual evaporation from canopy and depression storage and PET is the potential evapotranspiration. For the MBGWFM SMB, all land use classes rely on California Irrigation Management Information System (CIMIS) reference evapotranspiration (ETo) data and the crop coefficient method to calculate PET, as further described in *Section 2.8* below.

$$CS_2 = CS_1 - AET_c \quad (4)$$

$$PET_{leftover} = PET - AET_c \quad (5)$$

$$rainfall_{leftover} = rainfall - interception \quad (6)$$

The subscript "leftover" indicates that portion of either rainfall or PET that is not yet used at this point in the SMB model calculation.

2.4 Rainfall-Excess Runoff

Precipitation in excess of interception reaches the land surface and under certain conditions can become runoff (i.e., overland surface flow). Rainfall-excess runoff occurs when the rate of precipitation exceeds the rate at which water can move downwards through the soil. In the SMB model, rainfall-excess runoff is estimated using the U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Curve Number approach. Under this approach, runoff is a function of rainfall amount and surface properties including the land cover type and soil hydrologic group.

$$S = \frac{1000}{CN} \quad (7)$$

$$S_{adj} = S * \left(1 - \max\left(0\middle|\frac{SM_1 - \left(\frac{FC+WP}{2}\right)}{SM_{sat} - \left(\frac{FC+WP}{2}\right)}\right)\right) \quad (8)$$

where S is the maximum retention, CN is the curve number (a function of land cover type and soil hydrologic group), FC is the field capacity and WP is the wilting point (both functions of soil type), SM is the soil moisture (inches) at that grid cell (a transient variable calculated by the model), and SM_{sat} is the soil moisture at saturation. Equation (8) essentially adjusts the S parameter for varying antecedent moisture conditions, and thus the "adj" subscript is applied.

$$Ia_{adj} = 0.2 * CN_{adj} \tag{9}$$

where Ia is the initial abstraction (initial loss).

For cells where $rainfall_{leftover} - Ia_{adj} > 0$ and $rainfall_{leftover} - Ia_{adj} - CN_{adj} > 0$

$$Runoff_{CN} = \frac{(rainfall_{leftover} - Ia_{adj})^2}{rainfall_{leftover} - Ia_{adj} - CN_{adj}} \tag{10}$$

$$rainfall_{leftover} = rainfall_{leftover} - Runoff_{CN} \tag{11}$$

where $Runoff_{CN}$ is the volume (depth) of rainfall-excess runoff via the Curve Number approach.

2.5 Applied Water from District Deliveries

District delivery records are used to estimate applied surface water[1] rates to lands within their respective water service areas within the Basin. Deliveries data were provided on a monthly basis and are therefore first normalized to a daily basis by dividing by the number of days in the month.

Within the Monterey Subbasin, all district deliveries are designated for urban use (i.e., there are no deliveries to agricultural customers). Historical distributions of indoor vs. outdoor urban water use were not available at a monthly resolution, and thus a few simplifying assumptions had to be made to parse District delivery records into their indoor and outdoor water use fractions using information obtained from the individual water agencies' Urban Water Management Plans (UWMPs). Ultimately, the applied surface water term ($SW_{applied}$) was calculated by multiplying total deliveries from each district by a user-specified fraction of outdoor water use:

$$SW_{applied} = Total\ Deliveries * Outdoor\ Water\ Use\ Fraction \tag{12}$$

The outdoor water use fraction was set at 25% for all water service areas within the Basin and was held constant throughout the simulation. Given that outdoor urban water use is generally limited to the summer months, applied surface water on urban lands was further constrained to only occur from April through September.

Monthly applied surface water volumes were distributed equally among all cells within each respective water service area.

[1] Not all District-delivered water is surface water; however, for purposes of this documentation, the term $SW_{applied}$ refers to all District-delivered water regardless of the actual source of the water.

2.6 Interim Calculations of Soil Moisture, Soil Water Content, Available Water, ET Stress Function, and Vegetative Water Demand

While not strictly a water movement or hydrologic process, the SMB model performs a set of interim calculations prior to the calculation of applied water from District deliveries. These interim calculations include updating soil moisture (SM), soil water content (SWC, expressed as a percentage of total soil volume), available water (AW), as follows:

$$SM_2 = SM_1 + rainfall_{leftover} + SW_{applied} \tag{13}$$

$$SWC_2 = \frac{SM_2}{rootdepth} \tag{14}$$

$$AW_2 = SWC_2 - WP \tag{15}$$

Calculation of an ET Stress Function ($ETSF$) allows for a reduction in vegetative water demand under dry soil conditions for the grid cells that are not irrigated up to full PET (i.e., the native and urban land cells).

$$ETSF = \max\left(0\middle|\min\left(1\middle|\frac{AW_2}{(FC-WP)*ETSF_{mult}}\right)\right) \tag{16}$$

where $ETSF_{mult}$ is the user-specified ETSF multiplier ($ETSF_{mult} = 0.5$ for the Monterey SMB).

As mentioned previously, the Vegetative Water Demand (VWD) is calculated using the crop coefficient method for all land use classes within the Basin. For agricultural land cells, VWD is calculated by multiplying the leftover PET by land use-specific crop coefficients:

$$VWD = PET_{leftover} * crop\ coeff \tag{17}$$

For urban and native land cells, VWD is further constrained by the ET Stress Function, as follows:

$$VWD = PET_{leftover} * crop\ coeff * ETSF \tag{18}$$

2.7 Applied Water from Private Groundwater Pumping

Private groundwater pumping on agricultural lands is estimated in the SMB model as the amount of residual water required to meet the vegetative water demand after accounting for leftover precipitation ($rainfall_{leftover}$) and applied surface water ($SW_{applied}$), adjusted for irrigation efficiency (IE):

$$pumping_{initial} = \max\left(0\middle|\left(\frac{VWD - rainfall_{leftover}}{IE}\right) - SW_{applied}\right) \tag{19}$$

Pumping can be limited by a user-defined pumping limit applied on a cell basis (allowing for pumping to be turned off, if needed for certain cases), as follows:

$$pumping = \min(pumping_{initial} | pumping\ limit) \tag{20}$$

The difference between the initial pumping estimate and the potentially limited pumping is tracked as a pumping deficit for later use in the actual soil/root zone ET calculation:

$$pumping_{deficit} = pumping_{init} - pumping \tag{21}$$

2.8 Evapotranspiration by Vegetation

As described above, the SMB model uses CIMIS ET and crop coefficients as the basis for PET for all lands within the Monterey Subbasin. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California, which provides reference evapotranspiration (ETo) values based on surface weather stations.

Actual ET from the root/soil zone is calculated differently for agricultural land cells than for urban and native land cells. For agricultural lands (including golf courses), the actual ET is equal to the full VWD and is satisfied by a combination of applied surface water and/or private pumping, minus pumping deficit due to pumping limits:

$$AET_s = \max(0|VWD) \tag{22}$$

For urban and native lands, the actual ET is the lesser of the VWD and the available moisture above the wilting point:

$$AET_s = \min\left(VWD\middle|SM_2 - (WP * root\ depth)\right) \tag{23}$$

For all grid cells, the soil moisture is updated at this point as follows:

$$SM_3 = SM_2 + pumping - AET_s \tag{24}$$

2.9 Aerial Recharge

Aerial recharge is the process of water movement below the bottom of the root zone where it then travels by gravity through the unsaturated zone to the saturated zone, adding to groundwater storage. Additional types of recharge such as stream recharge also occur and are accounted for in the MBGWFM separately from the aerial recharge calculated with the SMB model. Aerial recharge occurs when the soil moisture exceeds the field capacity of the soil, and continues until the soil moisture reaches field capacity. It is also subject to a maximum daily recharge limit.

$$recharge = \max\left(0\middle|\min\left(max\ daily\ recharge\middle|SM_3 - (FC * root\ depth)\right)\right) \tag{25}$$

Soil moisture is once again updated after recharge:

$$SM_4 = SM_3 - recharge \tag{26}$$

2.10 Saturation Excess Runoff

Saturation excess runoff occurs when the soil becomes completely saturated due to high rates of rainfall or applied water exceeding the rate at which recharge can drain water from the soil. This process is relatively common in areas with shallow water tables but is relatively rare in the Basin due to the thick unsaturated zones and relatively permeable soils.

$$Runoff_{SE} = max\left(0 \middle| SM_4 - (porosity * root\ depth)\right) \quad (27)$$

Soil moisture and soil water content are updated one final time:

If $Runoff_{SE} > 0$

$$SM_5 = porosity * root\ depth \quad (28)$$

If $Runoff_{SE} = 0$

$$SM_5 = SM_4 \quad (29)$$

$$SWC_5 = \frac{SM_5}{root\ depth} \quad (30)$$

2.11 Soil Moisture Storage

Soil moisture storage provides a short-term reservoir allowing for the relatively continuous outputs to evapotranspiration and transpiration from the discontinuous rainfall and applied water inputs. Soil moisture storage typically varies between field capacity, which is the maximum quantity of water that can be held in the soil against gravity, and wilting point that is the threshold under which vegetation cannot extract water further. During wet periods soil moisture may rise temporarily above field capacity. Soil moisture storage is a key component of the SMB model and is updated at several points during the calculation of each time step, per equations (13), (24), (26), and (29).

3. INPUT DATASETS

This section describes the input datasets used to develop and apply the SMB model for the MBGWFM. These datasets provide the spatial and temporal information on factors that control the movement of water through the SMB model.

3.1 Grid Data

The following attributes are assigned by the SMB model to grid cells, based on input datasets that were developed using a combination of Geographic Information System (GIS) and spreadsheet analysis.

- Active cell: flag specifying whether the grid cell is active (i.e., in the MBGWFM) or inactive
- Grid area: specifies the area of the grid cell (in square feet)
- Soil code: code corresponding to the soil map unit key; soils data were obtained from the United States Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO)[2]
- District: location within a water service area (if any), based on the boundaries for the five water service areas within the Basin, including MCWD, CalAm (Ambler, Hidden Hills and Toro Units) and California Water Service (CWS)

[2] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_053627

- Land use (static): based on land use information obtained from the U.S. Department of Agriculture (USDA) Forest Service Region 5 Classification and Assessment with Landsat of Visible Ecological Groupings (CalVeg) dataset for Zone 5 (Central Valley)[3] and from various historical and projected land use surveys conducted by MCWD
- PRISM cell identifier: 4-kilometer PRISM cell identifier for use in linking SMB grid cells to PRISM[4] precipitation data (below)

3.2 Climate Data

The following datasets are used to define the climate characteristics for the SMB model period.

- CIMIS ETo: Daily ETo data from the CIMIS Salinas North #116 and Laguna Seca #229 stations
- PRISM precipitation: gridded daily precipitation data from the PRISM dataset.

3.3 Deliveries Data

Monthly surface water delivery data from the five water agencies within the Basin (MCWD, CWS, Cal Am Ambler, Hidden Hills, and Toro Units) is used to inform applied surface water volumes in each respective water service area

3.4 Other Data

Several other datasets are used as input including the following:

- Soil characteristics: based on SSURGO soils data (see above)
- Curve Number: by land use class and hydrologic soil group, from the USDA (*USDA, 1986*)
- Canopy Storage: from California Polytechnic State University's Irrigation Training and Research Center (*Howes et al., 2015*)
- Stress periods: corresponding to the month and year of the historical simulation

3.5 User-Specified Parameters

In addition to the spatial and temporal datasets described above, the SMB model uses several parameters to modify certain inputs or calculations for purposes of model calibration.

- Depression storage capacity: set at 0.33 inches;
- ETSF multiplier: set at 0.5;
- Irrigation efficiency: set at 85%
- Outdoor water use fraction: set at 25%; only applied from April - September

[3] https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192
[4] https://prism.oregonstate.edu/recent/

4. REFERENCES

AKEL Engineering Group, 2020. Marina Coast Water District Water Master Plan, dated May 2020.

Howes, D.J, Fox, P., & Hutton, P. H., 2015. Evapotranspiration from Natural Vegetation in the Central Valley of California: Monthly Grass Reference-Based Vegetation Coefficients and the Dual Crop Coefficient Approach. *J. Hydrologic Engineering,* Vol. 20 Issue 10, dated 20 January 2015. https://doi.org/10.1061/(ASCE)HE.1943-5584.0001162

MCWRA; LSCE, 2006. Monterey County Groundwater Management Plan, dated May 2006.

PRISM, 2019. Descriptions of PRISM Spatial Climate Datasets for the Conterminous United States. Last revised October 2019.

Schaaf & Wheeler, 2021. Marina Coast Water District 2020 Urban Water Management Plan, dated May 2021.

USDA, 1986. Urban Hydrology for Small Watersheds. *TR-55*, dated June 1986.

Wallace Group, 2020. Corral de Tierra Subarea Water and Wastewater Usage Analysis, dated 30 October 2020.

Appendix 6-C

Technical Memorandum: Monterey Subbasin Modeling, dated April 2, 2021

MONTGOMERY
& ASSOCIATES
Water Resource Consultants

Groundwater experts since 1984

TECHNICAL MEMORANDUM

DATE: April 2, 2021 PROJECT #: 9100

TO: SVBGSA Advisory Committee

CC: Donna Meyers

FROM: Abby Ostovar, Greg Nelson, Staffan Schorr, and Derrik Williams

SUBJECT: Monterey Subbasin Modeling

INTRODUCTION

Two groundwater models have been developed that encompass the Monterey Subbasin, and which could potentially be used to prepare the Monterey Subbasin Groundwater Sustainability Plan (GSP). These models include:

- The **Salinas Valley Integrated Hydrologic Model (SVIHM)** developed by the U.S. Geological Survey (USGS)), including its future version, the Salinas Valley Operational Model, or SVOM, which encompass the entire Salinas Valley Groundwater Basin; and
- The **Monterey Subbasin Model** developed by Marina Coast Water District Groundwater Sustainability Agency's (MCWD GSA) consultant EKI Environment & Water, Inc. (EKI), which encompasses the Monterey Subbasin and incorporates observed boundary conditions with the adjoining Seaside Subbasin and the 180/400 Foot Aquifer Subbasin.

SVBGSA recently obtained the SVIHM, and Montgomery & Associates (M&A) has been reviewing the SVIHM and developing water budgets based on model results. M&A's review suggests that the SVIHM does not accurately reflect hydrologic conditions in the Monterey Subbasin. SVIHM calibration efforts primarily focus on other portions of the Salinas Valley Groundwater Basin where there is significant agricultural groundwater use. The SVIHM was not calibrated to any groundwater level data from the Seaside Subbasin and included only one calibration location in the Monterey Subbasin. M&A believes the SVIHM is not detailed or accurate in the Monterey Subbasin.

The Monterey Subbasin Model focuses on conditions within the Monterey Subbasin and has incorporated over 30,000 water level measurements from the Monterey Subbasin in its calibration. It also incorporates water level data from the 180/400-Foot Aquifer Subbasin and Seaside Subbasin to establish transient boundary conditions and account for conditions in these adjoining subbasins. EKI has worked closely with M&A to incorporate feedback regarding conditions in the Corral de Tierra area and the 180/400-Foot Aquifer Subbasin.

Due to the limitations of the SVHIM in its representation of the Monterey Subbasin and the more robust calibration of the Monterey Subbasin Model for this subbasin, SVBGSA and MCWD GSA plan to use the Monterey Subbasin Model for developing the Monterey Subbasin GSP. The Monterey Subbasin Model will also form the basis for the seawater intrusion model that SVBGSA has received grant funding to develop for the Monterey Subbasin.

MODELING COLLABORATION

EKI and M&A began collaborating on modeling while developing the SGMA Round 3 Planning Grant application for the Monterey Subbasin. Based on this application, MCWD received grant funds to develop the Monterey Subbasin Model, and SVBGSA received grant funds to develop a seawater intrusion model for the Monterey Subbasin.

EKI engaged M&A during the Monterey Subbasin Model development process to review the model's layering and structure, connectivity of the aquifers, input data such as historical groundwater elevations and extractions, boundary conditions with adjacent subbasins, and calibration. EKI and M&A will continue to collaborate in the interpretation of model results.

M&A will use the Monterey Subbasin Model as the basis for the seawater intrusion model for the Monterey Subbasin. Aquifer layers in the Monterey Subbasin Model will be extended north into the 180/400 Aquifer Subbasin in a manner that is consistent with SVIHM layering and incorporate boundary conditions and flows from the SVIHM. Development of the seawater intrusion model will begin upon completion and calibration of the Monterey Subbasin Model.

Since these are grant funded, no additional funding is needed for the modeling other than consultant staff time, and both agencies will have access to both models. SVBGSA and MCWD have a collaborative working relationship.

MODEL COMPARISON

M&A has been reviewing and interrogating the SVIHM model. The SVIHM was provided in a provisional and preliminary status, meaning that the USGS can, and likely will, update and change the model prior to its release to the public. The Monterey Subbasin and Seaside Subbasin are included in the SVIHM; however, model development and calibration in these subbasins appears not to have been performed to the same degree as other areas of the Model. For example, the SVIHM did not include any water level calibration points in the Seaside Subbasin and only one calibration location in the Monterey Subbasin.

Model calibration is an assessment of how a model simulates observed historical conditions. Generally, a model's calibration is evaluated through calibration statistics – comparing simulated groundwater elevations to measured groundwater elevation data. One commonly used statistic is known as the scaled root mean squared residual of the error between simulated water levels and observed water levels. A general rule of thumb in assessing model calibration is that the model is considered adequately calibrated when the scaled root mean squared error is less than 10%. The basin-wide statistics of the SVIHM meet these criteria (see Attachment A).

In the Monterey Subbasin, the SVIHM includes only one location containing calibration data; and an assessment of the Subbasin calibration cannot be adequately performed using the limited measurements from only this one data location. To check the accuracy of the SVIHM in the Subbasin, M&A compared simulated groundwater elevations from the SVIHM to an additional 4,555 observed water levels from 55 locations in the Monterey Subbasin. With the additional data. The root mean squared error of the residuals is over 7%, which indicates reasonable calibration (see Attachment B).

However, comparing simulated and observed hydrographs across the Subbasin shows that the model results do not match measured data in many areas: particularly in the Corral De Tierra. Some hydrographs have opposite trends, indicating the model is not adequately calibrated in this area. Attachment C includes some example hydrographs that illustrate certain wells with inadequate calibration. Measured data on these hydrographs are shown with black dots, and simulated data are shown with blue lines. The clear difference between measured and simulated trends on these plots results in poor confidence in the model's ability to simulate at least parts of the Monterey Subbasin. This poor confidence only applies to the Monterey Subbasin; much of the rest of the model is well calibrated.

In the Corral de Tierra area, only the bottom three layers of the SVIHM are active. These three layers represent the bedrock (bottom layer) and part of the El Toro Primary Aquifer System (other two active layers). This model configuration raises concerns over the adequacy of hydrogeologic representation of the Corral de Tierra area.

In contrast to the SVIHM, the Monterey Subbasin Model being developed by EKI currently has a root mean squared error residual of less than 2% (Attachment D). Calibration of the Monterey Subbasin model is ongoing, and all results are still preliminary. The Monterey Subbasin Model also has more detailed and more accurate representation of the hydrogeology in the Corral de Tierra area, which was developed incorporating input from M&A. EKI has also included additional groundwater level data for calibration throughout the Monterey Subbasin, totaling 30,555 observations from 608 wells. Thus, because of the more accurate calibration and hydrogeologic representation of the Monterey Subbasin within the Monterey Subbasin Model, SVBGSA plans to use the Monterey Subbasin Model for the development of the Monterey Subbasin GSP.

MODEL COMPATIBILITY

To assess model compatibility, EKI and M&A have been collaborating on modeling and most recently have compared information from the Monterey Subbasin Model and the SVIHM. This includes analyzing conditions along the boundary of the 180/400-Foot Aquifer Subbasin and beneath the Salinas River. Groundwater levels along this boundary are being compared to ensure the two models are compatible and simulate this boundary comparably. Model layering and hydrogeologic representation have also been reviewed and appear to reasonably match. In some areas, the Monterey Subbasin Model has greater vertical resolution with more refined aquifer layers. In general, however, the Monterey Subbasin Model layer is compatible with the SVIHM layering.

In the future, when the SVIHM becomes public, the information from the Monterey Subbasin Model could be incorporated into the SVIHM. Additionally, SVBGSA could expand the seawater intrusion model into the 180/400-Foot Aquifer Subbasin by incorporating SVIHM parameters so that it can model the impacts of valley-wide projects on seawater intrusion.

CONCLUSION

A detailed description of the Monterey Subbasin Model will be included as an appendix to the Monterey Subbasin GSP, which will be made available for public review and comment. In addition, the Monterey Subbasin Model will be submitted to the California Department of Water Resources as part of the GSP. It will be available for future use by the USGS and others as part of basin-wide modeling efforts.

All groundwater models are tools to help understand groundwater conditions and how factors may change groundwater conditions. Given the complexity of groundwater interactions, models provide the best tool for understanding of these interactions and their effects. Exact numbers will change as the Model is refined and updated; however, it will not likely change the direction and approach of groundwater management.

Attachments:

Attachment A: SVIHM Calibration Statistics for entire Salinas Valley Groundwater Basin

Attachment B: SVIHM Calibration Statistics for Monterey Subbasin (with added water level observations)

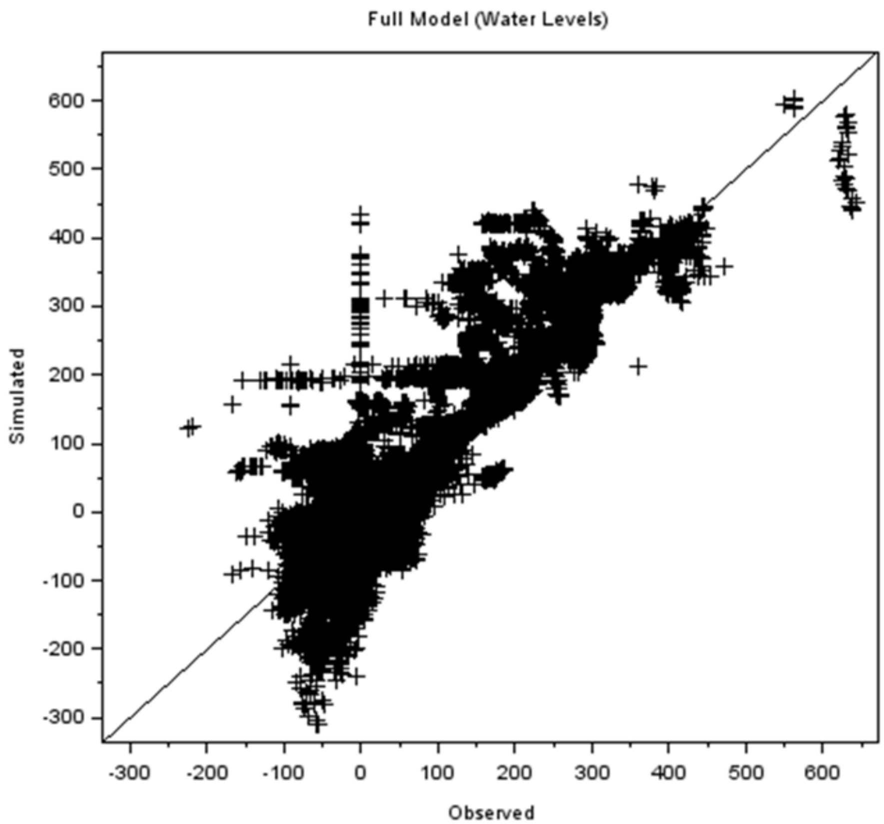
Attachment C: Measured and SVIHM Simulated Hydrographs for Monterey Subbasin

Attachment D: Monterey Subbasin Model Preliminary Calibration Statistics (as of 3/29/2021)

SVIHM Note:

This data (model and/or model results) are preliminary or provisional and are subject to revision. This model and model results are being provided to meet the need for timely best science. The model has not received final approval by the U.S. Geological Survey (USGS). No warranty, expressed or implied, is made by the USGS or the U.S. Government as to the functionality of the model and related material nor shall the fact of release constitute any such warranty. The model is provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the model.

ATTACHMENT A
SVIHM CALIBRATION STATISTICS FOR ENTIRE SALINAS VALLEY GROUNDWATER BASIN



Number of Values: 52719

Mean Residual: 1.811

Mean Absolute Residual: 36.33

Root-Mean-Squared-Residual: 53.01

Residual Standard Deviation: 52.98

Range in Observations: 868

Scaled Mean Residual [%]: 0.21

Scaled Mean Absolute Residual [%]: 4.19

Scale Root-Mean-Squared-Residual [%]: 6.11

Scaled Residual Standard Deviation [%]: 6.1

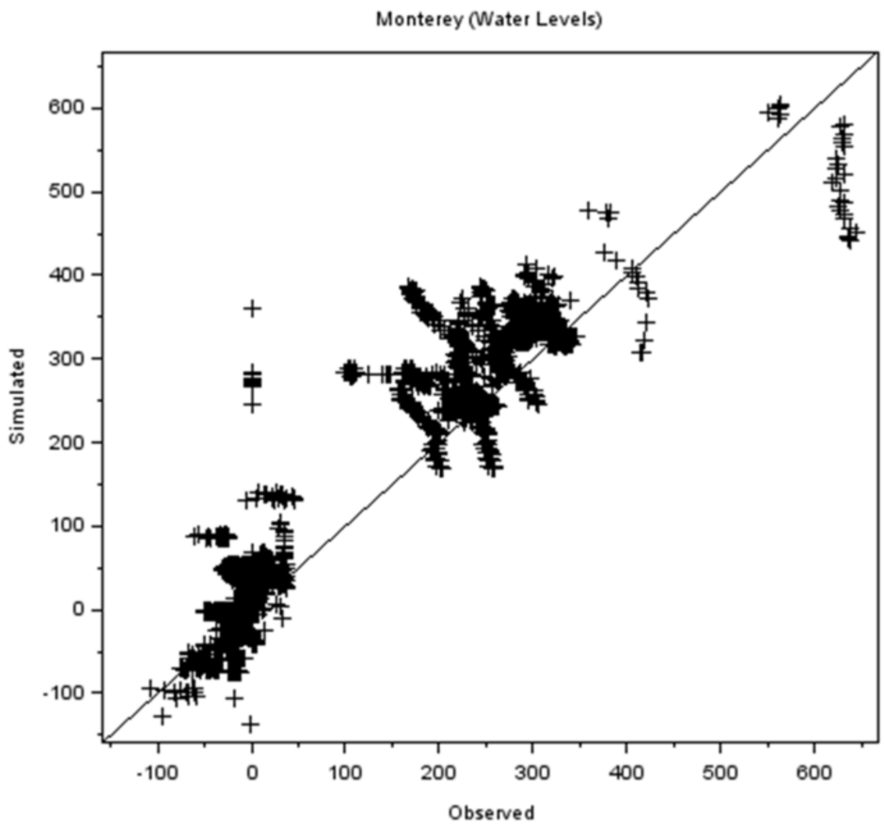
Coefficient of Determination (R^2): 0.837

Note: All reported statistics are in feet unless otherwise noted.

All model results are provisional and subject to revision.

ATTACHMENT B

SVIHM CALIBRATION STATISTICS FOR MONTEREY SUBBASIN (WITH ADDED WATER LEVEL OBSERVATIONS)



Number of Values: 4555

Mean Residual: -30.102

Mean Absolute Residual: 40

Root-Mean-Squared-Residual: 55.12

Residual Standard Deviation: 46.18

Range in Observations: 751

Scaled Mean Residual [%]: -4.01

Scaled Mean Absolute Residual [%]: 5.33

Scale Root-Mean-Squared-Residual [%]: 7.34

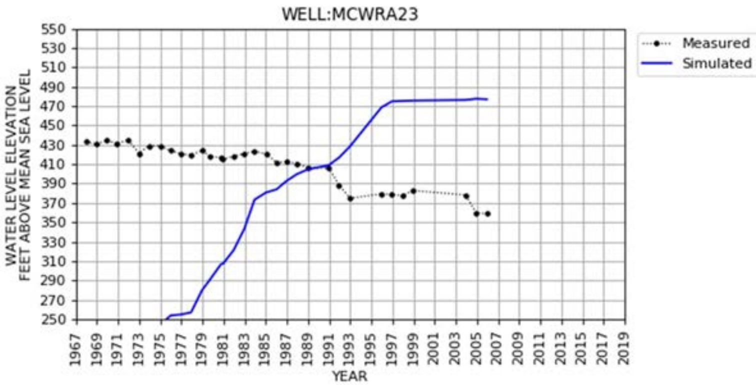
Scaled Residual Standard Deviation [%]: 6.15

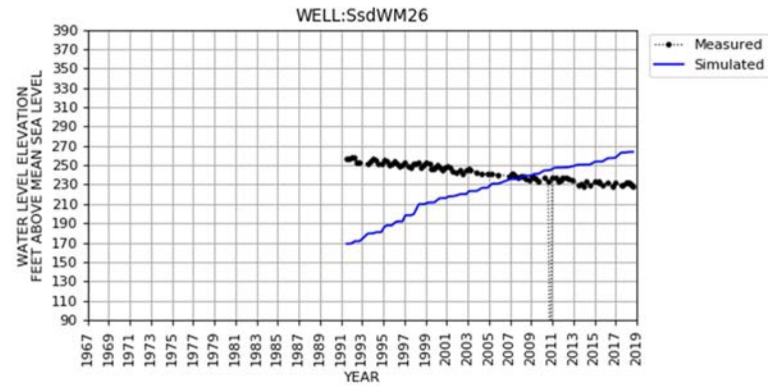
Coefficient of Determination (R^2): 0.865

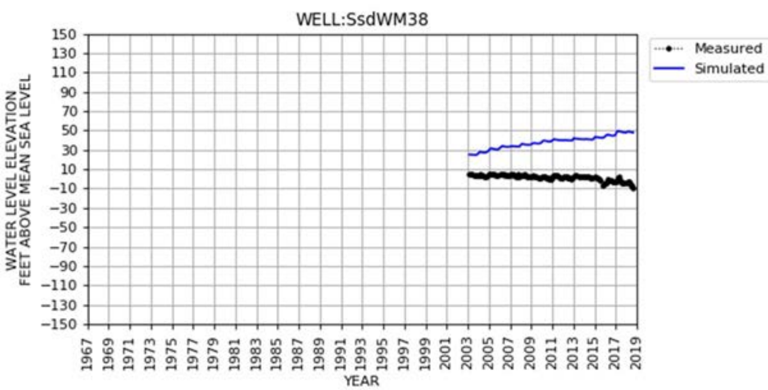
Note: All reported statistics are in feet unless otherwise noted.

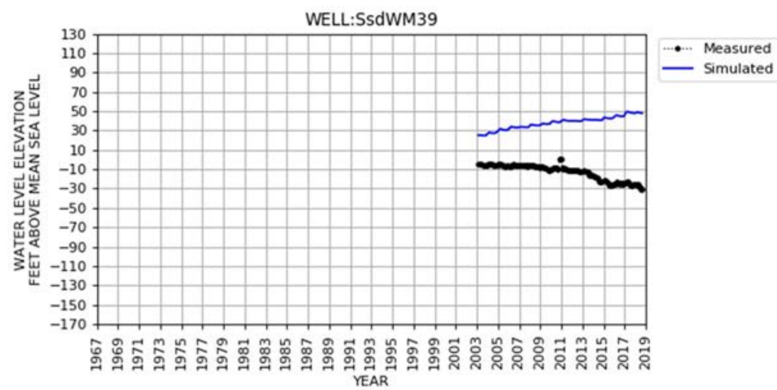
All model results are provisional and subject to revision

ATTACHMENT C
MEASURED AND SVIHM SIMULATED HYDROGRPAHS
FOR MONTEREY SUBBASIN







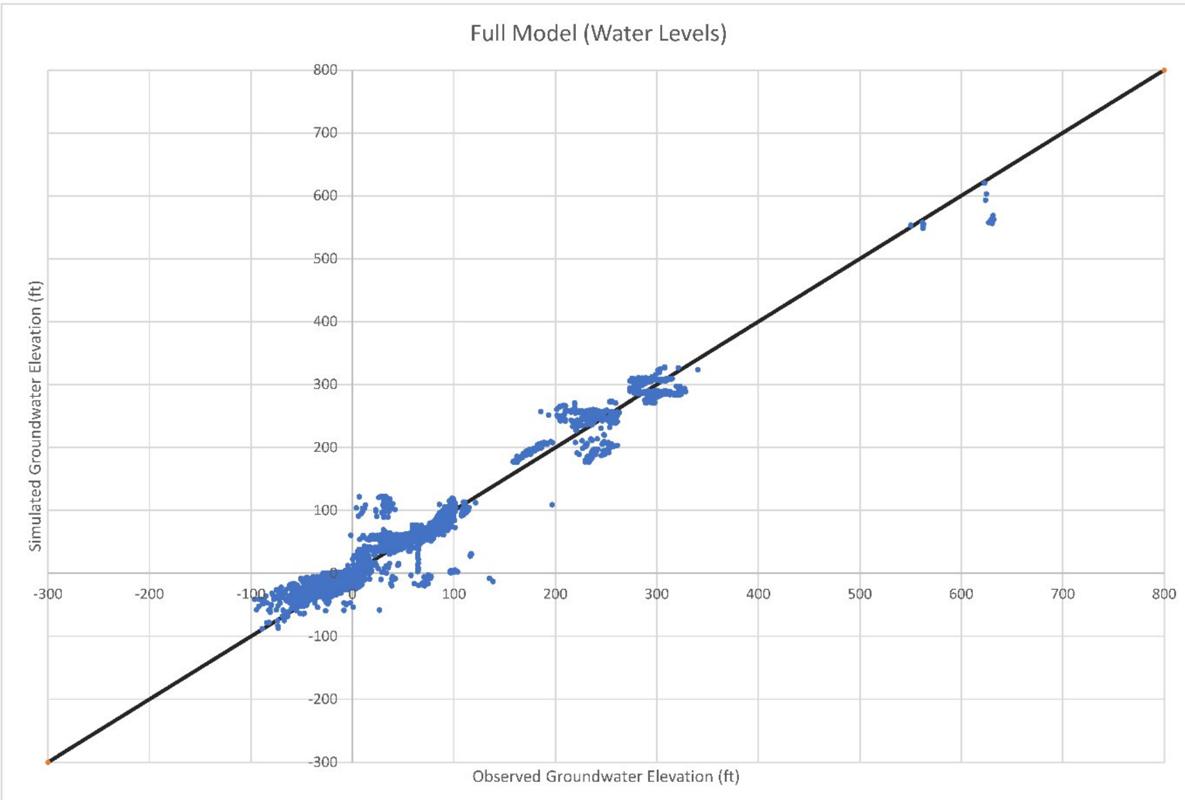


Note: All reported statistics are in feet unless otherwise noted.

All model results are provisional and subject to revision

ATTACHMENT D

MONTEREY SUBBASIN MODEL PRELIMINARY CALIBRATION STATISTICS (AS OF 3/29/2021)



Number of Wells:	608
Number of Observations:	30555
Mean Residual (ft):	-1.93
Mean Absolute Residual (ft):	8.38
Root-Mean-Squared Residual (ft):	12.77
Residual Standard Deviation (ft):	12.62
Range in Observations (ft):	728.44
Scaled Mean Residual [%]:	-0.26%
Scaled Mean Absolute Residual [%]:	1.15%
Scaled Root-Mean-Squared Residual [%]:	1.75%
Scaled Residual Standard Deviation [%]:	1.73%
Coefficient of Determination (R^2):	0.94

Note: All results are preliminary and subject to revision.

Appendix 7-A

MCWRA CASGEM Monitoring Plan

CASGEM Monitoring Plan
for High and Medium Priority Basins
in the Salinas Valley Groundwater Basin

March 10, 2015

Monterey County Water Resources Agency
893 Blanco Circle
Salinas, CA 93901

This page intentionally left blank.

Table of Contents

List of Tables

List of Figures

Appendices

List of Acronyms and Abbreviations

CASGEM	California Statewide Groundwater Elevation Monitoring
DWR	California Department of Water Resources
MCWRA	Monterey County Water Resources Agency
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
WY	Water Year

1.0 Introduction

This monitoring plan has been developed by the Monterey County Water Resources Agency (MCWRA) to meet requirements of the California Department of Water Resources (DWR) California Statewide Groundwater Elevation Monitoring (CASGEM) program. The plan to covers monitoring of groundwater elevations within high and medium priority alluvial subbasins identified in DWR Bulletin 118 that are located in Monterey County, and for which a Monitoring Entity has not yet been designated. This monitoring plan provides information on the groundwater basins, the wells to be sampled, and the monitoring schedule and methods.

1.1 Scope and Purpose

The monitoring plan presents descriptions of the groundwater subbasins; monitoring schedule and well network distribution; procedures for collecting and reporting the groundwater elevation data; and a description of the monitoring plan rationale.

This groundwater monitoring plan can be revised as necessary when refinements are made to the monitoring network to address program needs and data gaps. Revisions will be submitted to DWR when additions or removal of wells from the monitoring network occur.

2.0 Groundwater Basin Descriptions and Hydrogeology

Monterey County is located in the Central Coast Hydrologic Region. Thirteen basins and subbasins are identified in DWR Bulletin 118 as being partially or fully located within Monterey County (Figure 1).

This monitoring plan addresses seven of the subbasins in the Salinas Valley Groundwater Basin, specifically those which DWR has prioritized as “high” or “medium” (Table 1). Three of the basins - Cholame Valley (3.5), Lockwood Valley (3-6), and Peach Tree Valley (3-32) - have been prioritized as “low” or “very low” and will be covered by a subsequent monitoring plan.

Table 1 - DWR Basin Nomenclature, Numbering, and Prioritization

Subbasin Name	Basin/Subbasin Number	Basin Prioritization
180/400 Foot Aquifer	3-4.01	High
East Side Aquifer	3-4.02	High
Forebay Aquifer	3-4.04	Medium
Upper Valley Aquifer	3-4.05	Medium
Paso Robles Area	3-4.06	High
Langley Area	3-4.09	Medium
Corral de Tierra Area	3-4.10	Medium

The remaining three basins in Monterey County - Carmel Valley (3-7), Pajaro Valley (3-2), and the Seaside Area (3-4.08) - have a designated Monitoring Entity. The Monterey Peninsula Water Management District (MPWMD) is the Monitoring Entity for the Carmel Valley and Seaside basins; Santa Cruz County Environmental Health Services is the Monitoring Entity for the Pajaro Valley basin. The Paso Robles Area will be monitored both by MCWRA and the San Luis Obispo County Flood Control & Water Conservation District, with monitoring split along the county lines.

2.1 Overall Setting

The Salinas Valley is an intermontane alluvial basin extending 120 miles southeast from the Monterey Bay to Paso Robles. Although the valley fill is as thick as 15,000 feet, all of the principal water-bearing sediments lie within 2,000 feet of the ground surface (Showalter et al, 1983). These water-bearing sediments consist of Tertiary and Quaternary marine and terrestrial sediments, including the Pliocene Purisima Formation, the Plio-Pleistocene Paso Robles Formation, the Pleistocene Aromas Formation, and the Pleistocene to Holocene Valley Fill.

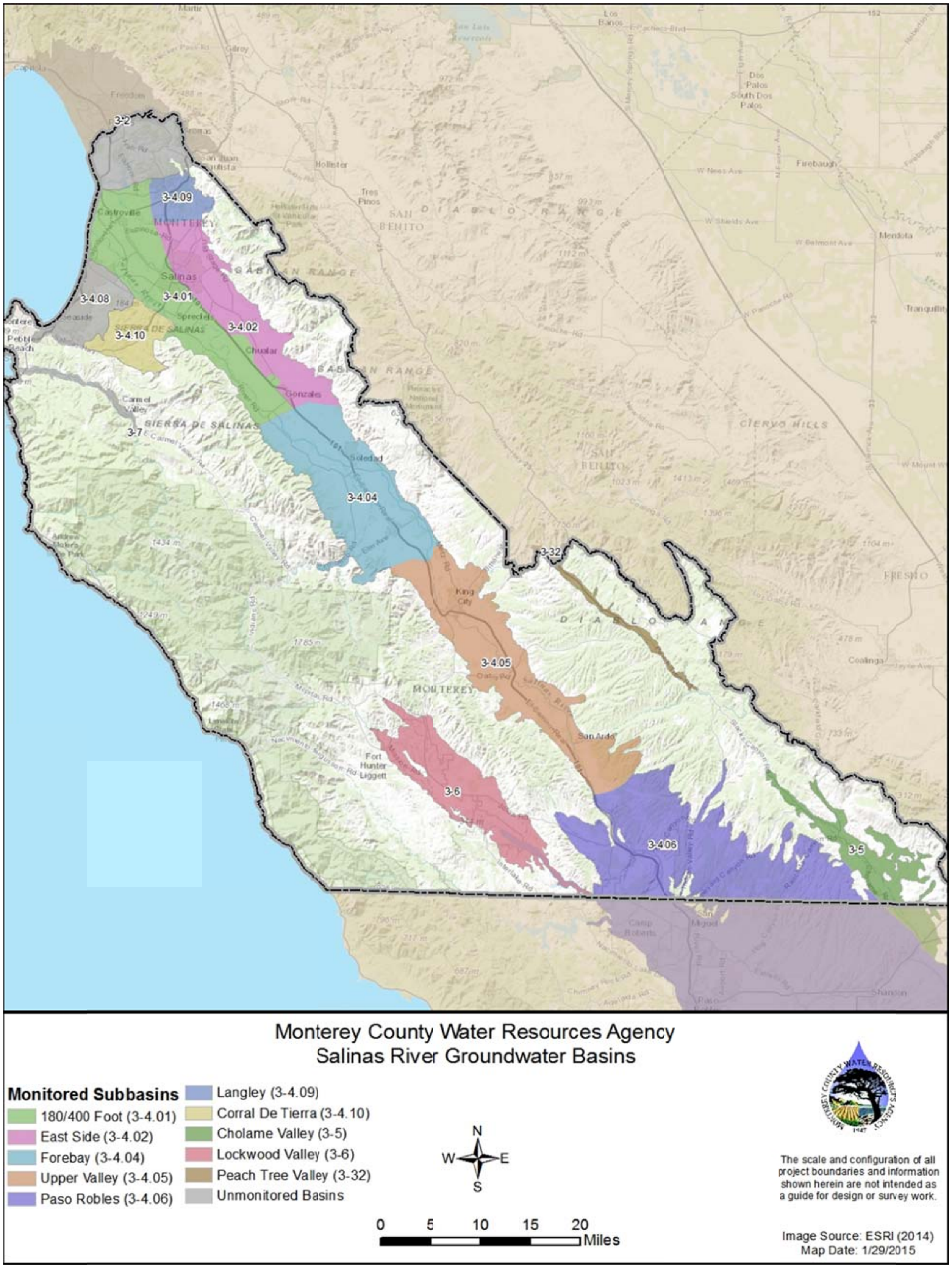
2.2 180/400 Foot Aquifer

The 180/400 Foot Aquifer subbasin is located in the northwestern part of the Salinas Valley basin. The northeastern boundary of the 180/400 Foot Aquifer subbasin is shared with the East Side Aquifer subbasin; the Forebay Aquifer subbasin lies on southeastern boundary, near the City of Gonzales. Monterey Bay abuts the northwestern boundary of the 180/400 Foot Aquifer subbasin.

The 180-Foot Aquifer ranges from 50 to 150 feet in thickness and is confined by an overlying blue clay layer, known as the Salinas Aquitard, which ranges from 25 to 100 feet thick. The Salinas Aquitard thins to the east and south of the subbasin and is present only in this subbasin. The 180-Foot Aquifer consists of interconnected layers of sand, gravel, and clay that are separated from the 400-Foot Aquifer by blue marine clay and other discontinuous aquifers and aquitards ranging from 10 to 70 feet in thickness. The 400-Foot Aquifer has an average thickness of 200 feet and consists of sands, gravels, and clay lenses (DWR, 2003). The blue marine clay aquitard has been reported to be absent in some areas of the 180/400 Foot Aquifer subbasin (Kennedy/Jenks, 2004).

There is a third water-bearing unit underlying the 180/400 Foot Aquifer subbasin, often referred to as the Deep Aquifer, which is separated from the overlying 400-Foot Aquifer by a blue marine clay aquitard (DWR, 2003). The Deep Aquifer is a confined unit that has been less developed than the 180-Foot and 400-Foot Aquifers, but wells are increasingly being drilled into this unit, so it will be included in the monitoring plan for this subbasin.

Figure 1 – Groundwater Basins and Subbasins in Monterey County



2.3 East Side Aquifer

The East Side Aquifer subbasin is located in the northeastern portion of the Salinas Valley basin, bounded by the foothills of the Gabilan Range to the northeast and Highway 101 to the southwest (Kennedy/Jenks 2004).

The East Side Aquifer subbasin is dominated by poorly bedded sequences of gravel, silt, sand, gravelly/sandy clay, and clay. In portions of the East Side Aquifer subbasin, decomposed granite is a prominent component of the sediments (Kennedy/Jenks, 2004). The primary water-bearing units of the East Side Aquifer subbasin are the same units that are present in the 180/400 Foot Aquifer subbasin. However, the near-surface Salinas Aquitard is not present in the East Side Aquifer subbasin, and the aquitard that separates the 180-Foot and 400-Foot Aquifers is less continuous in the East Side Aquifer subbasin, leading to semi-confined to unconfined conditions for much of the groundwater (DWR, 2003).

2.4 Forebay Aquifer

The Forebay Aquifer subbasin is located in the central portion of the Salinas Valley basin, bounded by the Sierra de Salinas and Gabilan Range to the west and east, respectively. The Forebay subbasin is bounded to the north by the 180/400 Foot Aquifer and East Side Aquifer subbasins. The southern boundary of the Forebay Aquifer subbasin is shared with the Upper Valley Aquifer subbasin (DWR, 2003).

Many of the same hydrostratigraphic units that comprise the 180/400 Foot Aquifer subbasin are present in the Forebay Aquifer subbasin, though the aquitard separating the two water bearing units in the northern subbasin is absent in the Forebay Aquifer subbasin. Groundwater in the Forebay Aquifer subbasin is unconfined and occurs in lenses of sand and gravel that are interbedded with massive units of finer grained material (DWR, 2003).

2.5 Upper Valley Aquifer

The Upper Valley Aquifer subbasin occupies a stretch of the Salinas Valley groundwater basin from just south of Greenfield, CA to San Ardo, CA. The northern border of the Upper Valley Aquifer subbasin is shared with the Forebay Aquifer subbasin, while the southern border is shared with the Paso Robles Area subbasin.

Groundwater in the Upper Valley Aquifer subbasin is unconfined and is derived primarily from an aquifer of unconsolidated to semi-consolidated and interbedded gravel, silt, sand, and alluvial fan and river deposits (DWR, 2003).

2.6 Paso Robles Area

The Paso Robles Area subbasin is partially located in Monterey County, though the majority of the subbasin is located in San Luis Obispo County. The Upper Valley Aquifer subbasin forms the northern boundary of the Paso Robles Area subbasin.

Groundwater in the Paso Robles Area subbasin is found in two formations: Holocene age alluvium and the Pleistocene age Paso Robles Formation. Groundwater in the fine- to coarse-grained sand, pebbles, and boulders of the alluvium is unconfined while groundwater in the Paso Robles Formation is generally confined (DWR, 2003).

The Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles Formation (SLOCFCWD, 2014).

2.7 Langley Area

The Langley Area subbasin is located in the northeastern part of the Salinas Valley groundwater basin. Portions of the Langley Area subbasin are underlain by granitic bedrock that is not considered to be a viable water-bearing unit. In the remaining areas of the Langley Area subbasin, the groundwater supply is derived from shallow, well-sorted sands separated by confining layers of interbedded clays and silty clays (DWR, 2003).

A study of hydrogeology in northern Monterey County was conducted by Fugro West, Inc. (Fugro) and included most of the Langley Area subbasin. The Fugro study further divided the subbasin, as it is defined by DWR, into hydrogeologic subareas using factors such as well yields, depth to bedrock, volume of groundwater storage, and sources of recharge (Fugro, 1995). Two of the hydrogeologic subareas defined by the Fugro study are coincident with approximately 75% of the Langley Area subbasin: Highlands South and Granite Ridge (Figure 2).

The Highlands South subarea consists of saturated Aromas Sands (interbedded sands, clay, and gravel) overlying the Purisima Formation (semi-consolidated units of fine sand, clay, and silt), which has not proved a viable aquifer (Fugro, 1995). The Highlands South hydrogeologic subarea, as defined by the Fugro report, covers approximately 46% of the Langley Area subbasin.

The Granite Ridge subarea is characterized by a thin layer of Aromas Sands overlying granitic bedrock or weathered granite. Wells in the Granite Ridge subarea are typically completed in either granular materials (Aromas Sands and weathered granite); fresh granite; or other consolidated formations (Fugro, 1995). Approximately 29% of the Langley Area is coextensive with the Granite Ridge subarea.

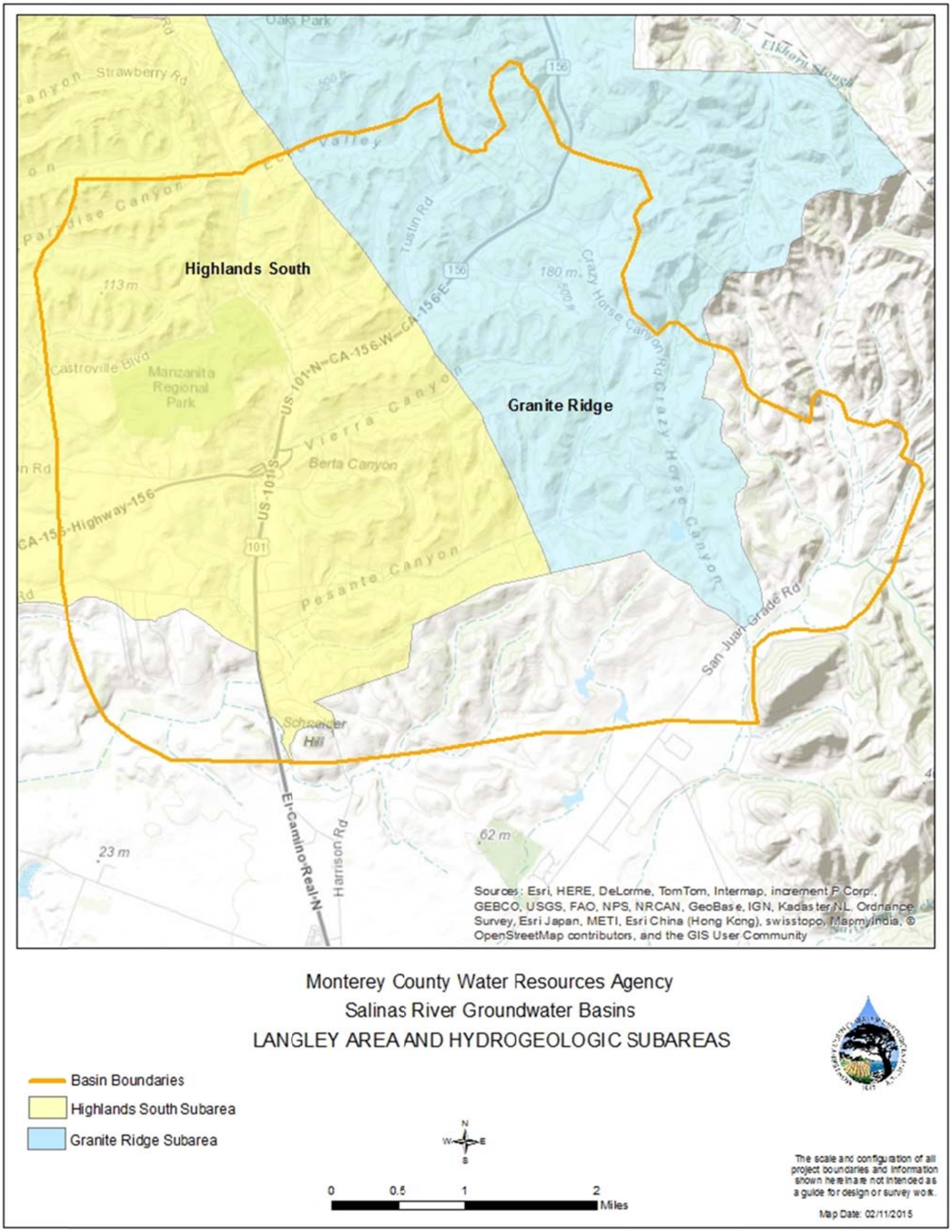
The transition between hydrogeologic conditions of the Highlands South and Granite Ridge subareas is gradual and occurs slightly east of the center of the Langley Area. The transition is characterized by the thinning of saturated sediments to the east, eventually thinning to the extent that the granitic bedrock is above regional saturation (Fugro, 1995).

2.8 Corral de Tierra Area

The Corral de Tierra Area subbasin is located to the west of the 180/400 Foot Aquifer subbasin and contains portions of the former Fort Ord and other unincorporated areas. It is bounded to the northwest by the Seaside Area subbasin.

Groundwater in the Corral de Tierra Area subbasin comes primarily from the Paso Robles Formation, which consists of sand, gravel, and clay interbedded with minor calcareous beds. The poorly consolidated marine sandstone of the Santa Margarita Formation also yields water in the Corral de Tierra Area subbasin (DWR, 2003). A previous study which included the Corral de Tierra Area found that although there are thick sequences of low permeability material in some areas of the subbasin that may limit vertical hydraulic communication between aquifer units, a comparison of water level data shows general consistency between wells screened in different units (Geosyntec, 2007).

Figure 2 – Langley Area Subbasin and Hydrogeologic Subareas



3.0 Groundwater Level Monitoring

The following sections discuss the history of groundwater level monitoring in the Salinas Valley groundwater basin; current monitoring activities in the basin; and the proposed network of CASGEM monitoring wells. Data gaps in the monitoring network are also identified and discussed.

3.1 Monitoring History

Groundwater level measurements in the Salinas Valley groundwater basin have been ongoing, in some form, since the 1940s. Presently, MCWRA conducts monthly and annual surveys of groundwater levels to monitor fluctuations in water level and determine relative changes in storage over time. Data collected through the MCWRA groundwater level monitoring program also contributes to analysis of seawater intrusion in coastal groundwater zones.

MCWRA maintains a small network of dedicated monitoring wells where groundwater level data is recorded by a pressure transducer on an hourly basis. However, the distribution of the dedicated monitoring wells is limited; much of the groundwater level data is collected from privately-owned agricultural production wells where owners have granted permission to MCWRA. MCWRA collects groundwater level measurements from over four hundred wells on an annual basis; on a monthly basis, groundwater levels are measured in about one quarter of these wells.

3.2 Monitoring Network Rationale

The CASGEM network is of a combination of dedicated monitoring wells that are owned by MCWRA and wells that are owned by private individuals who elected to participate in the CASGEM program.

The MCWRA-owned monitoring wells were selected for inclusion in the program due to their distribution throughout Monterey County, the availability of detailed and reliable well construction data, and relative ease of data collection.

In the selection of privately owned wells, preference was given to wells that are in the MCWRA monthly groundwater level monitoring program, since the minimum number of data points for CASGEM reporting are already being gathered. MCWRA also considered wells that are in the annual groundwater level monitoring program. Wells in the annual program are currently measured only once per year, so additional staff effort will be required to schedule a second visit in order to satisfy the biannual measurement criteria for CASGEM reporting.

Additional privately owned wells were sought in areas where dedicated monitoring wells are not available. MCWRA filled as many data gaps as possible with privately owned wells, working toward a target minimum density of 10 wells per 100 square miles of groundwater basin.

Approximately one third of the land in the Corral de Tierra Area is federal property. MCWRA has reached out to the United States Army Corps of Engineers (USACE), which owns the property, seeking participation in the CASGEM program (Appendix A). As of the date of this monitoring plan, USACE has not responded to MCWRA's letter. As such, the land owned by USACE is considered a data gap in the Corral de Tierra Area. The following subbasin-specific discussions address data gaps in the MCWRA CASGEM network in more detail.

MCWRA considered the availability of reliable well construction data choosing CASGEM wells. Where appropriate, wells were also selected to provide coverage of vertically distinct aquifers.

Table 2 - Recommended Monitoring Well Network Density by Subbasin

Subbasin Name	Subbasin Area in Monterey County (mi²)	Federal Land Area of Subbasin (mi²)	Wells Needed for Target Minimum Density
High and Medium Priority (10 wells per 100 mi²)			
180/400 Foot Aquifer	132	0	13
East Side Aquifer	90	0	9
Forebay Aquifer	147	0	15
Upper Valley Aquifer	153	0	15
Paso Robles Area	221	0	22
Langley Area	24	0	2
Corral de Tierra Area	35	12	4
Total wells in High and Medium Priority Subbasins			**80**

3.3 CASGEM Monitoring Network and Data Gaps

This section describes the number and distribution of wells in the CASGEM monitoring network of each subbasin, identifies data gaps in some of the monitored subbasins, and outlines the approach for addressing data gaps where applicable.

As shown in Table 3, the CASGEM network meets the target minimum density in some subbasins, while additional wells are required in other subbasins in order to meet the target.

Table 3 – CASGEM Network Compared to Target Minimum Density Numbers

Subbasin Name	Target Minimum Density	CASGEM Wells	Voluntary Wells	Wells Remaining to Meet Target Minimum Density
180/400 Foot Aquifer	13	22	1	0[a]
East Side Aquifer	9	8	0	1
Forebay Aquifer	15	9	2	11[b]
Upper Valley Aquifer	15	3	0	12
Paso Robles Area	22	1	0	21
Langley Area	2	3	0	0[c]
Corral de Tierra Area	4	2	0	2
TOTAL	**80**	**48**	**3**	**47**

Notes

(a) Additional wells will be sought to address a data gap in the vertical distribution of the well network as funding is available.

(b) Forebay Aquifer CASGEM wells include multiple well clusters, so only four geographic locations are covered by the nine wells.

(c) Additional wells will be sought to address data gaps in horizontal distribution of the well network as funding is available.

3.3.1 180/400 Foot Aquifer

The CASGEM well network for the 180/400 Foot Aquifer subbasin is shown on Figure 3. MCWRA has fifteen (15) dedicated monitoring wells in the 180/400 Foot Aquifer subbasin, all of which will be included in the CASGEM network. Some of the monitoring wells consist of clusters of multiple nested wells at a single location, with each well in the cluster monitoring a different aquifer. The CASGEM well network includes seven (7) privately owned wells; where the well owner has granted permission for MCWRA to include his/her well in the CASGEM program. There is also one (1) voluntary well in the 180/400 Foot Aquifer subbasin.

Data Gaps – Horizontal Distribution of Wells

The 180/400 Foot Aquifer subbasin is 132 square miles. Based on the target minimum density of ten (10) wells per 100 square miles, this subbasin should have 13 monitoring wells to meet the needs of the CASGEM program. MCWRA has met the target minimum density in the 180/400 Foot Aquifer subbasin with a network distributed throughout the basin, as shown in Figure 3.

Data Gaps – Vertical Distribution of Wells

As discussed in Section 2.2, the 180/400 Foot Aquifer subbasin has three distinct water-bearing zones, each separated by a blue marine clay aquitard. All three aquifers will be monitored by the wells in the CASGEM network, as shown in Table 4.

Table 4 - Vertical Distribution of Wells in 180/400 Foot Aquifer

Aquifer Zone	Dedicated Monitoring Wells	Privately Owned CASGEM Wells	Total Wells
180-Foot Aquifer	8	1	9
400-Foot Aquifer	3	5	8
180/400 Foot Aquifers	4	0	4
Deep Aquifer	0	1	1
TOTAL	**15**	**7**	**22**

As shown in Table 4, eight (8) of the MCWRA dedicated monitoring wells are constructed with screens in the 180-Foot Aquifer, as is one (1) of the privately owned wells. Three (3) of the MCWRA monitoring wells are constructed with screens in the 400-Foot Aquifer, as are five (5) of the privately owned wells. Groundwater elevations in the Deep Aquifer will be monitored at one (1) well location where permission has been granted by the well owner.

Two sets of the MCWRA dedicated monitoring wells (four total wells) are constructed in areas recognized as hydrogeologic transition zones between the 180/400 Foot Aquifer and the East Side Aquifer, and between the 180/400 Foot Aquifer and the Forebay Aquifer. The transition zone between the 180/400 Foot Aquifer and the East Side Aquifer is distinguished by a shift from predominantly fluvial facies, common to the 180/400 Foot Aquifer, to predominately alluvial fan facies (Kennedy/Jenks, 2004). The transition from the 180/400 Foot Aquifer to the Forebay Aquifer is characterized by thinning and/or pinching out of the near surface confining unit, the Salinas Aquitard (DWR, 2003).

Although the site-specific geology at these monitoring wells suggests that the wells are more representative of the East Side Aquifer or Forebay Aquifer, MCWRA has assigned these four wells to the 180/400 Foot Aquifer subbasin because they are geographically located in this basin, as directed by DWR (staff communication, 2015). If an opportunity arises in the future to adjust the groundwater basin/subbasin boundaries, wells like these will be useful for defining transitional zones and aligning basin boundaries with known hydrogeology.

Though MCWRA has met the target minimum density in the 180/400 Foot Aquifer, there is only one well monitoring the Deep Aquifer Zone, which suggests a data gap in the CASGEM network. MCWRA will address this data gap by evaluating the possibility of including new privately owned wells in the CASGEM program, and will reach out to well owners seeking participation when an appropriate well is found. Additionally, while there are no funds accessible at present to drill new monitoring wells, MCWRA will consider this option if funding becomes available.

3.3.2 East Side Aquifer

The CASGEM network for the East Side Aquifer subbasin is shown on Figure 4. MCWRA has two (2) dedicated monitoring wells in the East Side Aquifer subbasin, both of which will be included in the CASGEM network. The CASGEM well network also includes six (6) privately owned wells in the East Side Aquifer subbasin.

Data Gaps – Horizontal Distribution of Wells

The East Side Aquifer subbasin has an approximate area of 90 square miles, suggesting that the subbasin should have nine (9) monitoring wells to meet the CASGEM program target minimum density. The CASGEM network in this monitoring plan, which consists of eight (8) wells, is one well short of this target minimum density.

There remains an area in the central portion of the subbasin of approximately 26 square miles (29% of the subbasin area) where there are no monitoring wells. MCWRA continues to seek suitable privately owned wells in this area for inclusion in the CASGEM program. Additionally, as funding opportunities become available, MCWRA will consider the installation of new monitoring wells in this area of the East Side Aquifer subbasin.

Data Gaps – Vertical Distribution of Wells

Groundwater in the East Side Aquifer is semi-confined to unconfined, as discussed in Section 2.3 of this document. For purposes of monitoring in this subbasin, MCWRA distinguishes the unconfined (shallow) portion of the aquifer from the semi-confined (deeper) portion, though there is not a continuous confining layer present at all locations within the subbasin.

Recognizing this distinction, the East Side Aquifer CASGEM network includes wells that are screened in both unconfined and semi-confined water-bearing zones: two (2) of the wells are screened in the shallow zone and one (1) is screened in the deeper zone.

Five (5) of the wells in the CASGEM network have screens in both zones. These wells have been included in the CASGEM network because there are few MCWRA program wells (i.e. potential CASGEM wells) in this subbasin that are screened in a discrete aquifer zone. Despite having screened intervals in both the shallow and deep zones, viable groundwater elevation data can be gleaned from these wells. Trends in the groundwater elevation data from these dual-screened wells is compared to that from wells that are screened in a discreet zone, and professional judgment is used to determine which zone is best represented by the dual-screened well and how the data fits with overall data trends seen in other wells across the basin.

MCWRA will evaluate the possibility of including additional privately owned wells, including ones that may not currently be in a monitoring program, to resolve data gaps in the East Side Aquifer. Preference will be given to wells that are screened in a single water-bearing zone. As funding becomes available, the option to install new monitoring wells will also be considered.

3.3.3 Forebay Aquifer

The CASGEM network for the Forebay Aquifer subbasin is shown on Figure 5. MCWRA has nine (9) dedicated monitoring wells in the Forebay Aquifer subbasin, all of which will be included in the CASGEM network. The nine (9) monitoring wells cover four (4) geographic locations within the basin, divided as follows: three (3) clusters of two (2) nested wells each and one (1) cluster of three (3) nested wells. The Forebay Aquifer subbasin also includes two (2) voluntary wells.

Data Gaps – Horizontal Distribution of Wells

The Forebay Aquifer subbasin is approximately 147 square miles, indicating a need for 15 monitoring wells in order to achieve the target minimum density. For the purposes of horizontal distribution, the CASGEM network in the Forebay Aquifer subbasin will cover four (4) locations due to the nested construction at some of the monitoring well pairs. An additional 11 wells are required to meet the target minimum density for this subbasin.

MCWRA does not currently have funding to support installation of an additional 11 monitoring wells in the Forebay Aquifer subbasin. However, as funding opportunities become available, MCWRA will review the possibility of installing additional wells to address data gaps in the CASGEM network. In the meantime, MCWRA will continue to evaluate existing privately owned wells and, as deemed appropriate, entreat the permission of the well owners for inclusion of more wells into the CASGEM network.

Data Gaps – Vertical Distribution of Wells

The Forebay Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CASGEM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

3.3.4 Upper Valley Aquifer

The CASGEM network for the Upper Valley Aquifer subbasin is shown on Figure 6. The CASGEM network will include the three (3) wells: one (1) dedicated monitoring well owned by MCWRA in the Upper Valley Aquifer subbasin and two (2) privately owned wells.

Data Gaps – Horizontal Distribution of Wells

The Upper Valley Aquifer subbasin is 153 square miles; therefore, 15 monitoring wells are required to meet the target minimum density for the subarea. To meet this target, the Upper Valley Aquifer subbasin will require an additional 12 wells.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Upper Valley Aquifer subbasin to alleviate the data gap in this subbasin. However, should funding become available, MCWRA will explore the installation of dedicated monitoring wells where data gaps exist in the CASGEM network. Until such funding becomes available, MCWRA will seek additional participation from private well owners whose wells are deemed suitable to achieve the needs of the CASGEM program.

Data Gaps – Vertical Distribution of Wells

The Upper Valley Aquifer is considered to be an unconfined aquifer. As such, there are no data gaps in the vertical distribution of the CASGEM network. The current wells, and any additional wells that may be incorporated in the future, will be monitoring the same vertical water-bearing zone.

Figure 3 – 180/400 Foot Aquifer Subbasin

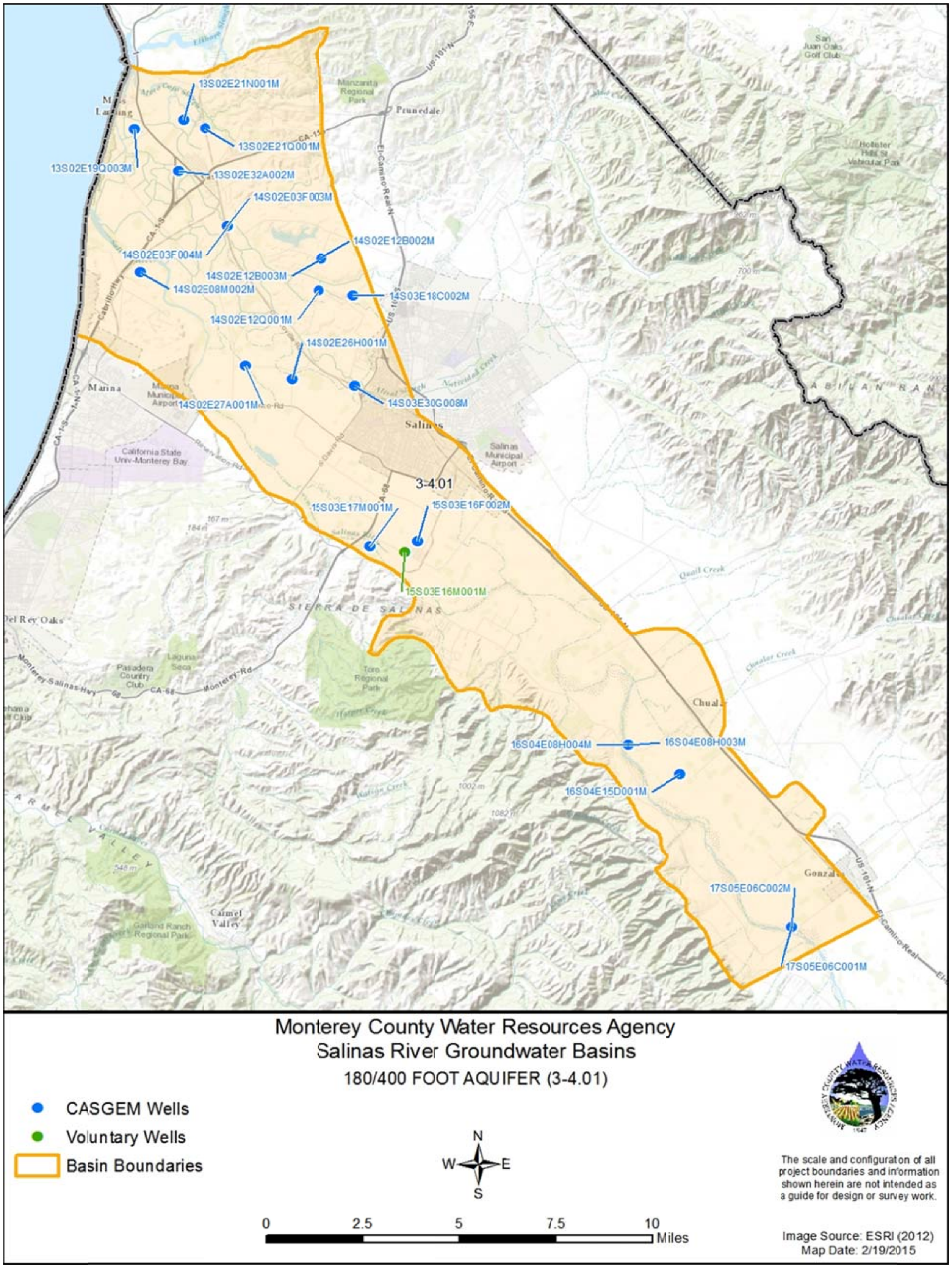


Figure 4 – East Side Aquifer Subbasin

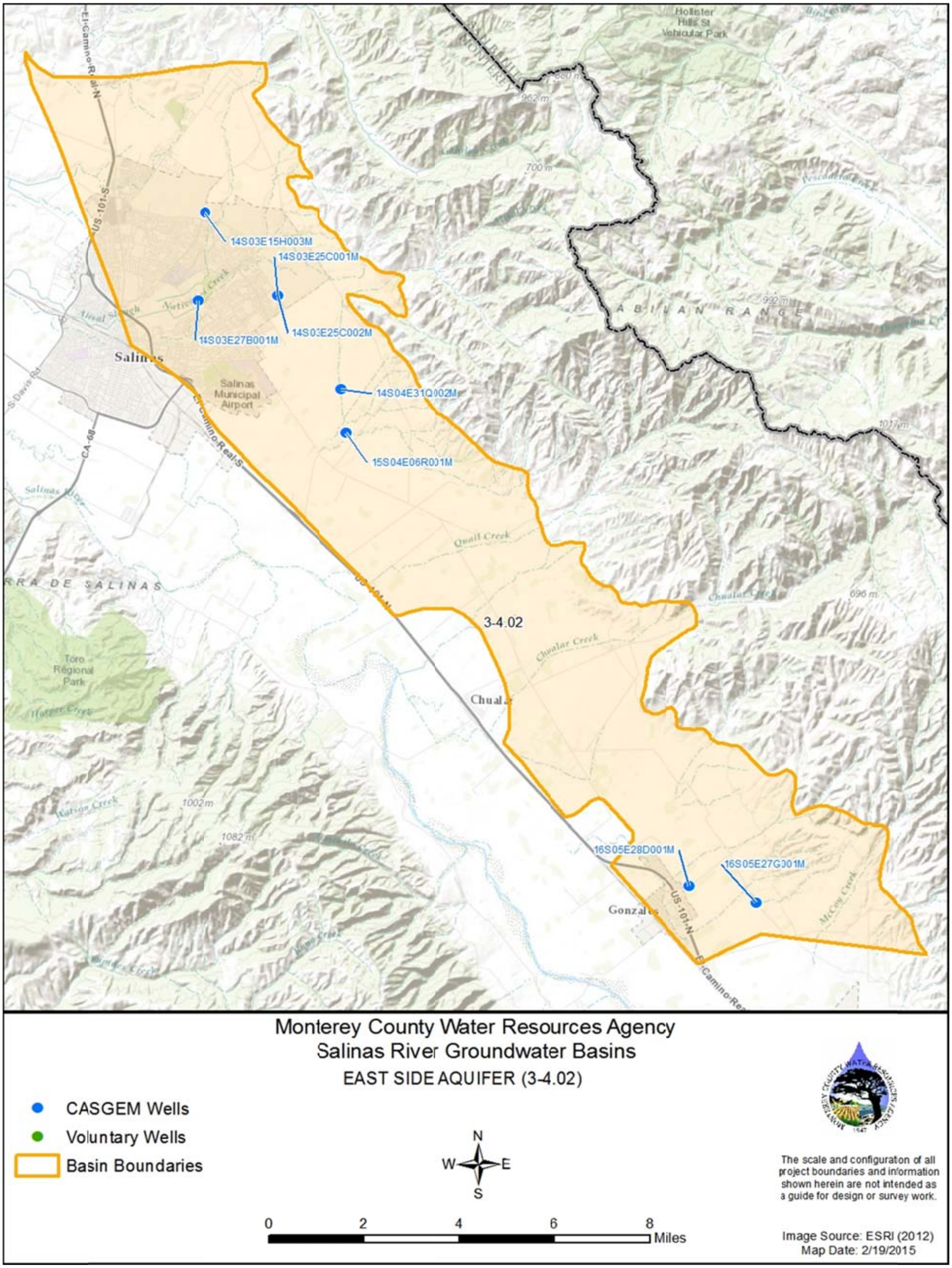


Figure 5 – Forebay Aquifer Subbasin

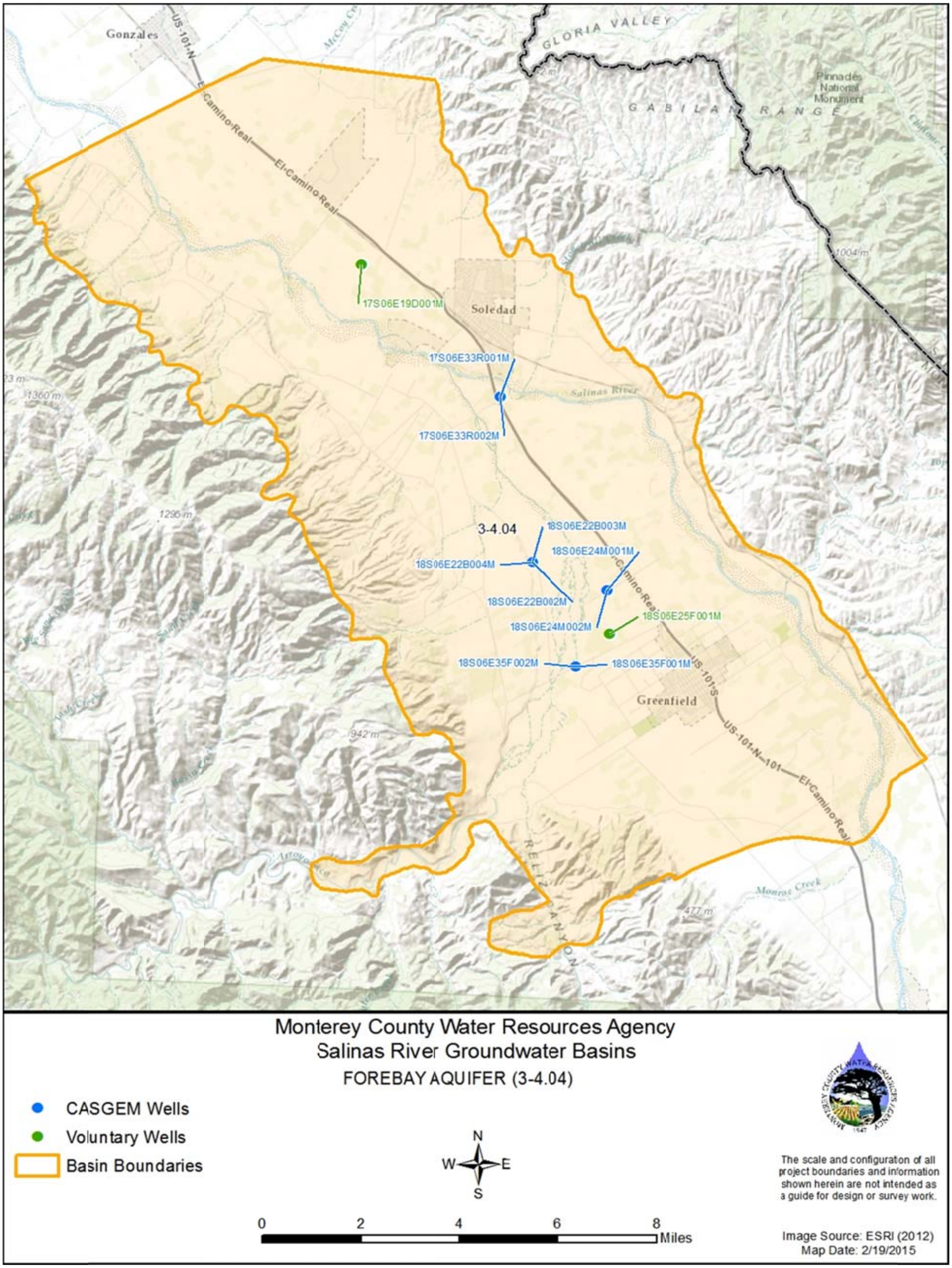
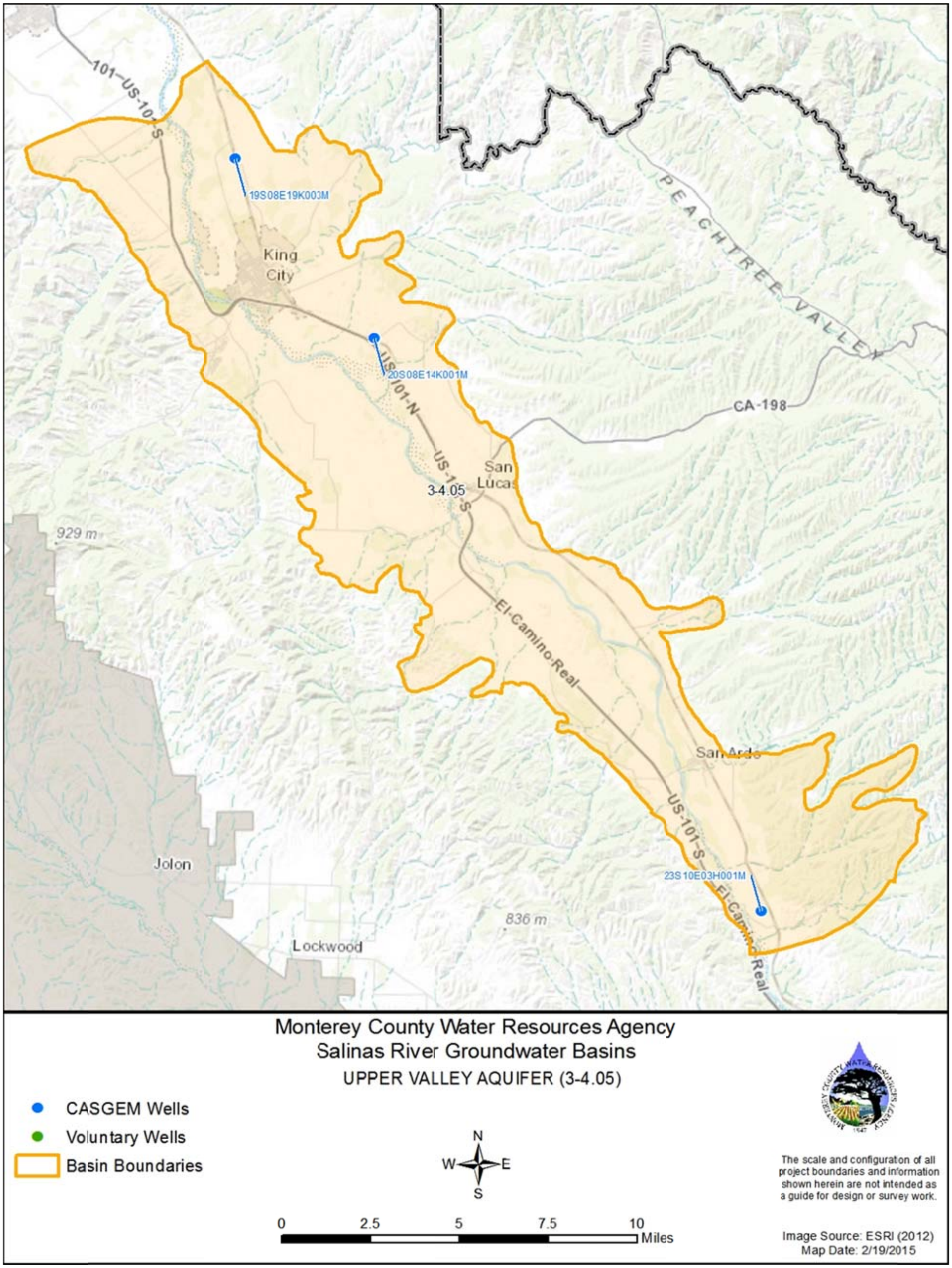


Figure 6 – Upper Valley Aquifer Subbasin



3.3.5 Paso Robles Area

The Paso Robles Area subbasin is located in both Monterey and San Luis Obispo counties, as shown on Figure 7. The subbasin is split by the county lines, with approximately 221 square miles of the Paso Robles Area located in Monterey County. Based on the area within Monterey County, 22 monitoring wells would be required to meet the target minimum density for the subarea. The remainder of the Paso Robles Area subbasin will be monitored by the San Luis Obispo County Flood Control & Water Conservation District.

MCWRA has one (1) dedicated monitoring well in the Paso Robles Area subbasin, which will be included in the CASGEM network (Figure 7). The San Luis Obispo County portion of the Paso Robles Area is currently monitored by fourteen (14) wells, as shown on Figure 7 (SLOCFCWD, 2014); one of these wells is very close to the Monterey County/San Luis Obispo County line.

MCWRA does not currently have plans or funding to install any additional monitoring wells in the Paso Robles Area Subbasin, though if funding becomes available, the construction of new monitoring wells will be explored as a mechanism for addressing this data gap in the CASGEM network. Consideration will be given to the San Luis Obispo County CAGSEM network when evaluating installation of new wells or incorporation of privately owned wells from the subbasin in the CASGEM network, as it is monitoring of the basin a whole that is the priority.

Data Gaps – Horizontal Distribution of Wells

With only one well located in the Paso Robles Area, there is a data gap to address in this subbasin; 21 additional wells are required to meet the target minimum density. MCWRA will continue to investigate the possibility of locating privately owned wells for the CASGEM program, while also considering the installation of additional monitoring wells should a funding mechanism become available. As discussed above, the existing CASGEM network in the San Luis Obispo County portion of the subbasin will be considered when evaluating augmentation of the monitoring network in the Monterey County portion of the subbasin.

Data Gaps – Vertical Distribution of Wells

As discussed in Section 2.6 of this Monitoring Plan, the Paso Robles Groundwater Basin Computer Model (Model) has characterized flow in the basin using four vertical groundwater zones: one in the alluvium and three within the Paso Robles Formation (SLOCFCWD, 2014).

The one (1) monitoring well that currently comprises the CASGEM network in this subbasin is monitoring the unconfined alluvial unit. Any future wells that are brought into the CASGEM program will be evaluated and selected with consideration given to the zone that is monitored by the well. Similarly, any new monitoring wells that may be installed in this area will be designed such that all of the zones defined by the Model are monitored.

3.3.6 Langley Area

The Langley Area subbasin is approximately 24 square miles in area. Based on the target minimum density, the CASGEM network for this subbasin should include two (2) wells. MCWRA does not have any dedicated monitoring wells in the Langley Area subbasin, but three (3) CASGEM wells have been located for this subbasin (Figure 8).

Data Gaps – Horizontal Distribution of Wells

The three (3) CASGEM wells in the Langley Area are located in the eastern half of the subbasin, leaving a data gap in the western portion of the subbasin, near the boundary with the 180/400 Foot Aquifer subbasin. MCWRA has identified possible privately owned wells that are located in the data gap area and continues to work with the well owners toward inclusion of these wells in the CASGEM program. In addition, should funding become available, MCWRA will consider this area as a candidate for installation of new monitoring wells.

Data Gaps – Vertical Distribution of Wells

The dominant water-bearing unit in the Langley Area is the Aromas Red Sands. Based on the depth of the CASGEM wells, the Aromas Red Sands are being monitored, so there are no apparent vertical data gaps to address. Other geologic units present in the Langley Area are neither alluvial nor considered to be water-bearing.

3.3.7 Corral de Tierra Area

The Corral de Tierra subbasin is approximately 35 square miles in area, so four (4) monitoring wells are required to meet the target minimum density for the subarea. MCWRA does not have any dedicated monitoring wells in the Corral de Tierra subbasin; however, MCWRA has identified two (2) CASGEM wells in this subbasin (Figure 9).

Data Gaps – Horizontal Distribution of Wells

Land that is part of the former Fort Ord, now owned by the United States Army Corps of Engineers (USACE), occupies the northwestern, and part of the northeastern, areas in the Corral de Tierra Area subbasin. MCWRA has contacted USACE seeking their participation in the CASGEM program, but has yet to receive a response (Appendix A). MCWRA cannot access the USACE land, therefore, the CASGEM network will be limited to the eastern/southeastern areas of the subbasin. The two (2) CASGEM wells are located in the south-central part of the Corral de Tierra Area, leaving a data gap in the eastern part of the subbasin.

Though MCWRA does not currently have funding to install any additional monitoring wells in the Corral de Tierra Area subbasin, this will be explored as a possibility if funding becomes available. MCWRA has been unable to secure approval for participation from the well owners contacted in this portion of the subbasin, but staff continues to look for privately owned wells and will assess the feasibility of incorporating such wells into the CASGEM network as a means of addressing data gaps. In addition, MCWRA will coordinate with USACE if that agency becomes willing to allow access to wells on the federal land at some point in the future.

Data Gaps – Vertical Distribution of Wells

Previous studies indicate that there is no significant limitation on vertical communication between the two water-bearing units in this subbasin and that wells screened in both units exhibit similar water levels (Geosyntec, 2007). Any additional wells added to the network to address horizontal data gaps will simply enhance monitoring of the same units.

Figure 7 – Paso Robles Area Subbasin

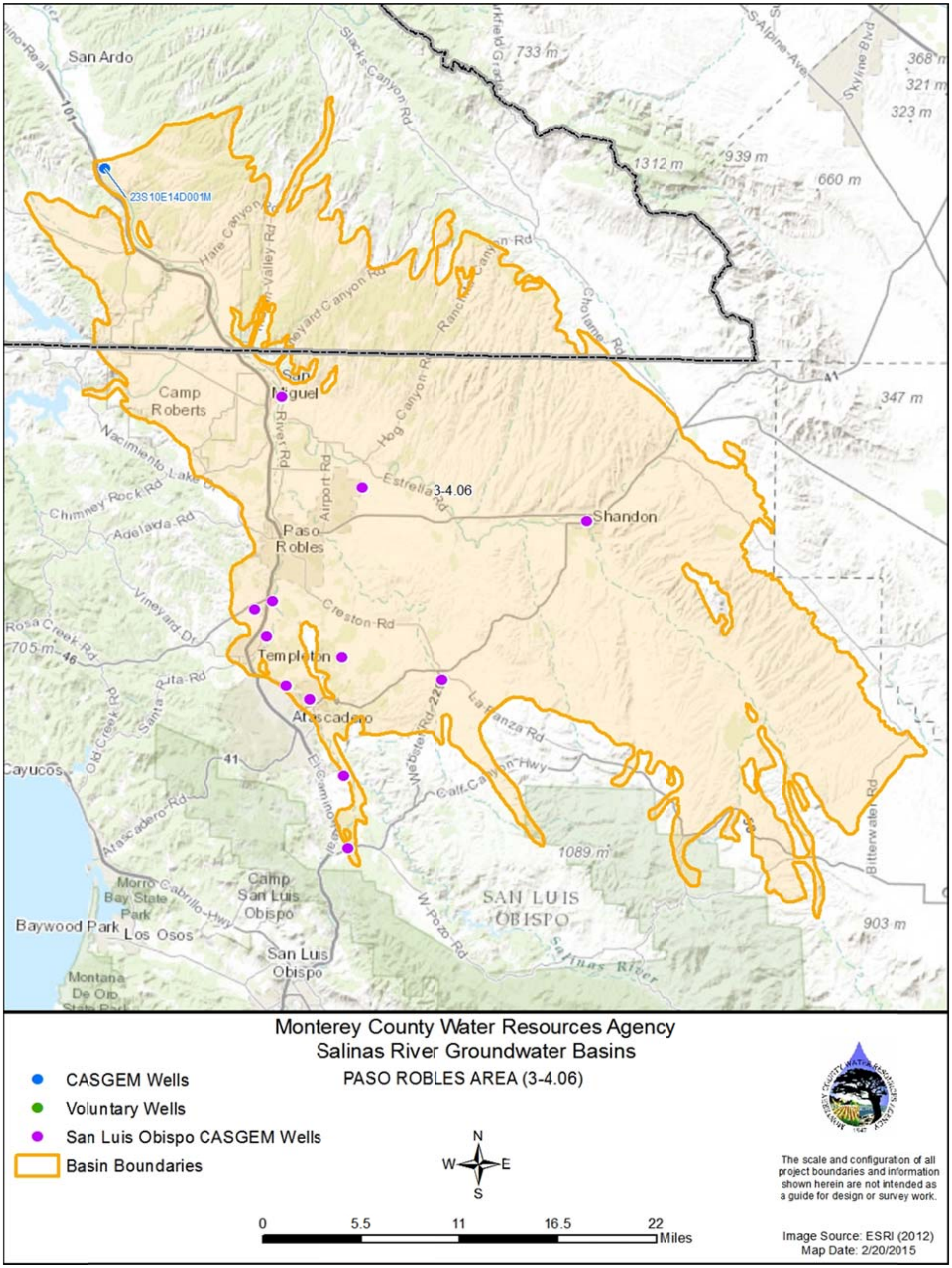


Figure 8 – Langley Area Subbasin

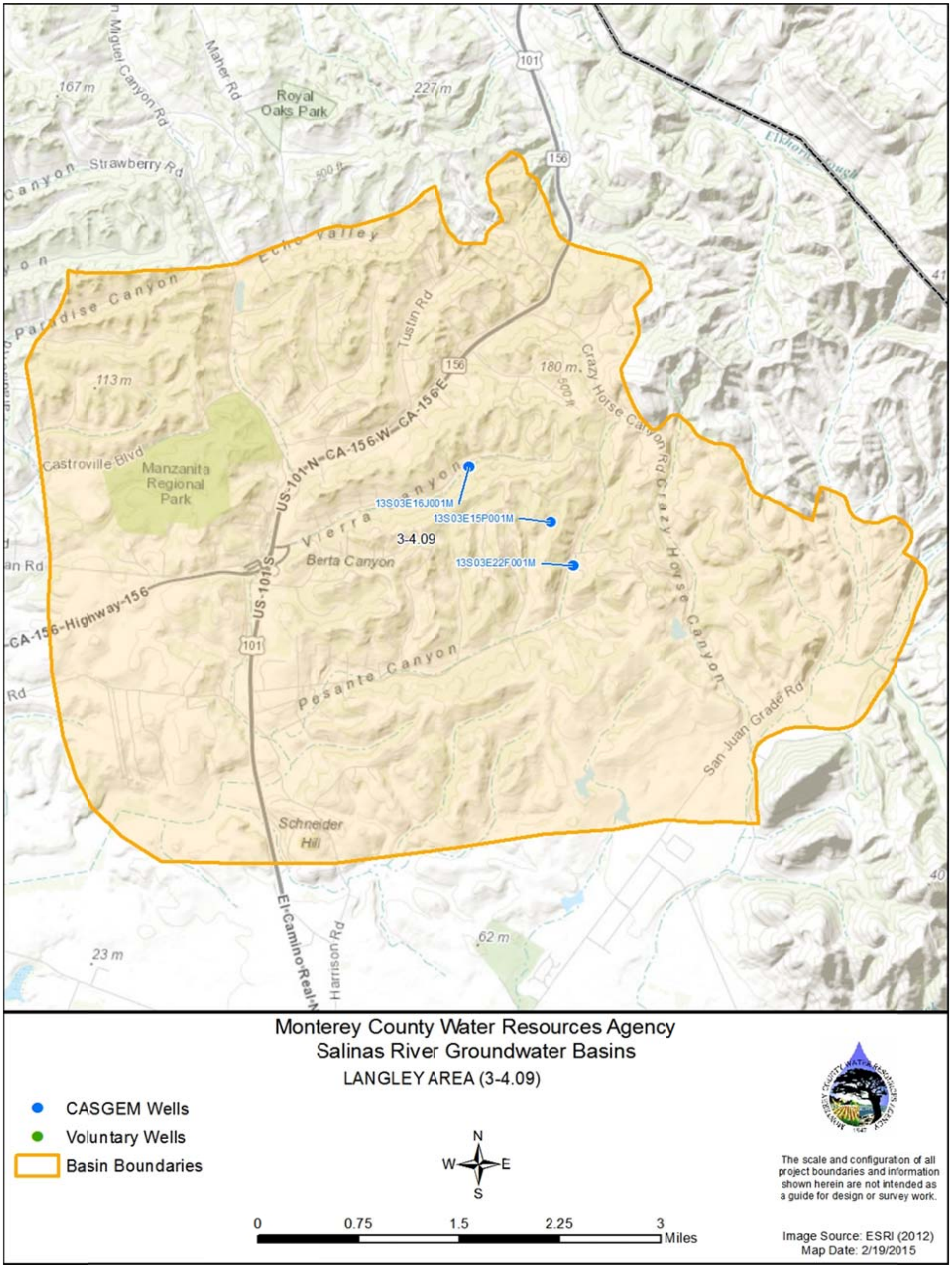
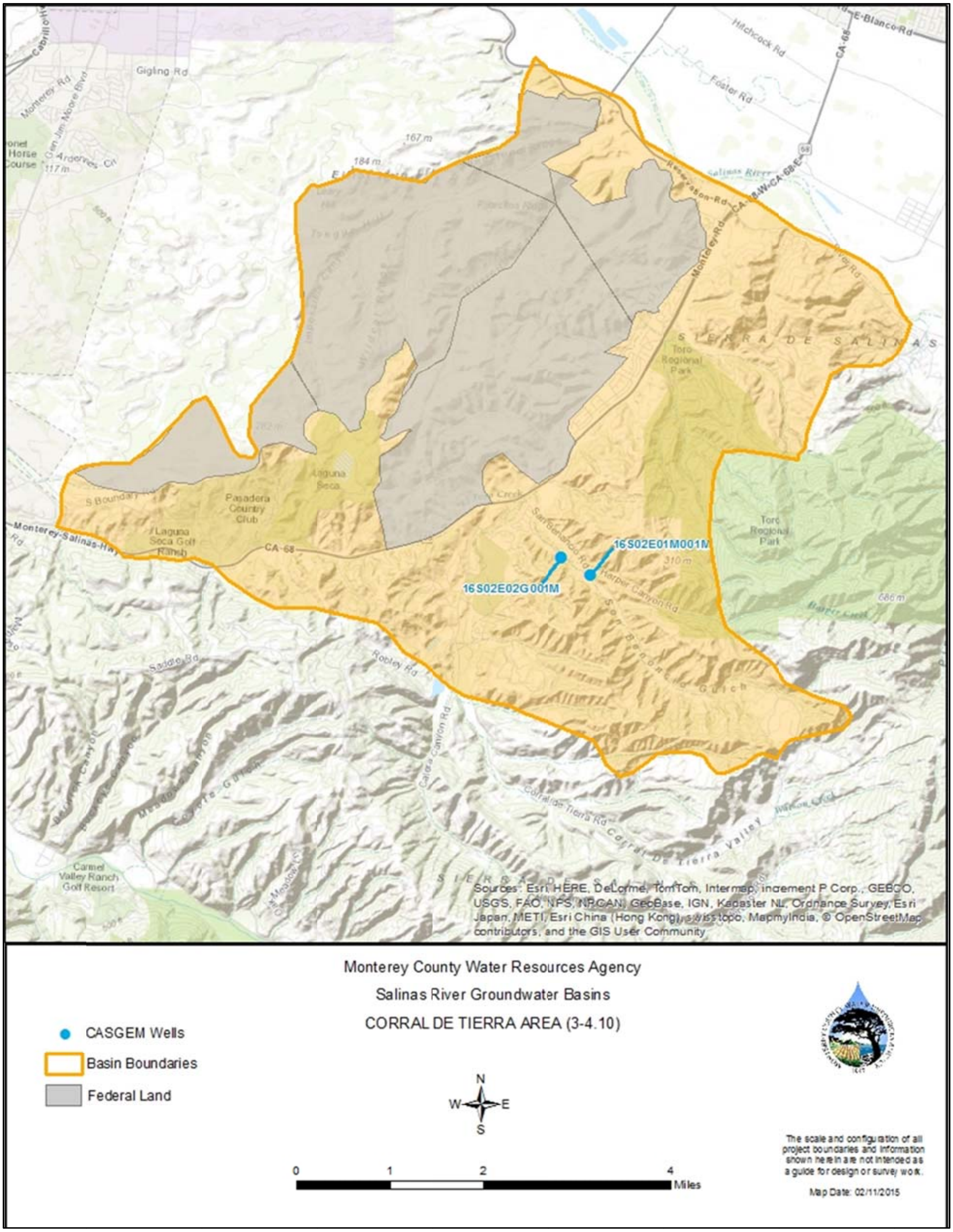


Figure 9 – Corral de Tierra Area Subbasin



4.0 Monitoring Procedures

This section addresses the various procedures and protocols involved in collecting, processing, and reporting data from wells in the CASGEM network.

4.1 Monitoring Frequency and Timing

Nineteen (19) of the CASGEM wells are currently, and will continue to be, measured on a monthly basis. The three (3) voluntary wells are also measured monthly. MCWRA will use the monthly measurements from August and either January, February, or March to satisfy the biannual CASGEM reporting criteria.

To determine the monthly distribution of seasonal high and low groundwater elevations, MCWRA analyzed measurements from approximately 50 wells throughout the Salinas Valley Groundwater Basin. This included wells in the 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer. The measurements were collected during eight (8) different Water Years (WY): WY 1985, representative of near normal conditions; WY 1991, representative of dry conditions; and the six most recent Water Years, WY 2009 through WY 2014. MCWRA reports this data on a quarterly basis; a sample report is included in Appendix B.

Based on this analysis of historical data, August is typically representative of seasonal low conditions (Figure 10). A relaxation of groundwater levels, or seasonal high conditions, is evident during the period from January to March (Figure 11). Data from these three months will be evaluated and the highest groundwater elevation from that series will be submitted to the CASGEM online submittal system. The month chosen to be representative of the seasonal high groundwater conditions will be consistent across all data groups.

Nineteen (19) of the CASGEM wells are equipped with pressure transducers which collect depth to water data on an hourly basis. This data will be synthesized so that biannual measurements representing seasonal high and low conditions are available for CASGEM reporting. The groundwater level measurement collected at noon on the fifteenth day of the month will be selected and compared to other monthly data to ensure that it is a representative value. Data from the month of August will be used to represent the seasonal low and a fall/winter measurement from either January, February, or March will be used to represent the seasonal high; the same month will be used as was selected based on monthly well measurements, as discussed above.

Four (4) of the wells in the CASGEM network are currently measured once per year, during the period from November to January. Based on the recent analysis of seasonal groundwater highs, this period will be shifted to cover the months from January through March. An additional measurement event will be added during the month of August for these wells in order to also capture the seasonal groundwater low.

Appendix C contains a summary of the frequency and timing of measurement of wells in the CASGEM network. Any new wells that are brought into the CASGEM program will be monitored on a biannual basis, with data collection occurring on the same schedule as the other wells that are measured twice a year.

4.2 Well Locations

The latitude and longitude of each well was collected using a handheld GPS unit, which has accuracy to within one (1) meter. Coordinates for wells in the CASGEM network are shown in Appendix A. Any wells incorporated into the CASGEM network in the future will be geographically located using a similar method.

4.3 Reference Points

All of the wells that comprise the CASGEM network described herein are currently part of a groundwater level monitoring program conducted by MCWRA. As part of the existing monitoring programs, reference points (RP) have been established for all of the wells. To ensure consistency in measuring depth to water, a description of each well's RP is recorded in a field data collection notebook. In many cases, photographs have also been taken of the RP. Reference point elevations have been determined for all wells that are currently in a monitoring program; this data is listed in Appendix A.

A reference point will be determined for any new wells that are brought into the CASGEM network. Reference point elevations are determined using a digital elevation model from the United States Geological Survey (USGS) with a cell size of 32 feet by 32 feet.

Figure 10 – Distribution of Seasonal High Groundwater Elevations by Month

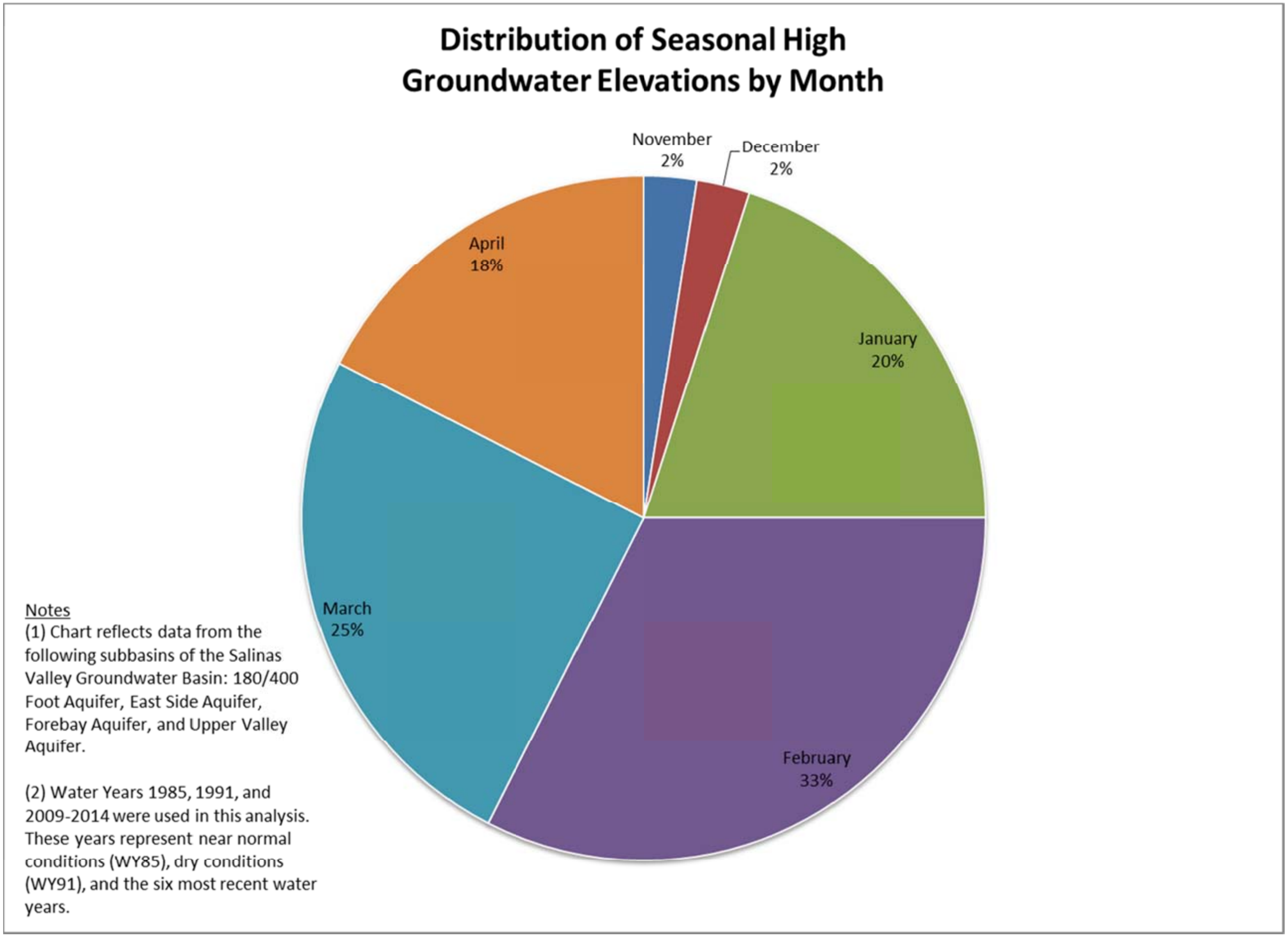
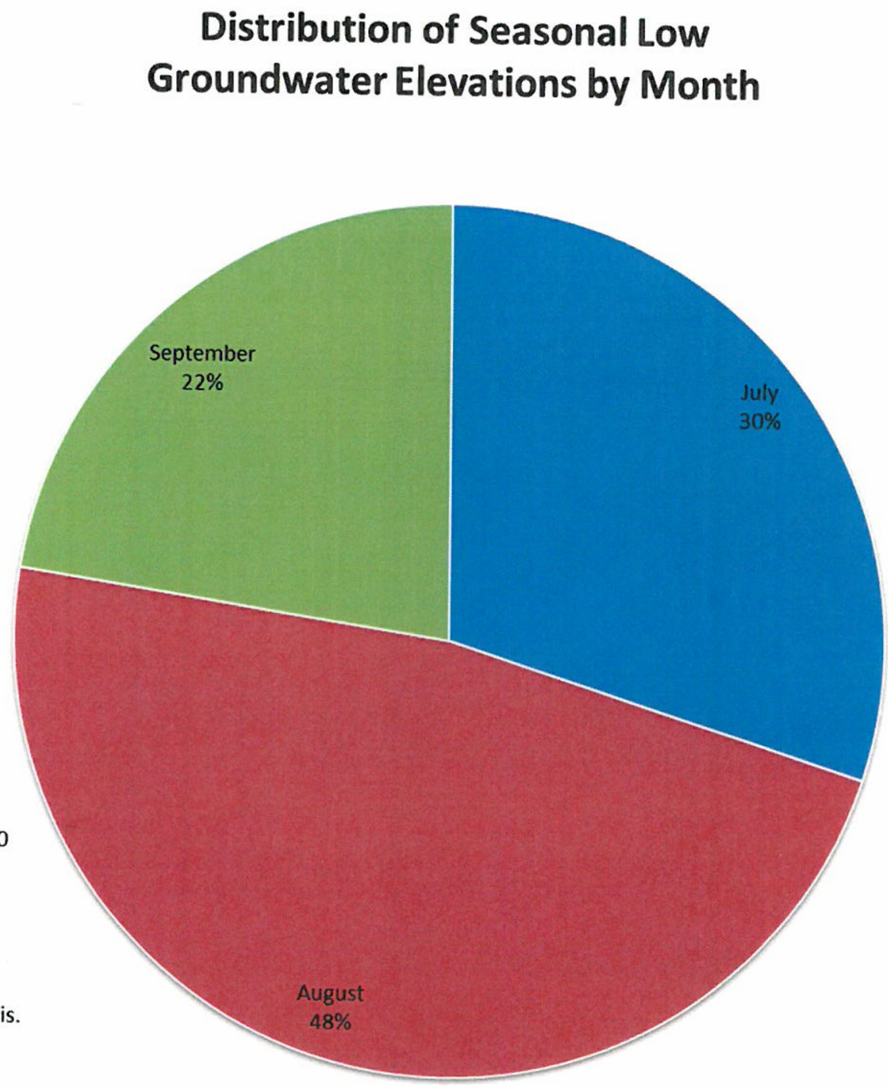


Figure 11 – Distribution of Seasonal Low Groundwater Elevations by Month



Notes

(1) Chart reflects data from the following subbasins of the Salinas Valley Groundwater Basin: 180/400 Foot Aquifer, East Side Aquifer, Forebay Aquifer, and Upper Valley Aquifer.

(2) Water Years 1985, 1991, and 2009-2014 were used in this analysis. These years represent near normal conditions (WY85), dry conditions (WY91), and the six most recent water years.

4.4 Field Methods

Groundwater elevation data collected from wells in the CASGEM network is intended to reflect static conditions. Best efforts will be made to ensure that wells have not recently been pumped prior to collecting a data point. Depth to water measurements will be made using one or more of the methods discussed in the following sections. Measurement methods described in the following sections are based on the Department of Water Resources document *Groundwater Elevation Monitoring Guidelines* (December 2010) with some alterations specific to wells in the monitored basins/subbasins described in this Monitoring Plan.

4.4.1 Graduated steel tape

Prior to measurement:

- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Review the notes and comments for previous measurements in the field data collection notebook to determine if there are any unique circumstances at this well.
- Take note of whether oil has previously been present at this well; this will be recorded in the comments section of the data form.

Making a measurement:

- Use the previous depth to water measurement to estimate a length of tape that will be needed.
- Lower the tape into the well, feeling for a change in the weight of the tape, which typically indicates that either (a) the tape has reached the water surface or (b) the tape is sticking to the side of the well casing.
- Continue lowering the tape into the well until the next whole foot mark is at the reference point. This value on the tape should be recorded in the field data collection notebook.
- Bring the tape to the surface and record the number of the wetted interval to the nearest foot.
- If an oil layer is present, read the tape at the top of the oil mark to the nearest foot. Note in the comments section of the data form that oil was present.
- Repeat this procedure a second time and note any differences in measurement in the field data collection notebook.

4.4.2 Electric water level meter

This method of measurement employs a battery-powered water level meter and a small probe attached to a ruled length of cable. Depth to water measurements collected using this equipment are recorded to the nearest tenth of an inch. This instrument is sometimes referred to as a "sounder".

Prior to measurement:

- Review the field data sheet for the well and note whether oil has been present at this well in the past. The electric water level meter should not be used in wells where oil is present.
- Ensure that the reference point on the well can be clearly determined. Check notes in the field data collection notebook.
- Confirm that the water level meter is functioning and is turned on so that the beeping indicator will operate properly.

Making a measurement:

- Review previous depth to water measurements for the well to estimate the length of tape that will be needed.
- Lower the electrode into the well until the indicator sounds, showing the probe is in contact with the water surface.
- Place the tape against the reference point and read the depth to water to the nearest 0.1 foot. Record this value on the field data sheet.
- Make a second measurement and note any differences in measurement in the field data collection notebook.

4.4.3 Sonic water level meter

This meter uses sound waves to measure the depth to water in a well. The meter must be adjusted to the air temperature outside the well; there is a card with reference temperatures in the case with the sonic meter.

Making a measurement:

- Insert the meter probe into the access port and push the power-on switch. Record the depth from the readout.
- Record the depth to water measurement in the field data collection notebook.

4.4.4 Pressure transducer

Automated water-level measurements are made with a pressure transducer attached to a data logger. Pressure transducers are lowered to a depth below the water level in the well and fastened to the well head at a reference point. Data points are logged on an hourly basis. MCWRA uses factory-calibrated, vented pressure transducers (Appendix D). MCWRA staff collects the pressure transducer data once per quarter. During the data collection process, data loggers are stopped, and the data is downloaded onto a laptop, and then the data logger is reactivated and scheduled to begin collecting data again on the next hour. Upon return from the field, data is processed and reviewed for errors.

4.5 Data Collection, Processing, and Reporting

Following completion of all fieldwork, data is transcribed from field data sheets and checked for errors before being loaded into MCWRA's Oracle platform database. All data will be stored in the MCWRA database before being uploaded to the CASGEM website. Submittal of data to the CASGEM website will occur at a minimum of twice per year, no later than January 1 and July 1, per DWR CASGEM program guidelines.

Bi-annual submittal of data to the CASGEM website will include the following for each well in the CASGEM network, as described in the DWR document *CASGEM Procedures for Monitoring Entity Reporting*:

- Well identification number
- Measurement date
- Reference point and land surface elevation, in feet, using NAVD88 vertical datum
- Depth to water, in feet
- Method of measuring water depth
- Measurement quality codes
- Measuring agency identification
- Comments about measurement, if applicable

The following information will also be submitted to the CASGEM online system, as it is required by DWR unless otherwise noted:

- Monitoring Entity name, address, telephone number, contact person name and email address, and any other relevant contact information
- Groundwater basins being monitored (both entire and partial basins)
- State Well Identification number (recommended)
- Decimal latitude/longitude coordinates of well (NAD83)
- Groundwater basin or subbasin
- Reference point elevation of the well, in feet, using NAVD88 vertical datum
- Elevation of land surface datum at the well, in fee, using NAVD88 vertical datum
- Use of well
- Well completion type (e.g. single well, nested well, or multi-completion well)
- Depth of screened interval(s) and total depth of well, in feet, if available
- Well Completion Report number (DWR Form 188), if available

5.0 References

Department of Water Resources, 2010. *California Statewide Groundwater Elevation Monitoring (CASGEM) Program Procedures for Monitoring Entity Reporting*.

Department of Water Resources, 2010. *Groundwater Elevation Monitoring Guidelines*.

Fugro West, Inc., 1995. *North Monterey County Hydrogeologic Study, Volume I, Water Resources*.

Geosyntec Consultants, 2007. *El Toro Groundwater Study, Monterey County, California*.

Kennedy/Jenks Consultants, 2004. *Final Report - Hydrostratigraphic Analysis of the Salinas Valley*.

San Luis Obispo County Flood Control & Water Conservation District, 2014. *CASGEM Monitoring Plan for High and Medium Priority Groundwater Basins in the San Luis Obispo County Flood Control and Water Conservation District.*

Showalter, P., Akers, J.P., and Swain, L.A., 1983, Design of a ground-water quality monitoring network for the Salinas River Basin, California: U.S. Geological Survey Water-Resources Investigation Report 83-4049, 74 p.

This page intentionally left blank.

Appendix A

This page intentionally left blank.

MONTEREY COUNTY

WATER RESOURCES AGENCY

PO BOX 930
SALINAS , CA 93902
(831)755-4860
FAX (831) 424-7935

DAVID E. CHARDAVOYNE
GENERAL MANAGER

STREET ADDRESS
893 BLANCO CIRCLE
SALINAS, CA 93901-4455

David Eisen
United States Army Corps of Engineers
Fort Ord BRAC Office
PO Box 5008
Monterey, CA 93944-504

February 13, 2015

Dear Mr. Eisen:

On behalf of the Monterey County Water Resources Agency (MCWRA) I am writing to request the U.S. Army Corps of Engineers' voluntary participation in the California Statewide Groundwater Elevation Monitoring (CASGEM) program.

On November 4, 2009, the State Legislature amended the California Water Code with Senate Bill SBx7-6, which resulted in development of the CASGEM program by the California Department of Water Resources (DWR). As part of the CASGEM program, MCWRA is the designated Monitoring Entity for certain groundwater basins in Monterey County, including the Salinas Valley Groundwater Basin.

The U.S. Army Corps of Engineers (USACE) owns multiple parcels of land, specifically portions of the former Fort Ord, which are located in the Salinas Valley Groundwater Basin. MCWRA is seeking USACE's voluntary participation in the CASGEM program because the existing monitoring well network does not extend to this area of the groundwater basin.

MCWRA has no specific knowledge as to the location of monitoring wells on USACE property, so consent to participate in the CASGEM program would require disclosure of well information and either permission for MCWRA to access these wells or an arrangement wherein USACE would provide data to MCWRA. If USACE is considering participation, MCWRA can discuss this in more detail as needed.

As part of the CASGEM program, MCWRA would submit certain data about USACE wells to DWR for inclusion in a statewide database. The database will be available to the public for local and state entities to evaluate and monitor groundwater conditions. MCWRA will report the following to DWR for any well included in the CASGEM program:

- Depth to static (non-pumping) groundwater level, reported two times per year, beginning in 2015
- Approximate well location, within 1,000 feet of the actual well location
- Screened interval(s) and depth of the well as provided on the well log
- General category of well use (i.e. monitoring, public supply, domestic)

MCWRA sincerely appreciates your consideration of voluntary participation in the CASGEM program. Please feel free to contact MCWRA at 831-755-4860 if you have any questions. Additional information about the CASGEM program is also available from DWR at www.water.ca.gov/groundwater/casgem.

Regards,

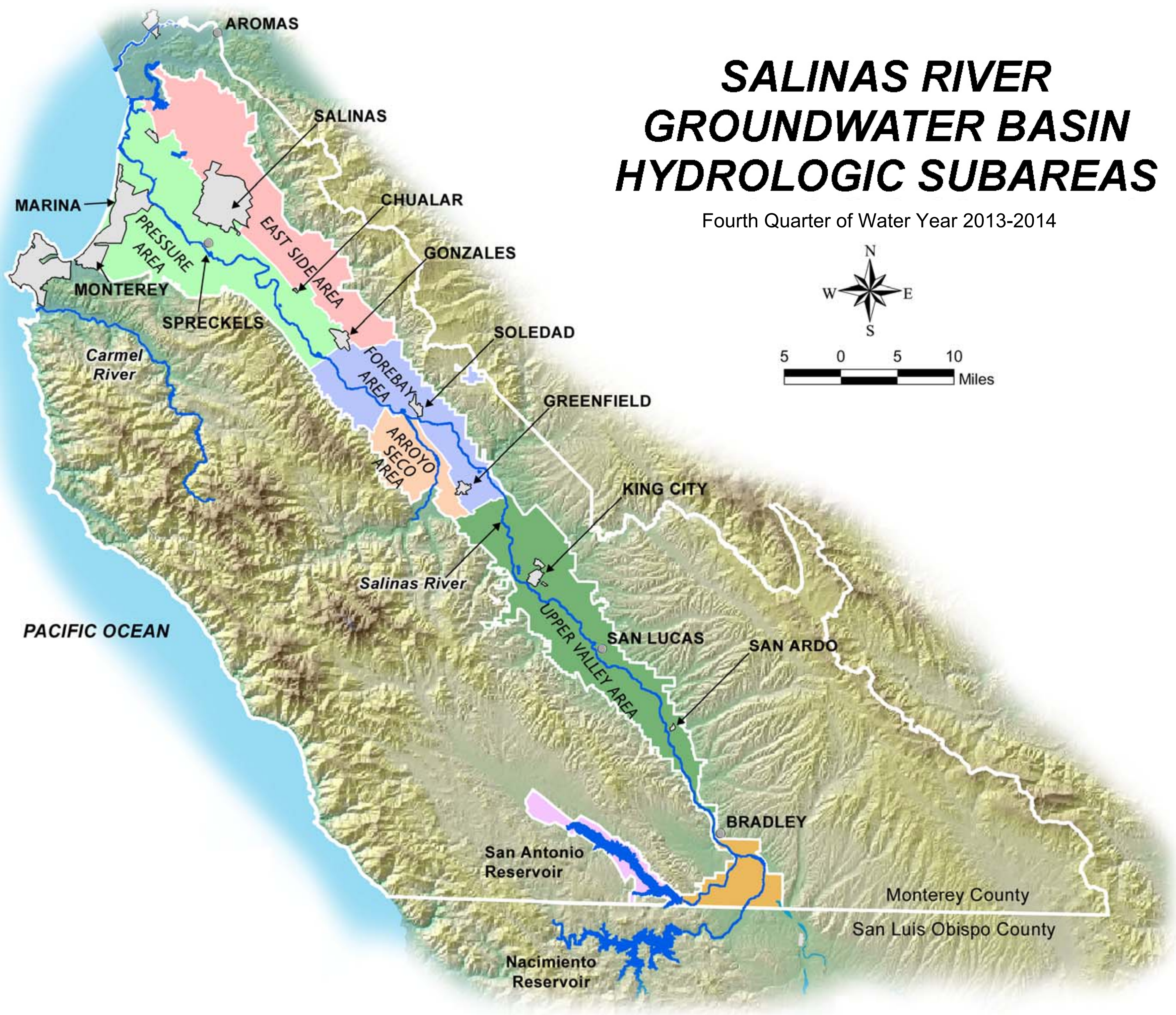
David E. Chardavoyne

David E. Chardavoyne
General Manager

Cc: California Department of Water Resources - C. Michael McKenzie, PG

Appendix B

This page intentionally left blank.



SALINAS RIVER
GROUNDWATER BASIN
HYDROLOGIC SUBAREAS
Fourth Quarter of Water Year 2013-2014
N
W
E
S
5
0
5
10
Miles
AROMAS
SALINAS
CHUALAR
GONZALES
SOLEDAD
GREENFIELD
KING CITY
SAN LUCAS
SAN ARDO
BRADLEY
MARINA
MONTEREY
SPRECKELS
PRESSURE AREA
EAST SIDE AREA
FOREBAY AREA
ARROYO SECO AREA
UPPER VALLEY AREA
Carmel River
Salinas River
PACIFIC OCEAN
San Antonio Reservoir
Nacimiento Reservoir
Monterey County
San Luis Obispo County

MONTEREY COUNTY WATER RESOURCES AGENCY
BOARD OF DIRECTORS

MEETING DATE:	October 27, 2014	**AGENDA ITEM:**	
AGENDA TITLE:	RECEIVE REPORT ON SALINAS VALLEY WATER CONDITIONS FOR THE FOURTH QUARTER OF WATER YEAR 2013-2014		
Consent (X)	**Action ( )**	**Information ( )**	
SUBMITTED BY: **PHONE:**	Robert Johnson 755-4860	**PREPARED BY:** **PHONE:**	Peter Kwiek, Jess Barreras 755-4860
DEADLINE FOR BOARD ACTION:	October 27, 2014		

RECOMMENDED BOARD ACTION:

Receive report on Salinas Valley water conditions for the fourth quarter of Water Year 2013-2014.

PRIOR RELEVANT BOARD ACTION:

A report was last presented to the Board on September 22, 2014, covering the third quarter of Water Year 2013-2014.

DISCUSSION/ANALYSIS:

This report covers the fourth quarter of Water Year 2013-2014 (WY14), July through September, 2014. It provides a brief overview of water conditions in the Salinas Valley with discussion of precipitation, reservoir storage, and ground water level trends. Data for each of these components are included as graphs and tables in Attachments A through I.

Precipitation – The fourth quarter of WY14 brought less than normal rainfall to Salinas and King City. Cumulative totals for the quarter were 0.11 inches (55% of normal rainfall for the quarter) at the Salinas Airport, while no measurable rainfall was logged in King City, which, on average, receives a total of 0.17 inches during the months of July through September.

Attachment A contains graphs for both stations showing monthly and cumulative precipitation data for the current and a normal water year. Tables with precipitation values shown on the graphs and percent of normal precipitation are also presented in Attachment A.

Rainfall data for Salinas and King City should be considered preliminary until verified by National Weather Service data at a later date.

Reservoirs - The following table compares fourth quarter storage at Nacimiento and San Antonio reservoirs for the past two years. Storage in Nacimiento Reservoir is 46,763 acre-feet lower than in September 2013, while storage in San Antonio Reservoir is 8,547 acre-feet lower.

Reservoir	**September 30, 2014 (WY14) Storage in acre-feet**	**September 30, 2013 (WY13) Storage in acre-feet**	**Difference in acre-feet**
Nacimiento	63,850	110,613	-46,763
San Antonio	12,266	20,813	-8,547

Graphs for both reservoirs showing daily storage for the last five water years and average daily storage are included as Attachments B and C.

Ground Water Levels – More than 80 wells are measured monthly throughout the Salinas Valley to monitor seasonal ground water level fluctuations. Data from approximately 50 of these wells is used in the preparation of this report. The measurements are categorized by hydrologic subarea, averaged, and graphed to compare current water levels with selected past conditions. Graphs for individual subareas, showing the current year's water level conditions, last year's conditions (WY13), dry conditions (WY91), and near-normal conditions (WY85), are found in Attachments D through H. Attachment I is a summary of water level changes for all subareas.

Ground water level measurements indicate that, by the end of the fourth quarter of WY14, water levels were recovering in the Pressure and East Side Subareas, but not in the Forebay or Upper Valley Subareas. Over the past month, average ground water levels rose by four feet in the Pressure 180-Foot Aquifer, two feet in the Pressure 400-Foot Aquifer, and one foot in the East Side Subarea while declining by two feet in the Forebay Subarea and one foot in the Upper Valley Subareas.

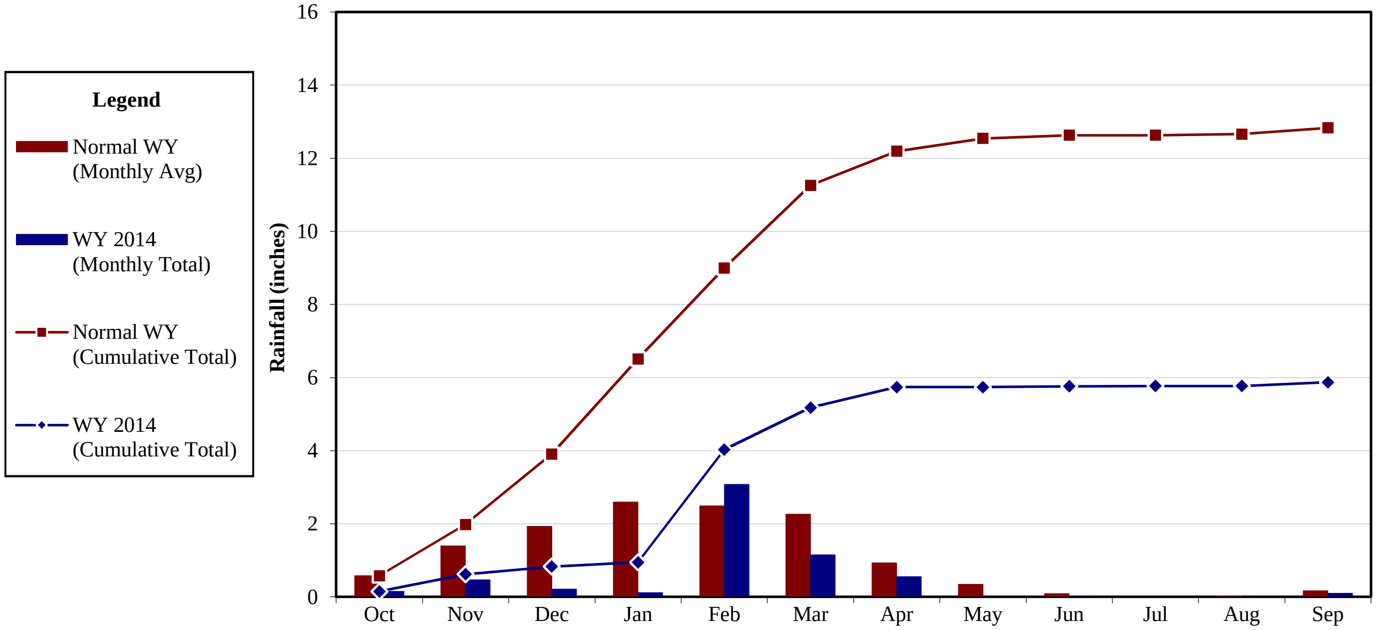
Compared to September 2013, average ground water levels in September 2014 were eight to twelve feet lower in all subareas, as shown in Attachment I.

When compared to WY85, which is considered to be a year of near normal ground water conditions, current water levels are 25 feet lower in the East Side Subarea, 10 feet lower in the Pressure 180-Foot Aquifer, eight feet lower in the Forebay Subarea and six feet lower in the Upper Valley Subarea. Water levels in the Pressure 400-Foot Aquifer are two feet higher than in WY85.

Average ground water levels for the fourth quarter of WY14 have fallen to WY91 levels in the Forebay Subarea, while falling below WY91 levels in both the East Side and Upper Valley Subareas. In the Pressure 180-Foot Aquifer, water levels equaled WY91 levels in August 2014 before recovering by two feet by the end of the quarter. By contrast, throughout the fourth quarter, water levels in the Pressure 400-Foot Aquifer remained eight to 10 feet higher than in WY91.

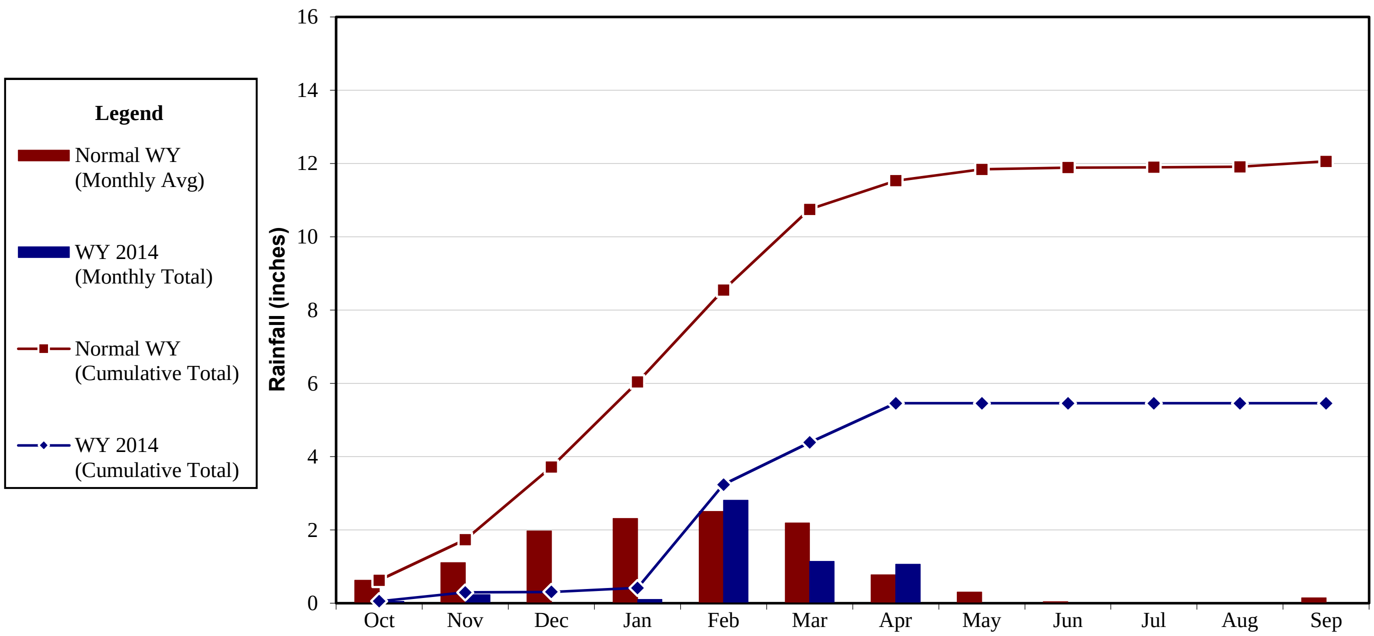
FINANCIAL IMPACT:	**YES ( )** **NO (X)**
FUNDING SOURCE:	
COMMITTEE REVIEW AND RECOMMENDATION:	None
ATTACHMENTS:	1. Salinas Valley Hydrologic Subareas Map 2. Salinas and King City Precipitation Graphs, Attachment A 3. Nacimiento and San Antonio Reservoir Graphs, Attachments B and C 4. Salinas Valley Monthly Water Level Graphs for Each Subarea, Attachments D through H 5. Generalized Ground Water Trends, Attachment I.
APPROVED:	______________________________ **General Manager** **Date**

SALINAS AIRPORT RAINFALL
WATER YEAR 2014



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Monthly Rainfall (WY 2014)	0.15	0.47	0.21	0.12	3.08	1.15	0.56	0.00	0.02	0.01	0.00	0.10
Monthly Rainfall (Normal WY*)	0.58	1.40	1.93	2.60	2.49	2.26	0.93	0.35	0.09	0.00	0.03	0.17
Percent of Normal for Month	26%	34%	11%	5%	124%	51%	60%	0%	22%	N/A	0%	59%
Cumulative Rainfall (WY 2014)	0.15	0.62	0.83	0.95	4.03	5.18	5.74	5.74	5.76	5.77	5.77	5.87
Cumulative Rainfall (Normal WY*)	0.58	1.98	3.91	6.51	9.00	11.26	12.19	12.54	12.63	12.63	12.66	12.83
Percent of Cumulative Normal	26%	31%	21%	15%	45%	46%	47%	46%	46%	46%	46%	46%

KING CITY RAINFALL
WATER YEAR 2014

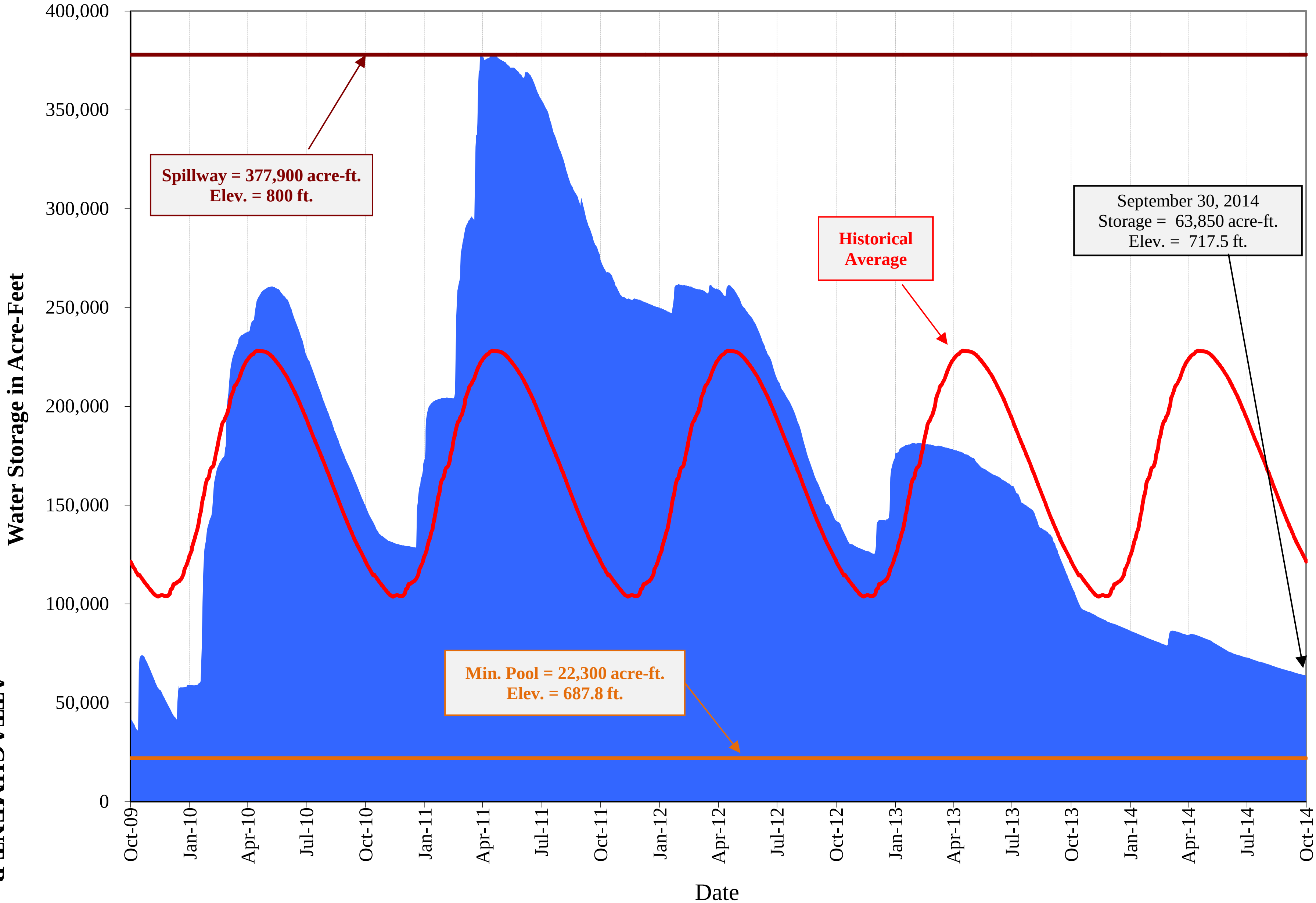


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Monthly Rainfall (WY 2014)	0.06	0.24	0.01	0.11	2.82	1.15	1.07	0.00	0.00	0.00	0.00	0.00
Monthly Rainfall (Normal WY*)	0.63	1.11	1.98	2.32	2.51	2.20	0.78	0.31	0.05	0.01	0.01	0.15
Percent of Normal for Month	10%	22%	1%	5%	112%	52%	137%	0%	0%	0%	0%	0%
Cumulative Rainfall (WY 2014)	0.06	0.30	0.31	0.42	3.24	4.39	5.46	5.46	5.46	5.46	5.46	5.46
Cumulative Rainfall (Normal WY*)	0.63	1.74	3.72	6.04	8.55	10.75	11.53	11.84	11.89	11.90	11.91	12.06
Percent of Cumulative Normal	10%	17%	8%	7%	38%	41%	47%	46%	46%	46%	46%	45%

*Average precipitation over the most recent 30-year period ending in a decade (1981-2010)

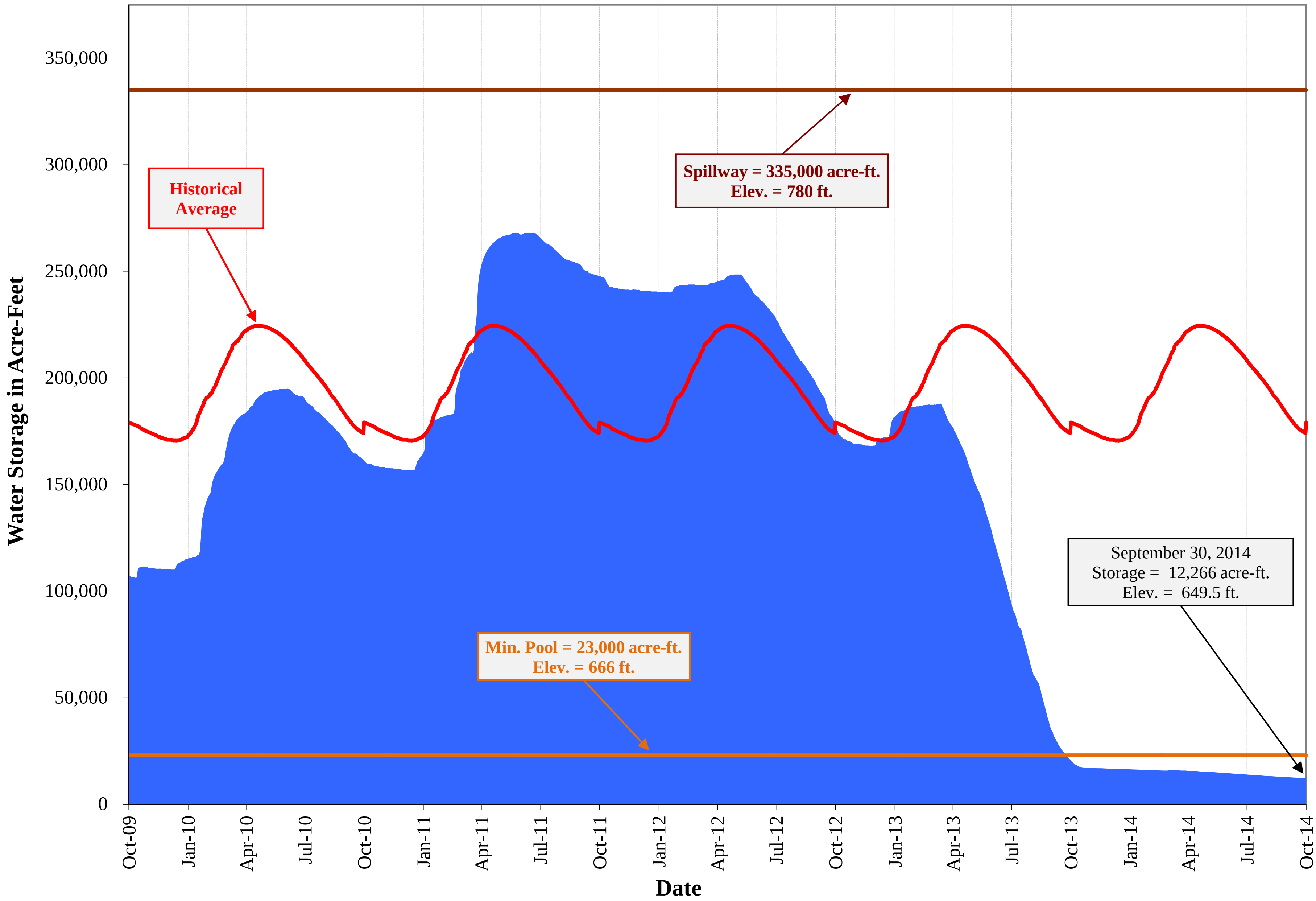
ATTACHMENT A

NACIMIENTO RESERVOIR
DAILY STORAGE



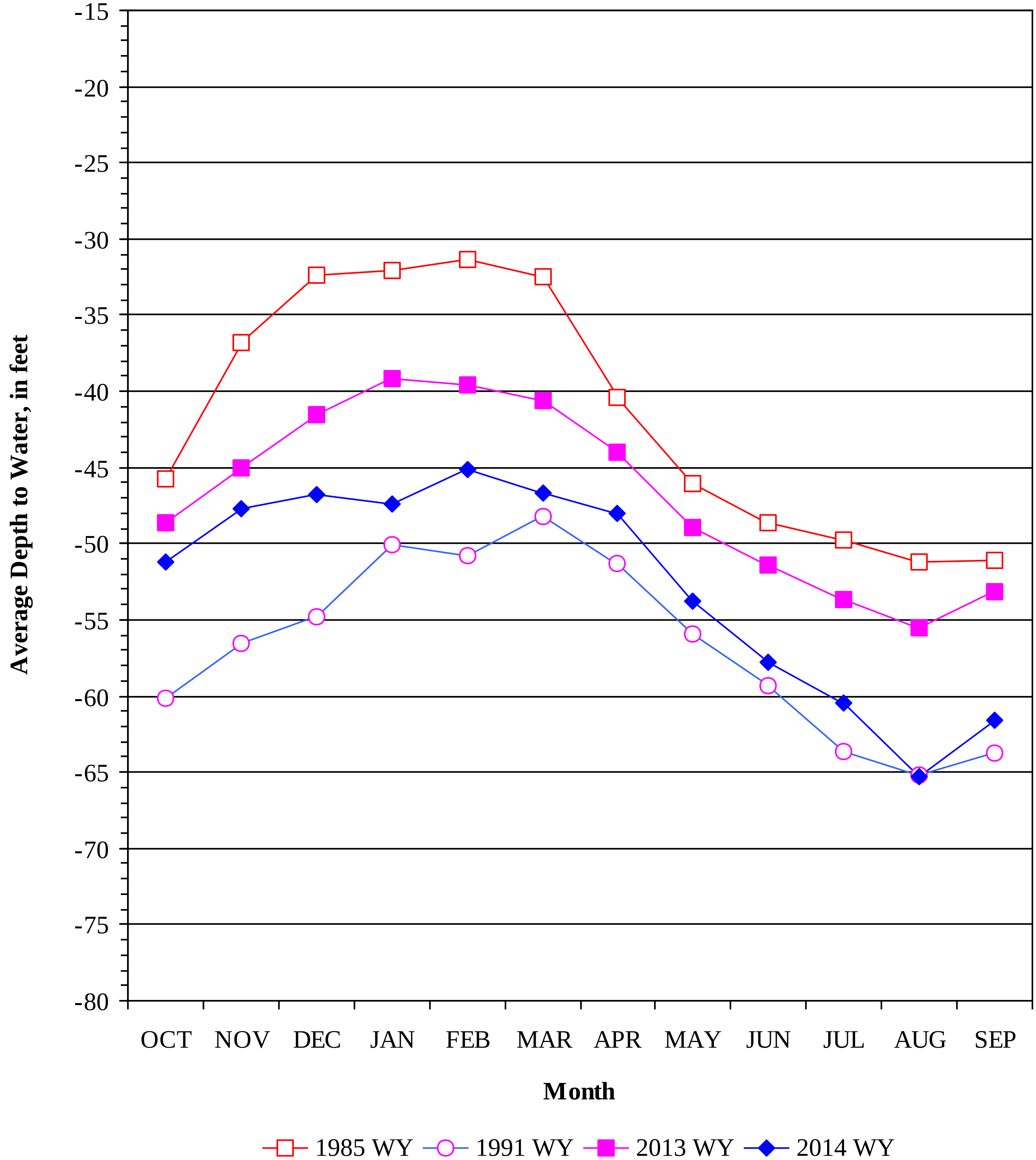
ATTACHMENT B

SAN ANTONIO RESERVOIR
DAILY STORAGE



ATTACHMENT C

HISTORIC GROUND WATER TRENDS
PRESSURE 180-FOOT AQUIFER
5 Wells

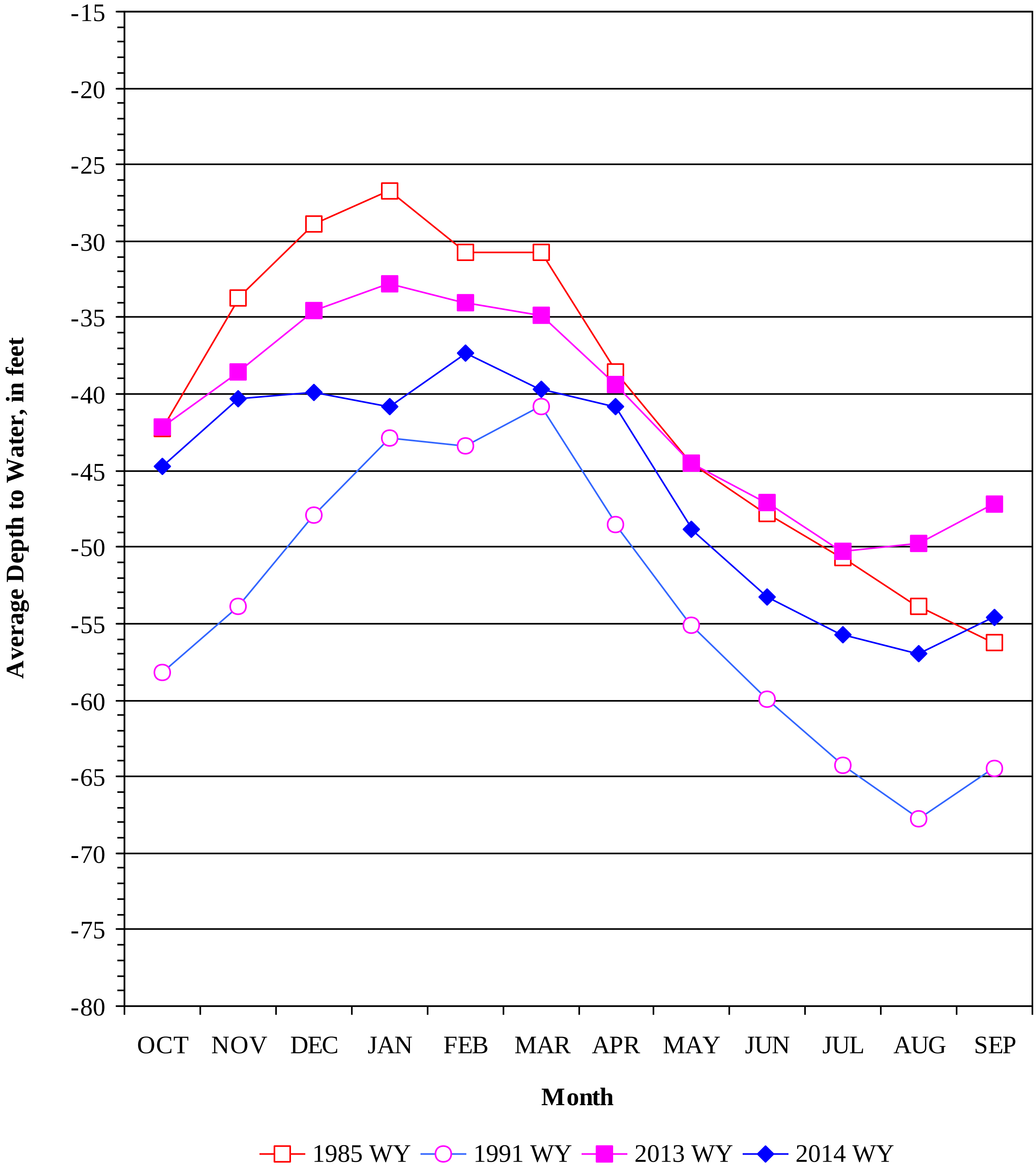


ATTACHMENT D

HISTORIC GROUND WATER TRENDS

PRESSURE 400-FOOT AQUIFER

11 Wells

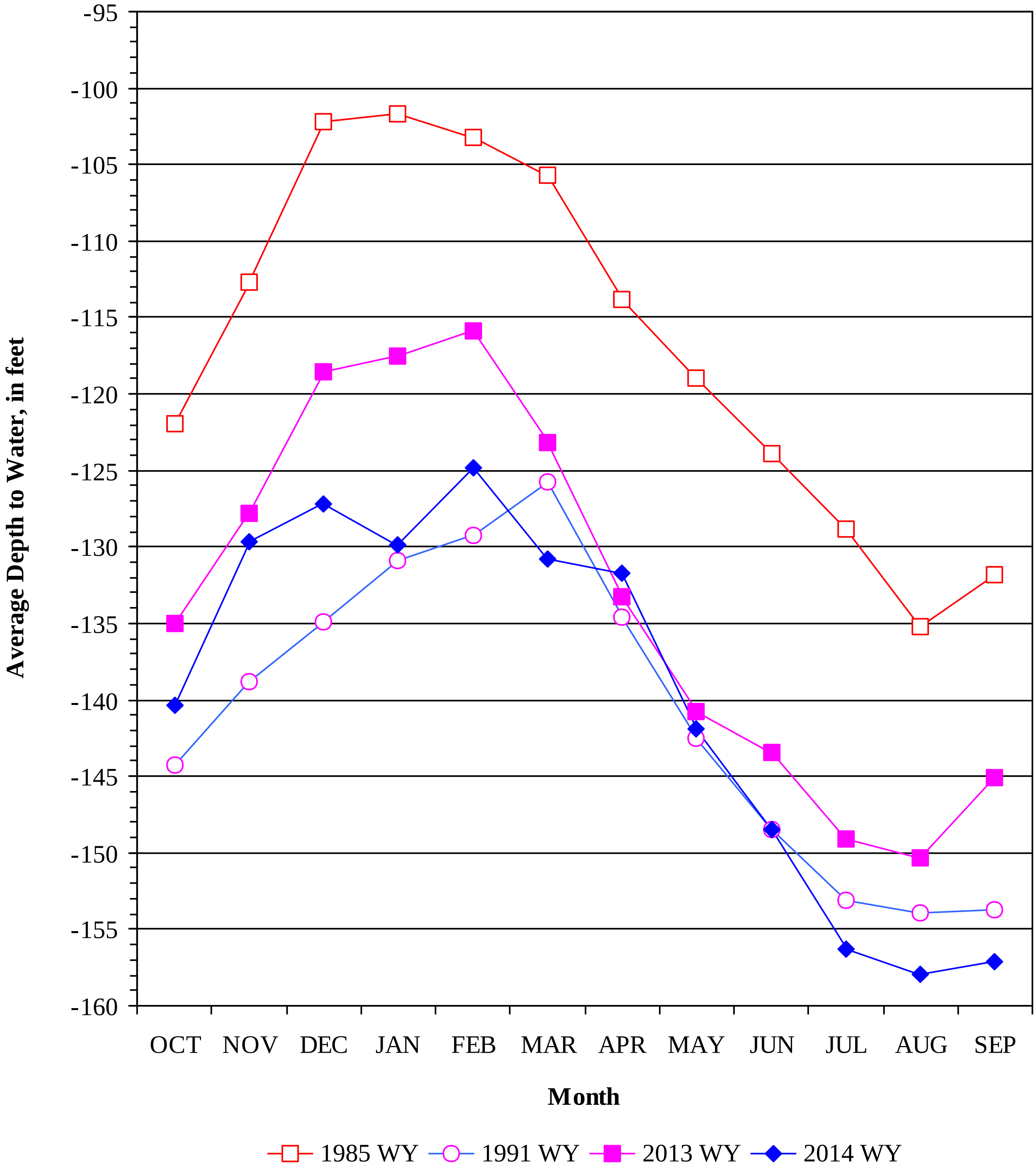


ATTACHMENT E

HISTORIC GROUND WATER TRENDS

EAST SIDE SUBAREA

11 Wells

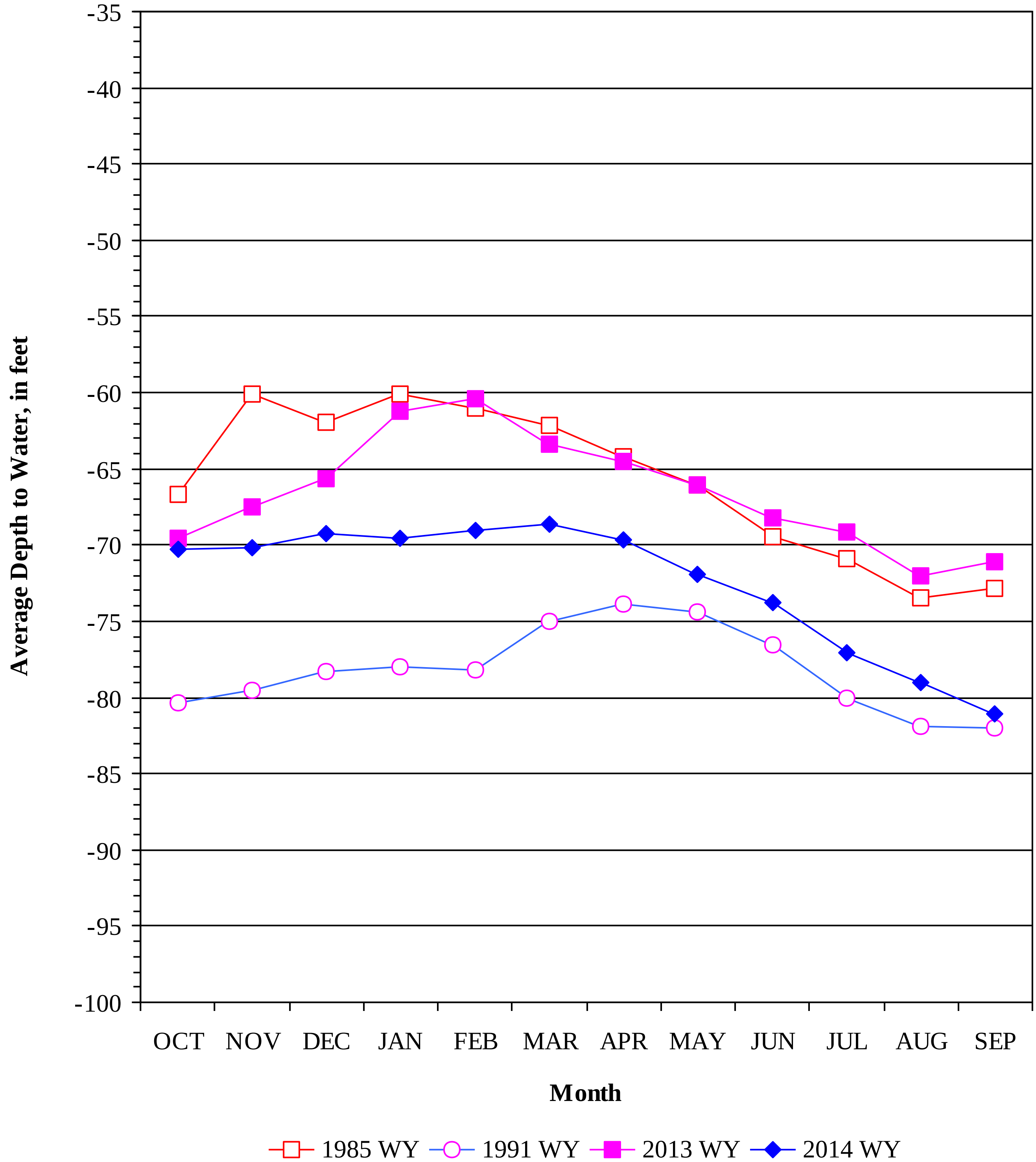


ATTACHMENT F

HISTORIC GROUND WATER TRENDS

FOREBAY SUBAREA

10 Wells

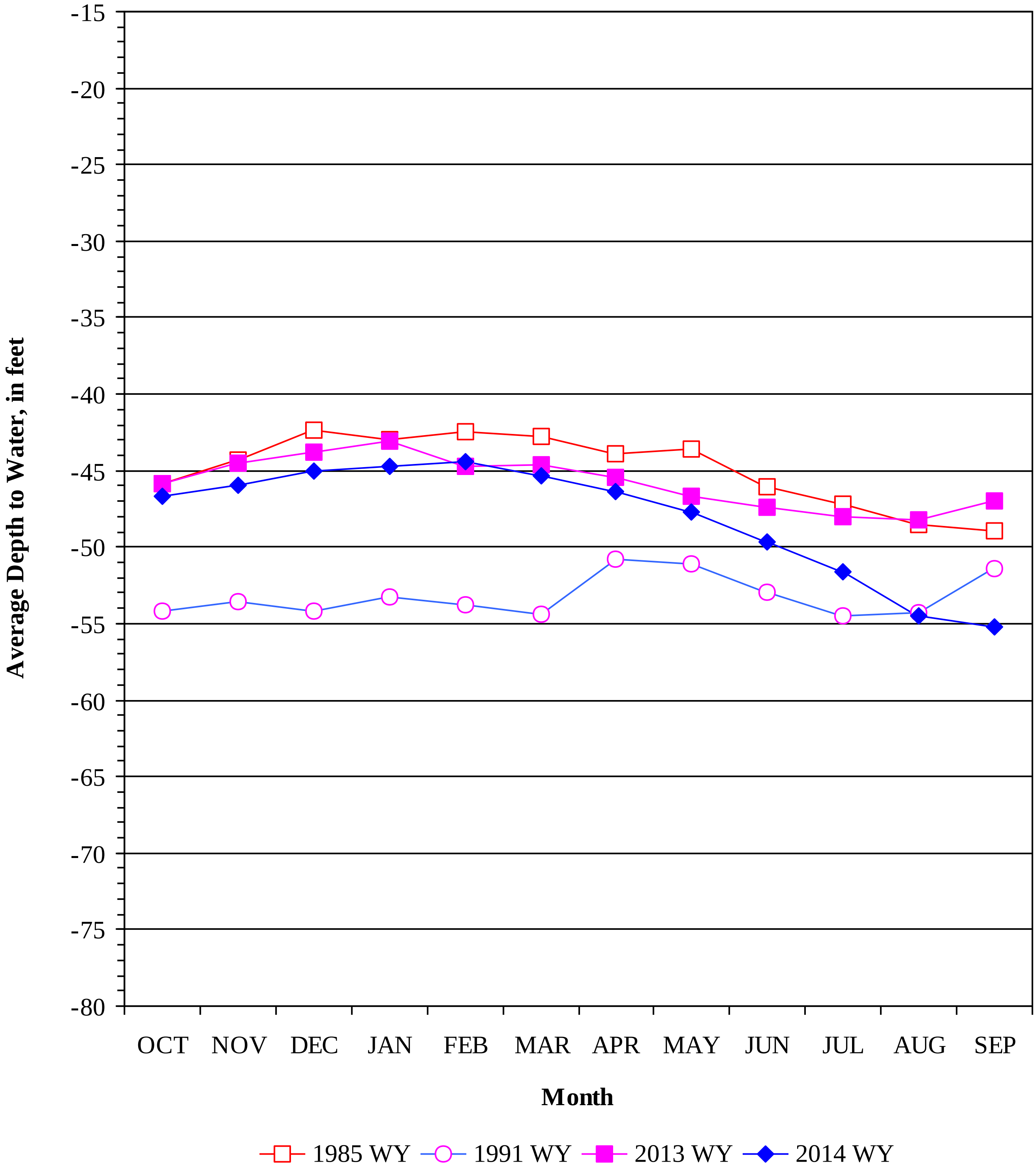


ATTACHMENT G

HISTORIC GROUND WATER TRENDS

UPPER VALLEY SUBAREA

9 Wells



ATTACHMENT H

Generalized Ground Water Trends
September 2014

Area	September 2014 Depth to Water	1 Year Change	Change From WY 1985	1 Month Change
Pressure 180-Foot Aquifer	62'	down 8'	down 10'	up 4'
Pressure 400-Foot Aquifer	55'	down 7'	up 2'	up 2'
East Side Subarea	157'	down 12'	down 25'	up 1'
Forebay Subarea	81'	down 10'	down 8'	down 2'
Upper Valley Subarea	55'	down 8'	down 6'	down 1'

September water levels, compared to last year, range from 12' lower to 7' lower.

September water levels, compared to WY 1985, range from 25' lower to 2' higher.

September changes in water levels over the last month range from 2' lower to 4' higher.

ATTACHMENT I

This page intentionally left blank.

Appendix C

This page intentionally left blank.

Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.01 180/400 Foot Aquifer	13S02E19Q003M	75	36.780798	-121.784687	18	not available	irrigation	single	1220-1550	1562	071658	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E21N001M	2432	36.784731	-121.761804	17.3	16.7	irrigation	single	369-550	550	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E21Q001M	SELA22633	36.781644	-121.751387	12.4	12.8	dedicated monitoring	single	105-155	157	E011401	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	13S02E32A002M	10161	36.765339	-121.763589	10.6	not available	irrigation	single	300-600	600	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E03F003M	ESPB22635	36.745480	-121.739493	28.2	28.7	dedicated monitoring	single	420-450	455	E011400	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E03F004M	ESPA22636	36.745391	-121.739314	24.2	24.7	dedicated monitoring	single	154-204	205	E011399	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E08M002M	239	36.727523	-121.780250	14.6	13.5	irrigation	single	314-325, 367-399, 426-456	500	71883	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12B002M	RODA14455	36.734316	-121.695850	55.5	56.1	dedicated monitoring	single	210-260	265	338411	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12B003M	RODB14456	36.734282	-121.695864	55.9	56.1	dedicated monitoring	single	350-380	390	338410	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E12Q001M	1707	36.722108	-121.696473	64	62	domestic	single	273-280, 288-292	619	not available	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E26H001M	AMST22651	36.688875	-121.707934	37.7	38.1	dedicated monitoring	single	287-337	339	E011403	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S02E27A001M	MCFD22632	36.693296	-121.729435	24.7	25.1	dedicated monitoring	single	240-290	293	E011398	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E18C001M	BORA15009	36.720722	-121.680556	54.8	55.1	dedicated monitoring	single	165-215	225	201242	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E18C002M	BORB15010	36.720736	-121.680531	54.9	55.1	dedicated monitoring	single	270-320, 365-385	395	201241	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	14S03E30G008M	MKTC22650	36.686880	-121.678517	44.3	44.8	dedicated monitoring	single	240-290	293	E011402	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E16F002M	1862	36.629202	-121.647449	59.5	58.5	irrigation	single	427-445, 485-570	592	81037	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E16M001M*	1359	36.624978	-121.653213	59.5	58.2	irrigation	single	not available			monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	15S03E17M001M	1480	36.626540	-121.669184	49.2	47.6	irrigation	single	128-160, 165-180	271	25902	monthly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E08H003M	CHEB21205	36.555033	-121.546546	91.5	88.9	dedicated monitoring	nested	240-290	295	491023	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E08H004M	CHEA21208	36.555022	-121.546558	90.6	88.8	dedicated monitoring	nested	85-135	140	491023	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	16S04E15D001M	BRME10389	36.544407	-121.522009	102	103.3	dedicated monitoring	single	170-189, 314-358	384	100604	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	17S05E06C001M	GZWB21201	36.488323	-121.468404	119.7	120.1	dedicated monitoring	nested	250-290	300	491020	hourly	(1) August (2) Jan. to Mar.
3-4.01 180/400 Foot Aquifer	17S05E06C002M	GZWA21202	36.488324	-121.468395	119.7	120.105	dedicated monitoring	nested	60-110	115	491020	hourly	(1) August (2) Jan. to Mar.

Notes
ft = feet
ft-bgs = feet below ground surface
* = voluntary well

Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.02 East Side Aquifer	14S03E15H003M	752	36.717412	-121.622173	126	not available	irrigation	single	200-775	784	38491	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E25C001M	FALB22618	36.692754	-121.594058	143.8	144.2	dedicated monitoring	single	570-670	680	773476	hourly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E25C002M	FALA22619	36.692725	-121.594032	143.8	144.2	dedicated monitoring	single	175-195, 240-260, 300-360	370	768985	hourly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S03E27B001M	15126	36.690611	-121.624200	42	42	Irrigation	single	60-335	348	not available	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	14S04E31Q002M	806	36.666105	-121.569391	104	103	irrigation	single	250-390, 400-550, 580-640, 690-710	710	552493	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	15S04E06R001M	1726	36.651722	-121.566933	93.7	92.5	irrigation	single	190-270, 345-390, 430-776	786	not available	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E27G001M	2519	36.512244	-121.407957	272	271.5	irrigation	single	281-322, 368-410, 512-543, 565-631, 694-757, 793-930, 966-1,091	1,122	50822	monthly	(1) August (2) Jan. to Mar.
3-4.02 East Side Aquifer	16S05E28D001M	871	36.516669	-121.432772	169	168	irrigation	single	200-215, 242-368, 408-425, 448-460, 480-508, 639-695, 754-762, 798-808	832	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E19D001M*	1485	36.442444	-121.368184	170	170	irrigation	single	not available	170	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E33R001M	VidaDeep21209	36.404756	-121.316169	197.4	198.0	dedicated monitoring	nested	200-250	260	491019	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	17S06E33R002M	VidaShallow21210	36.404723	-121.316163	197.6	198.0	dedicated monitoring	nested	50-115	120	491019	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B002M	LosCochesC18449	36.356198	-121.303324	227.4	227.9	dedicated monitoring	nested	510-580	590	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B003M	LosCochesB21066	36.356178	-121.303292	228.5	229.0	dedicated monitoring	nested	220-270	280	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E22B004M	LosCochesA21314	36.356206	-121.303260	227.8	228.3	dedicated monitoring	nested	40-90	95	490996	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E24M001M	HUD B18467	36.348507	-121.275550	232.5	233.0	dedicated monitoring	nested	193-243	253	490994	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E24M002M	HUD A21067	36.348475	-121.275639	232.5	233.0	dedicated monitoring	nested	70-120	130	490994	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E25F001M*	1495	36.335895	-121.274486	254.5	not available	irrigation	single	not available	120	not available	monthly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E35F001M	THNB18502	36.325857	-121.286318	265.6	266.1	dedicated monitoring	nested	198-248	258	490995	hourly	(1) August (2) Jan. to Mar.
3-4.04 Forebay Aquifer	18S06E35F002M	THNA21068	36.325833	-121.286378	265.7	266.1	dedicated monitoring	nested	60-110	120	490995	hourly	(1) August (2) Jan. to Mar.

Notes
ft = feet
ft-bgs = feet below ground surface
* = voluntary well

Table C.1 - CASGEM Network Well Data Summary

Associated Basin/Subbasin	State Well Identification Number	Local Well Designation	Latitude	Longitude	Reference Point Elevation (NAVD88, ft)	Ground Surface Elevation (NAVD88, ft)	Well Use	Well Completion Type	Depth of Screened Interval (ft-bgs)	Total Depth (ft-bgs)	Well Completion Report Number (DWR Form 188)	Frequency of Measurements	Timing of Measurements to be Submitted
3-4.05 Upper Valley Aquifer	19S08E19K003M	1379	36.261416	-121.143185	282	not available	irrigation	single	130-178	212	114600	monthly	(1) August (2) Jan. to Mar.
3-4.05 Upper Valley Aquifer	20S08E14K001M	1735	36.190341	-121.071326	347.2	not available	irrigation	single	115-145, 148-205	236	43828	monthly	(1) August (2) Jan. to Mar.
3-4.05 Upper Valley Aquifer	23S10E03H001M	SArdoN19447	35.959280	-120.871501	463.6	461	dedicated monitoring	single	72-132	142	490983	monthly	(1) August (2) Jan. to Mar.
3-4.06 Paso Robles Area	23S10E14D001M	SArdoS19450	35.936241	-120.866068	465.8	463.1	dedicated monitoring	single	72-132	142	490086	monthly	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E15P001M	13572	36.795258	-121.63002	365.1	364	domestic	single	300-430	430	199702	biannual	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E16J001M	13625	36.801055	-121.641165	270	270	domestic	single	104-244	252	38447	biannual	(1) August (2) Jan. to Mar.
3-4.09 Langley Area	13S03E22F001M	13950	36.790570	-121.626689	236.2	235	domestic	single	260-270, 280-290, 310-320	334	22780	biannual	(1) August (2) Jan. to Mar.
3-4.10 Corral de Tierra Area	16S02E01M001M	16797	36.568031	-121.707315	406	405	domestic	single	80-120, 160-180	294	43634	biannual	(1) August (2) Jan. to Mar.
3-4.10 Corral de Tierra Area	16S02E02G001M	16820	36.570536	-121.713413	371	370	domestic	single	320-340, 360-440	448	38099	monthly	(1) August (2) Jan. to Mar.

Notes
ft = feet
ft-bgs = feet below ground surface
* = voluntary well

Appendix D

This page intentionally left blank.

In-Situ Inc.

Innovations in Water Monitoring

Level **TROLL**® 400, 500 & 700 Data Loggers

Get water level data the way you want it, when you want it with industry-leading water level/pressure and temperature data loggers. By partnering with In-Situ® Inc., you receive durable Level TROLL® Data Loggers that provide years of service, accurate results, intuitive software, and real-time functionality.

Be Effective

- **Increase productivity:** Reduce training and installation time with In-Situ Inc.'s intuitive software platform and integrated components. Patented twist-lock connectors, included on Level TROLL Loggers and RuggedCable® Systems, ensure error-free deployments.
- **Set up real-time networks:** Access data 24/7 and receive event notifications when you connect data loggers to telemetry systems, radios, or other third-party data collection platforms. Control gates, pumps, alarms, and other equipment by using built-in Modbus/RS485, SDI-12, or 4-20 mA communication protocols.
- **Streamline analysis and reporting**: Automate water level corrections and post-processing, graph data, and accelerate report generation with Win-Situ® Software. Easily export data to Excel®, a web-based management service, or data analysis software.

Be Reliable

- **Deploy in all environments:** Install loggers in fresh water, saltwater, and contaminated waters. Solid titanium, sealed construction outperforms and outlasts specially-coated data loggers.
- **Log accurate data:** Get optimal accuracy under all operating conditions. Sensors undergo NIST®-traceable factory calibration across the full pressure and temperature range. For applications requiring the highest levels of accuracy, use a vented (gauged) system.
- **Get long-lasting operation:** Reduce trips to the field with low-power loggers that typically operate for 10 years.

Be In-Situ

- Receive **free**, 24/7 technical support and online resources.
- Order data loggers and accessories from the In-Situ e-store.
- Get guaranteed 7-day service for maintenance (U.S.A. only).

Applications

- Aquifer characterization: slug tests & pumping tests
- Coastal: tide/harbor levels & wetland/estuary research
- Hydrologic events: crest stage gages, storm surge monitoring, & flood control systems
- Long-term, real-time groundwater & surface water monitoring
- Mining & remediation

Level TROLL® 400, 500 & 700 Data Loggers

General	*Level TROLL 400*	*Level TROLL 500*	*Level TROLL 700*	*BaroTROLL*
Temperature ranges[1]	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)
Diameter	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)	1.83 cm (0.72 in.)
Length	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)	21.6 cm (8.5 in.)
Weight	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)
Materials	Titanium body; Delrin® nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone
Output options	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA
Battery type & life[2]	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings
External power	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
Memory *Data records*[3] *Data logs*	2.0 MB 130,000 50	2.0 MB 130,000 50	4.0 MB 260,000 50	1.0 MB 65,000 2
Log types	Linear, Fast Linear, and Event	Linear, Fast Linear, and Event	Linear, Fast Linear, Linear Average, Event, Step Linear, True Logarithmic	Linear
Fastest logging rate	2 per second	2 per second	4 per second	1 per minute
Fastest output rate	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second	Modbus: 2 per second SDI-12 & 4-20 mA: 1 per second
Real-time clock	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period
Sensor Type/ Material	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium
Range	*Absolute (non-vented)* 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft)	*Gauged (vented)* 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	*Absolute (non-vented)* 30 psia: 11 m (35 ft) 100 psia: 60 m (197 ft) 300 psia: 200 m (658 ft) 500 psia: 341 m (1120 ft) 1000 psia: 693 m (2273 ft) *Gauged (vented)* 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	30 psia (usable up to 16.5 psi; 1.14 bar)
Burst pressure	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Vaccum/over-pressure above 16.5 psi damages sensor
Accuracy @ 15° C[4]	±0.05% full scale (FS)	±0.05% FS	±0.05% FS	±0.05% FS
Accuracy (FS)[5]	±0.1% FS	±0.1% FS	±0.1% FS	±0.1% FS
Resolution	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better
Units of measure	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH_2O, inH_2O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH_2O, inH_2O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH_2O, inH_2O Level: in., ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH_2O, inH_2O
Temperature Sensor	Silicon	Silicon	Silicon	Silicon
Accuracy & resolution	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better
Units of measure	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit
Warranty[6]	3 years	3 years	3 years	3 years
Notes	[1] Temperature range for non-freezing liquids. [2] Typical battery life when used within the factory-calibrated temperature range. [3] 1 data record = date/time plus 2 parameters logged (no wrapping) from device within the factory-calibrated temperature range. [4] Across factory-calibrated pressure range. [5] Across factory-calibrated pressure and temperature ranges. [6] Up to 5-year (total) extended warranties are available for all sensors—call for details. Delrin is a registered trademark of E.I. du Pont de Nemours and Company.			

Every Application & Budget

Use maintenance-free, non-vented systems for long-term monitoring and at flood-prone or high-humidity sites.

Use high-accuracy, vented systems to conduct aquifer tests and to view barometrically compensated water level data in real time.

Forgot to set a level reference at the beginning of a deployment? Automate level corrections by using Win-Situ Software's post-level correction Wizard.

BaroTROLL® Data Logger

Using a non-vented system? Collect barometric pressure and temperature data with a titanium BaroTROLL Data Logger in order to compensate data for barometric pressure fluctuations.

Calculating barometric efficiency? Use the BaroTROLL Logger with vented systems.

Win-Situ® Baro Merge® Software automates post correction of water level data.

Specifications are subject to change without notice.

In-Situ Inc.

Call to purchase or rent—www.in-situ.com

221 East Lincoln Avenue, Fort Collins, Colorado, U.S.A. 80524
1-800-446-7488 (toll-free in U.S.A. and Canada)
1-970-498-1500 (U.S.A. and international)

Appendix 7-B

MPWMD CASGEM Monitoring Plan

Monterey Peninsula Water Management District

CASGEM Monitoring Plan

April 18, 2012

Contents

Figures

Tables

Introduction

The Monterey Peninsula Water Management District (MPWMD or District) is participating in the California Statewide Groundwater Elevation Monitoring Program (CASGEM) which is administered by the Department of Water Resources (DWR). This groundwater monitoring plan lays the foundation for this monitoring effort and provides information on the wells to be sampled, monitoring schedule, and the characteristics of the groundwater basins. This plan contains two parts because MPWMD will be providing monitor well data from the Seaside Groundwater Basin as well as the Carmel Valley Alluvial Aquifer under the CASGEM.

Regional Geologic Setting for the Seaside Groundwater Basin

Water Bearing Formations

The Seaside Groundwater Basin consists of a sedimentary sequence of water-bearing materials that overlie the relatively impermeable Monterey Formation of Miocene age and older crystalline rocks. From oldest to youngest, the water-bearing units of the Seaside Basin are the Miocene Santa Margarita Sandstone (Tsm), the Tertiary and Quaternary "continental deposits" (QTc), and the Pleistocene and Holocene Aromas Sand and Older Dunes (Qe and Qt) (Yates and others 2005 and GTC 1986).

The Santa Margarita Sandstone corresponds to the "Santa Margarita Aquifer" and is a loose to weakly-cemented, marine sandstone with stratigraphic thickness up to approximately 300 feet. The upper portion of this deposit is medium-grained clean sand. With increasing depth and proximity to the underlying Monterey Formation, the clay content of the unit increases (Yates and others 2005).

The continental deposits correspond to the "Paso Robles Aquifer" and consist of a complex sequence of interbedded sand, gravel, and clay deposits. These deposits are more than 600 feet thick in some portions of the basin. The water-bearing portions of the continental deposits are thick lenses of sand and gravel of limited areal extent (Yates and others 2005).

The Aromas Sand and Older Dunes are surficial deposits that are of minor importance in the basin. The deposits are unconfined, in direct hydraulic communication with the ocean, and are only saturated in the extreme coastal portion of the basin (Yates and others 2005).

Surface outcrops within the area are limited primarily to alluvial sands and terrace deposits. Small areas of the Paso Robles and Santa Margarita Aquifers outcrop in the eastern portion of the Seaside Basin.

Monterey Peninsula Water Management District

Figure 1. Seaside Groundwater Basin CASGEM Monitor Wells, Seaside, Monterey County, California

)

Restrictive Structures

Structural deformation of the basin has resulted in varying thickness and depths of all of the geologic units across the basin (Yates and others 2005, GTC 1986, and DWR 1974). Basin structure is relatively well understood in the Laguna Seca and coastal subareas where production wells are numerous. Subsurface information in those areas reveals a complex arrangement of faults, anticlines, and synclines. Prominent among them is the Laguna Seca Anticline that uplifts the Monterey Formation and forms the boundary between the northern and southern subbasins. The Paso Robles and the Santa Margarita Aquifers thicken toward the eastern end of the southern subbasin as a result of a syncline. The Seaside and Ord Terrace faults create abrupt increases in basin thickness within the coastal parts of the southern and northern subbasins.

In the Seaside Basin, faults are associated with abrupt changes in basin thickness but appear to have little effect on groundwater flow where permeable units are present on both sides of the fault. All of the faults are steep normal or reverse faults, and most of them exhibit a combination of horizontal displacement (right-lateral) and vertical displacement (downthrown block on the north). All of them trend southeast-northwest. The Chupines fault forms the southern boundary of the basin where it juxtaposes relatively impermeable units of the Monterey Formation against the Santa Margarita Sandstone and continental deposits. The next fault to the north – the Seaside fault – passes obliquely through the southern subbasin. It is associated with as much as 500 feet of vertical displacement of the top of the Monterey Formation and it truncates the southern extent of the Santa Margarita Sandstone and continental deposits. Groundwater appears to flow freely across the Seaside fault in shallow aquifer horizons. Farther north, the Ord Terrace fault is similar to the Seaside fault, with as much as 450 feet of displacement of the top of the Monterey Formation. Neither the Seaside nor Ord Terrace faults are a significant barrier to groundwater flow.

The Seaside Basin does not appear to have a regional confining layer equivalent to the Salinas Valley Aquiclude that overlies the 180-Foot Aquifer throughout most of the coastal part of the Salinas Valley. The first clay layers encountered in the boreholes for four monitoring wells installed by MPWMD between Seaside and the Main Garrison area on the former Fort Ord are thin (less than 20 feet) and of inconsistent elevation.

Based on calibration of a groundwater flow model of the Laguna Seca area (the eastern part of the southern subbasin), the hydraulic conductivities for the Paso Robles and Santa Margarita Aquifers were estimated to be 2 ft/day and 3-5 ft/day, respectively. Similarly, calibrated storativity values were estimated to be 0.08 in unconfined aquifers and 0.0006 in confined aquifers.

Recharge Areas

The largest native sources of recharge to the basin are deep percolation of rainfall, irrigation water, and pipe leaks (Yates and others 2005, GTC 1986, and Muir 1982). This recharge occurs throughout the basin and is facilitated by the generally sandy soils. Septic system leach fields also contribute small amounts of groundwater recharge. The largest non-native source of recharge to the basin is by groundwater recharge via injection wells. Since 1998, MPWMD has injected over 4,300 acre-feet into specialized Aquifer Storage and Recovery (ASR) wells the northern subbasin.

A significant percentage of groundwater yield near the coast consists of groundwater inflow from inland areas. In addition, groundwater can flow to or from offshore areas depending on the elevation of groundwater levels near the coast. If coastal water levels are below sea level, groundwater flows onshore (landward). Initially, this onshore flow may not be salty if offshore parts of the aquifer still contain residual freshwater from previous decades when groundwater flow was greater or past periods when sea levels were lower. It is estimated that approximately 1,100 acre-feet of onshore flow from the offshore part of the Santa Margarita Aquifer occurred in 2002 (Yates and others 2005).

Groundwater Level Trends

Groundwater level monitoring in production and monitoring wells within the basin has generally shown declines in the period from the 1960's to the present. Most groundwater extraction in the Seaside Basin is from the coastal part of the northern subbasin. Hydrographs for that area show a significant decline in water levels in almost all wells in the Santa Margarita Aquifer since 1995. In many of these wells, water levels were consistently above sea level prior to 1995 and are now consistently below sea level. The net decline in spring water levels between 1995 and 2002 was 10-15 feet in many wells, and the amount of seasonal drawdown from spring to fall each year has also increased from less than 5 feet to 15 feet (Yates and others 2005). The hydrographs for some wells in the Paso Robles Aquifer have also been declining, while others have been rising. These patterns are more strongly related to groundwater extraction than to climatic conditions.

Groundwater Storage

The storage capacity of the Seaside Groundwater Basin was estimated to be 564,700 acre-feet in 1990 (SGD 1990). This estimate included a component for offshore storage and assumed a weighted average specific yield value of 12%. Of this total, the estimated storage for the onshore parts of the coastal subareas was 162,300 acre-feet, with 9,000 acre-feet estimated to be above sea level. More recent storage capacity estimates based on a specific yield value of 8% suggest that the amount of usable groundwater storage capacity in the coastal area of the basin is 6,200 acre-feet (Yates and others 2005).

Monitoring Plan Rationale

Monitor wells selected for CASGEM monitoring are distributed to give a good representation of groundwater conditions of the Seaside Groundwater Basin. However, it should be noted that large areas of the basin do not have adequate monitor well coverage due to the lack of historical development and land-use restrictions (i.e., inland firing ranges of the former Fort Ord).

Well Network

The well network consists of 22 wells located primarily in and near the coastal subareas of the Seaside Groundwater Basin. Many of these wells are paired and labeled deep and shallow to represent where they are screened in the aquifer. The list of monitoring wells for the Seaside Ground Water Basin is provided in Table 1. It is our understanding that Monterey County Water Resources Agency will be reporting on monitor wells that are located in and near the inland portions of the basin.

Monitoring Schedule

Wells for the CASGEM program will be monitored twice a year, once at the end of September and once at the end of March.

Description of Field Methods

Depth to the water table is measured directly with electric measuring tape to the nearest hundredth of a foot.

Table 1.

Well Name	State Well No.	Well Owner's Name	Date Drilled	DWR Well Drillers Report	MCHD Permit	Data Type	Hole Depth (feet)	Well Depth (feet)	Screened Interval (feet)	Strata Seal (feet)	Casing Type	Geologic Unit	Elevation (feet AMSL) (pre-2008)	Reference Point Elevation (feet AMSL)	Ground Level Elevation (feet AMSL)
Northern Coastal Subarea (and vicinity)															
MSC-Shallow	15S/1E-15N3	MPWMD	5/25/1990	338413		wl, wq	720	695	490 - - 680	95 - 275	2" pvc	QTc	80.58 (s1)	80.10	77.23
MSC-Deep	15S/1E-15N2	MPWMD	5/25/1990	338425		wl, wq	920	865	810 - 850	725 - 775	2" pvc	Tsm	80.78 (s1)	80.29	77.25
PCA-E (Multiple) Shallow	15S/1E-15K5	MPWMD	4/16/1990	338402	W5748	wl, wq	863	410	350 - 400	110 - 150	2" pvc	QTc	69.31(s1)	68.51	68.8
PCA-E (Multiple) Deep	15S/1E-15K4	MPWMD	4/16/1990	338402	W5748	wl, wq	863	710	650 - 700	580 - 620	2" pvc	Tsm	69.31(s1)	68.54	68.8
Ord Terrace-Shallow	15S/1E-23Ca	MPWMD	8/5/1999	- -		wl, wq	530	340	280 - 330	- -	2" pvc	Tsm (upper)	230 (e1)	228.65	228.74
MPWMD #FO-09-Shallow	15S/1E-11Pa	MPWMD	8/16/1994	- -		wl, wq	1,110	660	610 - 650	500 - 540	2" pvc	QTc/Tp	119.11(s3)	118.89	118.61
MPWMD #FO-09-Deep	15S/1E-11Pb	MPWMD	8/16/1994	- -		wl, wq	1,110	840	790 - 830	700 - 765	2" pvc	Tsm	119.15 (s3)	118.85	118.61
MPWMD #FO-10-Shallow	15S/1E-12Fa	MPWMD	9/3/1996	442738	WSAL 96-118	wl, wq	1,500	650	620 - 640	480 - 500	2" pvc	QTc	201.19 (s3)	200.85	200.45
MPWMD #FO-10-Deep	15S/1E-12Fc	MPWMD	9/3/1996	442738	WSAL 96-118	wl, wq	1,500	1,420	1,380 - 1,410	1,280 - 1,300	2" pvc	Tp	201.10 (s3)	201.03	200.45
Seaside Middle School-Shallow		MPWMD		EO100046		wl		670	570-650		2" pvc	QTc		333.35	333.35
Seaside Middle School-Deep		MPWMD		EO100047		wl		1,080	730--950		4" pvc	Tsm		332.62	332.62
CDM MW-1(Beach Range 8)	15S/1E-02Pa	MPWMD	11/12/2003			wl		140	130-140		2" pvc	Qod/Qar		93.15	93.81
CDM MW-2 (Ord Village Lift Sta.)	15S/1E-15Ga	MPWMD	11/17/2003			wl		91	81-91		2" pvc	Qod/Qar		63.51	63.82
Northern Inland Subarea (and vicinity)															
MPWMD #FO-07-Shallow	15S/1E-13La	MPWMD	7/12/1994	- -		wl	940	650	600 - 640	520 - 540	2" pvc	QTc	473.94 (s3)	470.19	473.95
MPWMD #FO-07-Deep	15S/1E-13Lb	MPWMD	7/12/1994	- -		wl	940	850	800 - 840	700 - 750	2" pvc	Tsm	473.97 (s3)	470.15	473.95
MPWMD #FO-08-Shallow	15S/1E-12Qa	MPWMD	7/25/1994	- -		wl	1,110	790	740 - 780	640 - 690	2" pvc	QTc	378.53 (s3)	378.04	379.13
MPWMD #FO-08-Deep	15S/1E-12Qb	MPWMD	7/25/1994	- -		wl	1,110	950	900 - 940	830 - 850	2" pvc	Tsm	378.54 (s3)	378.10	379.13
Southern Coastal Subarea (and vicinity)															
Plumas '90 Test	15S/1E-27J6	MPWMD	4/25/1990	338414		wl	550	485	430 - 470	- -	2" pvc	Tsm	158.41(s2)	157.83	157.83
CDM MW-3 (End Tioga Rd.)	15S/1E-22De	MPWMD				wl		59	49-59			Qod/Qar		33.81	34.44
CDM MW-4 (Seaside Beach lot)	15S/1E-21Ka	MPWMD				wl		53	43-53			Qod/Qar		18.69	19.24
Laguna Seca Subarea (and vicinity)															
MPWMD #FO-04-Shallow (E)	15S/1E-26Na	MPWMD	10/26/1988	192669		wl	320	320	260 - 300	- -	2" pvc	QTc	168.95 (s4)	168.23	168.43
MPWMD #FO-04-Deep (W)	15S/1E-26Nb	MPWMD	10/24/1988	192670		wl	640	580	500 - 560	340 - 345	2" pvc	Tsm	168.27 (s4)	167.44	167.79

NOTES:
1. Well Numbers are unofficial designations; not verified with DWR-assigned well numbers.
2. Geologic Unit refers to the unit adjacent to the screened interval: Qod/Qar = Quaternary "Older Dunes and Aromas Sand" (Dune aquifer); QTc = Tertiary and Quaternary "continental deposits" (Paso Robles aquifer); Tsm = Tertiary "Santa Margarita Sandstone" (Santa Margarita aquifer); Tp = "Purisima Formation"; and Tm = "Monterey Formation".
3. Elevation = reference point elevation at the wellhead: (e1) = estimated with Paulin altimeter; (e2) = estimated from topo map; (s1) = surveyed by Land Data Services (LDS) (Jul 20, 1990); (s2) = surveyed by LDS (Aug 27, 1992); (s3) = surveyed by Sandis Humber Jones (1995 and 1997); (s4) = surveyed, source uncertain; (s5) = surveyed by MPWMD (Jun 6, 1997).
4. "- -" in a blank cell means not applicable or not available. "- -" in a Screened Interval cell indicates multiple screen intervals.
5. Data Type refers to MPWMD data collected: wl = water level; wq = water quality.
6. Well completion data at sites MPWMD #FO-01, 2, and 3 are documented in "Fort Ord Ground Water Monitoring Well Project", Staal, Gardner & Dunne, Inc. (SGD), Jan 1987.
7. Well completion data at site MPWMD #FO-04 are documented in "Supplemental Hydrogeologic Assessment, Monterey Research Park, Laguna Seca Subarea", SGD, Nov 1988.
8. Well completion data at site MPWMD #FO-05 and 6 are documented in "Laguna Seca Ranch, Supplemental Hydrogeologic Assessment", SGD, Jul 12, 1991.
9. Well completion data for MSC, PCA-W, PCA-E, Plumas '90 Test and Paralta Test sites are documented in individual reports for each of these sites, SGD, Jul 1990.
10. Well completion data for Justin Court site are documented in "Additional Investigations of Ryan Ranch's Water Supply", John Logan, Jun 27, 1981.
11. Well completion data for LS Pistol Range, York Rd-West, Seca Place, and Robley Rd sites are documented in "Phase II Hydrogeologic Investigation, Laguna Seca Subarea", SGD, Sep 1988.
13. Well completion data for LS Driving Range (SCS Deep) and LS No. 1 Subdivision sites are listed in Appendix B of "Phase II Hydrogeologic Investigation, Laguna Seca Subarea", SGD, Sep 1988.
14. Geologic unit picks for MPWMD FO-09 and FO-10 sites from Feeney and Rosenberg, Mar 31, 2003 (Figure 4).
15. The well at the location of "Blue Larkspur-East End" has been described in LSS Phase II and III reports as "LSR '59 Pond Test". However, based on information and notes from DWR Log #43668, it appears that "LSR '59 Pond Test" well has been misinterpreted to be located at the east end of Blue Larkspur Lane. Accordingly, well completion data for "Blue Larkspur-East End" are not known.
16. In addition to the wells shown in this table, the MPWMD utilizes water level data from selected CAW production wells as part of its monthly groundwater storage tracking program in the coastal subareas of the basin.
17. It should be noted that the Seaside Basin Watermaster conducted a wellhead elevation survey of monitor and production wells in 2008. Please see MPWMD Seaside Basin Watertmaster Memorandum 2008-05 for updated wellhead reference elevation data.

Regional Geologic Setting for the Carmel Valley Alluvial Aquifer

The 36-mile-long Carmel River drains 255 square miles of the central coast of California (Figure 2). The watershed includes the Santa Lucia Mountains to the south and the Sierra del Salinas to the north. Bedrock in the basin is mainly Sur Series crystalline rock (granite, gneiss, schist) or Monterey Shale with significant outcrops of sandstone and volcanics (Page and Mathews, 1984). Mean annual rainfall varies from about 14 inches along the northeast perimeter of the basin to over 40 inches in the high peaks (up to approximately 5,000 feet in elevation) of the southern portion (James, 1999). Upper reaches on the Carmel River flow through steep-sided canyons, while the lower 16 miles is a relatively flat alluvial valley to the ocean that ranges in width from 300 to 4,500 feet. The average annual runoff at the San Clemente Dam site is 69,200 acre-feet (James, 1999). Bankfull flow is 2,200 cubic feet per second (cfs) near the mouth. On March 10, 1995, the river peaked at 16,000 cfs, which is the largest recorded (gaged) event on the Carmel River.

The unconsolidated sediments of the younger alluvium is the most significant water bearing unit in the Carmel Valley Alluvial Aquifer (Figure 2). The valley floor is composed of Holocene age poorly consolidated boulders, gravel, sand, and silt deposited by the Carmel River. Clay layers are thin and uncommon. However, silt becomes more common in the lower part of the valley. Aquifer thickness ranges from 30 feet at the drainage basin narrows to about 180 feet 1 mile upstream from the Carmel River lagoon (Kapple, 1984).

Recharge to the aquifer comes primarily through river infiltration which is about 85 percent of the net recharge. During normal to above normal rainfall years the water table recovers completely from the dry seasonal lows.

Historical Water Levels for the Carmel Valley Alluvial Aquifer

In general, the water table of the Carmel Valley Alluvial Aquifer recovers fairly rapidly with the onset of the rainy season and an increase in stream flow. For example, after the two year drought of 1976-1977, precipitation that began in January of 1978 caused water levels to recover by February 1978 (Kapple, 1984).

Monitoring Plan Rationale

Monitor wells selected for CASGEM monitoring are distributed to give a good representation of groundwater conditions of Carmel Valley Alluvial Aquifer.

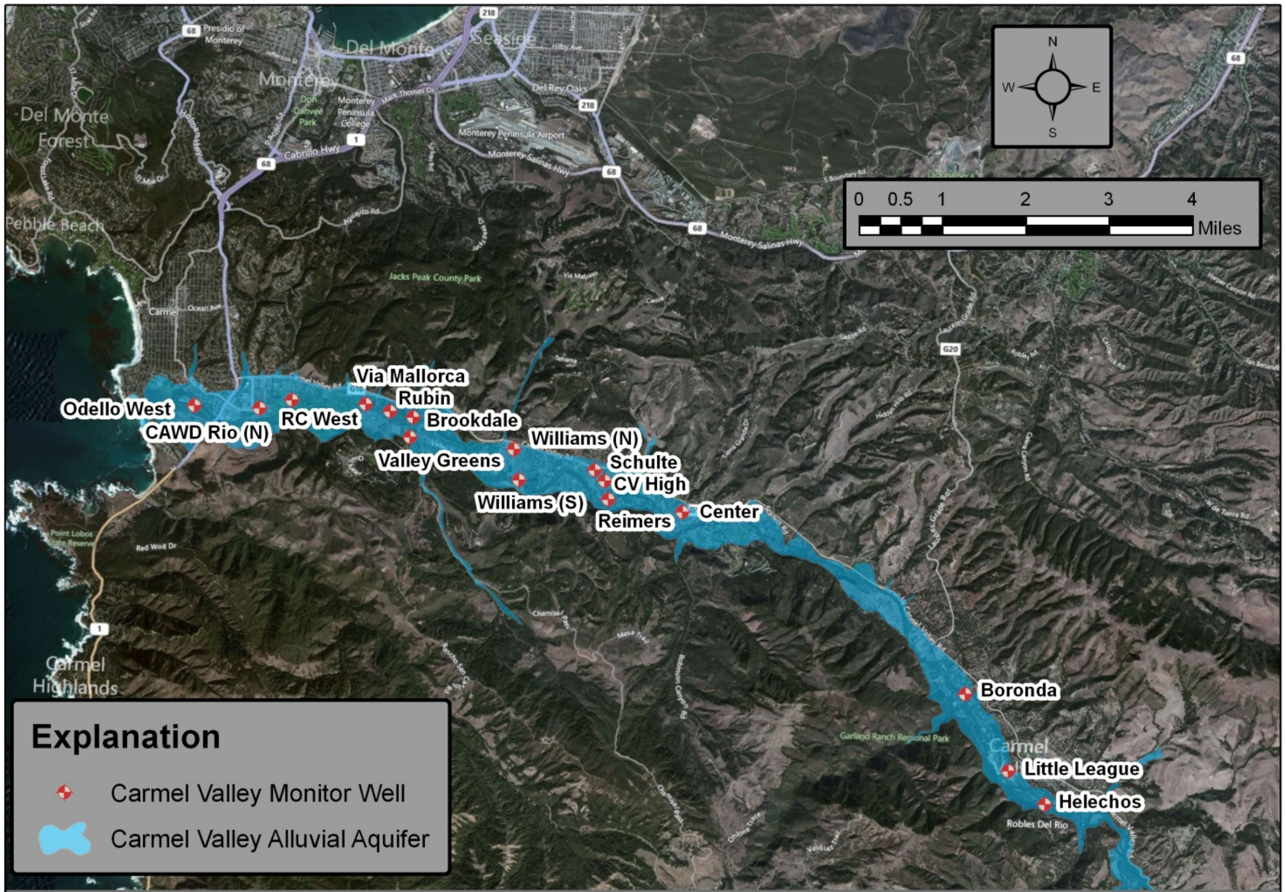


Figure 2. Carmel Valley Alluvial Aquifer CASGEM Monitor Wells, Carmel Valley, Monterey County, California

Well Network

The well network in the Carmel Valley Alluvial Aquifer consists of 16 wells. These wells are spread throughout the alluvial aquifer to establish groundwater elevation trends. Monitor well information for the Carmel Valley Alluvial Aquifer is provided in Table 2.

Monitoring Schedule

Wells for the CASGEM program will be monitored twice a year, once at the end of September and once at the end of March.

Description of Field Methods

Depth to the water table is measured directly with electric measuring tape to the nearest hundredth of a foot.

Table 2. Attribute Data for Carmel Valley Alluvial Aquifer Monitor Wells

River Mile[1]	Distance from River (feet)	Well Common Name	State Well No.[2]	Well Owner's Name	Aquifer Subunit[3]	Date Drilled	DWR Drillers Log	Well Type[4]	Data Collection[5]	Well Depth (feet)	Screened Interval (feet)	Reference Point Elevation (feet AMSL)[6]	Ground Level Elevation (feet AMSL)[6]	Other Name Designations or Notes
0.72	250	Odello West - near CAWD (W)	T16S/R1W-13Lc	MPWMD	4	3/10/1989	Y	DMW	WL, WQ	130	120-129	15.10 (e)	15.74	MW3(D), CSD_Deep, CSD_TURN_WEST
1.65	790	CAWD-Rio North (D)	T16S/R1E-18Mc	MPWMD	4	8/27/1993	492664	DMW	WL	159	54-154	25.88 (s)	25.88	
2.13	1350	RC West Monitor	T16S/R1E-18Ka	MPWMD	4	9/10/1993	492668	DMW	WL	100	40-90	38.00 (a)	38.00	5th Hole West Course
3.25	280	Via Mallorca	T16S/R1E-17Lc	MPWMD	4	7(?)/84	N	DMW	WL	115	5-115	47.38 (s)	47.75	see DMA Phase III, 1/85 report
3.56	80	Rubin	T16S/R1E-17Jd	MPWMD	3	7(?)/84	N	DMW	WL	95	5-95	48.59 (s)	50.14	see DMA Phase III (1/85) , Suppl Data, Vol. 1
3.85	350	Brookdale Drive	T16S/R1E-17J4	MPWMD	3	5/27/1981	Y	DMW	WL, WQ	39	29-34	57.58 (s)	57.96	
3.86	900	Valley Greens Drive	T16S/R1E-17R2	MPWMD	3	5/22/1981	Y	DMW	WL, WQ	50	40-45	68.18 (s)	68.44	VG&SC
5.44	2400	Williams North Monitor	T16S/R1E-22Da	MPWMD	3	9/15/1993	492670	DMW	WL	77	32-72	100.00 (e)	99.43	east side of Williams Ranch Road right-of-way
5.57	50	Williams South Monitor	T16S/R1E-22Fc	MPWMD	3	7/84?	N	DMW	WL	100	5-100	87.08 (s)	87.33	see DMA Phase III (1/85) , Suppl Data, Vol. 1
6.53	2300	Schulte Road	T16S/R1E-23E4	MPWMD	3	5/28/1981	Y	DMW	WL, WQ	58	43-53	110.31(s)	110.56	
6.70	1300	Carmel Valley High School #1	T16S/R1E-23Fb	MPWMD	3	11/16/1988	Y	DMW	WL, WQ	180	60-160	112.42 (s)	112.94	16S/1E-23F(CVH)
6.72	150	Reimers #1	T16S/R1E-23La	MPWMD	3	11/9/1988	Y	DMW	WL, WQ	122	50-122	102.10 (s)	102.25	16S/1E-23L(R-1)
8.02	1390	Center Street	T16S/R1E-24N5	MPWMD	3	5/29/1981	Y	DMW	WL,WQ	57	47-52	135.04 (s)	135.54	
12.52	260	Boronda Road	T16S/R2E-33Q1	MPWMD	2	5/31/1981	137408	DMW	WL, WQ	32	22-27	220.42 (s)	218.07	
13.65	380	Little League #1	T17S/R2E-03La	MPWMD	2	9/24/1988	192663	DMW	WL, WQ	50	30-50	251.00 (s)	251.60	LL#1
14.28	250	De Los Helechos	T17S/R2E-10B1	MPWMD	2	5/15/1981	137402	DMW	WL, WQ	28	18-23	272.62 (s)	273.00	Via Helechos

NOTES:

1. River Mile designations are referenced to the mouth of the Carmel River at Carmel Bay (i.e. RM 0.0). Distances are based on the June 1986 aerial photo enlargements (1" = 100').
2. Official State Well Number ends with a numeral, unofficial MPWMD Well Number ends with a small case letter.
3. Aquifer Subunit designations are as follows: AS1 - San Clemente Dam to Esquiline Bridge, AS2 - Esquiline Bridge to the Narrows, AS3 - Narrows to Via Mallorca Bridge, AS4 - Via Mallorca Bridge to Carmel Bay, CVU - Carmel Valley Upland.
4. DMW - Dedicated Monitor Well, PPW - Private Production Well.
5. WL - Water Level data, WQ - Water Quality data.
6. (s) = surveyed elevation, (h) = hand-leveled elevation, (a) = altimeter elevation, (e) = estimated elevation from topo map.
7. It should be noted that not all wells shown in this table are currently being monitored by the MPWMD.

References

California Department of Water Resources, 1974. Zone 11 Investigation, Carmel Valley and Seaside Groundwater Basins, Monterey County, Prepared by the DWR San Joaquin District, Fresno, CA, July 1974.

Geotechnical Consultants, Inc., 1986. Hydrogeologic Update, Fort Ord Military Reservation and Vicinity, Monterey County, California. Prepared for U.S. Department of the Army, Corps of Engineers, Sacramento District, Sacramento, CA.

James, Greg, 1999. Carmel River Basin – Surface Water Resources Data Report, Water Years 1996-1999, Monterey Peninsula Water Management District, December 1999.

Kapple, G., Mitten, H., Durbin, T., and Johnson, M., 1984. Analysis of the Carmel Valley Alluvial Groundwater Basin. U.S. Geological Survey. Water-Resources Investigations Report 83-4280.

Muir, K.S., 1982. Groundwater in the Seaside Area, Monterey County, California. U.S. Geological Survey Water Resources Investigation 82-10. Washington, D. C. September 1982.

Page, G. and G. Mathews, 1984. Carmel River Management Plan, Monterey Peninsula Water Management District, 1984.

Staal, Gardner and Dunne, Inc., 1990. Hydrogeologic Update, Seaside Coastal Groundwater Basins, Monterey County, California. Prepared for MPWMD, Monterey, CA. August 1990.

Yates E.B., Feeney, M.B. and Rosenberg, L.I., 2005. Seaside Groundwater Basin: Update on Water Resource Conditions. Prepared for MPWMD, Monterey, CA. April 2005.

Appendix 7-C

Quality Assurance Project Plan for the former Fort Ord, Appendix A

BW-2785I
AR

Quality Assurance Project Plan
Former Fort Ord, California
Volume I, Appendix A

Final Revision 7
Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

Prepared for:
U.S. Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, CA 95814-2922

On behalf of:
U.S. Department of the Army
Fort Ord BRAC
4463 Gigling Road, Room 101
Seaside, CA 93955

USACE Contract No. W91238-14-C-0048
Task No. 14

Prepared by:
Ahtna Environmental, Inc.
296 12th Street
Marina, CA 93933-6001

Report Date: **August 7, 2019**
Report Version: **Final**

Report Use and Limitations

Report Title:	**Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A Final Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume**
Prime Contractor:	Ahtna Environmental, Inc.
USACE Contract No.	W91238-14-C-0048
Task No.	14

Ahtna Environmental, Inc. (Ahtna) prepared this report at the direction of the U.S. Army Corps of Engineers (USACE) for the sole use of the U.S. Department of the Army (Army), the intended beneficiary. No other party should rely on the information contained herein without the prior written consent of the Army. This report and its interpretations, conclusions, and recommendations use the information presented in other documents, as cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

Table of Contents

Table of Contents (continued)

Table of Contents (continued)

Figures

Table

Attachments

Acronyms and Abbreviations

%	percent
%D	percent difference/percent drift
°C	degrees Celsius
µg/L	micrograms per liter
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCA	1,2-dichloroethane
1,2-DCE (total)	total 1,2-dichloroethene
1,2-DCPA	1,2-dichloropropane
1,3-DCPE (total)	total 1,3-dichloropropene
2/12	Sites 2 and 12
ACL	Aquifer Cleanup Level
ADR	Automated Data Review
AES	Ahtna Engineering Services
Ahtna	Ahtna Environmental, Inc.
Army	U.S. Department of the Army
BCT	BRAC Cleanup Team
BEC	BRAC Environmental Coordinator
BFB	4-bromofluorobenzene
BRAC	Base Realignment and Closure
CCB	continuing calibration blanks
CCRWQCB	California Regional Water Quality Control Board, Central Coast Region
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chemical of concern
COD	coefficient of determination
CQCR	Contractor Quality Control Report
CRF	Cooler Receipt Form
CT	carbon tetrachloride
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DTSC	California Department of Toxic Substances Control
DTW	depth to water
EDD	electronic data deliverable
EISB	enhanced *in situ* bioremediation

Acronyms and Abbreviations (continued)

ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EW	Extraction Well
FADL	Field Activity Daily Logbook
FODIS	Fort Ord Data Integration System
FO-SVA	Fort Ord-Salinas Valley Aquitard
GAC	granular activated carbon
GC/MS	gas chromatography-mass spectrometry
GIS	geographic information system
GWMP	groundwater monitoring program
GWTP	groundwater treatment plant
GWTS	groundwater treatment system
HCl	hydrochloric acid
HLA	Harding Lawson Associates
HNO_3	nitric acid
IC	ion chromatography
ICAL	initial calibration
ICP	inductively coupled plasma
ICS	interference check sample
ICV	initial calibration verification
ID	identification
IDQTF	Intergovernmental Data Quality Task Force
LCS	laboratory control samples
LCSD	LCS duplicate
LOD	limit of detection
LOQ	limit of quantitation
MACTEC	MACTEC Engineering and Consulting, Inc.
MC	methylene chloride
MCL	maximum contaminant level
MCWD	Marina Coast Water District
mg/L	milligrams per liter
mL	milliliter
MNA	monitored natural attenuation
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate
MSL	mean sea level
N/A	not applicable
ND	non-detect
NPL	National Priorities List

Acronyms and Abbreviations (continued)

O&M	operations and maintenance
ORP	oxidation-reduction potential
OU	operable unit
OU2	Operable Unit 2
OUCTP	Operable Unit Carbon Tetrachloride Plume
PARCCS	precision, accuracy, representativeness, comparability, completeness, sensitivity
PCE	tetrachloroethene
PDB	passive diffusion bag
PDS	post-digestion spike
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QSM	Quality Systems Manual
RI	Remedial Investigation
RF	response factor
ROD	Record of Decision
RPD	relative percent difference
RSD	relative standard deviation
SIM	selected ion monitoring
Sites 2/12	Sites 2 and 12
SM	Standard Methods
SOP	standard operating procedure
SRF	Sample Receipt Forms
SSHO	Site Safety and Health Officer
TAT	turnaround time
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
TS	treatment system
UCL	upper confidence limit
USACE	U.S. Army Corps of Engineers
VC	vinyl chloride
VOA	volatile organic analysis
VOC	volatile organic compound
Wood	Wood Environment & Infrastructure Solutions, Inc. (formerly Amec Foster Wheeler)

1.0 Introduction

On behalf of the U.S. Army Corps of Engineers (USACE), Sacramento District, Ahtna Environmental, Inc. (Ahtna) updated this Quality Assurance Project Plan (QAPP)[1] under Contract Number W91238-14-C-0048 for response actions to be performed at the former Fort Ord (Figure 1) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund") to address historical releases of chemicals of concern (COCs) at the former Fort Ord. The QAPP was updated and revised to:

- Update the number of wells monitored on an annual basis (Table 1), the list of wells sampled (Worksheet #17c) and the sampling location maps (Figures 2, 5A, 8A, 8B, 8C, and 9 through 13) based on newly installed wells,[2] recently decommissioned wells,[3] and recent progress in remedial actions for groundwater.[4]
- Update laboratory company name from SGS North America, Inc. to SGS.
- Update subcontractor company name from Amec Foster Wheeler to Wood Environment & Infrastructure Solutions, Inc. (Wood).
- Reference Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.1.
- Update metals analysis from 6010C to 6010D.
- Reflect recent changes in project personnel.
- Update Operable Unit 2 (OU2) groundwater treatment system (GWTS) changes based on the new groundwater treatment plant (GWTP) and new extraction wells (Figure 7 and Worksheets #17b1 and #17b2).
- Include a description of how COC concentration contours and groundwater elevation contours are drawn in the quarterly reports.

This QAPP is the governing guidance document for groundwater and treatment system sampling associated with Sites 2/12, OU2, and Operable Unit Carbon Tetrachloride Plume (OUCTP) at the former Fort Ord. This QAPP details quality assurance (QA) and quality control (QC) procedures for sampling and analytical activities performed for the GWTS and the groundwater monitoring program (GWMP). The QAPP ensures the data generated are accurate, precise, complete, and representative of field conditions, and of sufficient quality to support project decisions.

---

[1] This document is Appendix A to the *Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I*. Volume I is also the governing document for sampling and analysis of soil (Appendix B), soil gas (Appendix C), and landfill gas (Appendix D). Volume II of the QAPP pertains to the former Fort Ord military munitions response program.

[2] Based on the *Monitoring Well Installation Completion Report, Former Fort Ord, California* (Well Install Completion Report; Ahtna, 2019f).

[3] Based on the *2019 Monitoring Well and Soil Gas Probe Decommissioning Completion Report, Former Fort Ord, California* (Ahtna, 2019g).

[4] The United States Environmental Protection Agency (EPA), California Department of Toxic Substances Control (DTSC) and California Regional Water Quality Control Board, Central Coast Region (CCRWQCB) agreed to these changes.

2.0 Project Management

2.1 Worksheets #1 and #2: Title and Approval Page

Site Name/Project Name: Former Fort Ord/Superfund Response Actions

Site Location: Former Fort Ord, California

Document Title: Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A Final Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

Lead Organization: U.S. Army Corps of Engineers

Preparer's Name, Organization, and Contact Info: Holly Dillon, Ahtna
296 12th St, Marina, CA 93933
(831) 384-3735
hdillon@ahtna.net

Preparation Date: August 2, 2019

Project Role	Name Organization	Signature	Date
Investigative Organization's Project Manager	Derek Lieberman Ahtna	Derek J. Lieberman	7/24/2019
Investigative Organization's Program Chemist	Christopher Ohland Ahtna	Christopher Ohland	7/24/2019
Lead Organization's Technical Lead	Alex Kan USACE	KAN.ALEXANDER.1297094749 Digitally signed by KAN.ALEXANDER.1297094749 Date: 2019.08.06 14:16:59 -07'00'	
Lead Organization's Project Chemist	Jonathan Whipple USACE	WHIPPLE.JONATHAN.PAUL.1283504758 Digitally signed by WHIPPLE.JONATHAN.PAUL.1283504758 Date: 2019.08.06 14:35:12 -07'00'	

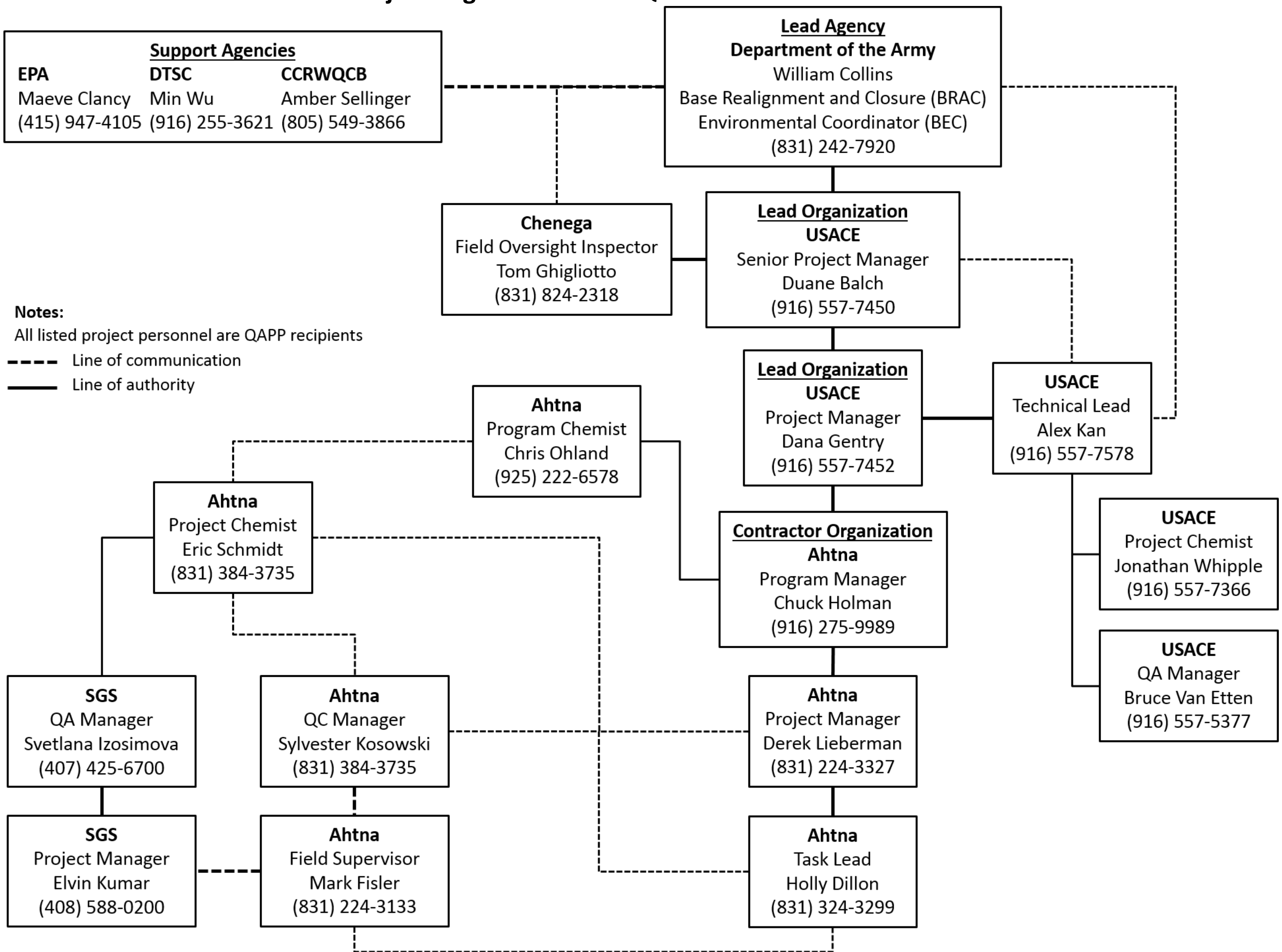
Plans and reports from previous investigations relevant to this project:

Site Name/Project Name:	Former Fort Ord/Superfund Response Actions
Site Location:	Monterey County, California
Site Number/Code:	Not Applicable (N/A)
Operable Units:	OU2, OUCTP, and Sites 2/12
Contractor Name:	Ahtna Environmental, Inc.
Contract Number:	W91238-14-C-0048
Contract Title:	Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring, Former Fort Ord, California
Work Assignment Number:	N/A
Guidance used to prepare QAPP:	Uniform Federal Policy for Quality Assurance Project Plans, Optimized UFP-QAPP Worksheets, March 2012, Revision 1. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1, 2017
Regulatory Program:	Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by Superfund Amendment and Reauthorization Act (SARA)
Approval Entities:	U.S. Environmental Protection Agency (EPA), California Department of Toxic Substance Control (DTSC), and Regional Water Quality Control Board, Central Coast Region (CCRWQCB)
Data Users:	U.S. Department of the Army (Army), USACE, EPA (and its consultant TechLaw, Inc.), DTSC, CCRWQCB, Army/USACE contractors, citizen groups, and members of the public
Organizational partners (stakeholders) and connection with lead organization:	USACE, Army (lead agency/owner), EPA (lead oversight agency), DTSC (support agency), and CCRWQCB (support agency)
The QAPP is (select one):	Generic:____ Project Specific:__X__

Dates and titles of QAPP documents written for previous site work:

Title	**Approval Date**
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 6	March 2018
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 5	June 2017
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 4	March 2016
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 3	June 2015
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 2	February 2014
Quality Assurance Project Plan, Superfund Response Actions, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Final Revision 1	December 21, 2012
Draft Final Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Groundwater, Appendix A, Groundwater Extraction and Treatment Systems at Operable Unit 2 and Sites 2 and 12; Groundwater Monitoring Program at Sites 2 and 12, Operable Unit 1, Operable Unit 2, and Operable Unit Carbon Tetrachloride Plume	May 31, 2011
Draft Final, QAPP/CDQMP Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP	January 20, 2010
Final Sampling and Analysis Plan, Operable Unit 2 and Sites 2 and 12 Groundwater Treatment Systems, Former Fort Ord	August 20, 2009

2.2 Worksheets #3 and #5: Project Organization and QAPP Distribution



2.3 Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet

Organization: Ahtna

Name	Project Title/Role	Education/ Experience[1]	Specialized Training/ Certifications[2]	Signature[3]	Date
Chuck Holman	Program Manager	Resume on file	HAZWOPER		7/24/2019
Derek Lieberman	Project Manager	Resume on file	First aid, CPR, MEC, PE, H&S, HAZWOPER, CQM		7/24/2019
Christopher Ohland	Program Chemist	Resume on file	H&S, HAZWOPER		7/24/2019
Eric Schmidt	Project Chemist	Resume on file	HAZWOPER, CQM		7/24/2019
Holly Dillon	Task Lead	Resume on file	First aid, CPR, MEC, H&S, HAZWOPER, CQM		7/24/2019
Mark Fisler	Field Supervisor	Resume on file	First aid, CPR, MEC, HAZWOPER, CQM		7/24/2019
Sylvester Kosowski	QC Manager	Resume on file	HAZWOPER, CQM		7/24/2019

Notes:

[1] Resumes available in Attachment B.

[2] Specialized Training/Certifications Key:

CPR: cardiopulmonary resuscitation

CQM: Construction Quality Management.

H&S: health and safety training, including, but not limited to: hazard communication, fire extinguisher use, defensive driving, behavior-based safety, confined spaces.

HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response

MEC: munitions and explosives of concern recognition and safety training

PE: registered Professional Engineer

[3] Signatures indicate personnel has read and agree to implement this QAPP as written.

Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: Wood Environment & Infrastructure Solutions, Inc. (Wood)

Name	Project Title/Role	Education/ Experience[1]	Specialized Training/ Certifications[2]	Signature[3]	Date
Jeff Fenton	Project Manager	Resume on file	HAZWOPER	[signature]	7/24/19
Scott Graham	Field Task Manager	Resume on file	HAZWOPER, first aid, CPR, MEC, CQM	[signature]	7/24/19
Kevin Garrett	Project Chemist	Resume on file	Not applicable	[signature]	7/24/19
Zachary Carroll	Data Validation Specialist	Resume on file	Not applicable	[signature]	7/24/19

Notes:

[1] Resumes available in Attachment B.

[2] Specialized Training/Certifications Key:

CPR: cardiopulmonary resuscitation

CQM: Construction Quality Management.

HAZWOPER: 40-hour and current 8-hour annual refresher Hazardous Waste Operations and Emergency Response

MEC: munitions and explosives of concern recognition and safety training

PE: registered Professional Engineer

[3] Signatures indicate personnel has read and agree to implement this QAPP as written.

Worksheets #4, #7, and #8: Personnel Qualifications and Sign-Off Sheet (Continued)

Organization: SGS

Name	Project Title/Role, Location	Education/ Experience[1]	Specialized Training/ Certifications	Signature[2]	Date
Elvin Kumar	Project Manager, Florida	Resume on file	Not applicable		07/25/19
Svetlana Izosimova	Quality Assurance Officer, Florida	Resume on file	Not applicable		7/25/19
Caitlin Brice	General Manager, Florida	Resume on file	Not applicable		7/25/19
Norman Farmer	Corporate Technical Director, Florida	Resume on file	Not applicable		7/25/19

Notes:

[1] Resumes available in Attachment B.

[2] Signatures indicate personnel has read and agree to implement this QAPP as written.

2.4 Worksheet #6: Communication Pathways

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Point of Contact with lead support agency (EPA)	Lead Agency – Army BEC	William Collins	(831) 242-7920	Project materials and information will be submitted to the EPA, DTSC, and CCRWQCB as appropriate by William Collins (or designee) via e-mail or hardcopy.
Point of contact with Army Base Realignment and Closure (BRAC) Office	USACE	Alex Kan	(916) 557-7578	Materials and information regarding the project will be forwarded to Army BRAC Office through USACE Technical Lead.
Point of Contact with lead organization (USACE)	Ahtna Program Manager	Chuck Holman	(916) 275-9989	Project materials and information will be submitted to Alex Kan via e-mail or hardcopy.
Manage Project – contractor organization	Ahtna Project Manager	Derek Lieberman	(831) 384-3735	Manage project schedule and budget. Communicate project information to project team and Alex Kan. Ahtna Team liaison to Ahtna Program Manager.
Manage Project – contractor organization	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Manage project fieldwork, data management, and document preparation. Communicate information to Project Manager.
Manage Project – subcontractor	Wood Project Manager	Jeff Fenton	(707) 793-3832	Manage project schedule and budget. Communicate project information to project team and Derek Lieberman.
Status Reports	Ahtna	Derek Lieberman	(831) 384-3735	Derek Lieberman will provide updates to USACE during weekly status meetings.
Stop work due to safety issues	Ahtna	Any person	(831) 384-3735	Any individual has the ability to stop work based on an unsafe work condition, or a potential for an unsafe work condition.
QAPP deviation in field	Wood Field Task Manager / Ahtna O&M Manager	Scott Graham/ Mark Fisler	(707) 364-3620/ (831) 224-3133	Notify Eric Schmidt by telephone or e-mail of variances to QAPP made in the field and the reasons within 24 hours. Eric Schmidt will notify Jonathan Whipple.

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
QAPP changes in field (modification to QAPP)	Wood Field Task Manager	Scott Graham	(707) 364-3620	Scott Graham will propose modifications to Kevin Garrett, Jeff Fenton, and Holly Dillon prior to implementation. Holly Dillon will propose an appropriate modification to Eric Schmidt and Derek Lieberman for approval. Derek Lieberman will propose a modification to Jonathan Whipple for approval. Communication regarding modification will be in writing (e-mail or hardcopy).
	Wood Project Chemist	Kevin Garrett	(303) 293-6082	
	Ahtna Program Chemist	Christopher Ohland	(925) 222-6593	
	Ahtna Project Chemist	Eric Schmidt	(831) 384-3735	
	USACE Project Chemist	Jonathan Whipple	(916) 557-7366	
QC and contract compliance	Ahtna QC Manager	Sylvester Kosowski	(831) 384-3735	Reviews project plans; assures Ahtna compliance with contract requirements.
Daily Field Progress Reports/Field QA/QC Issues	Wood Field Task Manager	Scott Graham	(707) 364-3620	Scott Graham will report field progress and field QA/QC issues daily by fax or e-mail to Jeff Fenton, Kevin Garrett, and Holly Dillon.
Laboratory Issues	SGS Project Manager	Elvin Kumar	(408) 588-0200	Elvin Kumar to notify Kevin Garrett of any problems with the laboratory (i.e. receipt of samples, instrument problems, detection limits (DLs), or any other issues that will affect the data or turnaround time (TAT) of reported results) within 24 hours of the occurrence, by phone and follow-up written communication (e-mail or hardcopy).
Field and Laboratory Data Quality Issues	Wood Project Chemist	Kevin Garrett	(303) 293-6082	Kevin Garrett will notify Jeff Fenton and Holly Dillon by phone or e-mail of field or lab QA/QC issues within one business day. Holly Dillon will notify Derek Lieberman and Eric Schmidt. Derek Lieberman will notify Jonathan Whipple.

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Field and Analytical Corrective Actions[1]	Wood Project Chemist	Kevin Garrett	(303) 293-6082	The need for field or laboratory corrective action will be determined by Kevin Garrett and/or Holly Dillon, which will be communicated in writing to Jeff Fenton, Derek Lieberman, and laboratory contact (when appropriate) within two business days. Derek Lieberman will notify Jonathan Whipple.
Release of Analytical Data	Wood Project Chemist	Kevin Garrett	(303) 293-6082	Analytical data will not be released for use until review or validation is completed, as appropriate. Following Eric Schmidt's approval of validation findings, Kevin Garrett will release the data via e-mail to the project team.
Data import and export	Wood Data Validator	Zack Carroll	(707) 793-3873	Uploads field/fixed lab and data recorder data into the Fort Ord Data Integration System.
Hazardous or unsafe conditions that raise question of stopping work	Wood Field Task Manager / Ahtna O&M Manager	Scott Graham/ Mark Fisler	(707) 364-3620/ (831) 224-3133	Confer with Derek Lieberman and/or the Ahtna Site Safety and Health Officer (SSHO) to determine whether work needs to be stopped; the Ahtna SSHO will report stop-work decision to the Ahtna PM.
Perform field QC checks to ensure proper sampling methods, custody procedures, packaging, and shipment are performed	Ahtna QC Manager	Sylvester Kosowski	(831) 384-3735	Report result of field checks to Derek Lieberman and Eric Schmidt.
Prepare initial write-up of field generated data to be included in final reports	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Confer with Derek Lieberman on questions and resolutions.

Communication Driver	Responsible Entity	Name	Telephone Number	Procedure (timing, pathways, documentation, etc.)
Database setup and data management planning	Ahtna Task Lead	Holly Dillon	(831) 384-3735	Provides information on sample and analytical reporting groups, and types of report tables required for the project.
Data verification/data validation	Wood Data Validator	Zack Carroll	(707) 793-3873	Report result of analytical QC checks to Chris Ohland.
Data review issues and corrective actions	Ahtna	Eric Schmidt	(831) 384-3735	Report result of analytical QC corrective action to Christopher Ohland and Derek Lieberman.

Notes:

[1] In the event significant corrective action is required for field or laboratory activities, information concerning the corrective action will be provided to the EPA, DTSC, and CCRWQCB by the Army within 30 days of the event, typically at the next scheduled monthly meeting of the BRAC Cleanup Team (BCT).

2.5 Worksheet #9: Project Planning Session Summary

Project Name: Former Fort Ord Basewide Groundwater and Soil Vapor Treatment and Monitoring **Projected Start Date:** Ongoing **Project Manager:** Derek Lieberman, Ahtna	**Site Name:** Former Fort Ord **Site Location:** Former Fort Ord, CA

Date of Session: October 2, 2018

Scoping Session Purpose: Define scope of work to be included in the QAPP

Name	Title	Affiliation	Telephone #	E-mail Address
Derek Lieberman	Project Manager	Ahtna	(831) 384-3735	dlieberman@ahtna.net
Eric Schmidt	Project Chemist	Ahtna	(831) 384-3735	eschmidt@ahtna.net
Holly Dillon	Task Lead	Ahtna	(831) 384-3735	hdillon@ahtna.net
Andrew Mauck	Field Technician	Ahtna	(831) 384-3735	amauck@ahtna.net

Planning Session Summary:
Reviewed contract to determine QAPP requirements and reviewed QAPP Revision 6 for potential updates needed.

Action Items:
Based on this review, Ahtna will:

- Initiate QAPP Revision 7 update.
- After review of the previous four quarters of data (Fourth Quarter 2017 through Third Quarter 2018) and comparison to decision rules in the QAPP, update the list of monitoring and extraction wells to be sampled quarterly and annually. Remove wells from sampling program as allowed by decision rules. Updates to be proposed for approval by the BCT at the meeting on November 14, 2018 and to be applied to the Fourth Quarter 2018 GWMP event to be conducted in December 2018.
- Update subcontractor from Amec Foster Wheeler to Wood.
- Review SGS changes to QAPP including QSM Version 5.1 changes.

3.0 Project Quality Objectives

3.1 Worksheet #10: Conceptual Site Model

3.1.1 Background and History

The former Fort Ord is located along the Pacific Ocean in northwest Monterey County, approximately 80 miles south of San Francisco, California (Figure 1). The former military installation covered about 28,000 acres, is bounded by Monterey Bay to the west and the Santa Lucia Range to the south, and is surrounded by the cities of Del Rey Oaks, Marina, Sand City, and Seaside. State Highway 1 and the Union Pacific Railroad right-of-way traverse through the western portion of the former Fort Ord, separating the Monterey Bay beach front from the rest of the installation. The former Fort Ord served as a training and staging facility for infantry troops from 1917 until its closure in 1994. In 1990, the former Fort Ord was placed on the EPA's National Priorities List (NPL),[5] primarily due to volatile organic compounds (VOCs) found in groundwater beneath the Fort Ord Landfills. The former Fort Ord was closed in 1994 under the Base Realignment and Closure Act (BRAC).[6] Environmental remediation at the former Fort Ord is being completed pursuant to the CERCLA §121 and the National Oil and Hazardous Substances Contingency Plan.

3.1.2 Sources of Known or Suspected Hazardous Waste

<u>Sites 2/12</u>

When the former Fort Ord was an active military facility, Site 2 consisted of the primary sewage treatment facility for Fort Ord and Site 12 included numerous industrial activities, including vehicle maintenance and repair, furniture repair, storage of motor oils, hazardous material storage, vehicle cleaning and degreasing, and disposal of waste and oil.

<u>OU2</u>

The source of the OU2 groundwater contamination was from the Fort Ord Landfills. No detailed records were kept on the amount or types of wastes disposed of at the Fort Ord Landfills; however, household and commercial refuse, ash from incinerated infectious wastes, dried sewage sludge, demolition material, and small amounts of chemical waste (such as paint, waste oil, pesticides, electrical equipment, ink and epoxy adhesives) are believed to have been disposed of in the Fort Ord Landfills (Dames & Moore, 1993).

---

[5] The NPL is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

[6] BRAC is the process the Department of Defense (DoD) has used to reorganize its installation infrastructure to more efficiently and effectively support its forces and increase operational readiness.

OUCTP

The apparent source of the OUCTP groundwater plume is located on what is now Lexington Court, a residential area in the northern portion of the former Fort Ord. Historical practices at this site included cleaning electronic equipment and radios.

3.1.3 Known Contaminants

Known contaminants, or COCs, were identified during Remedial Investigations at the sites and documented in the decision documents for each site. The COCs are listed in Worksheet #15a and are summarized below.

Sites 2/12

There are eight COCs for groundwater at Sites 2/12, with the primary COCs (those detected at the highest concentrations over the greatest area) identified as tetrachloroethene (PCE) and trichloroethene (TCE). Additionally, PCE and TCE are the two COCs for soil gas at Sites 2/12, which is described in the QAPP Volume I Appendix C for Soil Gas Monitoring (Ahtna, 2019c).

OU2

There are eleven COCs for groundwater at OU2, with the primary COC identified as TCE. Operations and maintenance (O&M) of the Fort Ord Landfills and the landfill gas extraction and treatment system is described separately in the QAPP Volume I, Appendix D, OU2 Landfills (Ahtna, 2019d).

OUCTP

The primary COC in groundwater at OUCTP is carbon tetrachloride (CT); however, there are eight COCs for the A-Aquifer, one COC for the Upper 180-Foot Aquifer, and two COCs in the Lower 180-Foot Aquifer.

3.1.4 Fate and Transport Considerations

Sites 2/12

There are or have been four potential migration pathways specific to Sites 2/12:

- Leaching of chemicals into underlying unsaturated zone soil.
- Diffusion of vapor phase chemicals in soil gas.
- Partitioning of chemicals between soil gas and groundwater.
- Migration of dissolved phase chemicals in groundwater.

Based on environmental conditions, historical data at Sites 2/12, and chemical-specific properties, PCE and TCE are considered to have medium to high persistence and moderate mobility. Soil types present at the site have a low retardation factor and there is insignificant adsorption of these chemicals. Additionally, PCE and TCE water solubilities and partition coefficients indicate moderate mobility. Persistence of PCE and TCE over time and the relative absence of breakdown products indicate little or no reductive dechlorination of these compounds, particularly in soil gas. Concentration-driven diffusion is likely a continuing process at Site 12 given the variation of concentration gradients in the unsaturated zone over time. Additionally, groundwater and soil gas analytical data and modeling during the Remedial

Investigation/Feasibility Study Addendum at Sites 2/12 indicated the areas of highest concentrations of PCE and TCE in soil gas were associated with concentrations of PCE and TCE in groundwater that exceed Aquifer Cleanup Levels (ACLs; AES, 2015). Groundwater contamination at Sites 2/12 affected the unconfined Upper 180-Foot Aquifer.

OU2

VOCs remaining in waste disposed of at the Fort Ord Landfills and VOCs detected in landfill gas have the potential to travel through soil pore space to exposure points via a number of mechanisms:

- Advection: mass transport due to bulk flow of water in which contaminants are dissolved;
- Dispersion: transport due to the groundwater flow whether or not a compound is dissolved;
- Diffusion: spreading of contaminants due to molecular diffusion in response to concentration gradients; and
- Volatilization: loss of chemical vapor to the atmosphere.

VOCs naturally undergo biological degradation processes in soil, soil gas, and groundwater; however, the rate of such degradation is limited by oxygen and nutrient sources depending upon the type of degradation that is occurring (aerobic vs. anaerobic). Further, degradation of compounds is dependent on the biological pathway available.

Groundwater contamination at OU2 affected the upper three groundwater aquifers: the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer (HLA, 1995). In the vicinity of OU2, the tops of each of these aquifers typically are first encountered at depths of about 60 feet bgs, 150 feet bgs, and 250 feet bgs, respectively. In monitoring well MW-OU2-73-A, located at the Fort Ord Landfills Area F source area, PCE and TCE are below their ACLs or not detected, but vinyl chloride is detected at the highest concentrations for the OU2 A-Aquifer. Vinyl chloride is a breakdown product in the natural reductive dechlorination process and may indicate this process is occurring locally at Fort Ord Landfills Area F.

With implementation of the remedy as prescribed in the OU2 Fort Ord Landfills Record of Decision (OU2 ROD; Army, 1994; engineered landfill cover system, and groundwater extraction and treatment system) in addition to operation of the landfill gas extraction and treatment system, impacts to the underlying groundwater from the Fort Ord Landfills have been greatly mitigated.

OUCTP

There are or have been four potential migration pathways specific to OUCTP:

- Leaching of chemicals into underlying unsaturated zone soil.
- Diffusion of vapor phase chemicals in soil gas.
- Partitioning of chemicals between soil gas and groundwater.
- Migration of dissolved phase chemicals in groundwater.

The CT plume appears to have originated from a training facility referred to in 1958 as “ST-11”, near what is now Lexington Court (Figure 8A), and migrated through the vadose zone beneath the vicinity of this facility and into groundwater of the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer; CT has not been detected in the 400-Foot Aquifer.

Hydraulic communication between the A-Aquifer and the underlying aquifers is limited to those areas west of OUCTP where the Fort Ord-Salinas Valley Aquitard (FO-SVA) clay unit pinches out, or where it was penetrated by wells without adequate sanitary seals. Two such vertical conduits were identified that resulted in the migration of CT from the A-Aquifer to the underlying Upper and Lower 180-Foot Aquifers. All identified vertical conduits have been destroyed (grouted and sealed) eliminating hydraulic communication between the A-Aquifer and the underlying aquifers. Groundwater in the Upper 180-Foot Aquifer flows to the southeast toward the apparent discontinuity in the underlying Intermediate 180-Foot Aquitard where it then recharges the Lower 180-Foot Aquifer. Groundwater in the Lower 180-Foot Aquifer primarily migrates to the east (Army, 2008).

In addition to CT, chloroform, TCE, and PCE were also present both within the vadose zone (vapor phase) and in the A-Aquifer near the source (dissolved phase). Chloroform is a biodegradation product of CT whose presence in OUCTP suggests there are native microbial bacteria acting within the subsurface to biodegrade CT. The presence of PCE and TCE in soil gas near the source area suggests these compounds were also disposed of in this area, presumably during the use of the same training facility.

In addition to CT, TCE is also present in the Lower 180-Foot Aquifer, which suggests groundwater originating from OU2 in the Upper 180-Foot Aquifer may be flowing from the southwest toward the apparent discontinuity in the Intermediate 180-Foot Aquitard (Ahtna, 2019b).

3.1.5 Potential Receptors and Exposure Pathways

Groundwater at Sites 2/12, OU2 and OUCTP currently is not used by residents within the Fort Ord area for domestic household purposes. Drinking water in the Fort Ord area is provided by the Marina Coast Water District (MCWD) and is pumped from wells that are located east of the Sites 2/12, OU2 and OUCTP areas. These supply wells are screened in the Lower 180-Foot Aquifer or deeper aquifers. Groundwater within the Sites 2/12, OU2 and OUCTP areas is located in the Prohibition Zone of the Special Groundwater Protection Zone at the former Fort Ord, within which the installation of new supply wells is restricted by Monterey County. According to Monterey County Code Title 15 Section 15.08.140, a prohibition zone is an area overlying or adjacent to a contaminant plume where water well construction is prohibited and applications for water wells will not be accepted; therefore, direct contact groundwater exposure pathways for residents potentially exposed to groundwater from the Sites 2/12, OU2 and OUCTP areas are currently incomplete and are expected to remain so in the future.

3.1.6 Land Use Considerations

<u>Sites 2/12</u>

In March 2004, the Army transferred the property at Site 12 and the land was redeveloped into a commercial retail area, which included construction of several big-box stores, a movie theater complex, food services, and a large parking area which is identified as The Dunes on Monterey Bay. The Army transferred the property at Site 2 in September 2006 and this land remains undeveloped and open to the general public as part of Fort Ord Dunes State Park. The Site 2 area was proposed for reuse as an aquaculture and oceanographic research facility, and later as a desalination plant (Fort Ord Reuse Authority [FORA], 1997); however, the site remains unused with the derelict sewage treatment plant facilities still onsite.

OU2

The OU2 area consists of the Fort Ord Landfills, which encompass approximately 120 acres of undeveloped land, as well as mixed-use residential, commercial, and undeveloped areas.

OUCTP

The apparent source of the OUCTP is located on what is now Lexington Court, part of the Abrams Housing Development, in the northern portion of the former Fort Ord. A groundwater contaminant plume emanating from this area ultimately extends across an area bounded by Del Monte Boulevard,

Abrams Drive, Neeson Road, and Blanco Road. The OUCTP area consists of mixed-use residential, commercial, light industrial, and undeveloped areas including habitat reserve areas.

3.1.7 Physiography and Topography

The predominant topography of the area reflects a morphology typical of the dune sand deposits that underlie the western and northern portions of the former Fort Ord. In these areas, the ground surface slopes gently to the west and northwest, draining toward Monterey Bay. Runoff is minimal because of the high rate of surface-water infiltration into the permeable dune sand. Consequently, well-developed natural drainages are absent throughout much of this area. Closed drainage depressions typical of dune topography are common. Elevations at the former Fort Ord range from approximately 50 feet above mean sea level (MSL) at Site 2 to 250 feet above MSL at the Fort Ord Landfills.

3.1.8 Geology and Hydrology

The predominant lithology is a loose, well-sorted (poorly graded) fine to medium sand. The sands represent active and recently active dunes and Pleistocene-age older dune sands. The active dune sands parallel the beach and extend several hundred feet inland. The older dune sands cover most of the northern and western portions of the former Fort Ord. Paleosols, representing former ground surfaces (silty sands) exist within these sands. These paleosols indicate that one or more cycles of dune deposition have occurred with intervening periods of soil development. The paleosols in the dunes bordering the beach indicate that older dune sand is locally present beneath the recent dune sand.

Three groundwater aquifers are in the remediation phase of cleanup activities at the former Fort Ord: the unconfined A-Aquifer, the unconfined and confined Upper 180-Foot Aquifer, and the confined Lower 180-Foot Aquifer. The aquifers consist predominantly of fine to coarse-grained sands which are separated by silty clay or clayey fine-grained sand aquitards. The A-Aquifer is located within the recent dune sands and is perched above the regional FO-SVA. To the west where the FO-SVA pinches out, the unconfined A-Aquifer and confined Upper 180-Foot Aquifer combine to form a continuous, unconfined hydrostratigraphic unit (identified as the unconfined Upper 180-Foot Aquifer). A north-trending groundwater divide in the unconfined Upper 180-Foot Aquifer exists midway between the FO-SVA and

Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer west of the divide flows west and discharges to the Monterey Bay. Groundwater in the unconfined Upper 180-Foot Aquifer east of the divide flows under the FO-SVA (becoming confined) toward the Salinas Valley. The Upper and Lower 180-Foot Aquifers, and portions of the 400-Foot Aquifer (locally) are contained within valley fill deposits. The Upper 180-Foot Aquifer is separated from the Lower 180-Foot Aquifer by the Intermediate 180-Foot Aquitard, which appears to be laterally discontinuous in the eastern portion of the former Fort Ord near the OU2 and OUCTP areas creating a natural conduit between the aquifers (Army, 2008).

3.2 Worksheet #11: Project/Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that outline the decision-making process and specify the data required to support corrective actions. DQOs specify the level of uncertainty that will be accepted in results derived from data. The DQO process used for developing data quality criteria and performance specifications for decision-making is consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 2006). The DQO process consists of the following seven steps:

Step 1: State the problem

Step 2: Identify the goals of the study

Step 3: Identify information inputs

Step 4: Define the boundaries of the study

Step 5: Develop the analytical approach

Step 6: Specify performance or acceptance criteria

Step 7: Develop the plan for obtaining data

The DQOs steps are presented below for the five operable units (OUs):

- Sites 2/12
- OU2
- OUCTP A-Aquifer
- OUCTP Upper 180-Foot Aquifer
- OUCTP Lower 180-Foot Aquifer

3.2.1 Step 1: State the Problem

Concentrations of VOCs (primarily PCE, TCE and related breakdown products, and CT) are present in groundwater at the former Fort Ord at concentrations above the ACLs prescribed in the relevant RODs or Explanations of Significant Differences (ESDs), thereby requiring periodic monitoring and reporting of groundwater conditions and VOC concentrations to the CCRWQCB, DTSC, EPA, and USACE. Groundwater contamination is present in three aquifers within and adjacent to the former Fort Ord footprint: A-Aquifer, Upper 180-Foot Aquifer, and the Lower 180-Foot. Three main study areas have been identified, and comprise the majority of the GWMP: Sites 2/12 (one aquifer: Upper 180-Foot Aquifer), OU2 (two aquifers: A-Aquifer and Upper 180-Foot Aquifer) and OUCTP (three aquifers: A-Aquifer, Upper 180-Foot Aquifer, and Lower 180-Foot).

<u>Sites 2/12</u>

Groundwater in the Upper 180-Foot Aquifer beneath Sites 2/12 has been adversely impacted by eight VOCs (Worksheet #15a) that are identified in the Basewide Remedial Investigation Sites Record of Decision (RI Sites ROD; Army, 1997). These compounds are identified as COCs because they are present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the RI Sites ROD and the RI Sites ESD (Army, 2016) require remediation of the Upper 180-Foot Aquifer beneath and downgradient of Sites 2/12 using groundwater extraction with liquid-phase granular activated carbon (GAC) treatment and soil gas extraction with vapor-phase GAC treatment (Ahtna, 2019c). Figure 2 shows the Sites 2/12 monitoring and extraction well locations by sampling schedule, Figure 3 shows the Sites 2/12 GWTS configuration with current extraction well status, and Figure 4 shows the Sites 2/12 GWTP schematic and sampling locations. A detailed discussion of the soil vapor extraction and treatment system can be found in the Soil Gas QAPP (Ahtna, 2019c).

Improper disposal of solvents from former activities in this area led to contamination of the groundwater by COCs at concentrations above ACLs. The extent of the plume is defined by the detectable presence of PCE in groundwater, as it is the most common and widespread chemical constituent in this area. Active remedial action at Sites 2/12 consists of groundwater extraction and treatment by liquid-phase GAC since 1999, and soil gas extraction and treatment by vapor-phase GAC since 2015. Additionally, monitoring wells at Sites 2/12 are subject to seawater intrusion due to their proximity to Monterey Bay; as a result, chloride concentrations are monitored annually at select wells.

<u>OU2</u>

Groundwater in the A-Aquifer and Upper 180-Foot Aquifer beneath and downgradient from the Fort Ord Landfills has been adversely impacted by 11 VOCs. These compounds were identified as COCs (Worksheet #15a) in the OU2 ROD (Army, 1994*)* because they are present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the OU2 ROD and the OU2 ESD (Army, 1995) require remediation of the A-Aquifer and Upper 180-Foot Aquifer beneath and downgradient of OU2 using groundwater extraction with GAC treatment and treated water recharged to the aquifer or reused at the surface. Figures 5A and 5B show the OU2 monitoring and extraction well locations by sampling schedule, Figure 6 shows the OU2 GWTS configuration with current extraction well status, and Figure 7 shows the OU2 GWTP schematic and sampling locations.

COC migration from landfills covering 150 acres in the area has led to contamination of the groundwater by COCs at concentrations above ACLs. Three water supply wells (FO-29, FO-30, and FO-31), which MCWD owns and operates as part of the drinking water supply system for the former Fort Ord and the City of Marina, are also located near the OU2 area. The extent of the plume is defined by the detectable presence of TCE in groundwater, as it is the most common and widespread chemical constituent in this area. Active and ongoing (since 1995) remediation at OU2 consists of extraction and GAC treatment of groundwater.

Disposal of spent small arms ammunition in the Fort Ord Landfills was also identified as a possible source for metals (antimony, copper, and lead) contamination of the groundwater. Metals are not identified as COCs for groundwater in the OU2 ROD and therefore do not have ACLs. However, metals (antimony, copper, and lead) concentrations are monitored at select wells around the Fort Ord Landfills annually to validate that groundwater is not impacted by soil and spent small arms ammunition disposed of in the Fort Ord Landfills during remediation of small arms firing ranges at Fort Ord.

<u>OUCTP A-Aquifer</u>

Improper disposal of CT, used as a cleaning solvent for activities conducted in this area, lead to contamination of the groundwater (Army, 2008). The extent of the OUCTP in the A-Aquifer is defined by the detectable presence of CT in groundwater, as it is the most common and widespread chemical constituent in this area. Remedial action at OUCTP includes a combination of enhanced *in situ* bioremediation (EISB) and monitored natural attenuation (MNA). EISB treatment began with the pilot study starting in 2008 and completed in 2012 at Deployment Areas 1 and 2. Post-treatment and long-term groundwater monitoring have been conducted since 2012 (AES, 2014).

Additional monitoring wells were installed in 2011 and 2015 to close data gaps for the MNA remedy. The wells installed in 2015 indicated the CT groundwater plume was migrating northeast of the A-Aquifer groundwater divide (Figure 11) and construction of EISB Treatment Area #3 was recommended as shown in Figure 14. EISB Deployment Area 3A construction was completed and remedial operations began on December 1, 2016. Operations were completed on August 4, 2017 and post-treatment long-term performance monitoring is continuing according to the *Final Operable Unit Carbon Tetrachloride Plume Remedial Action Work Plan Addendum, Former Fort Ord, California* (Ahtna, 2016).

The effectiveness of EISB treatment is determined through periodic monitoring and reporting of groundwater quality parameters (dissolved oxygen [DO] and oxidation-reduction potential [ORP] in specific wells listed in Worksheet #17c3) and VOC concentrations (Worksheet #15a) to the CCRWQCB, DTSC, EPA, and USACE. Figure 8A shows the OUCTP A-Aquifer monitoring well locations by sampling schedule.

<u>OUCTP Upper 180-Foot Aquifer</u>

Groundwater in the Upper 180-Foot Aquifer at OUCTP has been adversely impacted by CT (Worksheet #15a) as identified in the OUCTP ROD (Army, 2008). This compound is identified as a COC because it is present in groundwater at levels that pose an unacceptable risk to human health or the environment. As a result, the OUCTP ROD requires remediation of OUCTP in the Upper 180-Foot Aquifer using groundwater extraction and treatment via the existing OU2 GWTS. Figure 8B shows the OUCTP Upper 180-Foot Aquifer monitoring well locations by sampling schedule. Figure 6 shows the location of the OUCTP Upper 180-Foot Aquifer extraction well, EW-OU2-09-180.

<u>OUCTP Lower 180-Foot Aquifer</u>

Groundwater in the Lower 180-Foot Aquifer at OUCTP has been adversely impacted by CT (Worksheet #15a) as identified in the OUCTP ROD (Army, 2008). The remediation of the Lower 180-Foot Aquifer includes MNA and contingency wellhead treatment of the nearby MCWD supply wells. Figure 8C shows the OUCTP Lower 180-Foot Aquifer monitoring well locations by sampling schedule. Groundwater in the Lower 180-Foot Aquifer has been adversely impacted by TCE at concentrations exceeding the maximum contaminant level (MCL) for drinking water, which suggests groundwater originating from OU2 in the Upper 180-Foot Aquifer may be flowing from the southwest toward the apparent discontinuity in the Intermediate 180-Foot Aquitard (Army, 2008 and Ahtna, 2019b).

3.2.2 Step 2: Identify the Goals of the Study

The primary goals associated with the Sites 2/12, OU2, and OUCTP remediation projects are to monitor the programs and verify they reflect current site conditions and whether the sites are in continued compliance with the RI Sites ROD (Army, 1997) and ESD (Army, 2016), OU2 ROD (Army, 1994) and ESD (Army, 1995), and the OUCTP ROD (Army, 2008), respectively.

OU2 and Sites 2/12 GWTSs

Data collected from the Sites 2/12 and OU2 GWTS will be used to perform the following assessments:

- Evaluate whether the GWTS are effectively and efficiently reducing concentrations of COCs in the aquifers of concern.
- Assess whether GWTS effluent meets discharge requirements before it is used for groundwater recharge or onsite for non-potable construction purposes (dust control, soil compaction, etc.).
- Evaluate when the GWTS GAC requires change-out.
- Evaluate whether the GWTS provides adequate hydraulic containment of the COC plume and prevents its migration.
- Assess whether ACLs have been achieved for COCs within project boundaries and whether closure of the site or OU is warranted.
- Assess whether the current extraction well sampling frequency is adequate to meet project objectives.

OU2, Sites 2/12, and OUCTP GWMP

The data collected from the Fort Ord GWMP are used to evaluate the following decisions:

- Are concentrations of COCs in groundwater above the relevant ROD- or ESD-prescribed ACLs?
- What is the vertical and lateral extent of relevant ROD-specified COCs in groundwater?
- Are concentrations of TCE in the Lower 180-Foot Aquifer above the MCL?
- What is the vertical and lateral extent of TCE in the Lower 180-Foot Aquifer?
- What is the source of TCE in the Lower 180-Foot Aquifer?
- What are the groundwater and aquifer conditions relative to the stability of the contaminant plumes, and what trends and temporal changes in groundwater levels and COC concentrations are taking place?
- Does the conceptual site model need to be updated or verified?
- Is closure of the site or OU, or a hydraulic zone within the site or OU, warranted if concentrations of COCs in groundwater are less than or equal to the relevant ROD- or ESD-prescribed ACLs?
- Are concentrations of chloride in monitoring wells at Sites 2/12 above the Monterey County Water Resources Agency threshold of 500 mg/L for classification as "seawater intruded"?
- Are concentrations of dissolved antimony, copper, and lead above MCLs for drinking water in wells associated with the Fort Ord Landfills?[7]

[7] Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord Landfills, but are not identified as COCs for groundwater in the OU2 ROD and do not have ACLs; therefore, detected concentrations are compared to MCLs for drinking water. The Federal and California MCLs for antimony, copper and lead are the same numerical value (see Worksheet #15c). The MCL is the maximum concentration of a chemical that is allowed in public drinking water systems, though the groundwater being monitored is within the Prohibition Zone and is not intended for use as drinking water (see Section 3.1.5).

- Do post-treatment DO and ORP measurements in the OUCTP A-Aquifer monitoring wells indicate biodegradation is still occurring in the EISB Deployment Areas?

3.2.3 Step 3: Identify Information Inputs

OU2 and Sites 2/12 GWTSs

Inputs to decisions for the Sites 2/12 and OU2 GWTS are as follows:

- COC concentration data from extraction well samples collected to assess relative concentrations in the aquifer and whether ACLs have been met for COCs.
- COC concentration data from locations within the GWTS collected to assess whether the GWTS is operating effectively and efficiently.
- COC concentration data from TS-212-INJ and TS-OU2-INJ to confirm whether site-specific discharge requirements (Worksheet #15a) are met.
- COC concentration data from GAC treatment effluent collected to determine whether a GAC change-out is required.
- GWTS flow rate data collected to evaluate and document system operation.
- Groundwater monitoring data and/or groundwater flow modeling results to determine whether the plume is hydraulically contained.

OU2, Sites 2/12, and OUCTP GWMP

Decision inputs for the Fort Ord GWMP are as follows:

- Historical groundwater monitoring results and archived information.
- Historical knowledge of geologic and hydrologic conditions at Fort Ord.
- Groundwater modeling data from recent trend analysis.
- Statistical analysis of COC concentration trends on a well-by-well basis.
- ROD- or ESD-prescribed ACLs.
- State of California MCLs for drinking water.
- Fort Ord GWTS operational data and monitoring results.
- Drinking water production well data from local districts and municipalities.

3.2.4 Step 4: Define the Boundaries of the Study

The physical study boundaries for the Sites 2/12, OU2, and OUCTP groundwater remedies are described below and shown in Figure 1. Study boundaries are further divided into hydraulic zones based on the zone of groundwater with COC concentrations above ACLs and influenced by the groundwater remedy; therefore, hydraulic zones and study boundaries may be revised depending on changes in the extent of groundwater with COC concentrations above ACLs and modifications to the groundwater remedies. The long-term temporal boundaries for the remedies are indefinite; however, groundwater monitoring should continue at the sites in accordance with the decision rules presented in Step 5 of Worksheet #11 until the project objectives are met.

The overall geographic boundary for the site is the Main Garrison at the former Fort Ord including the Fritzsche Army Airfield area,[8] and the adjacent portion of the City of Marina. The lateral boundary is defined by the zone of groundwater impacted or potentially impacted by VOCs. The vertical boundary is defined by the zone of contaminated groundwater in the following aquifers or hydrogeologic units.

- A-Aquifer
- Upper 180-Foot Aquifer
- Lower 180-Foot Aquifer

The extent of groundwater with COC concentrations above ACLs is represented by the COC concentration contours shown on figures presented in quarterly and annual reports. COC analytical data are grouped by site for COC concentrations above ACLs and ArcGIS Desktop 10.4 (ESRI, 2017) is used to generate shapefiles depicting the COC concentration contours. Adjustments are made to the contours based on comparative evaluation of current COC concentrations and contours from previous quarters. If more than one sample is collected from a well in a quarterly monitoring event, the sample with the highest detected COC concentration will be used for generating the contour. The COC concentration contours can be compared to historical contours and used to optimize hydraulic zones and study boundaries, and interpret progress toward achieving remedial action objectives.

Groundwater elevations in each aquifer are represented by groundwater elevation contours shown on figures presented in quarterly and annual reports. Groundwater levels are measured each quarter at the wells listed in Worksheet #17 and compared to the wells' known top of casing elevation to determine the groundwater elevation at each well. For multi-port wells that have multiple ports in one aquifer, the groundwater level data from all the ports is averaged to determine the groundwater elevation at that location. Groundwater elevation data sets are imported into the Surfer® 15 (Golden Software, LLC) software application. Within Surfer® 15, the geostatistical gridding method (i.e., kriging) is used to interpolate a gridded surface from the groundwater elevation data. Point kriging, with a circular search ellipse and without a drift type (i.e., ordinary kriging), is used to estimate grid node values based on the known data points near the node with the data points weighted by their distance from the node. The size of the grid cells is set to approximately 30 feet by 30 feet. Once the grid is constructed, Surfer® 15 uses linear interpolation to generate contour lines of equal elevation based on the grid node values. Contour lines for each aquifer are exported from Surfer® 15 as shapefiles and imported into ArcGIS Desktop 10.4 (ESRI, 2017) for final manual adjustments, such as trimming the extents of the contours and smoothing curves. Finally, extraction well operation data are compared to measured groundwater levels at those wells and cones of depression are added manually around operating extraction wells. Groundwater elevation contours can then be used to interpret the flow characteristics of groundwater in each of the aquifers.

The time frame for decision-making relates to the quarterly monitoring and reporting schedule and periodic (e.g., annual) reporting and review cycles. With the exception of certain times of the year when

[8] Now the Marina Municipal Airport.

the presence of sensitive biological resources requires modification to the site or well access procedures, practical constraints on data collection are not applicable to this project.

Sites 2/12

Study boundaries at Sites 2/12 are as follows:

- The overall geographic boundary for the site is within the western Main Garrison area at the former Fort Ord.
- The lateral boundary is defined by the zone of groundwater impacted by COCs. The vertical boundary is defined by the zone of contaminated groundwater in the Upper 180-Foot Aquifer.
- Because the zone of contaminated groundwater is relatively small, limited to a single aquifer, and within the capture area of the existing extraction well network, there is currently only one hydraulic zone at Sites 2/12.

OU2

Study boundaries at OU2 are as follows:

- The overall geographic boundary for the site is the Main Garrison area and the Fort Ord Landfills at the former Fort Ord.
- The lateral boundary is defined by the zone of groundwater impacted by COCs. The vertical boundary is defined by the zone of contaminated groundwater in the A-Aquifer and Upper 180-Foot Aquifer.
- The study boundaries for OU2 are further divided into eight hydraulic zones based on the extent of the COC plumes in the A-Aquifer and Upper 180-Foot Aquifer, and groundwater extraction well network capture areas (Figures 9 and 10).

OUCTP

Study boundaries at OUCTP are as follows:

- The overall geographic boundary for the site is the Main Garrison area north of the Fort Ord Landfills at the former Fort Ord.
- The lateral and vertical boundaries are defined by the zone of groundwater impacted by COCs in the A-Aquifer, Upper 180-Foot Aquifer, and Lower 180-Foot Aquifer.
- The study boundaries for OUCTP are further divided into seven hydraulic zones based on the extent of the COC plumes in the A-Aquifer, Upper 180-Foot Aquifer and Lower 180-Foot Aquifer, and the areas of groundwater remedy influence for each aquifer (Figures 11, 12 and 13).

3.2.5 Step 5: Develop the Analytical Approach

The analytical approach has been developed by using decision rules on information inputs to support the goals of the project for the GWTSs and GWMP.

OU2 and Sites 2/12 GWTSs

Decision rules for the Sites 2/12 and OU2 GWTS have been developed to address the five major components of treatment system operation: discharge limit compliance; GAC change-out; hydraulic containment; sampling frequency; and plume remediation. Each of these components is described below.

Discharge Limit Compliance

- If analytical results indicate COC discharge limits (Worksheet #15a) are being met, then the system will continue to operate and GWTS effluent will be recharged to the aquifer.
- If analytical results indicate the discharge limit for any COC other than methylene chloride[9] is not met, then a confirmation sample will be collected and analyzed with a 24-hour TAT.
- If analytical results indicate the discharge limit for methylene chloride is not met, then the analytical results will be evaluated against QC sample analytical results associated with the same sampling event.
    - If the evaluation indicates the presence of methylene chloride above the discharge limit is not representative of groundwater conditions due to associated QC sample detections, then the OU2 GWTS will continue to operate and effluent will be recharged to the aquifer.
    - If the evaluation indicates the concentration of methylene chloride above the discharge limit is representative of groundwater conditions, then a confirmation sample will be collected from the OU2 GWTS discharge point of compliance and analyzed with a 24-hour TAT.
- If confirmation sample analytical results indicate the discharge limit for any COC is not met, then the affected GWTS will be shut down, operating conditions and GAC loading evaluated, extraction well flow rates adjusted as necessary and a variance report issued for any out-of-limits operation. Following operational changes, which may include GAC change-out, the GWTS will be restarted and re-sampled to verify compliance.
- If verification sample analytical results indicate discharge limits for COCs are being met, then the system will continue to operate and system effluent will be recharged to the aquifer.
- If verification sample analytical results indicate the discharge limit for any COC is not met, then the affected GWTS will be shut down, and operating conditions and GAC loading re-evaluated. Following operational changes, the GWTS will be restarted and re-sampled to verify compliance.

GAC Change-out

The decision rules for determining when a GAC change-out is needed at the Sites 2/12 GWTP are:

[9] Methylene chloride is a COC for OU2 and OUCTP in the A-Aquifer. EPA Method 8260-SIM, Analysis of Volatile Organics by GC/MS, Select Ion Monitoring (SIM) (Attachment A, SGS SOP# MS010) identifies methylene chloride as a common laboratory contaminant detected in the analysis for volatile organics.

- If analytical results for TCE and PCE from a process sample collected immediately downstream of the GAC vessel (upstream of the air stripper) are less than or equal to 90 percent (%) of ACLs, then a GAC change-out is not necessary. The Sites 2/12 system will continue to operate and the final effluent stream will continue to be recharged to the aquifer.
- If the analytical result for TCE or PCE from a process sample collected immediately downstream of the GAC vessel (upstream of the air stripper) is greater than 90% of ACLs, then a GAC change-out will be scheduled.

The *Operations and Maintenance Manual, Operable Unit 2 (OU 2) Groundwater Treatment Plant, Former Fort Ord* (OU2 GWTP O&M Manual; JV, 2018) provides procedures for O&M of the OU2 GWTS. The OU2 GWTP O&M Manual describes the conditions required for GAC change-out, but those instructions are superseded by the following based on Ahtna's experience operating GWTS using liquid-phase GAC as the primary treatment technology. At the OU2 GWTP, the average concentration of each COC in the lead GAC vessel effluent will be calculated based on analytical results from process samples collected immediately downstream of the lead GAC vessel (upstream of the second GAC vessel) during each process sampling event (where such samples are collected). Decision rules for determining when a GAC change-out at OU2 is necessary are:

- If the average concentration of each COC is less than 90% of its respective ACL (Worksheet #15a), then a GAC change-out is not necessary. The OU2 system will continue to operate and the final effluent stream will continue to be recharged to the aquifer.
- If the average concentration of any COC other than methylene chloride is equal to or greater than 90% of its ACL, a GAC change-out will be scheduled.
- If the average concentration of methylene chloride is equal to or greater than 90% of its ACL, then the analytical results for lead GAC vessel effluent sample will be evaluated against the analytical results for QC samples associated with the same sampling event.
  - If the evaluation indicates an average concentration of methylene chloride greater than 90% of its ACL is not representative of groundwater conditions due to associated QC sample detections, then a GAC change-out is not necessary. The system will continue to operate and OU2 GWTS effluent will be recharged to the aquifer.
  - If the evaluation indicates the concentration of methylene chloride above the discharge limit is representative of groundwater conditions and the average concentration of methylene chloride is equal to or greater than 90% of its ACL, a GAC change-out will be scheduled.

Hydraulic Containment

During remediation system operation, specific decision rules must be followed to demonstrate COC plume capture. The decision rules are:

- If groundwater monitoring and/or groundwater flow modeling demonstrate plume capture is occurring, then system operation will continue as currently configured. During operation, extraction well flow rates may be optimized to reduce O&M costs while maintaining plume capture.

- If the system flow rate data, in conjunction with the groundwater flow model, indicate the plume is being hydraulically contained, then the system will continue to operate.
- If groundwater monitoring and/or groundwater flow modeling indicate plume capture is not occurring, additional groundwater flow modeling will be conducted to determine whether adjustment of either extraction or recharge flow rates will improve capture or whether additional extraction wells or recharge points are required. Based on this evaluation, system reconfiguration may be recommended.

Plume Remediation

Assessment of aquifer cleanup resulting from the Sites 2/12 and OU2 GWTS is conducted through a GWMP that evaluates plume migration and COC concentrations. Extraction well monitoring data will be used for evaluating the operational status of individual extraction wells and for statistical evaluations of remediation progress. The decision rules for determining the operational status of groundwater extraction wells with respect to plume remediation are:

- An extraction well will continue to operate if any COC detected is greater than the corresponding ACL (Worksheet #15a).
- An extraction well will continue to operate if the extraction well flow rate data and analytical data from nearby wells, in conjunction with groundwater flow modeling, indicate operation of the extraction well is necessary for hydraulic containment of the plume.
- An extraction well will be shut off if COCs detected are less than the ACL for two consecutive quarterly monitoring events, and if the extraction well flow rate data and analytical data from nearby wells, in conjunction with groundwater flow modeling, indicate operation of the extraction well is no longer necessary for hydraulic containment of the plume.
- Following termination of pumping at an extraction well, the well will be incorporated into the GWMP.

Sampling Frequency

Extraction wells will be sampled quarterly when operating as part of the GWTS. The decision rules for determining the sampling frequency and monitoring status for groundwater extraction wells following termination of operation are:

- If four consecutive quarters of monitoring data show concentrations of COCs are below their respective limits of quantitation (LOQs) (Worksheet #15a) or below 10% of their respective ACLs (Worksheet #15a), whichever is greater, an annual monitoring schedule may be proposed.
- If two annual monitoring results show concentrations of COCs are below their respective LOQs or below 10% of their respective ACLs, whichever is greater, then the well may be proposed for removal from the sampling program.

- If wells adjacent to a well sampled annually, or no longer sampled, show detections of any COCs equal to or greater than their ACLs, then the well monitoring frequency may be increased to quarterly.
- If an annual well monitoring result shows a detection of any COC equal to or greater than its ACL, then the well monitoring frequency may be increased to quarterly.
- If a well is no longer needed for the program, it will be proposed for decommissioning.

Implementation of agency-approved exit strategies for Sites 2/12, OU2 and OUCTP, or portions thereof, may result in modification of these decision rules.

The statistical parameter of interest is the maximum value detected in the well or monitoring point compared to the ACLs or historical trend for that well or monitoring point. For perimeter control, the minimum value detected in the monitoring point (e.g., non-detect [ND] at the limit of detection [LOD]) is the statistical parameter of interest.

OU2, Sites 2/12, and OUCTP GWMP

The decision rules for groundwater monitoring are:

- If four consecutive quarters of monitoring data show concentrations of COCs below their respective LOQs, or below 10% of their respective ACLs (Worksheet #15a), whichever is greater, then an annual sampling schedule may be proposed.
- If two consecutive annual monitoring results show concentrations of COCs below their respective LOQs or below 10% of their respective ACLs, whichever is greater, then the well may be proposed for removal from the sampling program.[10]
- If wells adjacent to a well sampled annually, or no longer sampled, show detections of any COCs equal to or greater than their ACLs, then the well monitoring frequency may be increased to quarterly.
- If an annual well monitoring result shows a detection of any COC equal to or greater than its ACL, then the well monitoring frequency may be increased to quarterly.
- If monitoring or modeling input indicates the groundwater monitoring network no longer provides vertical or lateral control of COCs, then additional groundwater wells may be proposed to be added to the program.
- If a groundwater monitoring well is no longer needed for the program, it will be proposed for decommissioning.
- If a monitoring well in Sites 2/12 is determined to be intruded by seawater based on chloride data, the GWTS operator and Project Manager will be notified to implement possible GWTS changes.
- If concentrations of dissolved copper, lead, and antimony in select A-Aquifer wells (Worksheet #17c) exceed MCLs, the BCT will be notified.

[10] The well will continue to be monitored for depth to water until it is decommissioned or determined to be redundant or unnecessary water elevation data.

Decisions regarding application of passive diffusion bags (PDBs) are described in the *Technical Memorandum Passive Diffusion Bag Pilot Study Results and Recommendations* (Harding ESE, 2001).

OUCTP A-Aquifer EISB Post-Treatment Water Quality Parameter Monitoring

The parameters of interest for the OUCTP A-Aquifer are DO and ORP levels compared to the baseline values or historical trend for that well or monitoring point to evaluate the effectiveness of EISB. The decision rules for determining the monitoring frequency for post-treatment groundwater quality parameters are:

- Continue quarterly monitoring of post-treatment groundwater quality parameters if measurements indicate continued aquifer conditions are affected by the associated EISB treatment at the well; or measurements at one or more adjacent wells indicate aquifer conditions are affected by the associated EISB treatment; or measurements at one or more wells in an immediately upgradient Deployment Area indicates aquifer conditions are affected by the associated EISB treatment;
- If two consecutive quarters of post-treatment water quality parameter monitoring data show both DO and ORP measurements have returned to the approximate levels of recorded baseline conditions,[11] then water quality parameter monitoring may be reduced to an annual frequency at the well; or,
- If four consecutive quarters of post-treatment water quality parameter monitoring data show there has been no effect on the well by EISB treatment (i.e., there has been no significant deviation from recorded baseline conditions),[12] then water quality parameter monitoring may be reduced to an annual frequency at the well.
- If two consecutive annual monitoring periods of post-treatment water quality monitoring at an OUCTP A-Aquifer well show both DO and ORP have returned to the approximate levels of recorded baseline conditions,[13] then water quality parameter monitoring may be discontinued.
- If sampling a well for VOC analyses has been discontinued in accordance with the decision rules for the GWMP, then discontinuing post-treatment water quality parameter monitoring may be considered on a case-by-case basis in consultation with the BCT.

Measurement of post-treatment groundwater quality parameters in an OUCTP A-Aquifer well may be reinstated or increased in frequency should conditions change in an adjacent well or immediately upgradient Deployment Area, including additional EISB treatment.

[11] As presented in the *Final OUCTP Remedial Action Work Plan, Former Fort Ord, California; Appendix A OUCTP A-Aquifer Remedial Design Addendum* (OUCTP RAWP RD Addendum; AES, 2014)
[12] As presented in the OUCTP RAWP RD Addendum (AES, 2014).
[13] As presented in the OUCTP RAWP RD Addendum (AES, 2014).

Completion of Groundwater Restoration Remedial Actions[14]

The decision rules for determining when groundwater remedial actions are complete in a particular site or OU, or a hydraulic zone within the site or OU, are:

- If data collected during the GWMP indicate potential uncertainties regarding the remedy's effectiveness and/or current site conditions, or potential key data gaps, then the conceptual site model will be re-evaluated and updated.
- If COC concentrations in a well are above ACLs, then the well and its respective hydraulic zone will remain in the remediation monitoring phase.[15]
- If four consecutive quarters of monitoring data show concentrations of COCs in a well are less than or equal to their respective ACLs, the well may be evaluated for completion of the remediation monitoring phase.
    - If non-statistical data review shows all COCs in the well are ND, all detected COC concentrations are less than or equal to the ACLs, or a combination of the two, then the remediation monitoring phase is complete in the well.
    - If groundwater monitoring data do not lend themselves to a non-statistical review, then statistical analysis of the data set may be used (e.g., mean test or trend test).
    - If the selected statistical method demonstrates the 95% upper confidence limit (UCL) value is equal to or less than the ACL for the COCs where a statistical analysis was used, then the remediation monitoring phase is complete in the well.
- If a well has completed the remediation monitoring phase, then the well will enter the attainment monitoring phase.[16]
- If monitoring data show concentrations of COCs in a well are less than or equal to their respective ACLs, and it can be demonstrated COC concentrations will continue to be less than or equal to ACLs in the future, then the attainment monitoring phase is complete under any of the following conditions.
    - If all COCs in the well are ND, the LOQ is below the ACL, or a combination of ND sampling results and all detected COC concentrations are below the ACLs for eight consecutive sampling events, then a non-statistical or visual review of the COC data will be sufficient to conclude the attainment monitoring phase is complete in the well.

[14] Adapted from EPA, 2014a and EPA, 2014b.

[15] The remediation monitoring phase refers to the phase of the remedy where remedial activities are being implemented to reach groundwater cleanup levels selected in a remedy decision document. During this phase, groundwater sampling and monitoring data are collected to evaluate COC migration and changes in COC concentrations over time. The completion of this phase at a monitoring well typically occurs when the data collected and evaluated demonstrate that the groundwater has reached the cleanup levels for all COCs, as they are stated in the remedy decision document (EPA, 2013).

[16] The attainment monitoring phase typically occurs after it is determined the remediation monitoring phase is complete. When the attainment phase begins, data are collected to evaluate if the well has reached post remediation conditions (i.e., steady state conditions) where remediation activities, if employed, are no longer influencing the groundwater in the well (EPA, 2013).

- o If all COCs in the well are less than or equal to their respective ACLs for eight consecutive sampling events, and a statistical analysis (i.e., trend analysis) demonstrates COCs will remain less than or equal to ACLs in the future (the trend line has a statistically significant zero [steady state] or negative [decreasing] slope, and the 95% UCL value is less than or equal to the ACL), then the attainment monitoring phase is complete in the well.
- o If the well is removed from the sampling program in accordance with the decision rules applicable to GWMP decision rules presented above, then the attainment monitoring phase is complete in the well.

- If a well has completed the attainment monitoring phase and it is not needed for groundwater elevation data, then it will be proposed for decommissioning.
- If all the wells at particular site or OU, or a hydraulic zone within the site or OU have completed the attainment monitoring phase, then the attainment monitoring phase is complete for the particular site or OU, or hydraulic zone within the site or OU and the decision rules for GWMP no longer apply (i.e., sampling for COC analysis may be discontinued and the wells may be proposed for decommissioning unless needed for groundwater elevation data).
- If the attainment monitoring phase is complete at all the hydraulic zones within a site or OU, then the site or OU will be proposed for closure in a remedial action completion report.

The decision rules for the GWMP and for Completion of Groundwater Restoration Remedial Actions will be implemented concurrently; however, decision rules for determining when groundwater remedial actions are complete take precedence over the decision rules applicable to groundwater monitoring (e.g., if the attainment monitoring phase is complete at all wells in a hydraulic zone, then sampling for COC analysis is no longer necessary).

Exit strategy decision logic related to remedial process optimization and contingency measures should the remedies not progress as expected are presented in the *Final Technical Memorandum, Groundwater Remediation Exit Strategy, Sites 2/12 and OU2, Former Fort Ord, California* (MACTEC, 2009).

3.2.6 Step 6: Specify Performance or Acceptance Criteria

<u>OU2 and Sites 2/12 GWTSs</u>

The null hypotheses for the Sites 2/12 and OU2 GWTS are:

1) Concentrations of VOCs in groundwater entering the GWTS exist above the action levels
2) Concentrations of VOCs at the discharge points of compliance for the GWTS effluents are below discharge limits

The two types of decision errors that could result are a false acceptance decision error and a false rejection decision error. A false acceptance decision error for each null hypothesis would be to:

1) Assume a measured concentration is above the action level when in fact it is not.
2) Assume a measured concentration at a discharge point of compliance is below discharge limits when in fact it is not.

Consequences of the first false acceptance error might include unnecessarily treating groundwater that is not above action levels or continuation of remediation system operation after applicable ACLs have been met.

Consequences of the second false acceptance error might include delay of timely GAC change-out, resulting in discharge of water from the GWTS above discharge limits, or discontinuation of remediation system operation when applicable ACLs have not been met.

A false rejection error for each null hypothesis would be to:

1) Assume a measured concentration is not above the action level when in fact it is.
2) Assume a measured concentration at a discharge point of compliance is above the discharge limit when in fact it is not.

Consequences of the first false rejection error might include premature removal of extraction wells from the remediation system program before ACLs have been met.

Consequences of the second false rejection error might include unnecessarily performing or initiating confirmation sampling of GWTS effluent that actually met discharge limits during normal operation or remediation system shutdown, GAC change-out, and variance report issuance for effluent that met discharge limits after GAC vessel backwashing activities.

Decision errors are most likely to occur when the measured concentration is near the action level, or in the case of NDs, when the LOQ is near the action level. To control decision errors when the LOQ is near the action level, the laboratory is required to report any detections below the LOQ (but above the DL), thereby giving the data user additional information regarding trace level contamination. To control decision errors when the measured concentration is near the action level, the program is very conservative about making recommendations or changes based on individual sampling events and will require data from additional sampling or subsequent sampling events before modifying the treatment system network.

<u>OU2, Sites 2/12, and OUCTP GWMP</u>

VOCs in groundwater at the former Fort Ord range in concentration from ND to 12.3 micrograms per liter (µg/L) PCE (at Sites 2/12), 16.5 µg/L TCE (at site OU2), and 7.4 µg/L CT (at OUCTP), the primary COCs at these sites (as measured in the Third Quarter 2018 GWMP).

The null hypothesis for this project is that concentrations of VOCs in groundwater exist above the action levels. A false acceptance decision (i.e., false positive decision error) would be to assume a measured concentration is above the action level, when in fact, it is not. The consequences of this decision error would be to incur unnecessary expense to study and potentially modify the monitoring network to address an extent of contamination that does not exist.

A false rejection decision error (i.e., false negative decision error) would be to assume a measured concentration is not above the action level when in fact it is. The consequences of this decision error would be to not study or potentially modify the monitoring network, thereby resulting in an incomplete understanding of the extent of contamination and potential threat to groundwater quality.

Decision errors are most likely to occur when the measured concentration is near the action level, or in the case of NDs, when the LOQ is near the action level. To control decision errors when the LOQ is near the action level, the laboratory is required to report any detections below the LOQ (but above the DL), thereby giving the data user additional information regarding trace level contamination. To control decision error when the measured concentration is near the action level, the program is very conservative about making recommendations or changes based on individual monitoring events and will require data from additional sampling or subsequent sampling events before modifying the monitoring network.

In addition, trend analysis provides a valuable tool for assessing reliability of reporting concentrations. Furthermore, data are subjected to automated data review using an electronic system of QC checks, under the direction of a qualified chemist, using USACE and industry standards of analytical QC.

The null hypothesis is that EISB is not occurring in the Deployment Areas. A false acceptance decision (i.e., false positive decision error) would be to assume measured DO and ORP indicates there are no reducing conditions in the aquifer, when in fact there are. The consequences of this decision error would be to incur unnecessary expense to potentially perform additional EISB to establish reducing conditions in areas where they already exist.

A false rejection decision error (i.e., false negative decision error) would be to assume measured DO and ORP indicates there are reducing conditions in the aquifer, when in fact there are not. The consequences of this decision error would be to not perform additional EISB, thereby resulting in a longer period to achieve remedial action objectives.

Decision errors are most likely to occur when measured DO and ORP are near zero. To control such decision errors, the program is very conservative about making recommendations or changes based on individual monitoring events and will require data from additional sampling or subsequent sampling events before modifying the monitoring network. In addition, trend analysis provides a valuable tool for assessing reliability of reporting groundwater quality parameters.

3.2.7 Step 7: Develop the Plan for Obtaining Data

As a result of the DQO process, the optimum sampling design is derived for the Sites 2/12, OU2, and OUCTP remedies. Sample collection locations, rationales, and frequencies were established to achieve discharge compliance and provide a cost-effective means to evaluate the treatment of the impacted groundwater, and can be found in Worksheets #17a1 and #17a2 for Sites 2/12, and Worksheets #17b1 and #17b2 for OU2 and OUCTP. The EPA Method 8260-SIM (selected ion monitoring) analytical procedure for this project was selected to accurately quantify the chemicals of interest at the levels of concern. Method performance criteria for EPA Method 8260-SIM are presented in Worksheets #24 and #28a.

The overall sampling network design is described in Worksheet #17c1 through #17c5.

Sampling design considerations regarding application of PDBs are described in the *Technical Memorandum Passive Diffusion Bag Pilot Study Results and Recommendations* (Harding ESE, 2001).

3.3 Worksheet #12: Measurement Performance Criteria

The measurement performance criteria (MPC) for chemical analyses being performed for each matrix and analytical parameter are summarized in the tables below in Worksheet #12. The MPCs follow those defined in the referenced EPA method or laboratory standard operating procedures (SOPs). The quality of the data to be collected for this project will be verified through appropriate MPCs established for both sampling procedures and analytical methods. The criteria relate to data quality indicators (DQIs) consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as PARCCS parameters. The DQIs are defined as follows:

- Precision refers to the reproducibility of measurements. Precision is usually expressed as standard deviation, variance, percent difference, or range, in either absolute or relative terms.
- Accuracy refers to the degree of agreement between an observed value (such as sample results) and an accepted reference value. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits.
- Representativeness describes the extent to which a sampling design adequately reflects the environmental conditions of a site. Representativeness is determined by appropriate program design, with consideration of elements such as proper well locations, drilling and installation procedures, operations process locations, and sampling locations.
- Comparability addresses the degree to which different methods or data agree or can be represented as similar. Comparability is achieved by using standard methods (SM) for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.
- Completeness is a measure of the amount of valid data collected using a measurement system. Completeness is expressed as a percentage of the number of measurements that are specified in this QAPP.
- Sensitivity is the ability of a method or instrument to detect the target analytes at the level of interest. Sensitivity can be measured by calculating the percent recovery of the analytes at the LOQ, which is the minimum concentration of an analyte that can be routinely identified and quantified above the method LOQ by a laboratory.

The quality of the sampling procedures and laboratory results will be evaluated for compliance with project DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet #37 (Data Usability Assessment). The results will be summarized in an overall data usability report.

3.3.1 Worksheet #12a: VOCs - Sites 2/12 and OU2 GWTS and Sites 2/12, OU2, and OUCTP GWMP

Analytical Group/Method: VOCs by EPA Method 8260-SIM

Matrix: Groundwater (µg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOPs #1-5	Precision	RPD ≤ 30%	Field Duplicate	S
A: SGS SOP#MS010.7		Analyte RPD 1,1-DCA ≤ 15% 1,1-DCE ≤ 18% 1,2-DCA ≤ 14% 1,2-DCE (total) ≤ 17% 1,2-DCPA ≤ 14% 1,3-DCPE (total) ≤ 23% Benzene ≤ 14% CT ≤ 23% Chloroform ≤ 15% cis-1,2-DCE ≤ 15% MC ≤ 16% PCE ≤ 16% TCE ≤ 15% VC ≤ 18%	8260-SIM: LCS/LCSD and MS/MSD	A
A: SGS SOP#MS010.7	Accuracy / Precision	Analyte Recovery 1,1-DCA 81-122% 1,1-DCE 78-137% 1,2-DCA 75-125% 1,2-DCE (total) 76-127% 1,2,-DCPA 76-124% 1,3-DCPE (total) 75-120% Benzene 81-122% CT 76-136% Chloroform 80-124% cis-1,2-DCE 78-120% MC 69-135% PCE 76-135% TCE 81-126% VC 69-159%	8260-SIM: LCS and MS	A
A: SGS SOP#MS010.7	Bias	Analyte: Recovery 1,2-Dichloroethane-$_{d4}$: 74-125% Toluene-$_{d8}$: 88-111%	8260-SIM: Surrogates	A

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOPs #1-5 A: SGS SOP#MS010.7	Bias / Contamination	No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or > 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Method blank, field blank, trip blank	S&A
S: SOPs #1-5	Representative-ness	> 0°C ≤ 6°C	Cooler Temperature Blank	S
		Samples preserved to pH < 2.0	Measure pH of samples after analysis	
S: SOPs #1-5 A: SGS SOP#MS010.7	Comparability	Reasonableness	Historical data	S&A
		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOPs #1-5	Completeness	≥ 95% field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#MS010.7		≥ 90% analytical completeness	Evaluation of number of unqualified[17] results out of the total results reported	A
A: SGS SOP#MS010.7	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A
		Limit of quantitation	LOQ studies	

Notes on next page.

[17] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

Notes:

<: less than
≤: less than or equal to
>: greater than
≥: greater than or equal to
%: percent
°C: degrees Celsius
CCAL: continuing calibration
1,1-DCA: 1,1-dichloroethane
1,1-DCE: 1,1-dichloroethene
1,2-DCA: 1,2-dichloroethane
1,2-DCE (total): total 1,2-dichloroethene
1,2-DCPA: 1,2-dichloropropane
1,3-DCPE: 1,3-dichloropropene
A: analytical
cis-1,2-DCE: cis-1,2-dichloroethene
CT: carbon tetrachloride
DL: detection limit
DQI: data quality indicator
ICAL: initial calibration
LCS: laboratory control samples
LCSD: laboratory control sample duplicate
LOQ: limit of quantitation
MC: methylene chloride
MPC: measurement performance criteria
MS: matrix spike
MSD: matrix spike duplicate
PCE: tetrachloroethene
QC: quality control
RPD: relative percent difference
S: sampling
S&A: sampling and analytical
SIM: selected ion monitoring
SOP: standard operating procedure
TCE: trichloroethene
trans-1,2-DCE: trans-1,2-dichloroethene
VOC: volatile organic compound
VC: vinyl chloride

3.3.2 Worksheet #12b: Metals - OU2 GWMP

Analytical Group: Metals by EPA Method 6010D

Matrix: Groundwater (µg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOP #3	Precision	RPD ≤ 30%	Field Duplicate	S
A: SGS SOP#MET 108.03		RPD ±20%	LCS/LCSD and MS/MSD	A
A: SGS SOP#MET 108.03	Accuracy / Bias	MS and LCS: Antimony 80-120% Copper 80-120% Lead 80-120%	LCS and MS	A
S: SOP #3 A: SGS SOP#MET 108.03		The absolute values of all analytes must be < ½ LOQ or < 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	Method blank and field blank	S&A
S: SOP #3	Representativeness	Samples preserved to pH < 2.0	Measure pH of samples upon receipt	S
		> 0°C ≤ 6°C	Cooler Temperature Blank	
S: SOP #3	Comparability	Reasonableness	Historical data	S
A: SGS SOP#MET 108.03		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOP #3	Completeness	≥ 95% field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#MET 108.03		≥ 90% analytical completeness	Evaluation of number of unqualified results out of the total results reported[18]	A

[18] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
A: SGS SOP#MET 108.03	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A
		Limit of quantitation	LOQ studies	

Notes:
≤: less than or equal to
≥: greater than or equal to
A: analytical
°C: degrees Celsius
CCAL: continuing calibration
DL: detection limit
ICAL: initial calibration
LCS/LCSD: laboratory control sample/laboratory control sample duplicate
LOQ: limit of quantitation
MS/MSD: matrix spike/matrix spike duplicate
RPD: relative percent difference
S: sampling
S&A: sampling and analytical
SOP: standard operating procedure

3.3.3 Worksheet #12c: Wet Chemistry - Sites 2/12 GWTS and Sites 2/12 GWMP

Analytical Group: Chloride by EPA Method 9056A

Matrix: Groundwater (mg/L)

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
S: SOPs #3&5	Precision	RPD ≤ 30%	Field Duplicate	S
A: SGS SOP#GN22 8.9		Analyte RPD Chloride ≤ 20%	Laboratory duplicates and MS/MSD (chloride only)	A
A: SGS SOP#GN22 8.9	Accuracy / Bias	Analyte Recovery Chloride 90-110%	LCS and MS	A
S: SOPs #3&5 A: SGS SOP#GN22 8.9		No analytes detected > ½ LOQ or > ⅒ the amount measured in any sample or > ⅒ the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Method blank and field blank	S&A
S: SOPs #3&5	Representativeness	> 0°C ≤ 6°C	Cooler Temperature Blank	S
S: SOPs #3&5	Comparability	Reasonableness	Historical data	S
A: SGS SOP#GN22 8.9		Qualitative measure for field sampling procedures	LCS/LCSD and MS/MSD	A
S: SOPs #3&5	Completeness	≥ 95% field completeness	Number of samples collected out of total samples planned	S
A: SGS SOP#GN22 8.9		≥ 90% analytical completeness	Evaluation of number of unqualified results out of the total results reported[19]	A
	Sensitivity	Evidence of shift in instrument response or zero setting	LCS, ICAL, CCAL	A

[19] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

S&A SOPs	DQIs	MPC	QC Sample or Activity Used to Assess MPC	QC Sample Assesses (S, A, or S&A)
A: SGS SOP#GN228.9		Limit of quantitation	LOQ studies	

Notes:

≤: less than or equal to
≥: greater than or equal to
A: analytical
°C: degrees Celsius
CCAL: continuing calibration
ICAL: initial calibration
DL: detection limit
LCS/LCSD: laboratory control sample/laboratory control sample duplicate
LOQ: limit of quantitation
MS/MSD: matrix spike/matrix spike duplicate
RPD: relative percent difference
S: sampling
S&A: sampling and analytical
SOP: standard operating procedure

3.4 Worksheet #13: Secondary Data Uses and Limitations

Since the groundwater sampling activities for the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP are both long-term remedial action and monitoring programs and not active investigative programs, the secondary data that will be used to evaluate performance and concentration trends for both programs consist of the most recent annual monitoring reports as listed below. Secondary data and information that will be used, including originating sources, are identified below. How the secondary data will be used and the limitations on their uses are specified. Data from these documents will be utilized as appropriate.

Data Source	Data Generator	How Data Will be Used	Limitations on Data Use
Final Sites 2 and 12 Fourth Quarter 2017 through Third Quarter 2018 Groundwater and Soil Gas Monitoring and Treatment System Report, Former Fort Ord, California (Ahtna, 2019a)	Ahtna/Amec	Historical data used to evaluate GWTS performance over time	None
Final Operable Unit 2 Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring and Treatment System Report, Former Fort Ord, California (Ahtna, 2019e)	Ahtna/Amec	Historical data used to evaluate GWTS performance over time	None
Final Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring Report, Former Fort Ord, California (Ahtna, 2019b)	Ahtna/Amec	Historical data used to evaluate concentration trends	None

Note:
Amec: Amec Foster Wheeler

3.5 Worksheets #14 and #16: Project Tasks & Schedule

3.5.1 Project Tasks

Applicable SOP(s) for the project tasks outlined in this worksheet are listed in Worksheet #21 and provided in detail in Attachment A. The sampling tasks are described in Worksheets #17 and #18.

3.5.2 Waste and Equipment Decontamination

Wastewater generated during decontamination will be disposed of at the OU2 or Sites 2/12 GWTS and treated with the influent groundwater. Personal protective equipment and miscellaneous waste will be placed in large garbage bags, sealed, and disposed of in facility trash receptacles.

3.5.3 Quality Control Tasks

Implement field SOPs. Field QC samples will be collected at the frequency indicated in Worksheet #20. Samples will be analyzed by the laboratory in accordance with the stated method and the DoD QSM and this QAPP. For items related to QC, see Worksheets #11, #12, #15, #22, #24, #25, #27, and #28.

3.5.4 Secondary Data

See Worksheet #13.

3.5.5 Data Management Tasks

The following are the team members and their responsibilities for the data management process:

Program Chemist. Responsible for reviewing chain of custody forms and establishing the sample tracking system. Oversees proper use of Ahtna’s sample management system and accuracy of the information entered. Reviews laboratory data for accuracy and quality and compares electronic outputs for accuracy to laboratory electronic copies. Conducts tracking of samples, forwards tracking information and received data to the database manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and figures.

Database Manager. Responsible for setting up the data management system in consultation with the program chemist at the beginning of the data evaluation task. Also oversees the data management process, including data conversion/manual entry into the data management system, QC of the entered data, and preparation of the required tables and plots of the data. Coordinates with the person responsible for reviewing the entered data for QC purposes. Forwards all deliverables to the Project Manager.

Geographic Information System (GIS) Manager. Responsible for coordinating with the Project Manager to set up the geodatabase prior to sampling. Maintains spatial layers and overall geodatabase integrity and accuracy. Provides all GIS-related outputs for reports.

3.5.6 Sample Tracking

The program chemist is responsible for tracking samples in the sample tracking database to ensure that the analytical results for all samples sent for analysis are received. Copies of chains of custody from the field team are used to enter in sample identifications (IDs), collect data, and for analyses. Upon receipt of a sample receipt notice from the laboratory, the date received by the laboratory, and a date the electronic copy is due will be entered. Likewise, upon receipt of the electronic copy and electronic data deliverable (EDD), the date they are received will also be entered. The EDDs will be uploaded when received from the laboratory and will be tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

3.5.7 Data Types

The data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by Ahtna. The data source will be noted in the database.

3.5.8 Data Tracking and Management

Every data set received from analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent fashion. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of database entry for each data set will all be tracked and recorded in the project database.

Hard/Electronic Copy. Measurements made during field data collection activities will be recorded in field logbooks and sample processing logs. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks and sample processing logs. All raw analytical laboratory data are stored electronically.

Data Input Procedures. Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Other available field-related data collected will be manually entered onto standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading.

3.5.9 Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using Ahtna's and Wood's database to store and analyze project data submissions.

The database must be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The following procedures will be adopted to ensure protection:

- The master database will be stored on a network file server local to the installation of the Ahtna and Wood data management system. Members of the data management team involved in loading, modifying, or querying the database will be given access through user accounts and passwords, as well as the appropriate network server permissions.
- Copies of the master database will be stored on the local area network for access by project staff through reporting tools developed to minimize possible database corruption by users. Whenever the master database is updated or modified, it will be recopied to the local area

network to ensure that the current copy is available to users.

- Backups of the master database and its copies will be made to ensure that the data will not be lost due to problems with the network.

In addition to the internal computer database, EDDs will be uploaded to the BRAC Fort Ord Data Integration System (FODIS) database and the CCRWQCB GeoTracker database.

3.5.10 Geographic Information System Description

A project geodatabase will be set up prior to sampling by the Project Manager, database technician, and GIS technician. Ahtna will adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this QAPP and will meet the minimum requirements for spatial data in accordance with Spatial Data Standards for Facilities, Infrastructure and Environment, current version whenever possible. Ahtna will submit the native GIS files that will include map data (.mxd) and geodatabase (.dbf) format. Ahtna will provide validated geospatial data to USACE for submission by BRAC to the FODIS database.

Each geospatial data set shall be accompanied by metadata conforming to the Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata and the Army Installation Geospatial Information & Services Metadata Standard, v1. The horizontal accuracy of any geospatial data created shall be tested and reported in accordance with the National Standard for Spatial Data Accuracy and the results shall be recorded in the metadata. All data will have a datum of GCS_North American_1983 and a projection of North American Datum 1983 State Plane California Zone 4. The sea level datum used will be the National Geodetic Vertical Datum 1929 to conform with historical former Fort Ord data.

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

3.5.11 Documentation

Documentation of data management activities is critical because it provides the following:

- An electronic copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The data management plan will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

3.5.12 Presentation of Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ArcMap or similar analysis/presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. The information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.

3.5.13 Assessment and Audit Tasks

See Worksheets #31, #32, and #33.

3.5.14 Data Review Tasks

The laboratory will make sure that the data are complete for all samples received. Laboratory data will be validated by Ahtna or Wood. Validated data and field logs will be reviewed to assess total measurement error and determine the overall usability of the data for project purposes. Final data are placed in the database with qualifiers. See Worksheets #34 though #37 for the tasks.

3.5.15 Documentation and Records

Records and field measurements of all samples will be collected in notebooks. Chains of custody and sample logs will be prepared and retained for each sample. A copy of the final QAPP will be kept at the Ahtna Marina office. Field forms are shown in Attachment C.

3.5.16 Project Schedule

A general project schedule for long-term monitoring is presented below.

<table>
<tr><th>Activity</th><th>Responsible Party</th><th>Frequency</th><th>Deliverable(s)</th><th>Deliverable Due Date</th></tr>
<tr><td>OU2 GWTS O&M</td><td rowspan="5">Ahtna</td><td rowspan="2">Ongoing</td><td rowspan="5">Quarterly and Annual Reports</td><td rowspan="5">Quarterly Report (Final only) due 60 days after sampling event concludes*
Annual Report (Pre-Draft) due 75 days after sampling event concludes*</td></tr>
<tr><td>Sites 2/12 GWTS O&M</td></tr>
<tr><td>OU2 GWMP</td><td rowspan="3">Quarterly</td></tr>
<tr><td>Sites 2/12 GWMP</td></tr>
<tr><td>OUCTP GWMP</td></tr>
</table>

Notes:
* The conclusion of the sampling event is defined as the last day samples are collected for the event.

3.6 Worksheet #15: Laboratory-Specific Detection/Quantitation Limits

3.6.1 Worksheet #15a: VOCs by EPA Method 8260-SIM

Matrix: Groundwater (µg/L)

		Project Action Limits[1] (µg/L)									Analytical Method Limits[2] (µg/L)		Achievable Laboratory Limits[3] (µg/L)		
		Sites 2/12		OU2		OUCTP				Project LOQ (µg/L)					
						A-Aquifer	Upper 180-Foot Aquifer		Lower 180-Foot Aquifer						
Analyte	**CAS #**	**ACL**	**DCL[4]**	**ACL**	**DCL**	**ACL**	**ACL**	**DCL**	**ACL**		**DL**	**LOD and LOQ**	**DL**	**LOD**	**LOQ**
1,1-Dichloroethane	75-34-3	-	-	5	5[5]	-	-	-	-	0.50	0.03		0.10	0.25	0.50
1,1-Dichloroethene	75-35-4	6	6	-	-	6	-	-	-	0.50	0.12		0.10	0.25	0.50
1,2-Dichloroethane	107-06-2	0.5	0.5	0.5	0.5	-	-	-	0.5	0.50	0.02		0.10	0.25	0.50
1,2-Dichloroethene (total)[6]	540-59-0	-	-	-	-	6	-	-	-	1.0	0.49		0.10	0.25	0.50
1,2-Dichloropropane	78-87-5	-	-	1	0.5	-	-	-	-	0.50	0.02		0.10	0.25	0.50
1,3-Dichloropropene (total)[6]	542-75-6	0.5	0.5	-	-	-	-	-	-	0.50	0.27		0.10	0.25	0.50
Benzene	71-43-2	-	-	1	0.5	-	-	-	-	0.50	0.03	NP	0.10	0.25	0.50
Carbon Tetrachloride	56-23-5	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.50	0.02		0.10	0.25	0.50
Chloroform	67-66-3	2	2	2	2[5]	2	-	-	-	0.50	0.04		0.10	0.25	0.50
cis-1,2-Dichloroethene	156-59-2	6	6	6	6[5]	-	-	-	-	0.50	0.06		0.10	0.25	0.50
Methylene chloride	75-09-2	-	-	5	0.5	5	-	-	-	2.0	0.62		0.50	0.50	2.0
Tetrachloroethene	127-18-4	5	5	3	0.5	5	-	-	-	0.50	0.05		0.10	0.25	0.50
Trichloroethene	79-01-6	5	5	5	0.5	5	-	-	-	0.50	0.02		0.10	0.25	0.50
Vinyl Chloride	75-01-4	0.1	0.1	0.1	0.1	0.1	-	-	-	0.10	0.04		0.050	0.050	0.10

Notes on next page.

Notes:

µg/L: micrograms per liter
ACL: Aquifer Cleanup Level
CAS #: Chemical Abstracts Service Number
DCL: discharge limit
DL: detection limit
LOD: limit of detection
LOQ: limit of quantitation
NP: not provided in method
OU: Operable Unit
OUCTP: Operable Unit Carbon Tetrachloride Plume
-: not applicable

[1]ACLs and discharge limits are site-specific and identified in the relevant decision documents (Army, 1994; Army, 1995, Army, 1997; Army, 2008; and Army, 2016).

[2]Analytical method DLs, LODs and LOQs are those documented in published methods.

[3]Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated ("J-qualified").

[4]Discharge limit for the applicable groundwater treatment system using groundwater extraction and treatment with granular activated carbon (GAC). For Sites 2/12 GWTS, discharge to areas overlying the contaminated groundwater plume need only meet ACLs (HLA, 1999).

[5]Discharge limit revised to ACL for this COC to optimize GAC usage (HLA, 1999).

[6]Total of cis- and trans- isomers.

3.6.2 Worksheet #15b: Ion Chromatography by EPA Method 9056A

Matrix: Groundwater (mg/L)

Analyte	CAS Number	Project Action Limits[1] (mg/L) Sites 2/12	Project LOQ (mg/L)	Analytical Method Limits[2] (mg/L)		Achievable Laboratory Limits[3] (mg/L)		
				DL	LOD and LOQ	DL	LOD	LOQ
Chloride	16887-00-6	250	250	0.02	Not Provided in Method	0.80	1.0	2.0

Notes:
CAS: Chemical Abstracts Service
DL: detection limit
LOD: limit of detection
LOQ: limit of quantitation
mg/L: milligrams per liter
[1]Project Action Limits are National Secondary MCLs for Drinking Water Quality.
[2]Analytical method DLs, LODs and LOQs are those documented in published methods.
[3]Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated (“J-qualified”).

3.6.3 Worksheet #15c: Dissolved Metals by ICP by EPA Method 6010D

Matrix: Groundwater (µg/L)

Analyte	CAS Number	Project Action Limits[1] (µg/L) OU2	Project LOQs (µg/L)	Analytical Method Limits[2] (µg/L)			Achievable Laboratory Limits[3] (µg/L)		
				DL	LOD	LOQ	DL	LOD	LOQ
Antimony	7440-36-0	6.0	6.0	21	Not Provided in Method	Not Provided in Method	1.0	5.0	6.0
Copper	7440-50-8	1,000	25	3.6			1.0	2.0	25
Lead	7439-92-1	15	10	28			1.1	2.0	5.0

Notes:

CAS: Chemical Abstracts Service

DL: detection limit

LOD: limit of detection

LOQ: limit of quantitation

µg/L: micrograms per liter

[1]Project Action Limits are state or federal MCLs (whichever is lower) for drinking water in OU2 wells associated with the Fort Ord Landfills. Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord Landfills. MCLs are used to evaluate concentrations of these dissolved metals in groundwater near the Fort Ord Landfills; however, the groundwater being monitored is not intended for use as drinking water.

[2]Analytical method DLs, LODs and LOQs are those documented in published methods.

[3]Achievable DLs, LODs, and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. An analyte is ND at the LOD, and a measurable detection above the DL and less than the LOQ is estimated (“J-qualified”).

4.0 Sample Design

4.1 Worksheet #17: Sampling Design and Rationale

A summary of existing monitoring locations is listed in the worksheets below separated by site and aquifer accordingly.

4.1.1 Worksheet #17a1: Sites 2/12 GWTS Part I

Sampling Location	Activity	EPA Method	Comments/Rationale[4]	SOP Reference
TS-212-INF	GWTS monitoring[1]	8260-SIM	To measure influent COC concentrations and evaluate GWTS efficiency.	SOP #5
TS-212-GAC A			To measure COC concentrations downstream from the GAC vessel and evaluate GAC efficiency.	
TS-212-EFF			To measure COC concentrations downstream from the air stripper unit and evaluate air stripper efficiency.	
TS-212-INJ			To comply with discharge limits.	
EW-12-03-180U[6]	Groundwater Monitoring[2]	8260-SIM EPA Method 9056A SM 9056A	To measure changes in groundwater COC concentrations. To evaluate general inorganic constituents.	
EW-12-03-180M[5]				
EW-12-04-180U[6]				
EW-12-04-180M[6]				
EW-12-05-180M[3]				
EW-12-06-180M[3]				
EW-12-07-180M[3]				
EW-12-08-180U[3]				

Notes:

COC: chemical of concern
EFF: effluent
EW: extraction well
GAC: granular activated carbon
INF: influent
INJ: injection
TS: treatment system sampling port
SOP: standard operating procedure

[1] The sampling frequency is variable based on historical GAC breakthrough rates, as shown on Worksheet #17a2.

[2] Samples and water level measurements are collected quarterly or annually from the extraction wells based on the decision rules identified in Worksheet #10a.

[3] During the 3rd Quarter (Annual) sampling event, chloride is analyzed.

[4] The rationale for sampling locations and frequency is based on the RI Sites ROD and RI Sites ESD, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

[5] Pump removed from the inoperable extraction well, groundwater sampling conducted with PDBs as identified in Worksheet #17c.

[6] Well no longer sampled per decision rules (Worksheet #10a).

4.1.2 Worksheet #17a2: Sites 2/12 GWTS Part II

The *Final Operations and Maintenance Manual Volume II, Sites 2 and 12 Groundwater Remedy, Former Fort Ord, California* (Sites 2/12 GWTS O&M Manual; AES, 2009) provides procedures for O&M of the Sites 2/12 GWTS. The Sites 2/12 GWTS O&M Manual also describes the conditions required for GAC change-out in Section 4.2.3, but those instructions are superseded by Worksheet #17a2.

Sites 2/12 GWTS Sampling Frequencies[3]									
	Weeks after GAC change-out[4]								
Sample Point	**0**	**12**	**21**	**30**	**36**	**42**	**44**	**46**	**48[4]**
TS-212-INF			xx		x	xx	x	xx	x
TS-212-GAC-A[1]	x[2]		x	x	x	x	x	x	x
TS-212-EFF						x	x	x	x
TS-212-INJ		x	x	x	x	x	x	x	x

Notes:

≥: greater than or equal to

%: percent

x: sample collected

xx: sample and duplicate collected

[1] Sample point immediately downstream of the GAC vessel.

[2] Sample collected no less than 2 hours after bringing a newly repacked GAC vessel online.

[3] The sampling frequency is determined based on historical COC breakthrough rates; however, the sampling frequency may be altered if there are significant operational changes.

[4] If GAC change-out is not indicated by Week 48, further sampling will be performed weekly, or at a frequency determined by the Project Manager, until GAC effluent PCE or TCE concentration is ≥ 90% of the discharge limit.

4.1.3 Worksheet #17b1: OU2 GWTS Part I

Sampling Location	Activity	Test Methods	Comments/Rationale[3]	SOP Reference
TS-OU2-INF-01*	GWTS Monitoring[1]	EPA Method 8260-SIM	To measure influent COC concentrations and evaluate GWTS efficiency.	SOP #5
TS-OU2-INF-02*				
TS-OU2-EFF-1A*			To measure COC concentrations downstream from a GAC vessel and evaluate GAC efficiency.	
TS-OU2-EFF-1B*				
TS-OU2-EFF-1C*				
TS-OU2-EFF-2A*				
TS-OU2-EFF-2B*				
TS-OU2-EFF-2C*				
TS-OU2-INJ-01*			To measure COC concentrations downstream from the GAC vessels. To comply with discharge limits (point of compliance).	
EW-OU2-01-A[5]	Groundwater Monitoring[2]	EPA Method 8260-SIM	To evaluate changes in groundwater COC concentrations.	SOP #5
EW-OU2-02-A				
EW-OU2-03-A[5]				
EW-OU2-04-A				
EW-OU2-05-A				
EW-OU2-06-A				
EW-OU2-07-A[5]				
EW-OU2-09-A				
EW-OU2-10-A				
EW-OU2-11-AR				
EW-OU2-12-A				
EW-OU2-13-A				
EW-OU2-14-A				
EW-OU2-16-A				
EW-OU2-17-A				
EW-OU2-18-A				
EW-OU2-19-A				
EW-OU2-20-A				
EW-OU2-01-180[4]				
EW-OU2-02-180R				
EW-OU2-03-180				
EW-OU2-04-180[5]				
EW-OU2-05-180				
EW-OU2-06-180				
EW-OU2-07-180[4]				
EW-OU2-08-180				
EW-OU2-09-180[6]				

Sampling Location	Activity	Test Methods	Comments/Rationale[3]	SOP Reference
EW-OU2-10-180	Groundwater Monitoring[2]	EPA Method 8260-SIM	To evaluate changes in groundwater COC concentrations.	
EW-OU2-11-180				
EW-OU2-12-180				

Notes:
COC: chemical of concern
EFF: effluent
EW: extraction well
GAC: granular activated carbon
INF: influent
INJ: injection
TS: treatment system sampling port
[1] The sampling frequency is variable based on historical GAC breakthrough rates, as shown in Worksheet #17b2.
[2] Groundwater samples and water level measurements are collected quarterly or annually from the extraction wells based on the decision rules identified in Worksheet #10a.
[3] The rationale for sampling locations and frequency is based on the OU2 ROD, OU2 ESD, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.
[4] Pump removed from the inoperable extraction well, groundwater sampling conducted with PDBs as identified in Worksheet #17c5.
[5] Well no longer sampled per decision rules (Worksheet #10).
[6] Well operated to remediate the OUCTP Upper 180-Foot Aquifer as listed in Worksheet #17c4.
* The OU2 GWTP sampling locations were renamed as listed below.

New Name	Former Name
TS-OU2-INF-01	SP-IN-01
TS-OU2-INF-02	SP-IN-02
TS-OU2-EFF-1A	SP-1A-EF
TS-OU2-EFF-1B	SP-1B-EF
TS-OU2-EFF-1C	SP-1C-EF
TS-OU2-EFF-2A	SP-2A-EF
TS-OU2-EFF-2B	SP-2B-EF
TS-OU2-EFF-2C	SP-2C-EF
TS-OU2-INJ-01	SP-EF-01

4.1.4 Worksheet #17b2: OU2 GWTS Part II

The OU2 GWTP O&M Manual (JV, 2018) provides procedures for sampling of the OU2 GWTP and describes the conditions required for GAC change-out, but those instructions are superseded by Worksheet #17b2.

OU2 GWTS Sampling Frequencies[3,4] Median GAC Cycle to be determined[5]														
Sampling Point		**Weeks after GAC change-out[6]**												
		0	**1**	**2**	**3**	**4**	**5**	**9**	**13**	**16**	**19**	**22**	**24**	**26**
TS-OU2-INF-01	GAC change-out	x	x	xx	x	x	x	xx		x		xx		x
TS-OU2-INF-02		xx	x	x	x	xx	x			xx		x		xx
TS-OU2-EFF-1A[1]		x	x	x	x	x	x			x	x	x	x	x
TS-OU2-EFF-1B[1]		x								x		x		x
TS-OU2-EFF-1C[1]		x								x		x		x
TS-OU2-EFF-2A[1]		x	x	x	x	x	x			x	x	x	x	x
TS-OU2-EFF-2B[1]		x								x		x		x
TS-OU2-EFF-2C[1]		x								x		x		x
TS-OU2-INJ-01		x[2]	x	x	x	x	x	x	x	x	x	x	x	x

Notes:

TS-OU2-INF-01 (formerly SP-IN-01) = Eastern Main influent
TS-OU2-INF-02 (formerly SP-IN-02) = Western Main influent
TS-OU2-EFF-1A (formerly SP-1A-EF) = GAC 1A effluent
TS-OU2-EFF-1B (formerly SP-1B-EF) = GAC 1B effluent
TS-OU2-EFF-1C (formerly SP-1C-EF) = GAC 1C effluent
TS-OU2-EFF-2A (formerly SP-2A-EF) = GAC 2A effluent
TS-OU2-EFF-2B (formerly SP-2B-EF) = GAC 2B effluent
TS-OU2-EFF-2C (formerly SP-2C-EF) = GAC 2C effluent
TS-OU2-INJ-01 (formerly SP-EF-01) = discharge point of compliance
x: sample collected
xx: sample and duplicate collected
[1] Sample point to be immediately downstream of the lead GAC vessel.

[2] Sample collected no less than 2 hours after bringing a newly repacked GAC vessel on-line.

[3] The sampling frequency is determined based on historical COC breakthrough rates at the old OU2 GWTP; however, the sampling frequency may be altered at the discretion of the Project Manager if there are significant differences in operational conditions at the new OU2 GWTP.

[4] The sampling schedule assumes vessels GAC 1A and GAC 2A are in the lead position.

[5] The median GAC cycle for the new OU2 GWTP based on analytical results for process samples collected during the first year of operation.

[6] If GAC change-out is not indicated by Week 26, further sampling will be performed weekly or at a frequency determined by the direction of the Project Manager.

4.1.5 Worksheet #17c1: Sites 2/12 GWMP

Well Name	Cl	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
EW-12-03-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-02-05-180	A	A	Q	HydraSleeve™, PDB/ SOP #3,2	RI Sites ROD/ESD
MW-02-13-180M	A	Q	Q	HydraSleeve™, PDB/ SOP #3,2	RI Sites ROD/ESD
EW-12-05-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-06-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-07-180M	A	Q	Q	Pump Spigot/SOP #5	RI Sites ROD/ESD
EW-12-08-180U	A	Q	Q	Pump Spigot/SOP #5	RI Sites RI/FS Addendum
MW-12-01-180		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-05-180	A		Q	HydraSleeve™/ SOP #3	RI Sites ROD/ESD
MW-12-09R-180		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-14-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-15-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-16-180M		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-18-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-20-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-21-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-22-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-24-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-25-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-26-180U		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-28-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-29-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-30-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-31-180M		A	Q	PDB/SOP #2	RI Sites ROD/ESD
MW-12-32-180U		Q	Q	PDB/SOP #2	RI Sites ROD/ESD
The Following Wells Are Measured for Groundwater Elevation Data Only:					
EW-12-03-180U			Q	SOP #5	Groundwater elevation trend analysis
EW-12-04-180M			Q	SOP #5	Groundwater elevation trend analysis

Well Name	Cl	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
EW-12-04-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-02-06-180			Q	SOP #5	Groundwater elevation trend analysis
MW-02-10-180			Q	SOP #5	Groundwater elevation trend analysis
MW-02-13-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-07-180			Q	SOP #5	Groundwater elevation trend analysis
MW-12-08-180			Q	SOP #5	Groundwater elevation trend analysis
MW-12-12-180L			Q	SOP #5	Groundwater elevation trend analysis
MW-12-17-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-19-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-19-180M			Q	SOP #5	Groundwater elevation trend analysis
MW-12-23-180U			Q	SOP #5	Groundwater elevation trend analysis
MW-12-27-180U			Q	SOP #5	Groundwater elevation trend analysis

Notes:

A: sampled on an annual basis
Cl: chloride
ESD: Explanation of Significant Differences
PDB: passive diffusion bag
Q: sampled on a quarterly basis
RI: Remedial Investigation
ROD: Record of Decision
SIM: selected ion monitoring
SOP: standard operating procedures
VOCs: volatile organic compounds

[1] The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

4.1.6 Worksheet #17c2: OU2 GWMP

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
EW-OU2-01-180		Q	Q	PDB/SOP #2	OU2 ESD
EW-OU2-02-180R[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-02-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-03-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-04-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-05-180		Q	Q	PDB/SOP #2	OU2 ROD
EW-OU2-05-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-06-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-06-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-08-180		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-09-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-10-180[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-10-A		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-11-180[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-11-AR[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-12-180[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-12-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-13-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-14-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-15-A		Q	Q	PDB/SOP #2	OU2 ESD
EW-OU2-16-A		Q	Q	Pump Spigot/SOP #5	OU2 ROD
EW-OU2-17-A[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-18-A[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-19-A[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
EW-OU2-20-A[2]		Q	Q	Pump Spigot/SOP #5	OU2 GWTP Relocation
MW-BW-02-180		Q	Q	PDB/SOP #2	OU2 ESD/OUCTP ROD
MW-BW-13-A		Q	Q	PDB/SOP #2	OU2 ROD

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-BW-14-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-BW-50-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-01-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-02-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-04-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-06-180R2		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-06-AR		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-07-180R		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-07-A		A	Q	PDB/SOP #2	OU2 ROD
MW-OU2-08-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-12-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-20-180		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-23-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-24-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-25-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-27-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-28-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-28-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-30-180		A	Q	PDB/SOP #2	OU2 ESD
MW-OU2-34-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-39-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-40-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-43-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-44-A		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-44-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-45-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-46-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-46-180		Q	Q	PDB/SOP #2	OU2 ESD

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-OU2-47-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-50-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-51-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-53-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-56-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-61-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-62-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-63-180		A	Q	PDB/SOP #2	OU2 ESD
MW-OU2-73-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-74-A	A	Q	Q	HydraSleeve™, PDB/ SOP #2, 3	OU2 ROD
MW-OU2-75-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-79-A		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-80-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-81-A		Q	Q	PDB/SOP #2	OU2 ROD
MW-OU2-81-180		Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-83-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
The Following Wells Are Measured for Groundwater Elevation Data Only:					
EW-OU2-01-A			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-03-A			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-04-180			Q	SOP #5	Groundwater elevation trend analysis
EW-OU2-07-A			Q	SOP #5	Groundwater elevation trend analysis
MW-14-03-180			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-01-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-11-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-12-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-03-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-05-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-05-180			Q	SOP #5	Groundwater elevation trend analysis

Well Name	Cu, Pb, Sb (6010D)	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-OU2-09-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-09-180R			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-13-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-20-180X			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-21-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-23-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-29-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-29-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-30-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-31-180R			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-32-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-35-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-36-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-49-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-52-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-54-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-55-180			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-57-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-58-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-76-A			Q	SOP #5	Groundwater elevation trend analysis
MW-OU2-77-A			Q	SOP #5	Groundwater elevation trend analysis
PZ-OU2-06-180			Q	SOP #5	Groundwater elevation trend analysis

Notes:

A: sampled on an annual basis

Cu: copper

ESD: Explanation of Significant Differences

PB: lead

PDB: passive diffusion bag

Q: sampled on a quarterly basis

ROD: Record of Decision

Sb: antimony

SIM: selected ion monitoring

SOP: standard operating procedures

VOCs: volatile organic compounds

[1] The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

[2] New wells installed in 2016 to be operated and sampled once the new OU2 GWTP is online in 2018.

4.1.7 Worksheet #17c3: OUCTP A-Aquifer GWMP

Well Name	DO ORP	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
EISB-EW-01		Q	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-02		A	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-09		Q	Q	PDB/SOP #2	OUCTP ROD
EISB-EW-12	Q		Q	PTM/SOP #6/7	OUCTP ROD
EISB-EW-15	Q		Q	PTM/SOP #6/7	OUCTP ROD
EISB-MW-01		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-109-A		Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-112-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-119-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-124-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-132-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-135-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-144-A	Q		Q	PTM/SOP #6/7	OUCTP ROD
EW-BW-149-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-150-A	Q	A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-155-A	Q	Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
EW-BW-159-A	Q		Q	PTM/SOP #6/7	OUCTP ROD
EW-BW-160-A	Q	Q	Q	PDB/SOP #2	OUCTP ROD
EW-BW-161-A	Q		Q	SOP #5	OUCTP ROD
EW-BW-164-A	Q		Q	SOP #5	OUCTP ROD
EW-BW-165-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-166-A	Q	Q	Q	PDB/SOP #2	OUCTP ROD
EW-BW-167-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-168-A		A	Q	PDB/SOP #2	OUCTP ROD
EW-BW-169-A		A	Q	PDB/SOP #2	OUCTP ROD
MP-BW-46-095		A	Q	Westbay Port/SOP #1	OUCTP ROD
MW-B-12-A		Q	Q	PDB/SOP #2	OUCTP ROD

Well Name	DO ORP	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-B-14-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-15-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-17-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-24-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-26-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-27-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-28-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-30-A		A	Q	SOP #5	Groundwater elevation trend analysis
MW-BW-31-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-32-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-35-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-36-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-39-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-42-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-43-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-44-A		A	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
MW-BW-48-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-49-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-56-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-58-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-60-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-65-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-66-A		Q	Q	PTM/SOP #6/7; PDB/SOP #2	OUCTP ROD
MW-BW-74-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-75-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-77-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-78-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-79-A		Q	Q	PDB/SOP #2	OUCTP ROD

Well Name	DO ORP	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-BW-80-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-83-A		A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-85-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-86-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-87-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-88-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-89-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-90-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-91-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-92-A		Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-93-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-94-AR		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-95-A		Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
The Following Wells Are Measured for Groundwater Elevation Data Only:					
EISB-EW-03			Q	SOP #5	Groundwater elevation trend analysis
EISB-MW-04			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-92-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-93-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-100-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-104-A			Q	SOP #5	Groundwater elevation trend analysis
EW-BW-126-A			Q	SOP #5	Groundwater elevation trend analysis
MP-BW-46-080			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-48-113			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-48-133			Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-40-01-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-16-A			Q	SOP #5	OUCTP ROD
MW-BW-18-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-25-A			Q	SOP #5	Groundwater elevation trend analysis

Well Name	DO ORP	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-BW-34-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-38-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-41-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-45-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-46-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-51-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-53-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-54-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-57-A			Q	SOP #5	OUCTP ROD
MW-BW-59-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-63-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-67-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-71-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-81-A			Q	SOP #5	Groundwater elevation trend analysis
MW-BW-82-A			Q	SOP #5	Groundwater elevation trend analysis

Notes:

A: sampled on an annual basis
DO: dissolved oxygen
ORP: oxidation-reduction potential
PDB: passive diffusion bag
PTM: post-treatment monitoring
Q: sampled on a quarterly basis
ROD: Record of Decision
SIM: selected ion monitoring
SOP: standard operating procedures
[1] The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

4.1.8 Worksheet #17c4: OUCTP Upper 180-Foot Aquifer GWMP

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
EW-OU2-09-180	Q	Q	Pump Spigot/SOP #5	OUCTP ROD
MP-BW-41-231	A	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-46-170	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MW-BW-52-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-BW-57-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-BW-58-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-OU2-64-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-OU2-67-180	Q	Q	PDB/SOP #2	OUCTP ROD
MW-OU2-70-180	A	Q	PDB/SOP #2	OUCTP ROD
The Following Wells Are Measured for Groundwater Elevation Data Only:				
MP-BW-30-282		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-287		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-272		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-242		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-178		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-193		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-202		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-256		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-195		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-215		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-235		Q	Westbay Port/SOP #1	Groundwater elevation trend analysis
MP-BW-46-185		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-46-200		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-46-215		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-B-05-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-21-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-26-180		Q	SOP #5	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MW-BW-43-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-44-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-45-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-47-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-49-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-50-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-51-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-53-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-54-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-55-180		Q	SOP #5	Groundwater elevation trend analysis
MW-BW-56-180		Q	SOP #5	Groundwater elevation trend analysis

Notes:

A: sampled on an annual basis

PDB: passive diffusion bag

PTM: post-treatment monitoring

Q: sampled on a quarterly basis

ROD: Record of Decision

SIM: selected ion monitoring

SOP: standard operating procedures

[1] The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

4.1.9 Worksheet #17c5: OUCTP Lower 180-Foot Aquifer GWMP

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
Airfield	Q	Q	PDB/SOP #2	OUCTP ROD
EW-OU2-07-180	Q	Q	PDB/SOP #2	OUCTP ROD
FO-29	Q		Sampling Port/SOP #4	OUCTP ROD
FO-30	Q		Sampling Port/SOP #4	OUCTP ROD
FO-31	Q		Sampling Port/SOP #4	OUCTP ROD
Mini-storage	A		Sampling Port/SOP #4	OUCTP ROD
MP-BW-31-292	A	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-41-318	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-41-353	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-42-345	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-287	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-316	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-368	Q	Q	Westbay Port/SOP #1	OUCTP ROD
MP-BW-49-400	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-50-339	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-50-384	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MP-BW-51-405	Q	Q	Westbay Port /SOP #1	OUCTP ROD
MW-BW-04-180	A	Q	PDB/SOP #2	OUCTP ROD
MW-BW-59-180	Q	Q	PDB/SOP #2	Well Install Completion Report (Ahtna, 2019f)
MW-OU2-66-180	Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-69-180	Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-72-180	Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-78-180	Q	Q	PDB/SOP #2	OU2 ESD
MW-OU2-82-180	Q	Q	PDB/SOP #2	OU2 ESD
The Following Wells Are Measured for Groundwater Elevation Data Only:				
MCWD-08A		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-317		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MP-BW-30-342		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-397		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-467		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-30-537		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-332		Q	Westbay Port/SOP #1	Groundwater elevation trend analysis
MP-BW-31-362		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-407		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-457		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-31-522		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-332		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-366		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-412		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-472		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-32-522		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-317		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-352		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-33-397		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-292		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-357		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-422		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-492		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-34-537		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-312		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-366		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-402		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-467		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-527		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-35-562		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MP-BW-37-328		Q	Westbay Port/SOP #1	Groundwater elevation trend analysis
MP-BW-37-303		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-368		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-398		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-37-460		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-327		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-341		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-353		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-368		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-38-418		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-310		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-330		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-350		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-39-395		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-333		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-353		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-375		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-40-400		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-286		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-41-396		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-295		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-314		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-42-400		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-49-336		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-289		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-309		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-50-359		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-51-315		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis

Well Name	VOCs (8260-SIM)	Water Levels	Sampling Methods/SOP	Rationale[1]
MP-BW-51-340		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-51-370		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-323		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-338		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-363		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-388		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MP-BW-52-408		Q	Westbay Port /SOP #1	Groundwater elevation trend analysis
MW-BW-03-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-07-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-28-400		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-68-180		Q	SOP #7	Groundwater elevation trend analysis
MW-OU2-71-180		Q	SOP #7	Groundwater elevation trend analysis
Test 2		Q	SOP #7	Groundwater elevation trend analysis

Notes:

A: sampled on an annual basis
PDB: passive diffusion bag
PTM: post-treatment monitoring
Q: sampled on a quarterly basis
ROD: Record of Decision
SIM: selected ion monitoring
SOP: standard operating procedures

[1] The rationale for sampling locations and frequency is based on the applicable program RODs, ESDs, program history and precedent established by the BCT, which includes the Army, USACE, EPA, DTSC, and CCRWQCB.

4.2 Worksheet #18: Sampling Locations and Methods

This Worksheet was not used. Information that would be included in this worksheet is incorporated into Worksheets #17a through #17c.

5.0 Sampling Requirements

5.1 Worksheets #19 and #30: Sample Container, Preservation, and Hold Times

Laboratory: SGS

Florida:
4405 Vineland Rd, Suite C-15
Orlando, FL 32811

Telephone: 407-425-6700
Point of Contact: Svetlana Izosimova
E-mail: Svetlana.Izosimova@sgs.com

Sample Delivery Method: Courier to San Jose, CA distribution center or FedEx overnight shipment to Florida

Matrix	Analytical Group	Preparation/Analytical Method	Sample Volume	Containers	Preservation	Holding Time[1]	SGS Laboratory
Water	VOCs	EPA 5030/8260-SIM	120 mL	Three 40-mL Teflon-lined® VOA Vials	HCl to pH < 2 Sample temp > 0°C ≤ 6°C	14 days	Florida
	Dissolved Metals	EPA 3010A/6010D	500 mL	Two 250-mL HDPE bottles	HNO_3 to pH < 2 after field filtering Sample temp > 0°C ≤ 6°C	6 months	
	Chloride	EPA 9056A	100 mL	One 100-mL HDPE bottle	Sample temp > 0°C ≤ 6°C	28 days	

Notes:
°C: degrees Celsius
HCl: hydrochloric acid
HDPE: high-density polyethylene
HNO_3: nitric acid
mL: milliliter
VOA: volatile organic analysis
VOCs: volatile organic compounds
[1] Data package TAT is 15 business days

5.2 Worksheet #20: Field Quality Control Summary

Matrix	Analytical Group (Method)	Frequency of Field Duplicate Samples	Frequency of Trip Blanks	Frequency of Field Blanks	Frequency of Equip Blanks	Frequency of MS/MSD
Water	VOCs (8260-SIM)	10% of field samples collected	1 set per cooler /day	1 per sampling day	1 per sampling event (Westbay sampling only[1])	5% of field samples collected
	Metals (6010D)	10% of field samples collected	N/A	N/A	N/A	5% of field samples collected
	Cl (9056A)	10% of field samples collected	N/A	N/A	N/A	5% of field samples collected

Notes:
Cl: chloride
MS/MSD: matrix spike/matrix spike duplicate
N/A: not applicable
VOCs: volatile organic compounds
[1] Sampling at Westbay wells requires reuse and decontamination of sampling equipment. Sampling with PDBs, HydraSleeves and from sampling ports is performed with non-reusable sampling equipment, and no decontamination of field equipment is required. Westbay sample locations are identified as “Westbay Port” in the “Sampling Method” column of Worksheet #17c.

5.3 Worksheet #21: Field SOPs/Methods

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SOP #1	Westbay MOSDAX Sampler Probe – Model 2531 Operations Manual	Schlumberger	Oct. 20, 2006	Westbay Multi-port Wells	No	
SOP #2	PDB Sampling Protocol	Wood/U.S. Geological Survey (USGS)	2001	PDBs	Yes	Project-specific procedures are appended to USGS User's Guide
SOP #3	HydraSleeve Field Manual	GeoInsight	2006	HydraSleeve	No	
SOP #4	Supply and Irrigation Well Sampling Protocol	Wood/Ahtna	2016	Sampling Ports	Yes	GWMP project-specific procedures
SOP #5	OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements	Ahtna	2016	Sampling Ports	Yes	GWTS project-specific procedures
SOP #6	Low Flow Groundwater Quality Parameter Collection	Ahtna	2016	Horiba Multi-Meter and Low Flow Pump	Yes	OUCTP GWMP project-specific procedures
SOP #7	Downhole Meter Groundwater Quality Parameter Collection	Ahtna	2016	YSI Sonde Downhole Meter	Yes	OUCTP GWMP project-specific procedures

Note: SOPs are provided in Attachment A.

5.4 Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Electric Water Level Sounder	Calibrated against steel tape	Maintain in proper working order, store in a secure location, decon after each use	Check battery and sensitivity daily prior to use	Inspect tape for damage prior to use	Quarterly prior to use	Calibrates with steel tape to within 0.05 ft/100 feet depth to water	Send into factory for repair	Field Supervisor	SOPs #2 & #5
YSI Sonde Downhole Meter	Calibrated with solutions	Decon after each use, store according to manufacturer directions	Check battery prior to use	Inspect for damage prior to use	Quarterly prior to use	According to manufacturer instructions	Check manual or send into factory for repair	Field Supervisor	SOP #7
Digital Thermometer	Factory calibrated, ice-point method per HACCP-based SOP	Store in a secure location, avoid excessive heat	Check battery prior to use	Inspect for damage prior to use	Annually	Factory calibration, temperature reading = $0^oC \pm 1^oC$	Replace with new unit	Field Supervisor	SOPs #2 & #5

Notes:
°C: degrees Celsius
HACCP: Hazard Analysis & Critical Control Points (Title 9 Code of Federal Regulations Part 417)
N/A: not applicable
SOP: standard operating procedures

6.0 Analytical Requirements

6.1 Worksheet #23: Analytical SOPs

The SOPs referenced below are the laboratory-specific procedures for the tests for which the laboratory is certified under DoD Environmental Laboratory Accreditation Program (ELAP). Laboratories with the DoD ELAP certificate undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification. Copies certifications including the specifically referenced methods are included in Attachment F.

Data will be evaluated based on the guidance provided in the DoD QSM Version 5.1, the published methods, and the laboratory Quality Assurance Manual.

SOP Reference Number	Title	Organization	Revision Date	Equipment Type	Modified for Project Work?	Comments
SGS SOP# MS010.7	Analysis of Volatile Organics by GC/MS Select Ion Monitoring (SIM) (VOCs by 8260 SIM)	SGS	Aug 30, 2017	Analytical Instruments	No	
SGS SOP# MET108.03	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) (Metals by 6010D)	SGS	Feb 22, 2018	Analytical Instruments	No	
SGS SOP# GN228.9	Determination of Inorganic Anions by Ion Chromatography (Chloride by 9056A)	SGS	April 4, 2018	Analytical Instruments	No	
SGS SOP# SAM101.19	Sample Receipt and Storage	SGS	Oct 29, 2018	None	No	
SGS SOP# SAM108.10	Sample and Laboratory Waste Disposal	SGS	Jan 21, 2016	None	No	

6.2 Worksheet #24: Analytical Instrument Calibration

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
GC/MS – VOCs by EPA Method 8260-SIM	Check of instrument tuning using BFB	Prior to ICAL and every 12 hours	Refer to method for specific ion criteria	Re-tune instrument Re-analyze affected	GC/MS Analyst
	Multipoint calibration (minimum of five points), lowest point at or below LOQ	Initially and as required	Minimum RF per method. Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression $r^2 \geq$ 0.99 Option 3: non-linear regression – coefficient of determination (COD) $r^2 \geq$ 0.99 (six points shall be used for second order, seven for third order)	Correct problem, then repeat ICAL	GC/MS Analyst
	Second Source - ICV Standard	Once after each ICAL	Analytes within ± 20% of true value	Correct problem and verify second source standard. Re-run second source verification. If that fails, correct the problem and repeat ICAL.	GC/MS Analyst
	Instrument blanks and method blanks	After initial calibration and daily, prior to sample analysis (instrument blank) and with each	No analytes detected > ½ LOQ or > ⅒ the amount measured in any sample or ⅒ the regulatory limit, whichever is greater.	Re-analyze blank Clean system Re-analyze affected samples	GC/MS Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
		batch of samples (method blank)	Common contaminants must not be detected > LOQ.		
GC/MS – VOCs by EPA Method 8260-SIM (continued)	Continuing calibration verification (CCV) standard	Daily before sample analysis and every 12 hours of analysis time, and at the end of the analytical run	RF criteria per method. All reported analytes and surrogates within ± 20% of true value All reported analytes and surrogates within ± 50% for end of analytical batch CCV	Correct problem, then re-run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	GC/MS Analyst
ICP Metals by EPA Method 6010D	ICAL: Single or multipoint calibration. Minimum one high standard and a calibration blank	Daily ICAL prior to sample analysis	If more than one calibration standard is used, $r^2 \geq 0.99$	Correct problem, then repeat ICAL	ICP Analyst
	Second Source (ICV) Standard	Once after each ICAL, prior to sample analysis	Value of second standard source for target analytes within ± 10% of true value	Correct the problem and verify second source standard. Re-run ICV. If that fails, correct problem and repeat ICAL.	ICP Analyst
	CCV	After analysis of every 10 samples and at the end of the analytical sequence	Within ± 10% of true value	Correct problem, then re-run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	ICP Analyst
	Low-level calibration check standard (LOQ low point standard from calibration)	Daily, following one point ICAL	Within ± 20% of true value	Correct problem, then re-analyze.	ICP Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
	ICS (Interference check sample)	After ICAL and prior to sample analysis	ICS-A: Absolute value of concentration for all non-spiked project analytes < ½ LOQ (unless they are a verified trace impurity from one of the spiked analytes)	Terminate analysis. Locate and correct problem. Re-analyze ICS and samples.	ICP Analyst
ICP Metals by EPA Method 6010D (continued)	Calibration blanks	Immediately after the ICV and Immediately after every CCV.	The absolute values of all analytes must be < ½ LOQ or < 1/10 the amount measured in any sample.	Calibration blanks: Correct the problem. Re-prep and re-analyze calibration blank. Samples following the last acceptable calibration blank must be re-analyzed.	ICP Analyst
Ion Chromatography – Chloride by EPA Method 9056A	Initial Calibration (minimum three standards and one calibration blank)	ICAL prior to sample analysis	$r^2 \geq 0.99$	Correct problem, then repeat ICAL.	IC Analyst
	ICV	After each ICAL and prior to sample analysis	Analytes within ± 10% of true values and retention times within appropriate windows	Correct problem and verify second source standard. Re-run ICV. If that fails, correct the problem and repeat ICAL.	IC Analyst
	Retention time window position establishment	Once per multipoint calibration	Retention time width is set using the midpoint standard of the ICAL for each analyte when ICAL is performed. On days when ICAL is not performed, the initial CCV is used	If the retention time shifts by more than 10%, a new ICAL is performed.	IC Analyst

Instrument/ Analysis	Calibration Requirements	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person
Ion Chromatography – Chloride by EPA Method 9056A (continued)	CCV	After ICAL, after every ten samples, and at end of run	Analytes within established retention time windows and within ± 10% of true value	Correct problem, then re-run the CCV. If that fails, repeat ICAL. Re-analyze samples run since last successful CCV.	Wet Chemistry Analyst

Notes:

%D: percent difference / percent drift

BFB: 4-bromofluorobenzene

CCC: continuing calibration check compounds

CCV: continuing calibration verification

COD: coefficient of determination

GC/MS: gas chromatography / mass spectrometry

ICAL: initial calibration

ICP: inductively coupled plasma atomic emission spectroscopy

ICS: interference check sample

ICS-A: interference check standard A

ICS-AB: interference check standard AB

ICV: initial calibration verification

LOD: limit of detection

LOQ: limit of quantitation

N/A: not applicable

RF: response factor

RSD: relative standard deviation

SIM: selected ion monitoring

VOCs: volatile organic compounds

[1] Normal balance and thermometer calibration applies (Worksheet #25).

6.3 Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing and Inspection

Analytical instruments used for this project will be maintained in accordance with the requirements presented in the SGS QA Manual and the individual analytical method SOPs. The SGS QA Manual also presents the documentation requirements for maintenance activities.

Instrument/Equipment	Maintenance/Inspection Activity	Frequency	Person Responsible for Corrective Action
GC/MS	Inspect/replace column Clean ion source Inspect, clean concentrator trap Change electron multiplier Backflush purge and trap Change rough oil pump	As required. Refer to Analytical Method and instrument manufacturer.	GC/MS Analyst
ICP	Inspect/replace tubing and pump Inspect/replace windings Inspect/replace torch and injector	As required. Refer to Analytical Method and instrument manufacturer.	ICP Analyst
IC	Inspect/perform column cleanup	As required. Refer to Analytical Method and instrument manufacturer.	IC Analyst

Notes:
GC/MS: gas chromatography/mass spectrometry
IC: ion chromatography
ICP: inductively coupled plasma

6.4 Worksheets #26 and #27: Sample Handling, Custody, and Disposal

Groundwater samples will be collected in laboratory-provided bottles using methods described in Worksheets #17a through #17c and #19, and SOPs #1 through #5. Samples will be received and logged into the laboratory information management system for analysis as described in the DoD QSM Version 5.1. Chain of custody procedures will be performed in accordance with Worksheet #29.

Sample organization: Ahtna/ Wood

Laboratory: SGS

Method of sample delivery (shipper/carrier): SGS courier or FedEx overnight shipping

Number of days from reporting until sample disposal: No less than 30 days after final report sent to the client

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	Ahtna/ Wood Field Technicians	SOP #5
Chain of custody form completion	Ahtna/ Wood Field Technicians	SOP #5
Packaging	Ahtna/ Wood Field Technicians	SOP #5
Shipping coordination	Ahtna/ Wood Field Technicians	SOP #5
Sample receipt, inspection, & log-in	SGS Sample Management Supervisor	SOP #SAM101.19
Sample custody and storage	SGS Sample Management Supervisor	SOP #SAM101.19
Sample disposal	SGS Sample Management Supervisor	SOP #SAM108.10

Notes:
N/A: not applicable
O&M: operation and maintenance

6.5 Worksheet #28: Analytical Quality Control and Corrective Action

6.5.1 Worksheet #28a: VOCs

Matrix: Groundwater (µg/L)

Analytical Group/Test Method: VOCs by EPA Method 8260-SIM

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Method Blank	1 per analytical batch	No analytes detected > ½ LOQ or > ⅒ the amount measured in any sample or ⅒ the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	DoD QSM 5.1 App B Table 4	Re-analyze method blank. If fails, clean system and re-analyze blank and affected samples.	GC/MS Analyst	Accuracy/ Bias Contamination
Laboratory Control Sample (LCS)/ LCSD	1 set per analytical batch. Spike target compounds. VC to be spiked at DL of 0.1 µg/L.	<u>Analyte</u> <u>Recovery</u> <u>RPD</u> 1,1-DCA 81-122% ≤ 15% 1,1-DCE 78-137% ≤ 18% 1,2-DCA 75-125% ≤ 14% 1,2-DCE (total) 76-127% ≤ 17% 1,2-DCPA 76-124% ≤ 14% 1,3-DCPE (total) 75-120% ≤ 23% Benzene 81-122% ≤ 14% CT 76-136% ≤ 23% Chloroform 80-124% ≤ 15% cis-1,2-DCE 78-120% ≤ 15% MC 69-135% ≤ 16% PCE 76-135% ≤ 16% TCE 81-126% ≤ 15% VC 69-159% ≤ 18%	Lab-derived	Re-prep and re-analyze LCS/LCSD and associated batch samples	GC/MS Analyst	Bias Accuracy/ Precision

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
MS/MSD	1 per analytical batch spike target compounds. VC to be spiked at DL of 0.1 µg/L.	Same as LS/LCSD acceptance limits for 8260-SIM.	Lab-derived	If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. If the concentration in parent sample is > 4x the spiked amount, include in case narrative. No CA required.	GC/MS Analyst	Bias/Precision
Surrogates	Field samples and laboratory QC	1,2-Dichloroethane-$_{d4}$ 74-125% Toluene-$_{d8}$ 88-111%	Lab-derived	Re-prep and re-analyze affected samples unless matrix interference is present.	GC/MS Analyst	Bias
Internal Standards	Field samples, standards, and laboratory QC	Retention time ±10 seconds from retention time of the midpoint standard in the ICAL; extracted ion current profile area within -50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	DoD QSM 5.1 App B Table 4	Inspect mass spectrometer and GC for malfunction. Re-analysis of samples analyzed while system was malfunctioning is mandatory.	GC/MS Analyst	Bias/Precision

Notes on next page.

Notes:

%: percent
µg/L: micrograms per liter
cis-1,2-DCE: cis-1,2-dichloroethene
CT: carbon tetrachloride
1,1-DCA: 1,1-dichloroethane
1,1-DCE: 1,1-dichloroethene
1,2-DCA: 1,2-dichloroethane
1,2-DCE (total): total 1,2-dichloroethene
1,2-DCPA: 1,2-dichloropropane
1,3-DCPE (total): total 1,3-dichloropropene
DL: detection limit
DoD: Department of Defense
GC/MS: gas chromatography/mass spectrometry
ICAL: initial calibration
LCS: laboratory control sample
LCSD: laboratory control sample duplicate
LOQ: limit of quantitation
MC: methylene chloride
MS: matrix spike
MSD: matrix spike duplicate
N/A: not applicable
PCE: tetrachloroethene
QC: quality control
QSM: Quality Systems Manual
RPD: relative percent difference
TCE: trichloroethene
VC: vinyl chloride

6.5.2 Worksheet #28b: Metals

Matrix: Groundwater (µg/L)

Analytical Group/Test Method: Metals by EPA Method 6010D

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Method Blank	1 per analytical batch	Absolute values of analytes detected < ½ LOQ or < 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater.	DoD QSM 5.1 App B Table 8	Correct problem. Re-prep and re-analyze method blank and affected samples.	ICP Analyst	Accuracy/Bias Contamination
Laboratory Control Sample (LCS)	1 per analytical batch. Spike target compounds.	<u>Analyte</u> <u>Recovery</u> Antimony 80-120% Copper 80-120% Lead 80-120%	DoD QSM 5.1 App B Table 8 and App C Table 4	Re-prep and re-analyze LCS and associated batch samples	ICP Analyst	Bias Accuracy/ Precision
Laboratory Duplicate Sample	1 per analytical batch	< 20%	DoD QSM 5.1 App B Table 8	Narrate outliers in case narrative. No CA	ICP Analyst	Precision
MS/MSD	1 per analytical batch	<u>Analyte</u> <u>Recovery</u> <u>RPD</u> Antimony 80-120% ≤20% Copper 80-120% ≤20% Lead 80-120% ≤20%	DoD QSM 5.1 App C Table 4	Perform additional QC test (dilution test and/or post-digestion spike [PDS]) unless concentrations in parent sample are > 4x the spiked amount (no corrective action required). Perform PDS.	ICP Analyst	Bias/Precision
Dilution Test	1 per prep batch	5-fold dilution must agree within ± 10% of the original measurement	DoD QSM 5.1 App B Table 8	Perform post-digestion spike	ICP Analyst	Bias/Precision

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Responsible Person	Data Quality Indicator
Post-Digestion Spike (PDS)	Perform if MS/MSD fails, 1 per analytical batch	Recovery within 80-120%	DoD QSM 5.1 App B Table 8	Run associated samples by method of standard addition or flag data	ICP Analyst	Bias/Precision

Notes:

µg/L: micrograms per liter

ICP: inductively coupled plasma

LOQ: limit of quantitation

PDS: post-digestion spike

RPD: relative percent difference

6.5.3 Worksheet #28c: Wet Chemistry

Matrix: Groundwater (mg/L)

Analytical Group/Test Method: Chloride by EPA Method 9056A

QC Sample	Frequency	Acceptance Limits	Source of Acceptance Limits	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Method Blank	1 per analytical batch	No analytes detected > ½ the LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit	Laboratory limits	Correct problem. Re-prep and re-analyze method blank and affected samples.	Wet Chemistry Analyst	Accuracy/Bias Contamination
Laboratory Control Sample (LCS)	1 per analytical batch.	EPA 9056A: 90-110%	Laboratory performance-based limits	Re-prep and re-analyze LCS and associated batch samples.	Wet Chemistry Analyst	Bias Accuracy/ Precision
MS/MSD	1 set per analytical batch.	90-110% and RPD ±20%	Lab performance-based limit	Re-prep and re-analyze MS/MSD samples and report both sets of data. If concentration in parent sample is > 4x the spiked amount, include in case narrative. No CA required.	Wet Chemistry Analyst	Bias/Precision

Notes:

%: percent

LCS: laboratory control sample

mg/L: milligrams per liter

MS/MSD: matrix spike/ matrix spike duplicate

N/A: not applicable

RPD: relative percent difference

7.0 Data Management and Data Review

7.1 Worksheet #29: Project Documentation and Records

Project data and information will be documented, tracked, and managed in a manner to ensure data integrity, defensibility, and retrievability. Project records will be generated from various aspects of the project, including 1) Sample Collection and Field Measurement Records, 2) Analytical Records, and 3) Data Assessment Records. Project data and information are stored in the Fort Ord Administrative Record located at Building 4463, Room 101, Gigling Road, Seaside, California. The Administrative Record is managed by the Army and will be maintained until site closure, at which time disposition of site records will be determined by the Army.

7.1.1 Sample Collection and Field Measurement Records

At a minimum, the following documentation will be used for sample collection and field measurement activities. Examples of field forms are presented in Attachment C.

- Field Activity Daily Logbook – A bound, Field Activity Daily Logbook (FADL), with sequentially numbered pages will be used for field documentation of key sampling and analytical activities associated with the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP. The FADL will contain information to include:
  - Name and company of sampling technician
  - Date, time, and location of sample collection
  - Site observations and remarks related to sampling activities
  - Field equipment calibration documentation
- Groundwater Level Field Data Sheets – are used to record depth to groundwater measurements, and include the following information:
  - Sampling station name, date, and time of measurement
  - Depth to water (DTW) sounder serial number and documented calibration differential from steel tape
  - Samplers initials
  - Measured depth to water
  - Historical average DTW and total depth of well which are used to verify the measured reading in the field
- Groundwater Sampling Forms – are used to record collection of groundwater samples. Groundwater samples from the Sites 2/12, OU2 and OUCTP GWMP are collected via PDBs, Westbay multi-port wells, and sampling ports, while samples from the Sites 2/12 and OU2 GWTS are primarily collected via sampling ports. Each of these sampling systems has a designated groundwater sampling form, specific to the data needed for each sampling method; however, each groundwater sampling form will contain the same essential information:

  - Name of sampling technician
  - Date and time of sample collection
  - Depth to water (where applicable)
  - Depth of sample collection (or port number, or bag number)
  - Method of sample collection
  - Volume of sample collected
  - Preservation of samples (if any)
  - Analysis requested
  - QC samples collected at the sampling station

- Sample Labels – Sample labels will be affixed to each sample container upon collection and prior to transfer to the laboratory. Each sample will be assigned a unique sample identification number. The sample label will include the following information:

  - Project name, number, and location
  - Site name
  - Name of collector
  - Date and time of collection
  - Sample identification number
  - Sample preservation

- Chain of Custody Forms - A chain of custody form will be completed for every sample collected and submitted to the analytical laboratory to document custody of the sample from the time of collection to receipt at the laboratory. Chain of custody forms will be completed in triplicate (at a minimum) so one copy is kept at the field site, one copy is sent to the Project Manager or designee, and one copy accompanies the samples submitted to the analytical laboratory. The laboratory will send the project chemist, or designee, a copy of the completed chain of custody along with a completed Cooler Receipt Form (CRF) and completed log-in information within 24 hours of sample receipt and log-in. The chain of custody will include the following information:

  - Name, number, and location of project
  - Project Manager or "Report to" contact
  - Name and signature of sample collector, sampler, or recorder
  - Date and time of sample collection
  - Sample type/matrix
  - Number of containers submitted and preservative used (if any)
  - Analyses requested and TAT requirements
  - Signature trail of persons relinquishing and receiving samples
  - Receiving laboratory address and contact information
  - Date and time of sample receipt

7.1.2 Analytical Records

The analytical laboratory will maintain and submit the following records as part of the data deliverable for each sample. These records together make up the Comprehensive Certificate of Analysis, which is a required deliverable to report results and is used in the data validation process.

- Chain of custody records
- Sample/Cooler Receipt Forms (SRFs/CRFs) documenting the general condition of the samples upon receipt including temperature, sample preservation, and number of containers received as well as any discrepancies or issues
- Sample tracking forms
- Sample preparation and analysis forms/logbooks
- Tabulated data summary forms and raw data for field samples, QC samples, and standards. If manual integration is performed on project samples, raw data to include chromatographs from before and after manual integration is applied. The case narrative will also address the reason manual integration was performed on each affected sample
- Case narrative
- Date and times of sample receipt, extraction, and analysis
- QC sample results
- Communication logs
- Corrective action reports
- Definitions of laboratory qualifiers
- Instrument calibration data and summary reports
- Signatures for laboratory sign-off

7.1.3 Project Data Assessment Records

Project data assessment records will be generated and submitted as part of the quarterly or annual reporting requirements for the Sites 2/12, OU2, OUCTP GWMP and the Sites 2/12 and OU2 GWTS as necessary. Project Data Assessment reports may be created at any time throughout the project, and typically consist of the following:

- Field Sampling Audit Report (if applicable)
- Laboratory Audit Report (if applicable)
- Data Validation Summary Report

7.2 Worksheets #31, #32, and #33: Assessments and Corrective Action

Planned project assessments will be completed for the Sites 2/12 and OU2 GWTS and Sites 2/12, OU2, and OUCTP GWMP through the Three Phase Quality Control Process, as follows:

- Preparatory Phase: Activities and assessments conducted during the preparatory phase are conducted prior to the start of a feature of work to ensure technical requirements and work prerequisites have been completed. Discrepancies will be resolved and corrective actions implemented and verified prior to the start of work.
- Initial Phase: Activities and assessments conducted during the initial phase are performed during the first day of the feature of work to verify compliance with the specifications and requirements described in this QAPP and approved project plans and procedures. Discrepancies will be resolved and corrective actions implemented and verified prior to work proceeding.
- Follow-Up and Reporting Phase: Activities and assessments performed during the follow-up and reporting phase are conducted to verify continued compliance with project requirements and to verify project reports meet client and regulatory requirements.

An overview of the Three Phase Quality Control Process and related forms used to document the process are provided in Attachment D. The activities and assessments conducted during each phase of the Three Phase Quality Control Process are described below.

7.2.1 Assessments and Corrective Action

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Phase I - Preparatory Phase						
Planning Document review	Internal Memo	Document Author	Prior to the start of field activities	Response to comments documentation and USACE approval of document as applicable	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	One week
Planning document (QAPP) sign-off by field and laboratory	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS	Prior to the start of field activities	Obtain sign-off that document has been read and understood by field and lab personnel	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of lab and field personnel readiness	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS	Prior to the start of field activities	Provide kickoff meeting notes from field and lab meetings	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of field equipment	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna	Prior to the start of field activities	Provide checklist documenting field equipment is available and in good working order	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	Prior to the start of field activities

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Phase II – Initial Phase						
Field and laboratory audit	Field and lab audit report	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM, SGS Eric Schmidt, Project Chemist, Ahtna Jeff Fenton, PM, Wood Derek Lieberman, PM, Ahtna	Within 48 hours of audits	Field and laboratory to issue formal response to audit findings requiring corrective action	Christopher Ohland, Program Chemist, Ahtna Kevin Garrett, Project Chemist, Wood	One week
Review of Contractor QC Reports	Memo	Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Sylvester Kosowski, QC Manager, Ahtna	Within 48 hours of review	Revision of Contractor Quality Control Reports (CQCRs) as needed	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	One week

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Organization)	Timeframe for Response
Review of project plans to reflect current site or lab activities	Memo	Holly Dillon, Task Lead, Ahtna Scott Graham, Field Task Manager, Wood Mark Fisler, O&M Manager, Ahtna Elvin Kumar, PM SGS	Within 10 days of observations	Update project plans to reflect current conditions (may be addendum to existing document) or documentation of changes to field or lab protocol to be in accordance with project plans	Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	Prior to next scheduled sampling event
Phase III – Follow-Up and Reporting Phase						
Review of Data Reports	Internal comments from staff and external comments from client and regulatory agencies	Document Author Derek Lieberman, PM, Ahtna Jeff Fenton, PM, Wood	Internal = prior to issuance of report External = within 30 days of receipt of report	Provide response to comments and revise report as needed	Commenting client and/or agencies Alex Kan, Technical Lead, USACE	30 days

7.2.2 QA Management

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Sites 2/12 GWMP and GWTS O&M Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan – Technical Lead Fort Ord BRAC: William Collins – BEC Chenega: Tom Ghigliotto – Field Oversight Inspector Fort Ord Administrative Record EPA: Maeve Clancy – PM TechLaw: Robert Young CCRWQCB: Amber Sellinger – PM DTSC: Min Wu – PM
	Annually	Preliminary Draft 75 days after end of annual sampling event		
OU2 GWMP and GWTS O&M Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	
	Annually	Preliminary Draft 75 days after end of annual sampling event		
OUCTP GWMP Reports	Quarterly	Final 60 days after end of quarterly sampling event	Derek Lieberman, PM, Ahtna Holly Dillon, Task Lead, Ahtna	
	Annually	Preliminary Draft 75 days after end of annual sampling event		
CQCR	Quarterly, following each sampling event	Within 60 days of completion of field sampling event	Jeff Fenton, Project Manager, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Chenega: Tom Ghigliotto – Field Oversight Inspector Ahtna: Derek Lieberman, Project Manager

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Non-Routine Occurrences Report	As needed	Within 48 hours of a Non-Routine Occurrence in the field or laboratory. A copy of this report will also be included in the CQCR	Kevin Garrett, Project Chemist, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Chenega: Tom Ghigliotto – Field Oversight Inspector Ahtna: Christopher Ohland, Program Chemist Wood: Jeff Fenton, PM
Field Work Variance Report	As needed	Prior to implementation of proposed change or immediately following a variance implemented in the field. A copy of the Field Work Variance will also be included in the CQCR	Scott Graham, Field Task Manager, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan- Technical Lead Ahtna: Derek Lieberman - PM, Christopher Ohland - Program Chemist Wood: Jeff Fenton - PM, Kevin Garrett - Project Chemist Chenega: Tom Ghigliotto – Field Oversight Inspector
Validation Summary Report	Quarterly, following each sampling event	Produced as part of the Quarterly Monitoring Report	Kevin Garrett, Project Chemist, Wood	USACE: Dana Gentry – PM, Jonathan Whipple – Project Chemist, Alex Kan– Technical Lead Fort Ord BRAC: William Collins – BEC Fort Ord Administrative Record EPA: Maeve Clancy – PM TechLaw: Robert Young CCRWQCB: Amber Sellinger – PM DTSC: Min Wu – PM

7.3 Worksheet #34: Data Verification and Validation Inputs

Verification Input	Description	Internal / External	Responsible for Verification (Name, Organization)
Chain of custody and shipping forms	Chain of custody forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. When everything is verified, the shipper's signature on the chain of custody form will be initialed by the reviewer. A copy of the form will be retained in the site file, and the original and remaining copies will be taped inside the cooler for shipment. Refer to Attachment A for SOPs #4 and #7 for further detail.	I	Sites 2/12 and OU2 GWTS: Mark Fisler, O&M Manager, Ahtna
			Sites 2/12, OU2, OUCTP GWMP: Scott Graham, Field Task Manager, Wood
	Receiving laboratory will verify chain of custody forms with contents of coolers. Wood project chemist will be notified of any discrepancies or issues within 24 hours of sample receipt. Resolution will be documented in writing and submitted with final data package.	E	Elvin Kumar, Project Manager, SGS Laboratory
	Laboratory receipt/log-in report will be reviewed against chain of custody internally.	I	Sites 2/12 and OU2 GWTS: Holly Dillon, Data Manager, Ahtna Sites 2/12, OU2, OUCTP GWMP Zack Carroll, Data Validator, Wood
Field Notes	Field notes will be reviewed internally by the field supervisor for consistency with the chain of custody forms and SOPs. One copy of the field notes will be retained in the onsite project file, and originals will be forwarded to the Project Manager for review.	I	Sites 2/12, OU2 GWTS: Mark Fisler, O&M Manager, Ahtna Sites 2/12, OU2, OUCTP GWMP: Scott Graham, Field Task Manager, Wood

Verification Input	Description	Internal / External	Responsible for Verification (Name, Organization)
Laboratory Data	Analytical data packages will be verified by the laboratory performing the work for completeness prior to submittal.	I	Svetlana Izosimova, Quality Assurance Officer, SGS
	Received data packages will be verified according to the data validation procedures specified in Worksheet #35. Laboratory electronic deliverables will be verified against the data package hard copy reports.	I	Sites 2/12, OU2 GWTS: Christopher Ohland, Program Chemist, Ahtna Sites 2/12, OU2, OUCTP GWMP: Zack Carroll, Project Database Analyst, Wood

7.4 Worksheet #35: Data Verification Procedures

Stage 2A/2B	Validation Input	Description	Responsible for Verification – GWTS	Responsible for Verification – GWMP
2A	Methods used for sample collection	Field data notes will be reviewed for compliance with published methods and SOPs. Deviations from SOPs and methods described in this QAPP will be summarized and provided to the Project Manager in writing.	Mark Fisler, O&M Manager, Ahtna	Scott Graham, Field Task Manager, Wood
2A	Methods used for analysis	Laboratory data packages will be reviewed to verify the methods specified in this QAPP were followed. Deviations shall be documented in writing.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Sampling SOPs and Analytical Compliance	Review field notes for compliance with SOPs. Review laboratory data deliverables for compliance with QAPP and published methods.	Mark Fisler, O&M Manager, Ahtna Eric Schmidt, Project Chemist, Ahtna	Scott Graham, Field Task Manager, Wood Zack Carroll, Project Database Analyst, Wood
2A	Documentation of method QC results	Review laboratory data packages to determine if QC parameters required by the referenced methods were performed and reported. The QC forms will be reviewed to determine if method acceptance criteria were met. Method QC outliers will be identified by the laboratory in the case narrative. Reviewer will determine if data will require qualification due to outliers.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Documentation of QAPP QC sample results	Verify QC samples specified in this QAPP were analyzed and reported. Reviewer will identify QAPP QC sample results in the data validation report.	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood

Stage 2A/2B	Validation Input	Description	Responsible for Verification – GWTS	Responsible for Verification – GWMP
2B	Laboratory data package documentation	Laboratory data packages will be reviewed to ensure documentation requirements specified in the QAPP have been met. If deficiencies are found, the Data Reviewer will document the issue in a memorandum to the laboratory. The laboratory will address deficiencies in writing or submit a revised data package correcting the deficiencies.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Target analyte list	Laboratory report summary forms will be reviewed to verify the target compounds and parameters specified in the QAPP were reported.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	LOQs	Determine quantitation limits were achieved, as outlined in the QAPP. Verify the laboratory analyzed a low standard at the quantitation limit in the initial calibration.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Raw data and laboratory transcription errors	Ten percent (10%) of raw data will be reviewed to confirm laboratory calculations and that there are no transcription errors. Chromatographs containing manual integrations, if any, will be evaluated as part of the raw data review.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A and 2B	Data Validation Report	Summarize deviations from the referenced methods, SOPS, and QAPP-specific requirements. Include qualified data and explanations of all data qualifiers.	Christopher Ohland, Program Chemist, Ahtna	Zack Carroll, Wood
2A and 2B	Data Validation Report Review	Review validation reports and Validation Summary Report.	Christopher Ohland, Program Chemist, Ahtna	Kevin Garrett Project Chemist, Wood

7.5 Worksheet #36: Data Validation Procedures

Stage 2A/2B	Matrix	Analytical Group	Validation Criteria	GWTS Validator	GWMP Validator
2A	Aqueous	VOCs	EM-200-1-10. *Guidance for Evaluating Performance-based Chemical Data* (USACE, June 2005) and SW-846 Method 8260-SIM	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	VOCs	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Aqueous	Dissolved metals	EM-200-1-10 and SW-846 Method 6010D	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	Dissolved Metals	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2A	Aqueous	Wet Chemistry	EM-200-1-10, EPA Method 9056A (chloride)	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood
2B	Aqueous	Wet Chemistry	QAPP Worksheets and ADR Library	Eric Schmidt, Project Chemist, Ahtna	Zack Carroll, Project Database Analyst, Wood

Notes:

ADR: Automated Data Review program

7.5.1 Stage 1 Validation

Stage 1 validation of the laboratory analytical data package consists of verification and validation checks for the compliance of sample receipt conditions, sample characteristics (e.g., percent moisture), and analytical results (with associated information). The following minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 1 validation:

1) Documentation identifies the laboratory receiving and conducting analyses and includes documentation for all samples submitted by the project or requester for analyses.
2) Requested analytical methods were performed and the analysis dates are present.
3) Requested target analyte results are reported along with the original laboratory data qualifiers and data qualifier definitions for each reported result.
4) Requested target analyte result units are reported.
5) Requested LOQs for all samples are present and results at and below the requested (required) LOQs are clearly identified (including sample DLs if required).
6) Sampling dates (including times if needed), date and time of laboratory receipt of samples, and sample conditions upon receipt at the laboratory (including preservation, pH, and temperature) are documented.
7) Sample results are evaluated by comparing sample conditions upon receipt at the laboratory (e.g., preservation checks) and sample characteristics (e.g., percent moisture) to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

7.5.2 Stage 2A Validation

Stage 2A validation builds on the validation conducted in Stage 1. Stage 2A validation of the laboratory analytical data package consists of the Stage 1 validation plus the verification and validation checks for the compliance of sample-related QC. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 2A validation:

1) Requested methods (handling, preparation, cleanup, and analytical) are performed.
2) Method dates (including dates, times and duration of analysis for radiation counting measurements and other methods, if needed) for handling (e.g., Toxicity Characteristic Leaching Procedure), preparation, cleanup, and analysis are present, as appropriate.
3) Sample-related QC data and QC acceptance criteria (e.g., method blanks, surrogate recoveries, laboratory control sample (LCS) recoveries, duplicate analyses, matrix spike and matrix spike duplicate recoveries, serial dilutions, post-digestion spikes, standard reference materials) are provided and linked to the reported field samples (including the field QC samples such as trip and equipment blanks).
4) Requested spike analytes or compounds (e.g., surrogate, LCS spikes, post-digestion spikes) have been added, as appropriate.
5) Sample holding times (from sampling date to preparation and preparation to analysis) are evaluated.

6) The frequency of QC samples is checked for appropriateness (e.g., one LCS per 20 samples in a preparation batch).
7) Sample results are evaluated by comparing holding times and sample-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

7.5.3 Stage 2B Validation

Stage 2B validation builds on the validation conducted in Stage 2A. Stage 2B validation of the laboratory analytical data package consists of the Stage 2A validation plus the verification and validation checks for the compliance of instrument-related QC. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 2B validation:

1) Initial calibration data (e.g., initial calibration standards, initial calibration verification [ICV] standards, initial calibration blanks [ICBs]) are provided for all requested analytes and linked to field samples reported. For each initial calibration, the calibration type used is present along with the initial calibration equation used including any weighting factor(s) applied and the associated correlation coefficients, as appropriate. Recalculations of the standard concentrations using the initial calibration curve are present, along with their associated percent recoveries, as appropriate (e.g., if required by the project, method, or contract). For the ICV standard, the associated percent recovery (or percent difference, as appropriate) is present.
2) Appropriate number and concentration of initial calibration standards are present.
3) Continuing calibration data (e.g., continuing calibration verification [CCV] standards and continuing calibration blanks [CCBs]) are provided for all requested analytes and linked to field samples reported, as appropriate. For the CCV standard(s), the associated percent recoveries (or percent differences, as appropriate) are present.
4) Reported samples are bracketed by CCV standards and CCBs standards as appropriate.
5) Method specific instrument performance checks are present as appropriate (e.g., tunes for mass spectrometry methods, instrument blanks and interference checks for ICP methods).
6) The frequency of instrument QC samples is checked for appropriateness (e.g., gas chromatography-mass spectroscopy [GC-MS] tunes have been run every 12 hours).
7) Sample results are evaluated by comparing instrument-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

Metals and Wet Chemistry analyses are also reviewed under Stage 2B validation using a combination of criteria from the DoD QSM (where provided) and laboratory performance-based in-house acceptance criteria.

VOC data are used to evaluate compliance with the relevant ROD and ACLs for each of the GWTS. As a result, the VOC data are subject to a rigorous 100% EPA Stage 2B data review (EPA, 2009) to verify data are of a known quality in compliance with this QAPP, the *Department of Defense Quality Systems*

Manual for Environmental Laboratories, Final Version 5.1, the published analytical methods, and are capable of supporting project decisions.

Stage 2B review is performed using the automated data review software program ADR.NET. Flagging conventions for the test methods included in the QAPP are incorporated with the ADR program's reference library (Attachment E) to assess compliance with project requirements. The ADR program is used as an electronic validation tool for the following Stage 2B elements:

- Holding Times
- Instrument Performance Checks
- Method Blank Contamination
- Surrogates
- Laboratory Duplicates
- Laboratory Control Samples
- Matrix Spike Samples
- Field Blank Contamination
- Field Duplicates
- Initial and Continuing Calibration Data

Initial and continuing calibration files for each test method may need to be validated manually if the contract library is unable to provide electronic validation files.

The Data Reviewer checks the ADR-generated Non-Conformance Report, identifying items that do not conform to the ADR Project Library requirements, and the results are incorporated into the assessment of the data.

The Data Reviewer proceeds with the review of the ADR files in the ADR Data Review module. The ADR Data Review module identifies outliers and applies validation qualifiers to the data based on the ADR Project Library data review requirements. The ADR Library qualification scheme files are provided as Attachment E.

The Data Reviewer then reviews the ADR output, comparing the ADR findings with the lab reports to ensure the automated validation process is working accurately. The Data Reviewer may manually edit the validation qualifiers based on his or her professional judgment, which will be described in the Validation Summary Report. Flagging conventions used for data qualification are presented in Attachment E.

7.5.4 Stage 3 Validation

Stage 3 validation builds on the validation conducted in Stage 2B. Stage 3 validation of the laboratory analytical data package consists of the Stage 2B validation plus the recalculation of instrument and sample results from the laboratory instrument responses, and comparison of recalculated results to laboratory reported results. The following additional minimum baseline checks (as relevant) will be performed on the laboratory analytical data package received for a Stage 3 validation:

1) Instrument response data (e.g., GC peak areas, ICP corrected intensities) are reported for requested analytes, surrogates, internal standards, and deuterated monitoring compounds for all requested field samples, matrix spikes, matrix spike duplicates, LCS, and method blanks as well as calibration data and instrument QC checks (e.g., tunes, DDT/Endrin breakdowns, interelement correction factors, and Florisil cartridge checks).
2) Reported target analyte instrument responses are associated with appropriate internal standard analyte(s) for each (or selected) analyte(s) (for methods using internal standard for calibration).
3) Fit and appropriateness of the initial calibration curve used or required (e.g., mean calibration factor, regression analysis [linear or non-linear, with or without weighting factors, with or without forcing]) is checked with recalculation of the initial calibration curve for each (or selected) analyte(s) from the instrument response.
4) Comparison of instrument response to the minimum response requirements for each (or selected) analyte(s).
5) Recalculation of each (or selected) opening and closing CCV (and CCB) response from the peak data reported for each (or selected) analyte(s) from the instrument response, as appropriate.
6) A compliance check of recalculated opening and/or closing CCV (and CCB) response to recalculated initial calibration response for each (or selected) analyte(s).
7) Recalculation of percent ratios for each (or selected) tune from the instrument response, as appropriate.
8) A compliance check of recalculated percent ratio for each (or selected) tune from the instrument response.
9) Recalculation of each (or selected) instrument performance check (e.g., DDT/Endrin breakdown for pesticide analysis, instrument blanks, interference checks) from the instrument response.
10) Recalculation and compliance check of retention time windows (for chromatographic methods) for each (or selected) analyte(s) from the laboratory reported retention times.
11) Recalculation of reported results for each reported (or selected) target analyte(s) from the instrument response.
12) Recalculation of each (or selected) reported spike recovery (surrogate recoveries, deuterated monitoring compound recoveries, LCS recoveries, duplicate analyses, MS/MSD recoveries, serial dilutions, post-digestion spikes, standard reference materials etc.) from the instrument response.
13) Each (or selected) sample result(s) and spike recovery(ies) are evaluated by comparing the recalculated numbers to the laboratory reported numbers according to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

Selection of analytes, spikes, and performance evaluation checks for the Stage 3 validation checks for a laboratory analytical data package being verified and validated generally will depend on many factors including (but not limited to) the type of verification and validation being performed (manual or electronic), requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract, the number of laboratories reporting the data, the number and type of analytical methods reported, the number of analytes reported in each method, and the number of detected analytes.

7.5.5 Stage 4 Validation

10% of the data are subject to Stage 4 data review, which builds on the validation conducted in Stage 3. Stage 4 validation of the laboratory analytical data package consists of the Stage 3 validation plus the evaluation of instrument outputs. It is recommended that the following additional minimum baseline checks (as relevant) be performed on the laboratory analytical data package received for a Stage 4 validation:

1) All required instrument outputs (e.g., chromatograms, mass spectra, atomic emission spectra, instrument background corrections, and interference corrections) for evaluating sample and instrument performance are present.
2) Sample results are evaluated by checking each (or selected) instrument output (e.g., chromatograms, mass spectra, atomic emission spectra data, instrument background corrections, interference corrections) for correct identification and quantitation of analytes (e.g., peak integrations, use of appropriate internal standards for quantitation, elution order of analytes, and interferences).
3) Each (or selected) instrument's output(s) is evaluated for confirmation of non-detected or tentatively identified analytes.

In the event the findings of the Stage 4 validation indicate the potential for other reported results to be impacted by quality related issues, the Stage 4 validation may be expanded to include additional samples.

7.6 Worksheet #37: Data Usability Assessment

The suitability of the environmental data collected from both the Sites 2/12 and OU2 GWTS and the Sites 2/12, OU2, and OUCTP GWMP will be assessed by the Ahtna Project Chemist and the Wood Project Chemist, respectively. Data usability will comprise an evaluation of the quantity, type, and overall quality of the generated data against the project DQOs as presented in Worksheet #11 and the MPC presented in Worksheet #12. The usability of data associated with QC results outside of the established acceptance criteria is dependent on the degree of the exceedance, whether the potential bias is high or low, and whether the uncertainty implied by the exceedance is significant relative to project decisions and DQOs. Data usability will be assessed in accordance with the guidance provided in the DoD QSM Version 5.1 and additional applicable USACE and EPA guidance as well as the professional experience of the decision maker during data validation. The following items will be assessed and conclusions are drawn based on their results:

- **Precision** – Duplicate field and laboratory samples will be evaluated for precision based on relative percent difference (RPD). RPD will be calculated for each detectable result between the two samples. RPDs exceeding MPC in Worksheet #12 will be identified in the Validation Summary Report and any limitations on the use of the data will be noted. RPDs within the MPC will demonstrate the data have acceptable precision and the data are usable.
- **Accuracy** – Laboratory Control Samples (LCS), Laboratory Control Sample Duplicate (LCSD), MS/MSD sample results will be evaluated by comparing spike recovery results with MPC in Worksheet #12.
- **Sensitivity** – Data sensitivity will be verified by comparing method blank results with MPC in Worksheet #12 and cross checking analyte data with limits of quantitation (LOQs) and ACLs presented in Worksheet #15a.
- **Bias** – Laboratory surrogate compound recovery will be evaluated for bias by comparing results with MPC in Worksheet #12.
- **Contamination** – Field blank, trip blank and method blank data will be used to determine whether there are contamination issues based upon MPC in Worksheet#12.
- **Representativeness** – Sampling procedures will be implemented in accordance with SOPs to eliminate or minimize sources of error. Compliance with SOPs will be confirmed through QC field audits. Analytical procedures will be implemented in accordance with laboratory SOPs, QC acceptance limits, and the laboratory Quality Assurance Manual. Laboratories used for sample analysis will maintain DoD ELAP certification and undergo annual audits by the independent accrediting bodies responsible for the DoD ELAP certification.
- **Completeness** – The completeness of the sample event will be determined based upon the number of field samples collected compared to the number of samples planned and the number of unqualified laboratory results compared to the total number of results.[20] This information will be compared to MPC in Worksheet #12.

[20] Results qualified as estimated due to detected quantities between the LOQ and LOD will not be counted in the analytical completeness quantity assessment.

- **Comparability** – The data from each sampling event are comparable to past and future events as long as the same or similar sampling and analytical SOPs located in Attachment A are utilized.
- **Reconciliation** – Each of the DQOs presented in Worksheet #11 will be examined to determine whether the objectives were met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will be first evaluated separately in terms of the major impacts observed from the data validation, DQIs, and MPC assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality, data usability for each analysis will be determined. Based on the combined data usability from all analyses for an objective, it will be determined whether the DQO was met and whether action limits were exceeded.

In the event the data quantity or quality prove to be inadequate to meet project objectives, re-analysis or re-sampling may be required. Replacement samples may be collected when existing data are insufficient or inadequate to support project objectives. The decision to take replacement samples will be made in coordination with the project team and may include USACE, Ahtna or Wood Project Managers, and the Ahtna Program Chemist or Wood Project Chemist.

Usability of the data will be presented in the Validation Summary Report, included with each Quarterly Monitoring Report. Copies of the associated data validation reports will be presented as an attachment to the Validation Summary Report. The Validation Summary Report will contain the following information:

- Basic summary of validation results, including a summary of data qualified with validation flags as listed in Attachment E
- Summary of deviations from the QAPP
- Summary of rejected data that resulted in a data gap
- Summary of points that went into the reconciliation of each objective
- Comments on recovery issues with the MS/MSDs
- Comments on limitations on the data usability
- Comments on corrective action needed and/or taken
- Conclusions and recommendations

8.0 References[21]

AES, 2009. *Final Operations and Maintenance Manual Volume II, Sites 2 and 12 Groundwater Remedy, Former Fort Ord, California* (Sites 2/12 GWTS O&M Manual). August. AR# BW-2479G.

AES, 2014. *Final Operable Unit Carbon Tetrachloride Plume Remedial Action Work Plan, Former Fort Ord, California; Appendix A Operable Unit Carbon Tetrachloride Plume A-Aquifer Remedial Design Addendum*. April. AR# OUCTP-0062A.

AES, 2015. *Final Remedial Investigation/Feasibility Study Addendum at Sites 2 and 12, Former Fort Ord, California*. February 27. AR# BW-2721B.

Ahtna, 2019a. *Draft Sites 2 and 12 Fourth Quarter 2017 through Third Quarter 2018 Groundwater and Soil Gas Monitoring and Treatment System Report, Former Fort Ord, California.* February 8. AR# BW-2861.

Ahtna, 2019b. *Draft Operable Unit Carbon Tetrachloride Plume Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring and Treatment System Report, Former Fort Ord, California.* February 11. AR# OUCTP-0085.

Ahtna, 2019c. *Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix C, Final Revision 4, Soil Gas Monitoring at Sites 2 and* 12. February 15. AR# BW-2792G.

Ahtna, 2019d. *Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix D, Draft Final Revision 3, Operable Unit 2 Landfills*. February 19. AR# OU2-702G.

Ahtna, 2019e. *Draft Operable Unit 2 Fourth Quarter 2017 through Third Quarter 2018 Groundwater Monitoring and Treatment System Report, Former Fort Ord, California.* June. AR# TBD.

Ahtna, 2019f. *Draft Monitoring Well Installation Completion Report, Former Fort Ord, California*. June. AR# TBD.

Ahtna, 2019g. *Draft 2019 Monitoring Well and Soil Gas Probe Decommissioning Completion Report, Former Fort Ord, California*. June. AR# TBD.

Dames & Moore, 1993. *Baseline Risk Assessment, Remedial Investigation/Feasibility Study, Site 2 Landfills, Fort Ord, California*. June 7. AR# OU2-218.

Department of Defense (DoD), 2017. *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.1.* https://www.denix.osd.mil/edqw/documents/documents/qsm-version-5-1-final/

Fort Ord Reuse Authority (FORA), 1997. *Fort Ord Reuse Plan, Volume I: Context and Framework*. June. http://www.fora.org/Reports/BRP/BRP_v1_ContextAndFramework_1997.pdf

[21] At the end of references included in the Fort Ord Administrative Record are the Administrative Record Numbers (AR#s) (e.g. BW-1234). To find the referenced document, this number may be typed into the online search tool at: http://www.fortordcleanup.com/documents/search/. Please note the referenced documents were available in the Fort Ord Administrative Record at the time this document was issued; however, some may have been superseded by more current versions and were subsequently withdrawn. TBD: to be determined.

Harding ESE, 2001. *Technical Memorandum, Passive Diffusion Bag Pilot Study Results and Recommendations.* July 25. AR# BW-2099.

Harding Lawson Associates (HLA), 1995. *Final Basewide Remedial Investigation/Feasibility Study, Fort Ord, California, Volume II – Remedial Investigation, Basewide Hydrogeologic Characterization.* October 19. AR# BW-1283A.

HLA, 1999. *Draft Final Revised Treatment System Plan, OU2 Groundwater Remedy, Fort Ord, California.* January 29. AR# OU2-584.

Intergovernmental Data Quality Task Force (IDQTF), 2005. *Uniform Federal Policy for Quality Assurance Project Plans*, *Part 1: UFP-QAPP Manual, Final Version 1*. March. https://www.epa.gov/fedfac/assuring-quality-federal-cleanups#ufp-qapp

IDQTF, 2012. *Uniform Federal Policy for Quality Assurance Project Plans, Part 2a, Revision 1: Optimized UFP-QAPP Worksheets*. March. https://www.epa.gov/fedfac/assuring-quality-federal-cleanups#ufp-qapp

MACTEC Engineering and Consulting, Inc. (MACTEC), 2009. *Final Technical Memorandum, Groundwater Remediation Exit Strategy, Sites 2 and 12 and OU2, Former Fort Ord, California*. July 20. AR# BW-2485H.

Monterey County Water Resources Agency (MCWRA), 2017. *Recommendations to Address the Expansion of Seawater Intrusion in the Salinas Valley Groundwater Basin*. October. http://www.co.monterey.ca.us/home/showdocument?id=57432

RORE Innovative Solutions Joint Venture (JV), 2018. *Operations and Maintenance Manual, Operable Unit 2 (OU 2) Groundwater Treatment Plant, Former Fort Ord* (OU2 O&M Manual). October. AR# OU2-TBD.

U.S. Department of the Army (Army), 1994. *Record of Decision, Operable Unit 2, Fort Ord Landfills, Fort Ord, California*. July 15. AR# OU2-480.

Army, 1995. *Explanation of Significant Differences, Operable Unit 2, Fort Ord Landfills, Fort Ord, California.* August 3. AR# OU2-406.

Army, 1997. *Record of Decision, Basewide Remedial Investigation Sites, Fort Ord, California*. January 13. AR# RI-025.

Army, 2008. *Record of Decision, Operable Unit Carbon Tetrachloride Plume, Former Fort Ord, California*. February 6. AR# OUCTP-0021D.

Army, 2016. *Explanation of Significant Differences No. 1, Basewide Remedial Investigation Sites 2 and 12, Former Fort Ord, California*. February 1. AR# BW-2794.

U.S. Army Corps of Engineers (USACE), 2005. *EM-200-1-10, Guidance for Evaluating Performance Based Chemical Data.* June. http://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_200-1-10.pdf?ver=2013-09-04-070852-230

U.S. Environmental Protection Agency (EPA), 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4. February. https://www.epa.gov/fedfac/guidance-systematic-planning-using-data-quality-objectives-process

EPA, 2008. *Final Regulatory Determinations for Priority Contaminants on the Second Drinking Water Contaminant Candidate List.* July. https://www.epa.gov/ccl/regulatory-determination-2-contaminants-second-drinking-water-contaminant-candidate-list

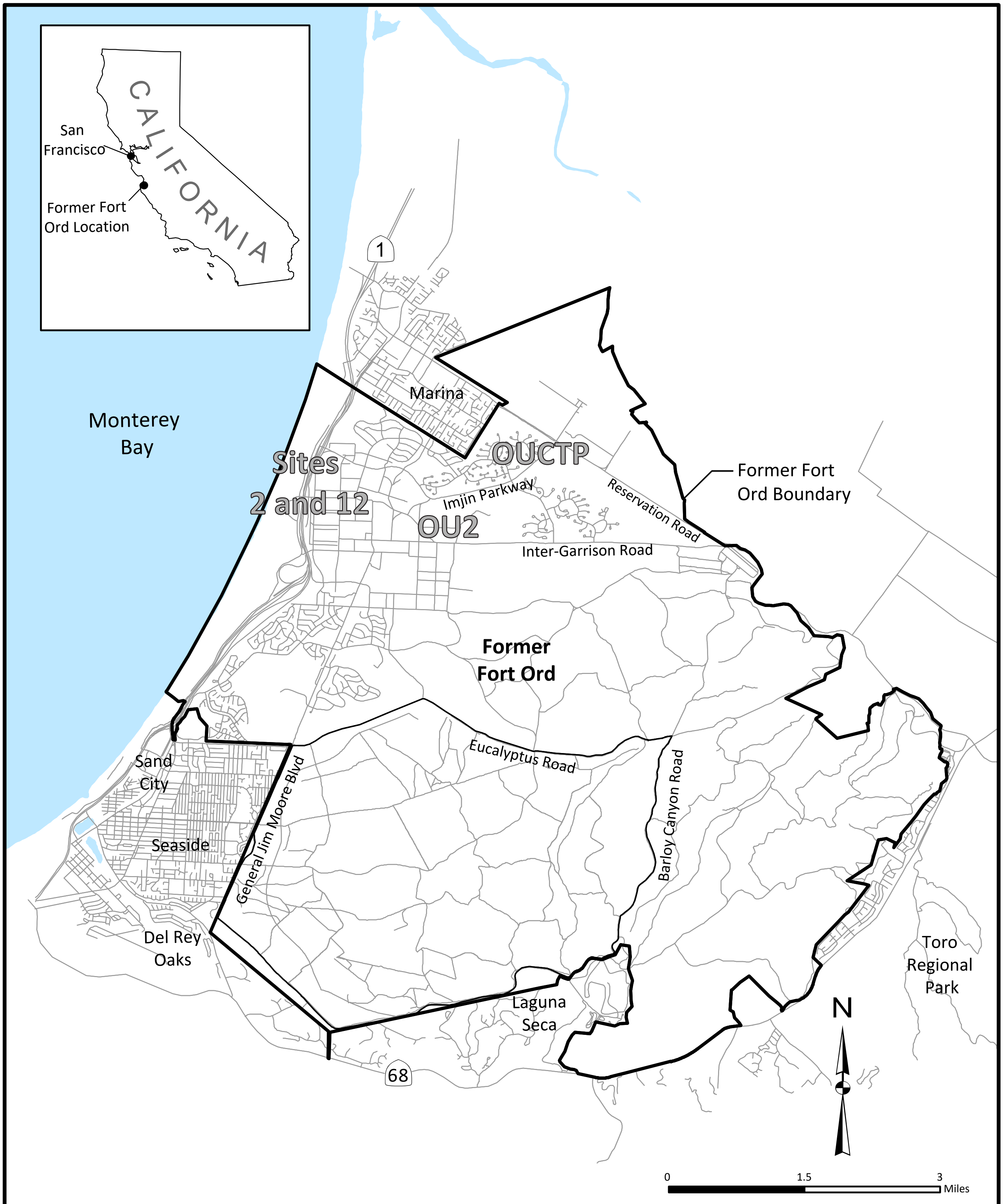
EPA, 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* January. OSWER No. 9200.1-85, EPA 540-R-08-005.

EPA, 2013. *Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions*. November. OSWER 9355.0-129.

EPA, 2014a. *Groundwater Remedy Completion Strategy, Moving Forward with the End in Mind*. May. OSWER 9200.2-144.

EPA, 2014b. *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well*. August. OSWER 9283.1-44.

FIGURES



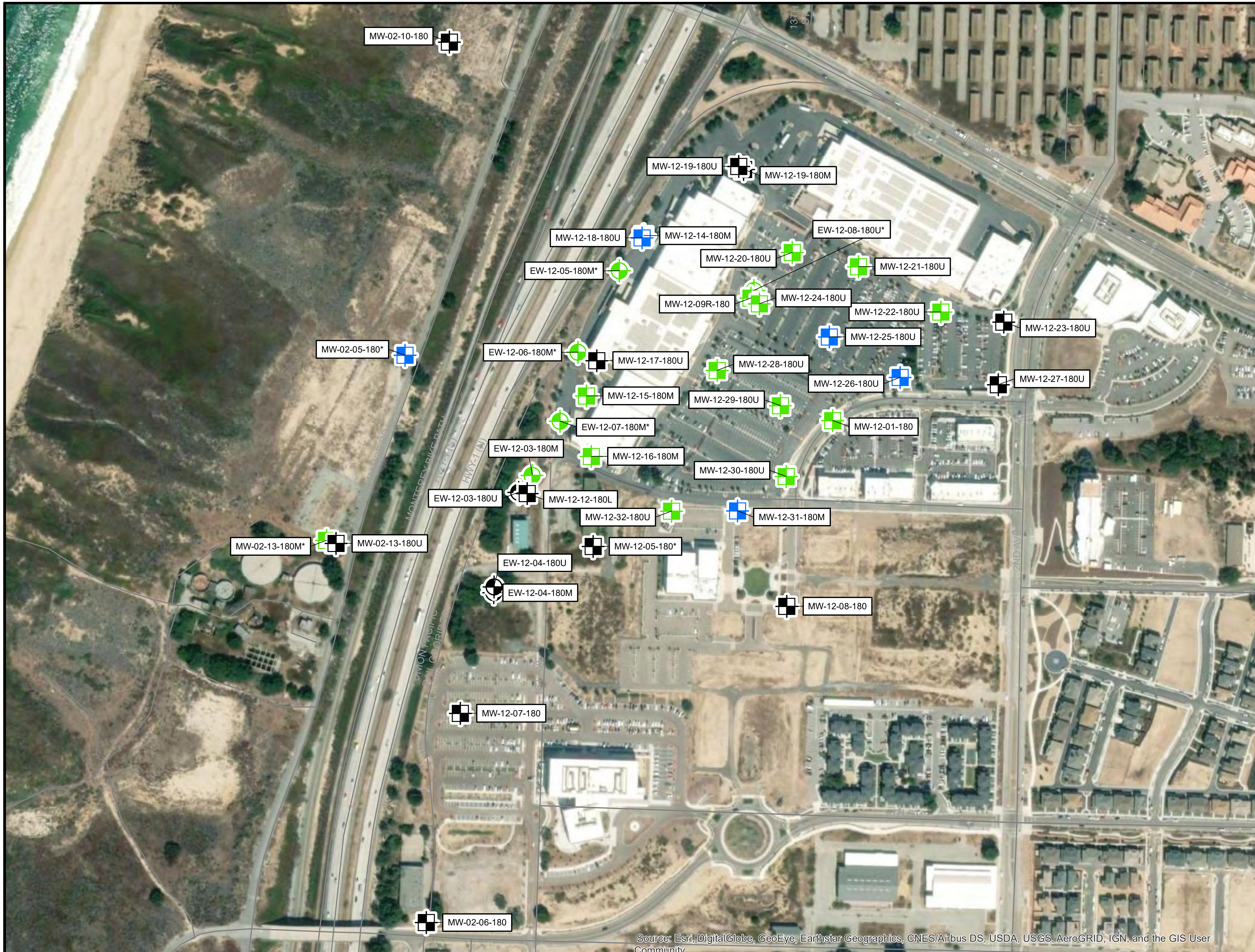
Ahtna

Former Fort Ord Location Map

Quality Assurance Project Plan, Former Fort Ord, California, Volume 1, Appendix A
Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2,
Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

Figure:

1



Legend

Roads

Sites 2/12 Wells 2019-2Q

Well Type and Sample Schedule

- Extraction Well - Quarterly VOCs
- Monitoring Well - Quarterly VOCs
- Monitoring Well - Annual VOCs
- Extraction Well - Water Levels
- Monitoring Well - Water Levels

*Annual chloride sample collected

N

0 100 200 400 Feet

Sites 2/12 Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

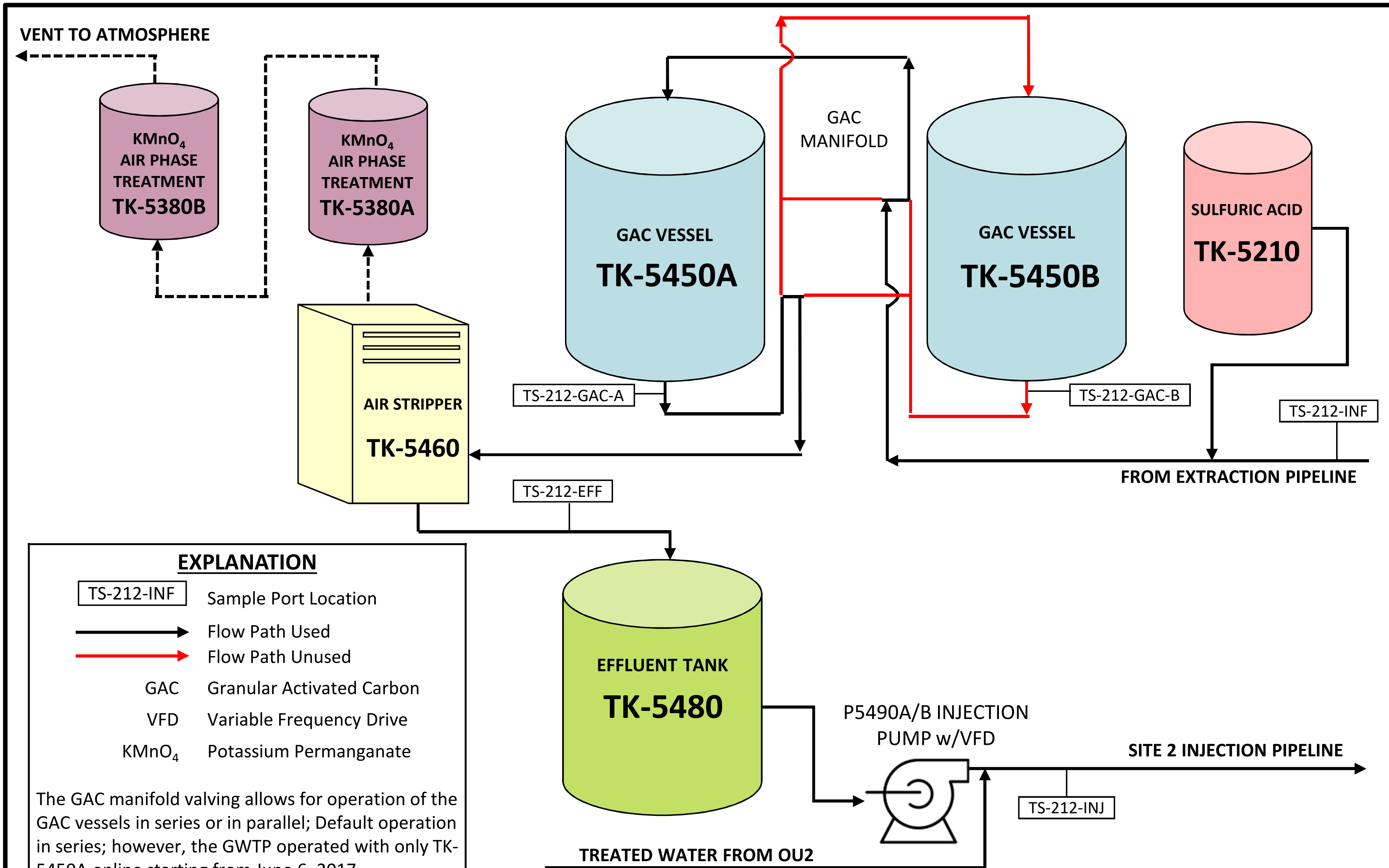
Figure: 2

Sites 2/12 Groundwater Remedy Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 3



EXPLANATION

TS-212-INF	Sample Port Location
(black arrow)	Flow Path Used
(red arrow)	Flow Path Unused
GAC	Granular Activated Carbon
VFD	Variable Frequency Drive
$KMnO_4$	Potassium Permanganate

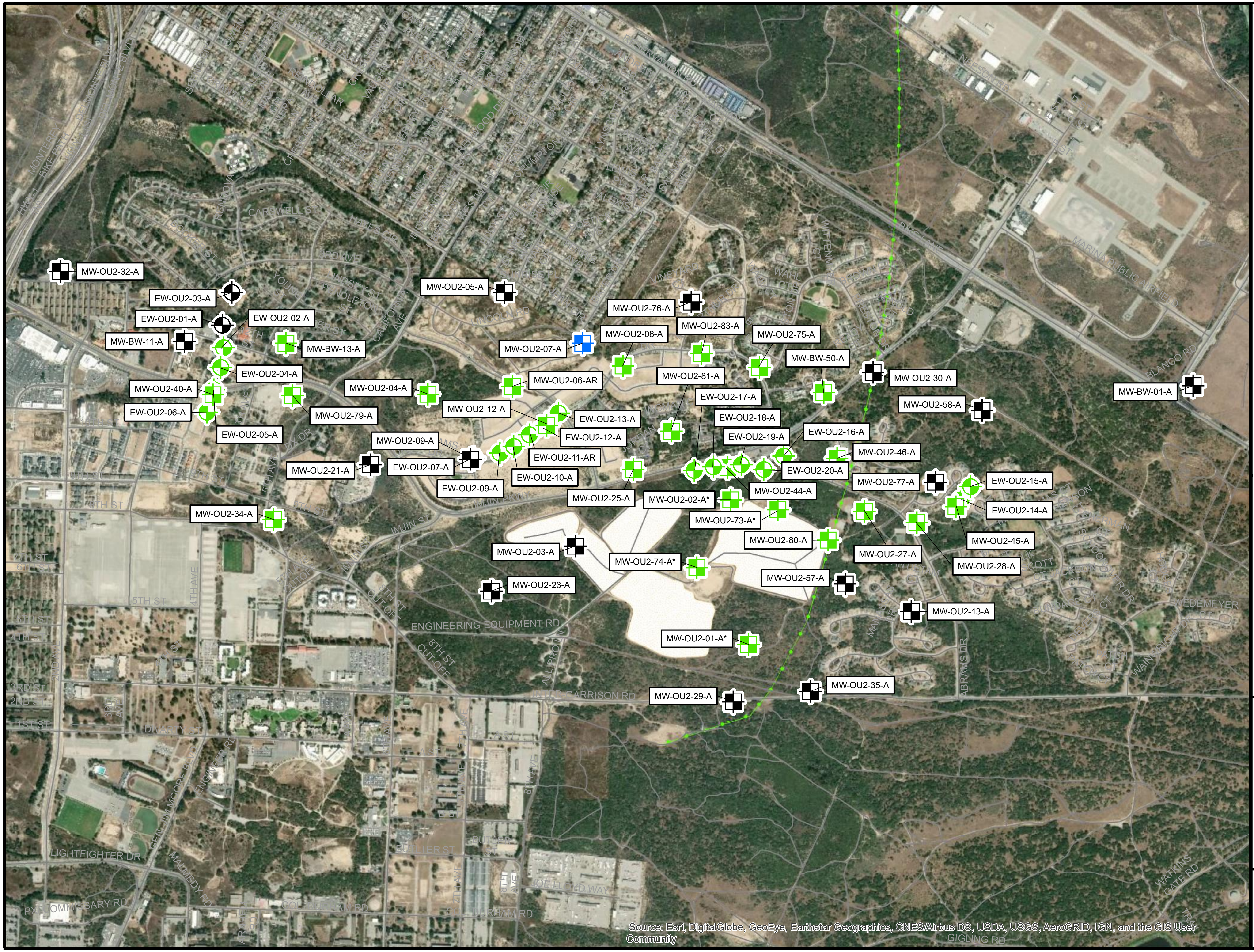
The GAC manifold valving allows for operation of the GAC vessels in series or in parallel; Default operation in series; however, the GWTP operated with only TK-5450A online starting from June 6, 2017.

Ahtna

Sites 2/12 Groundwater Treatment Plant Schematic

Quality Assurance Project Plan, Former Fort Ord, California, Volume I, Appendix A, Revision 7
Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and
Operable Unit Carbon Tetrachloride Plume

Figure: 4



Legend

- Roads
- Groundwater Divide
- Fort Ord Landfills

OU2-A Wells 2018-3Q

Well Type and Sample Schedule

- Extraction Well - Quarterly VOCs
- Monitoring Well - Quarterly VOCs
- Monitoring Well - Annual VOCs
- Extraction Well - Water Levels
- Monitoring Well - Water Levels

*Annual metals (antimony, copper, and lead) sample collected.

N

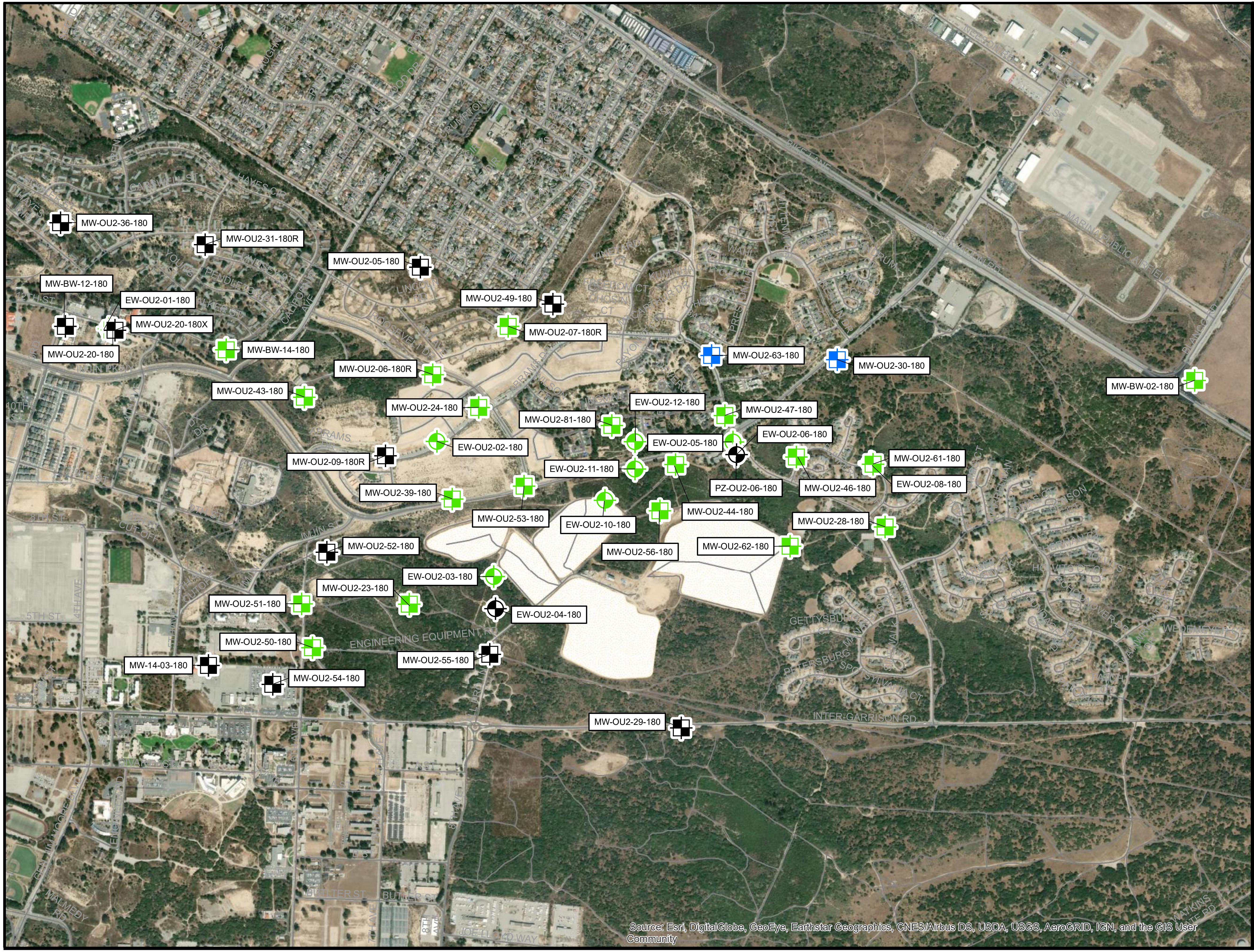
0 500 1,000 2,000 Feet

OU2 A-Aquifer
Groundwater Monitoring Program
Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:
5A



Legend

Roads

Fort Ord Landfills

OU2-Upper Wells 2018-3Q

Well Type and Sample Schedule

Extraction Well - Quarterly VOCs

Monitoring Well - Quarterly VOCs

Monitoring Well - Annual VOCs

Extraction Well - Water Levels

Monitoring Well - Water Levels

N

0 450 900 1,800 Feet

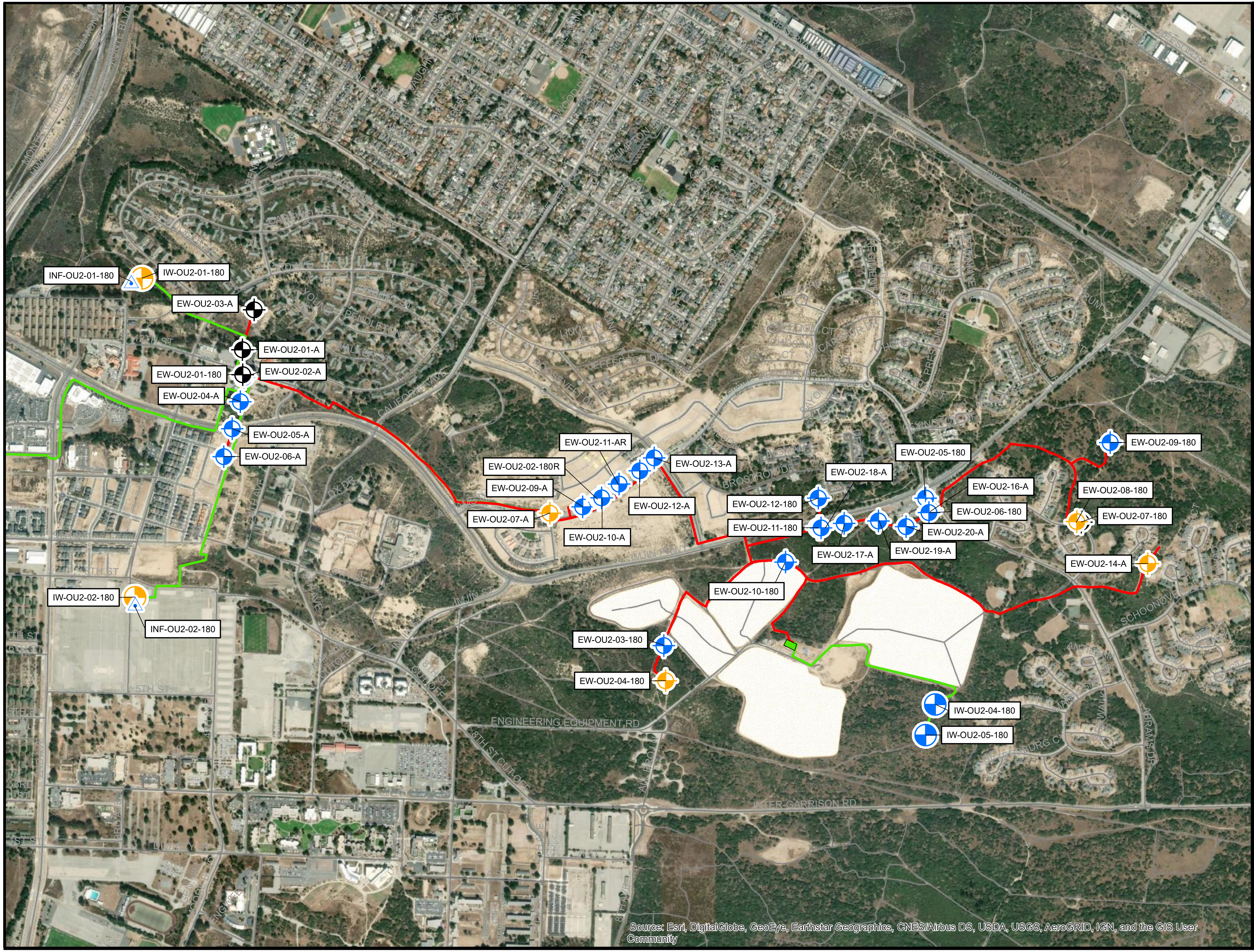
OU2 Upper 180-Foot Aquifer Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:

5B



Legend

- Roads
- Fort Ord Landfills
- OU2 GWTP

Extraction Well Status

- Extraction Well - Operated
- Extraction Well - Not Operated
- Extraction Well - No Pump

Groundwater Pipeline

- Groundwater Extraction
- OU2 Treated Water Discharge
- Injection Well - Not Used
- Injection Well - Operated
- Infiltration Gallery - Operated

N

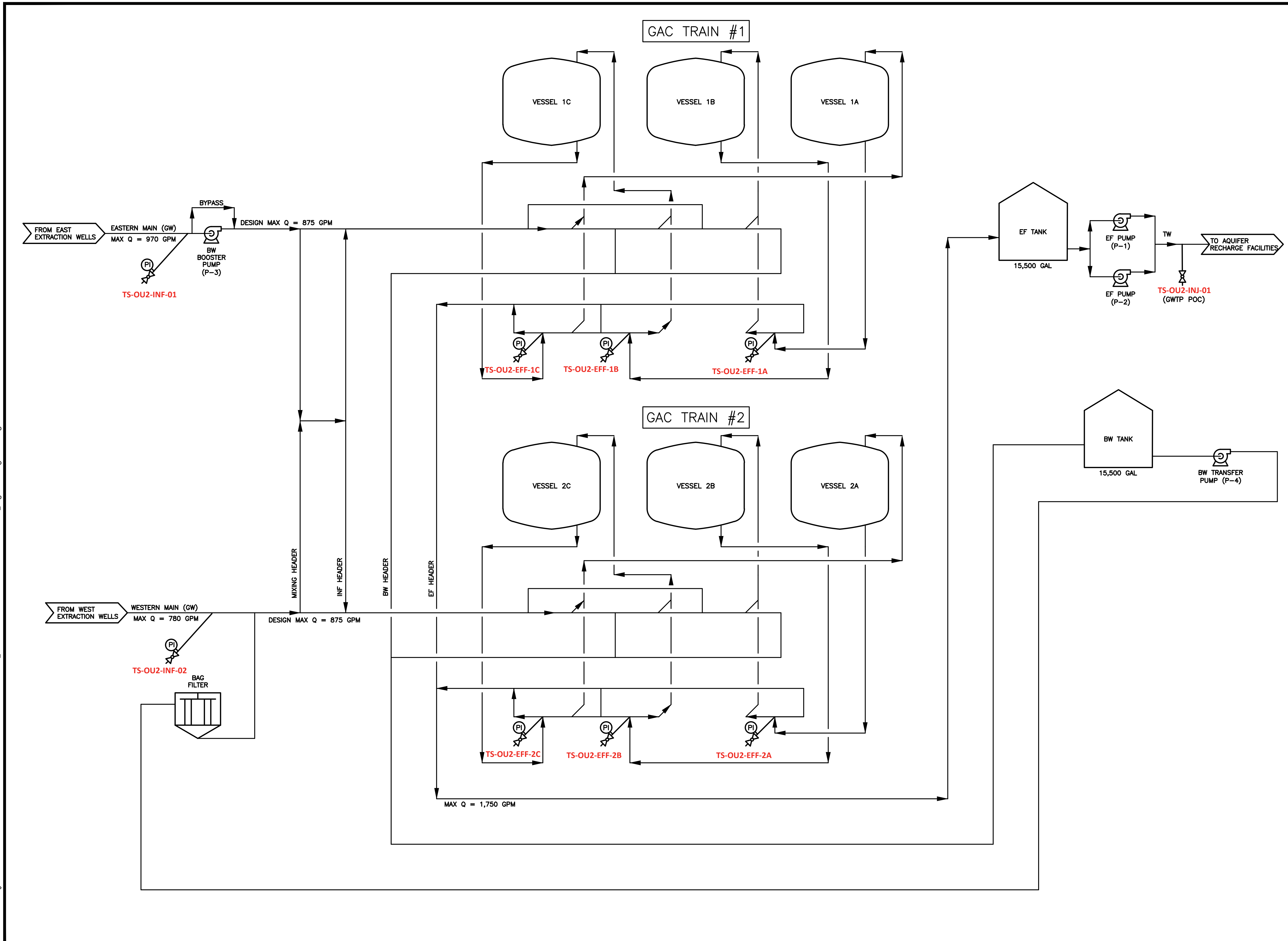
0 375 750 1,500 Feet

OU2 and OUCTP
Upper 180-Foot Aquifer
Groundwater Remedies Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 6



Legend

ABBREVIATIONS

BW	BACKWASH
EF	EFFLUENT
GAC	GRANULAR ACTIVATED C
GAL	GALLONS
GPM	GALLONS PER MINUTE
GW	GROUNDWATER (UNTREA
GWTP	GROUNDWATER TREATME
MAX	MAXIMUM
PI	PRESSURE INDICATOR
POC	POINT OF COMPLIANCE
Q	FLOW RATE
SP	SAMPLE PORT
TW	TREATED WATER

NOTES

1. VALVES ARE NOT INDICATED.
2. FLOW ARROWS INDICATE NORI OPERATION, WITH VESSEL SEC A-B-C IN EACH GAC TRAIN.

Locations in red font are sample locations

Note: The lead GAC vessel effluent will be sampled at the time of the sampling event

OU2 Groundwater Treatment Plant Schematic

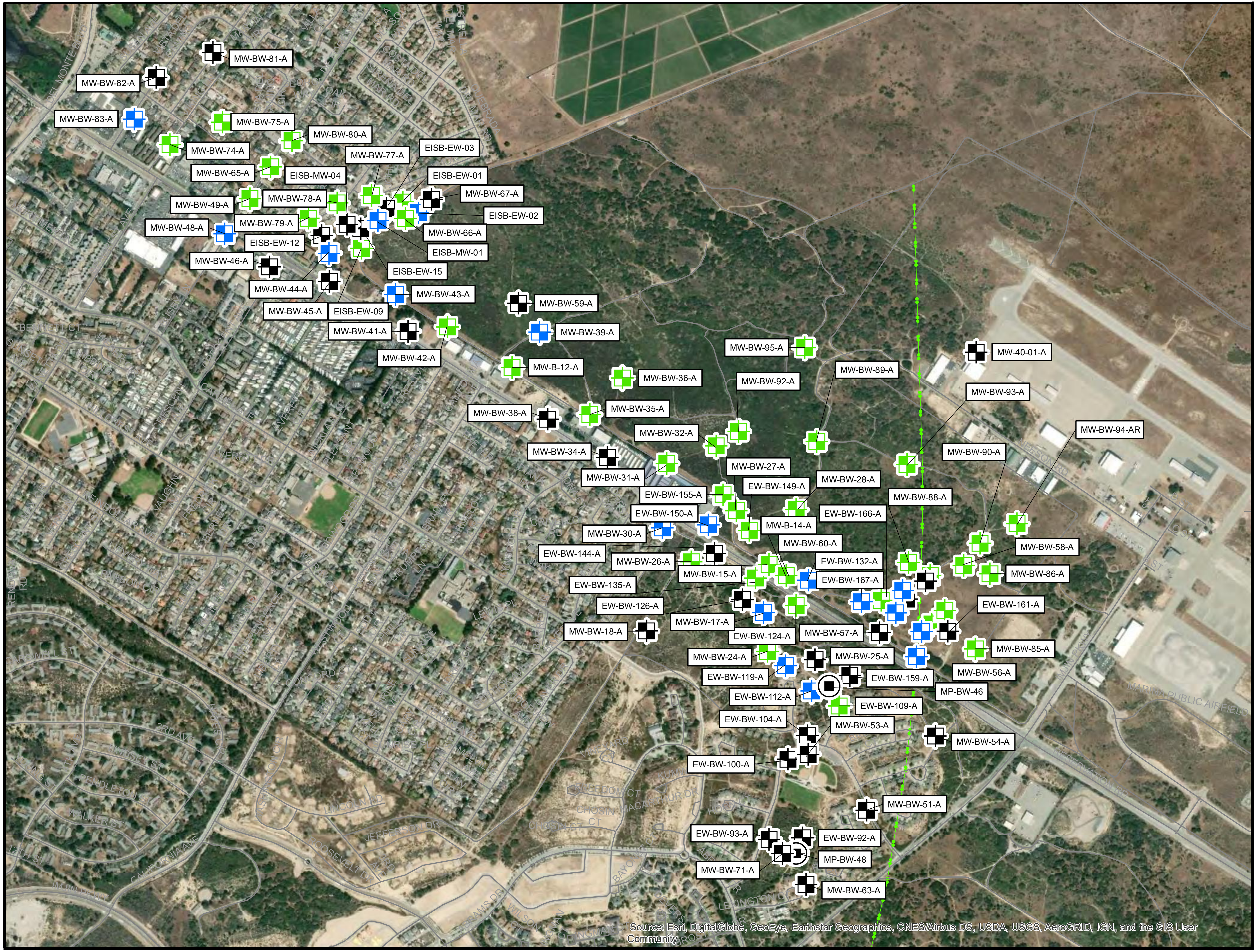
Quality Assurance Project Plan
Former Fort Ord, California
Volume I, Appendix A
Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

Ahtna RORE ITSI

Figure
7

FILENAME: P:\Projects\JRGF JV0001RORE JV GWTP Fort Ord\10.0 CADD\400_CADD Current Drawins\26.0 DandM _Figures\Fig 2-5.dwg

SAVED: Monday, 26 February 2018 - 9:54AM PRINTED: 26-FEB-2018



Legend

- Roads
- Groundwater Divide

OUCTP-A Wells 2019-2Q

Well Type and Sample Schedule

- Monitoring Well - Quarterly VOCs
- Multi-Port Well - Quarterly VOCs
- Monitoring Well - Annual VOCs
- Monitoring Well - Water Levels
- Multi-Port Well - Water Levels

N

0 300 600 1,200 Feet

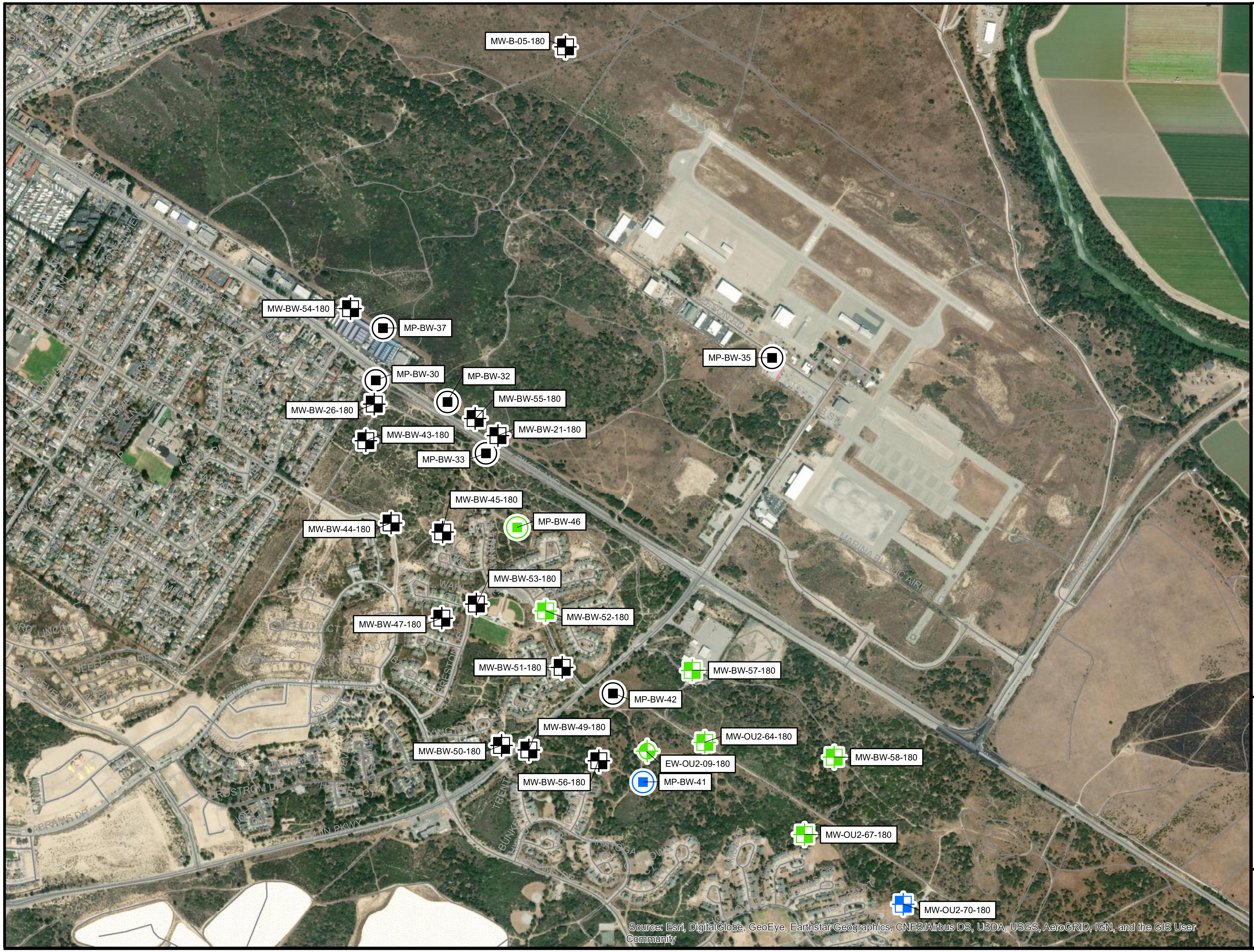
OUCTP A-Aquifer Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:

8A



Legend

Roads

Fort Ord Landfills

OUCTP-Upper Wells 2018-3Q

Well Type and Sample Schedule

- Extraction Well - Quarterly VOCs
- Monitoring Well - Quarterly VOCs
- Multi-Port Wells - Quarterly VOCs
- Monitoring Well - Annual VOCs
- Multi-Port Well - Annual VOCs
- Monitoring Well - Water Levels
- Multi-Port Well - Water Levels

N

0 375 750 1,500 Feet

OUCTP Upper 180-Foot Aquifer Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:
8B

Legend

Roads

Fort Ord Landfills

OUCTP-Lower Wells 2018-3Q

Well Type and Sample Schedule

- Extraction Well - Quarterly VOCs
- Monitoring Well - Quarterly VOCs
- Multi-Port Well - Quarterly VOCs
- Water Supply Well - Quarterly VOCs
- Monitoring Well - Annual VOCs
- Multi-Port Well - Annual VOCs
- Monitoring Well - Water Levels
- Multi-Port Well - Water Levels

N

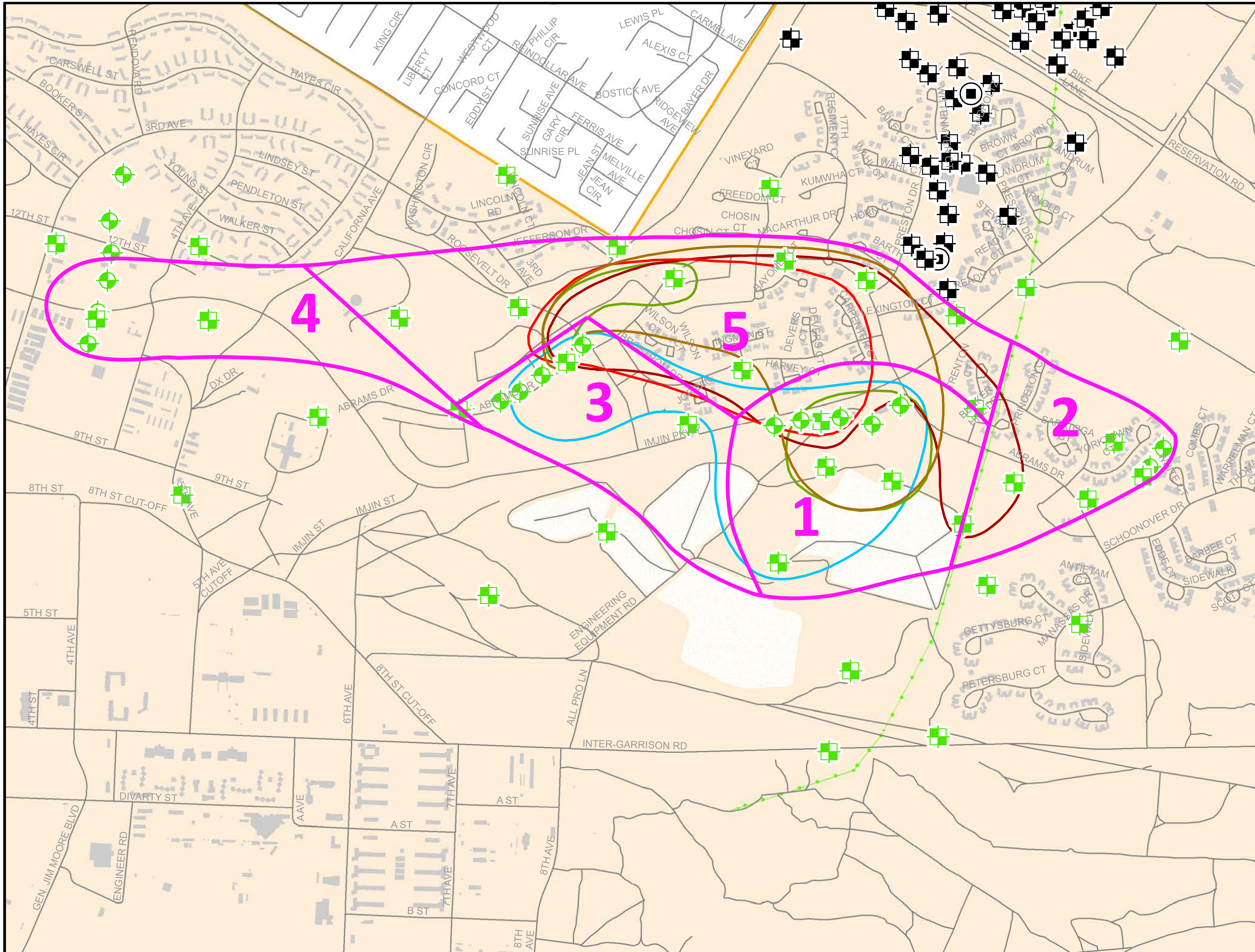
0 500 1,000 2,000
Feet

OUCTP Lower 180-Foot Aquifer Groundwater Monitoring Program Sampling Locations

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:
8C



Legend

- Buildings
- Roads
- Groundwater Divide
- Former Fort Ord Boundary
- Fort Ord Landfills

OUCTP A-Aquifer Well Type

- OUCTP-A Multi-Port Well
- OUCTP-A Monitoring Well

OU2 A-Aquifer Well Type

- OU2-A Extraction Well
- OU2-A Monitoring Well

OU2 COC ACL Exceedances 2018-2Q

- 1,1-DCA (5 ug/L)
- 1,2-DCA (0.5 ug/L)
- PCE (3 ug/L)
- TCE (5 ug/L)
- VC (0.1 ug/L)
- 1 Hydraulic Zone

N

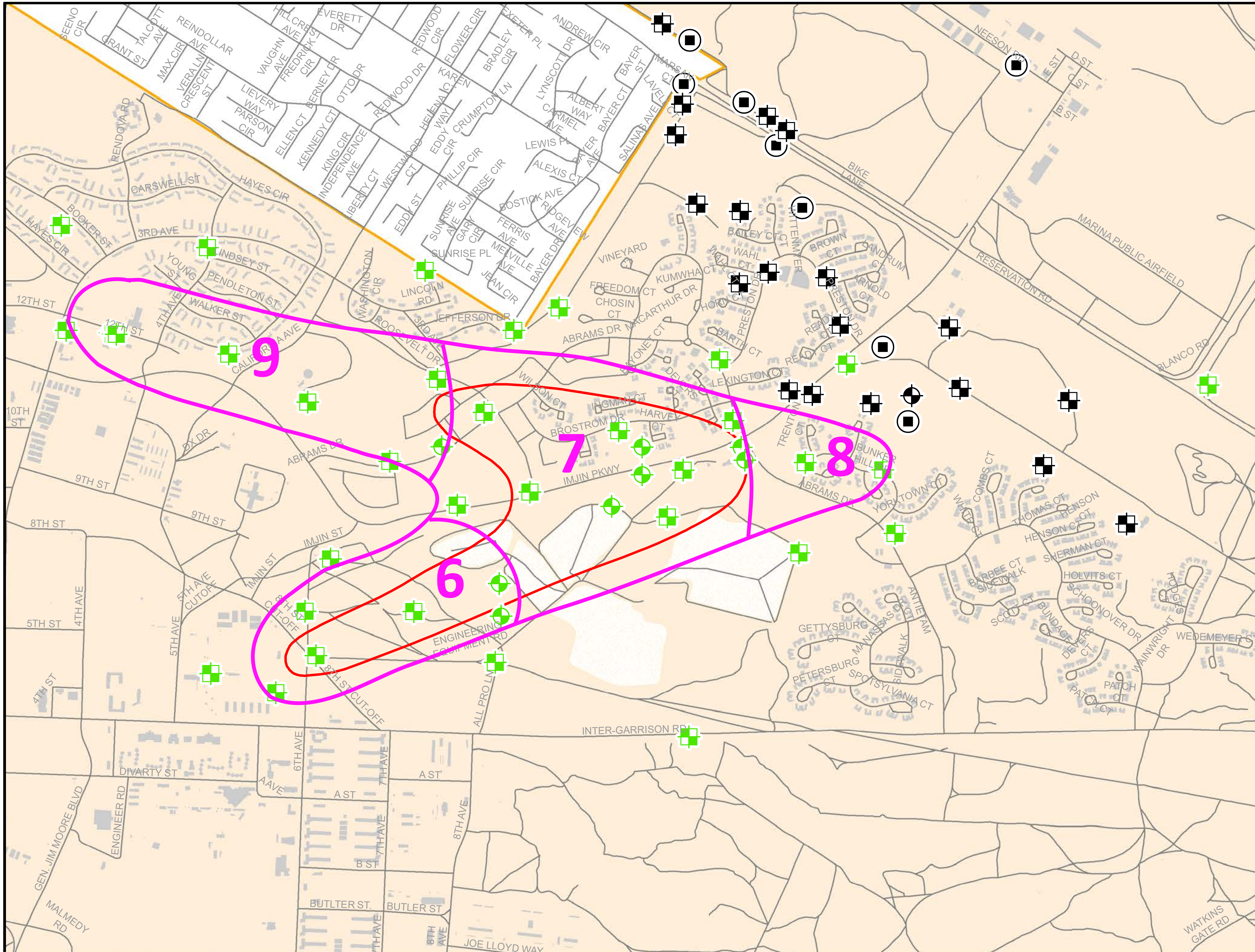
0 375 750 1,500 Feet

OU2 A-Aquifer Hydraulic Zone Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 9



Legend

OUCTP Upper Well Type

- OUCTP-U Extraction Well
- OUCTP-U Multi-Port Well
- OUCTP-U Monitoring Well

OU2 Upper Well Type

- OU2-U Extraction Well
- OU2-U Monitoring Well

OU2 COC ACL Exceedance 2018-2Q

- TCE (5 ug/L)
- Buildings
- Roads
- Fort Ord Landfills
- Former Fort Ord Boundary
- 1 Hydraulic Zone

0 375 750 1,500 Feet

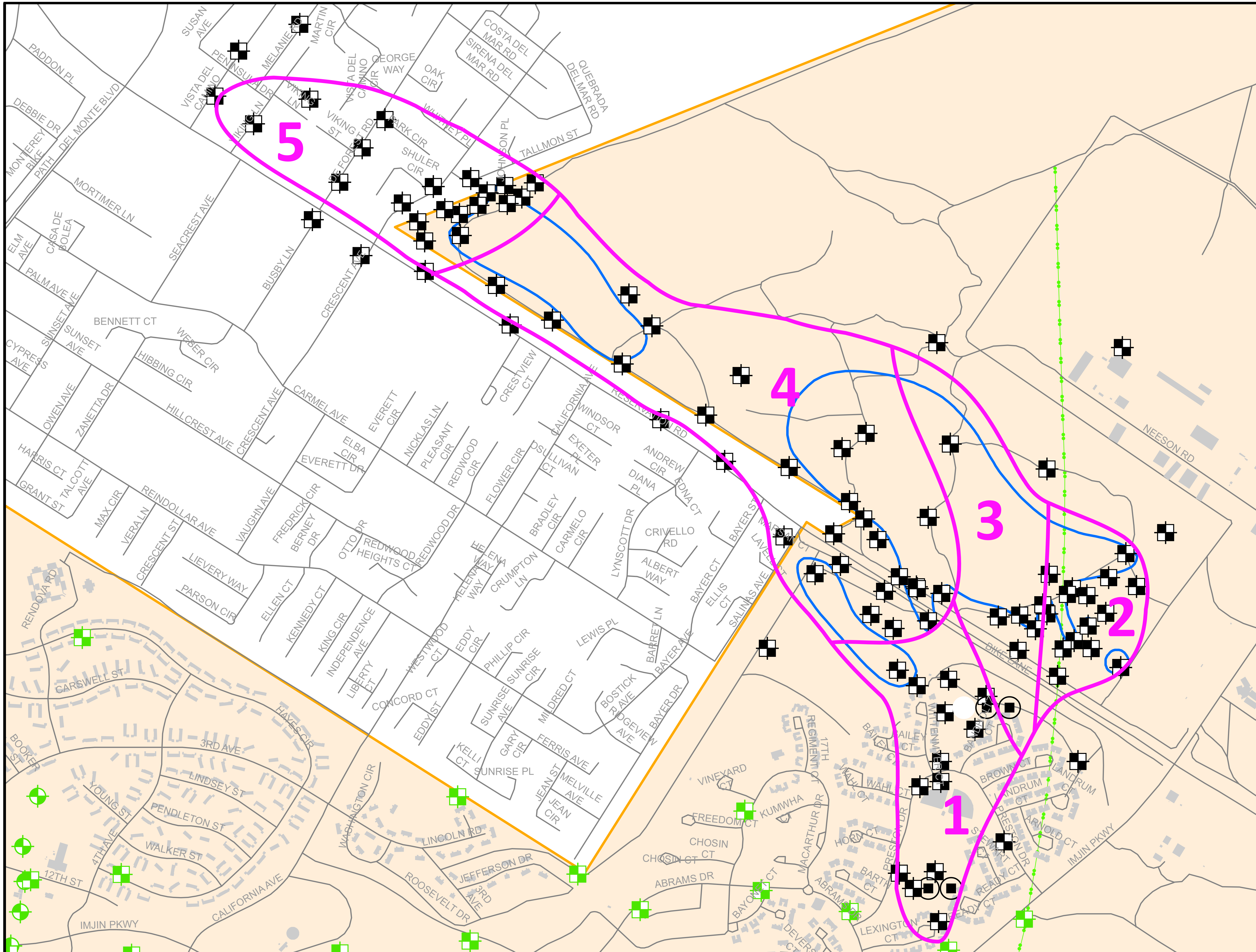
N

OU2 Upper 180-Foot Aquifer Hydraulic Zone Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 10



Legend

- OU2-A Extraction Well
- OU2-A Monitoring Well

A-Aquifer Well Type

- OUCTP-A Multi-Port Well
- OUCTP-A Monitoring Well

ACL Exceedance 2018-2Q

- CT (0.5 ug/L)
- Buildings
- Roads
- Groundwater Divide
- Former Fort Ord Boundary
- 1 Hydraulic Zone

0 300 600 1,200 Feet

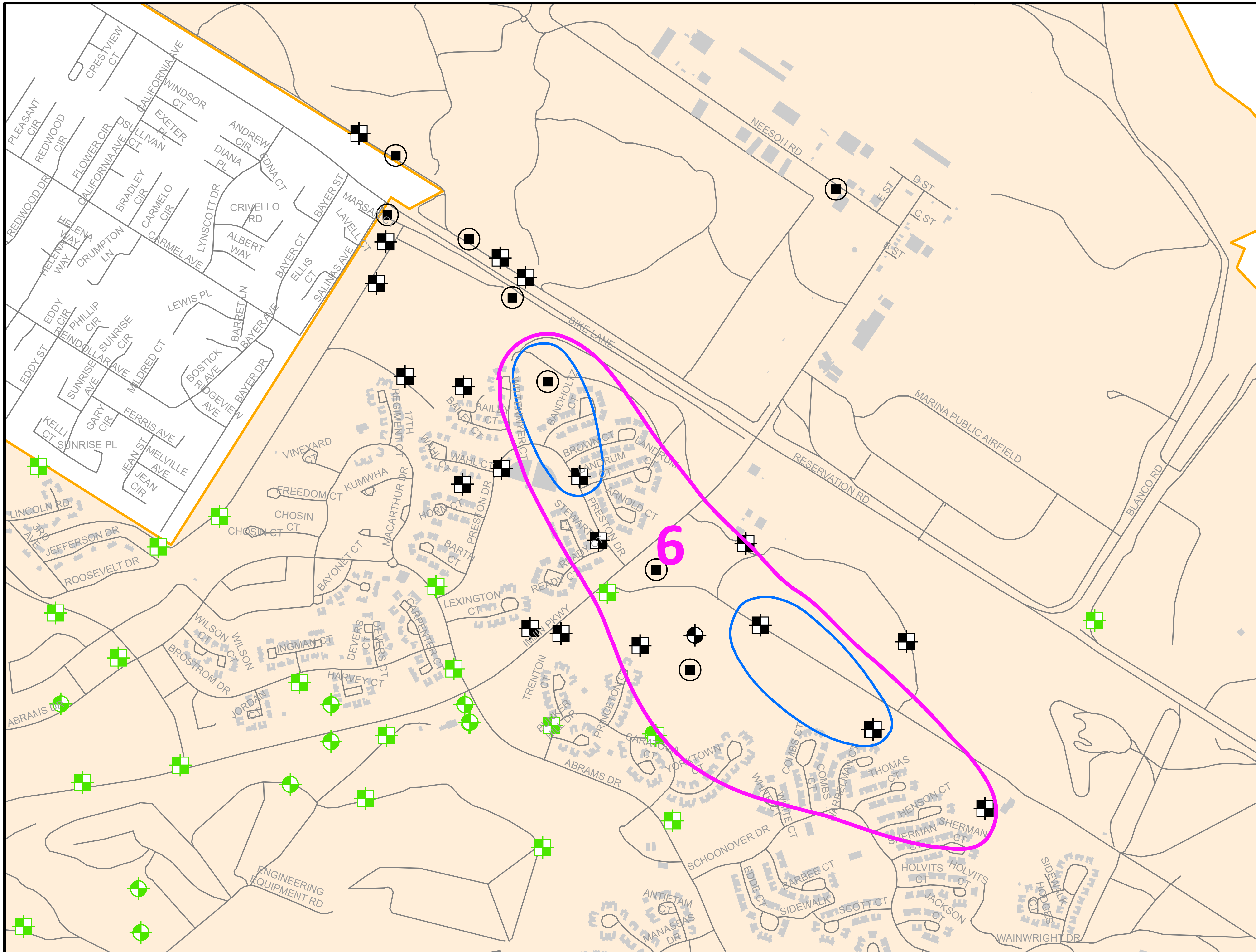
N

OUCTP A-Aquifer Hydraulic Zone Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure:
11

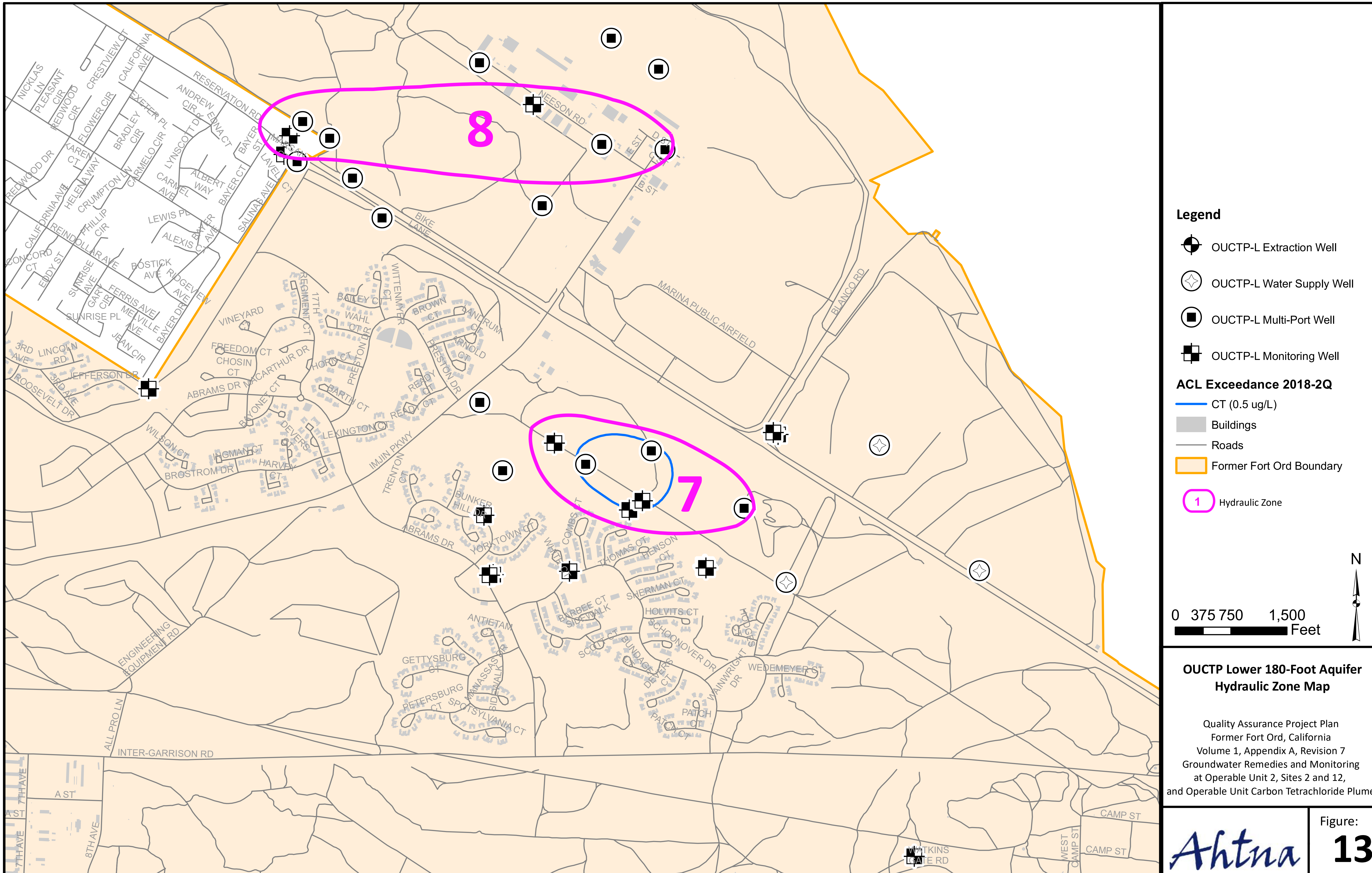


OUCTP Upper 180-Foot Aquifer Hydraulic Zone Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 12

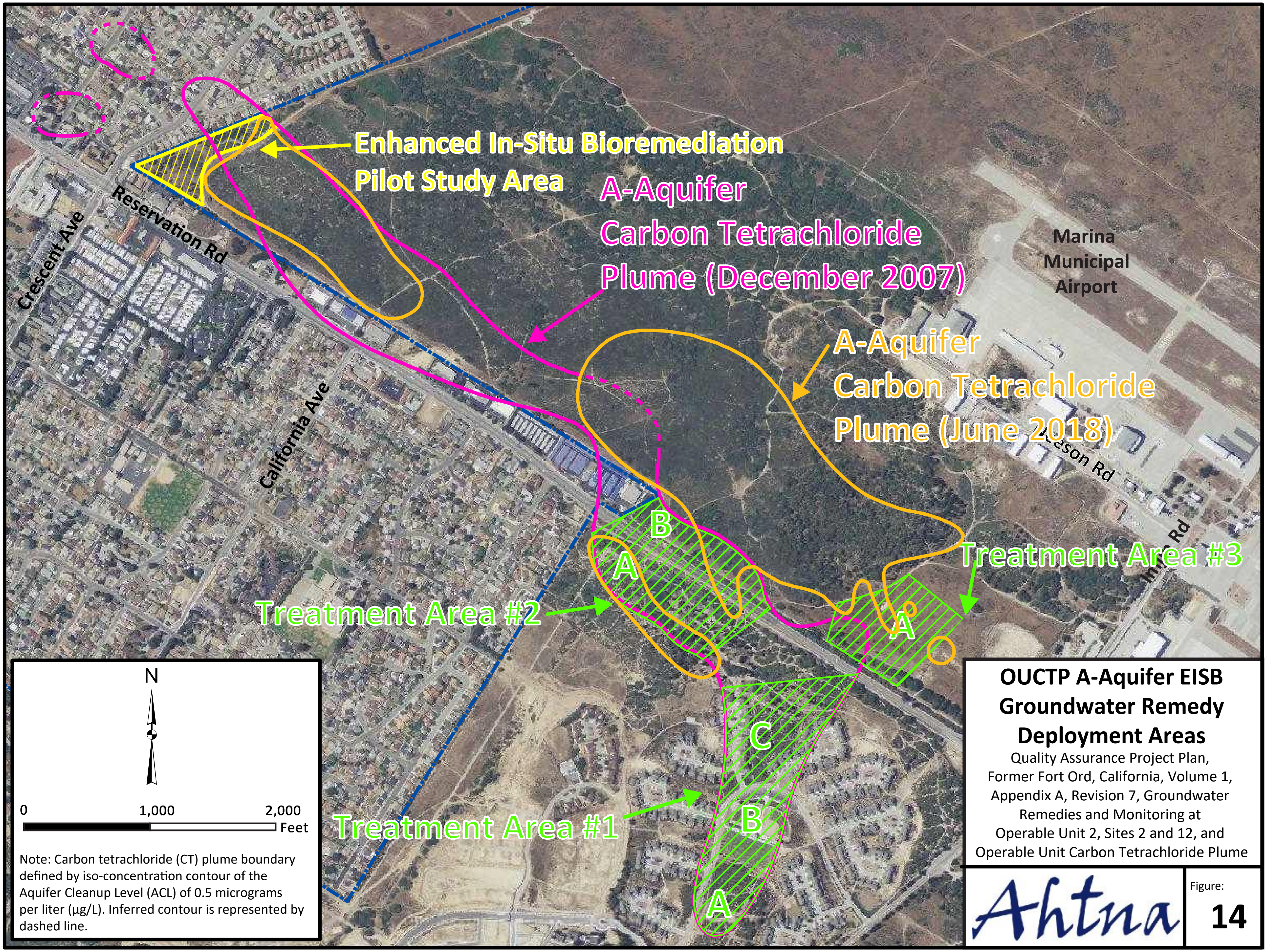


OUCTP Lower 180-Foot Aquifer Hydraulic Zone Map

Quality Assurance Project Plan
Former Fort Ord, California
Volume 1, Appendix A, Revision 7
Groundwater Remedies and Monitoring
at Operable Unit 2, Sites 2 and 12,
and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: **13**



OUCTP A-Aquifer EISB Groundwater Remedy Deployment Areas

Quality Assurance Project Plan, Former Fort Ord, California, Volume 1, Appendix A, Revision 7, Groundwater Remedies and Monitoring at Operable Unit 2, Sites 2 and 12, and Operable Unit Carbon Tetrachloride Plume

Ahtna

Figure: 14

TABLE

Table 1: Summary of Existing Monitoring Wells and Samples Collected Annually

Site	Aquifer	Total Number[1] of Wells Per Aquifer	Number of Army-Owned Wells	Total Number of Sample Ports Currently Sampled	Number of Well/Ports Sampled Quarterly	Number of Wells/Ports Sampled Annually	Number of Wells Not Sampled (water level only)	Number of Samples Collected Annually[2]
Sites 2 and 12	A	0	0	0	0	0	0	0
	Upper 180	38	38	24	19	5	14	89
	Lower 180	1	1	0	0	0	1	0
	Subtotal	**39**	**39**	**24**	**19**	**5**	**15**	**89**
Operable Unit 2	A	59	59	40	39	1	19	173
	Upper 180	45	45	31	29	2	14	130
	Lower 180	0	0	0	0	0	0	0
	Subtotal	**104**	**104**	**71**	**68**	**3**	**33**	**303**
Operable Unit Carbon Tetrachloride Plume	A	95	95	62	43	19	33	210
	Upper 180	37	37	9	7	2	28	33
	Lower 180	95	89	24	21	3	71	96
	Subtotal	**227**	**221**	**95**	**71**	**24**	**132**	**339**

Total Number of Samples Collected Annually	**730**

Notes:

[1] Number of wells in the groundwater monitoring program (not including wells not measured for depth to water and to be decommissioned at a later date).

[2] Includes duplicate samples collected during groundwater monitoring at a frequency of 10 percent (%) per quarterly event.

ATTACHMENTS

ATTACHMENT A

Standard Operating Procedures (SOPs)

Sampling SOPs

1. Westbay MOSDAX Sampler Probe – Model 2531 Operations Manual
2. Passive Diffusion Bag (PDB) Sampling Protocol
3. HydraSleeve Field Manual
4. Supply and Irrigation Well Sampling Protocol
5. OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements
6. Low Flow Groundwater Quality Parameter Collection
7. Downhole Meter Groundwater Quality Parameter Collection

OPERATIONS MANUAL

Westbay MOSDAX Sampler Probe - Model 2531

Schlumberger
WATER SERVICES

NOTICE

Operation of Westbay System equipment should only be undertaken by qualified instrument technicians who have been trained by Westbay authorized personnel.

This document contains proprietary information. No part of this document may be photocopied, reproduced or translated to another language without the prior written consent of Westbay Instruments Inc. The information contained in this document is subject to change without notice.

DO NOT OPEN THE SAMPLER

All warranties expressed or implied will be void if, after examination by Westbay Instruments Inc. personnel, it is established that any of the instrument housings have been opened without prior authorization from Westbay Instruments Inc.

DO NOT LET THE SAMPLER FREEZE

Extreme care should be taken to avoid freezing the MOSDAX Sampler probe. Permanent transducer damage may result from freezing.

Manual Revision: 1.13 20 October 2006

Issued for Serial No.: ____________

Date: ____________

Signature: ____________

Contents

1. DESCRIPTION

1.1 MOSDAX Sampler Probe, Model 2531

The MOSDAX Sampler is a downhole probe designed to collect fluid pressure information and fluid samples from Westbay System monitoring wells. Each MOSDAX pressure sensor is calibrated over its full pressure range for nonlinearity and temperature variation. MOSDAX Sampler probes are available in a variety of pressure ranges to permit operation to various depths. The shoe and valve motors can be operated from the surface. The power for the shoe and valve motors is supplied from the surface.

1.2 MOSDAX Automated Groundwater Interface (MAGI), Model 2536

The MOSDAX Sampler can be operated directly by the keypad on the MOSDAX Automated Groundwater Interface (MAGI), or by a Hand Held Controller (HHC) connected to the MAGI, or with a computer running Microsoft Windows (2000 or higher) and Westbay software connected to the MAGI. The MAGI translates the signals between the computer or HHC and the MOSDAX Sampler. The MAGI requires 12 volt DC power to operate.

Older versions of MOSDAX sampling equipment may incorporate a Model 2522 MOSDAX PC Interface (MPCI) and HHC rather than a MAGI. For such systems, reference to the MAGI in this document can be considered as reference to the MPCI and HHC.

1.3 Cable Reels

The manual cable reel can operate all Westbay probes and tools to a depth of 300m (1,000 ft) on a single-conductor cable. The manual reel is hand operated with an internal brake to control the speed of descent of the probe in the well. The two-pin cable connects the MAGI to the reel and the signals pass through a slipring located in the hub of the reel into the control cable. For maintenance information, see the appropriate cable reel manual.

Motorized cable reels are available for deeper applications.

1.4 Sample Containers

Sample containers can be used with the MOSDAX Sampler. The nonvented stainless steel sample containers maintain samples under formation pressure while the sampler and container are brought to the surface.

2. PRESSURE PROFILING

2.1 Items Required

- MOSDAX Sampler Probe, Model 2531
- MAGI, Model 2536 with:
  - one two-pin data cable
  - one three-pin power cable
  - hand held controller with cable and user's guide (optional)
  - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sheave with counter and tripod
- 12 VDC, 2 Amp power source (Battery pack, car/truck battery, or transformer)
- Water level measuring tape
- MProfile User's Guide for computer or the Handheld Controller Operations Manual
- Westbay Casing Log showing depths to ports and couplings in hole to be tested.

2.2 Surface Checks

1. Remove the MOSDAX Sampler from its storage case. Inspect the probe housing and body for any damage. Please contact Westbay for advice on any cover tube damage.
2. Assemble the tripod and counter over the well. Run the cable over the counter.
3. Connect the probe to the cable. Before attaching, inspect the O-ring at the top of the probe and lubricate with silicon. The O-ring should be clean and intact. Tighten the nut hand tight only.
4. Connect the two-pin cable from the MPCI to the cable reel. With the MPCI OFF connect the three-pin cable from the MPCI to the 12 v power supply.
5. Connect the 9 pin cable from computer or HHC to the MPCI and turn the MPCI ON.
6. Perform the following surface checks to ensure that the location arm and the shoe mechanisms are operating normally: Release the location arm. The location arm should extend smoothly. The number of revolutions used to release the location arm is displayed and should be 15 to 16 revolutions. If a smaller number of revolutions is reported, retract the arm and repeat. Place the probe in a piece of Westbay casing or coupling. Activate the shoe. The shoe should extend and hold the probe firmly in the coupling or casing. The display should indicate 16 to 19 revolutions. A reading of 23 revolutions indicates the probe is activated in open air. Retract the backing shoe.

7. Check that the face plate for sampling and the plastic plunger are installed on the sampler.
8. The probe is now ready to be lowered down the well.

2.3 Pressure Measurement Procedures

1. Obtain the completed Westbay Casing Log.
2. With the location arm retracted, lower the probe into the Westbay casing to immediately below the lowest measurement port coupling to be monitored. If magnetic collars have been installed on the well, the Collar Detect Command can be used to detect the collars. The Collar Detect Command is cancelled by pressing any key.
3. Release the location arm. The display should update and beep after the arm is released.
4. Raise the probe about 0.5 m (1.5 ft) above this measurement port. If the probe is accidentally lifted above the next higher coupling, it will be necessary to retract the location arm and lower the probe to below the measurement port and release the arm.
5. Lower the probe gently until the location arm rests in the measurement port.
6. Record the pressure and temperature inside the Westbay casing.
7. Optional: If a water level tape is available, measure and record the depth to water in the Westbay casing.
8. Activate the shoe. The pressure on the display should change to the formation pressure.
9. When the reading has stabilized, record the formation pressure.
10. Once the pressure has been recorded, retract the shoe.
11. Record the pressure of the fluid in the Westbay casing. This reading should be similar to that recorded in Step 6. If a large difference is noted between the readings, record the water level inside the Westbay casing again using the water level tape.
12. The three pressure readings plus the time and water level constitute a complete set of readings at a measurement port coupling.
13. Continue up the Westbay casing to obtain the pressure data from other measurement ports.
14. Take one last set of pressure and temperature readings at the surface. These readings should be similar to those recorded in Step 2.

CAUTION: If a water level tape was used, remove the water level tape from the Westbay casing before removing the sampler probe from the well to prevent them from becoming jammed.

3. FLUID SAMPLING

3.1 Items Required

- MOSDAX Sampler, Model 2531
- MAGI, Model 2536 with:
    - one two-pin data cable
    - one three-pin power cable
    - hand held controller with cable and user's guide (optional)
    - computer running Windows 2000 or higher with one nine-pin computer cable and MProfile software (optional)
- MOSDAX-compatible winch with cable
- Sample containers and connecting tubes
- Westbay Casing Log
- Groundwater Sampling Field Data Sheet
- 12 VDC, 2 amp power source (battery pack, car/truck, or transformer)
- Counter and tripod
- Westbay Sampling Kit including vacuum pump

3.2 Surface Checks and Preparation

1. Set up the MOSDAX Sampler probe following Steps 1 through 8 of Section 2.2.
2. Attach the sample containers.
3. Release the location arm. Locate the probe in the vacuum coupling.
4. Activate the shoe in the vacuum coupling.
5. Close the sampler valve. The motor should run about 5 seconds. The display should indicate one revolution.
6. Use the vacuum pump to apply a vacuum through the vacuum coupling. The vacuum should remain constant. If the vacuum is not maintained, inspect for leaks at the face seal of the probe, the connection to the pump and at the probe sampling valve.
7. Once a vacuum has been maintained, open the sampler valve. Apply a vacuum again to check that all connections are sealed.
8. Close the sampler valve. A vacuum has now been applied to the sample bottles.
9. Retract the shoe.

3.3 Drillhole Sampling

1. Check recent pressure logs of the hole and ensure that the head inside the Westbay casing is lower than the head outside the measurement port to be sampled.
2. After completing the surface checks, follow Steps 1 to 5 of Section 2.3 to locate the sampler at the measurement port in the monitoring zone to be sampled.
3. Record the pressure reading.
4. Activate the probe and record the formation pressure.
5. Open the sampler valve. The pressure should drop and then slowly increase as the bottles fill. When the pressure in the bottle equals the zone pressure from Step 4, the bottle is full. Wait a maximum of two minutes per sample bottle even if the pressures are not equal.
6. Close the sampler valve and retract the shoe.
7. Record the pressure reading. A reading the same as in Step 3 indicates that the sample is OK.
8. Reel the sampler to the surface and remove it from the Westbay casing.
9. **Do not open the sampler valve as damage to the probe or injury to the operator could occur.**
10. Remove the cap from the bottom sample bottle and open the valve on the bottle to release the pressure and to transfer the sample.
11. Open the sampler valve to allow the sample to flow from the bottles. Once the pressure in the sampler and bottles has decreased to atmospheric, the bottles may be disconnected to speed the process.
12. Take particular care in handling pressurized samples.

3.4 Rinsing Instructions

Rinse the sampler around the face seal and the bottom connector. With the sampler valve open, flush the interior of the sampler from the bottom connector. Rinse the sample bottles and connectors.

Note: Project specific procedures for decontaminating the sampler and sample bottles are the responsibility of the project manager and are not covered in this manual.

4. Care and Maintenance

The MOSDAX Sampler System must be routinely maintained for optimum performance. The procedures outlined here are required to keep the instrument operating properly. For any additional information or advice, please contact Westbay Instruments Inc.

4.1 MAGI

The MAGI should be cleaned to remove dirt and dust and inspected for damage or wear. If any part requires replacement, contact Westbay for information.

4.2 Cable Reels and Control Cable

The cable reels should be kept clean and protected from damage. The cable and cable head should be inspected for kinks and corrosion. Rehead the cable if necessary. For more information concerning cable reels and the control cable, refer to the appropriate reel manual.

4.3 MOSDAX Sampler Probe

1. Never allow the probe to freeze or the pressure transducer may be damaged.
2. Clean and inspect the probe for dents and scratches on the cover tube. Clean the threads with a nylon brush, such as a toothbrush. DO NOT use a wire brush. Protect the O-rings from damage and dirt.

4.3.1 Face Seal

Inspect the face seal and replace if damaged or worn.

1. Remove the two screws holding the face plate to the probe body and lift the face plate off.
2. Remove the face seal and plunger. Set the location arm assembly aside. Clean the plunger and probe body.
3. When reinstalling the face plate hold the face seal, plunger and location arm assembly in place. Replace the two screws the hold the face plate on the probe.

4.3.2 Location Arm

Release the location arm. Check that the arm moves smoothly and freely and check for damage and sharp edges due to wear. Replace the location arm if necessary.

1. Release the location arm. Remove the two screws and face plate (Section 4.3.1).
2. Remove the location arm with its spring and pivot pin. Clean and inspect all parts and replace if needed.
3. Insert the spring and pivot in the location arm and place the assembly in the probe body. Place the face plate over the face seal and location arm and tighten the two screws.

SECTION 4.3.2 SUPPLEMENT

WESTBAY Probe Location Arm replacement

a) It is easier when the arm is first extended to the "out" position (Fig. A). Do this before powering down and disconnecting the probe.

b) Remove the face seal slowly and stabilize the arm as it is under tension from the spring (Section 4.3.2.2) and may suddenly pop out. Observe the position and orientation of the parts as they are removed (Fig. B).

c) Insert the hook of bent leg of the spring into the tiny hole on the neck of the new arm and align the spring coil opening alongside the larger hole in the arm with the spring leg positioned directly against the arm and over the pivot facing out (Fig. C-1). The metal pivot pin goes through the hole in the arm and through the spring coil (Fig. C-2). The straight leg of the spring leads under the pivot into the smaller side slot on the side of the main arm aperture, parallel with the probe. Place the assembly into its space in the probe body (Fig. C-3). The arm assembly has to be held in place while replacing the face seal to counter the force of the slightly compacted spring (Fig.C-4).

d) Replace the face seal by sliding it toward the top of the probe and sliding the top edge into the slot while at the same time allowing the arm to protrude through the face seal. The arm should remain in the extended position while screwing down the face seal.

e) Check to see that the arm can be freely, manually pushed in and that it pops back out when released. Attach the probe to the cable and mechanically retract the arm using the MAGI commands.

Figure **A** - Arm is extended out at start of replacement operation.

Figure **B** - Disassembled face seal and location arm.

Figure **C-1 -** Orientation of spring relative to arm.

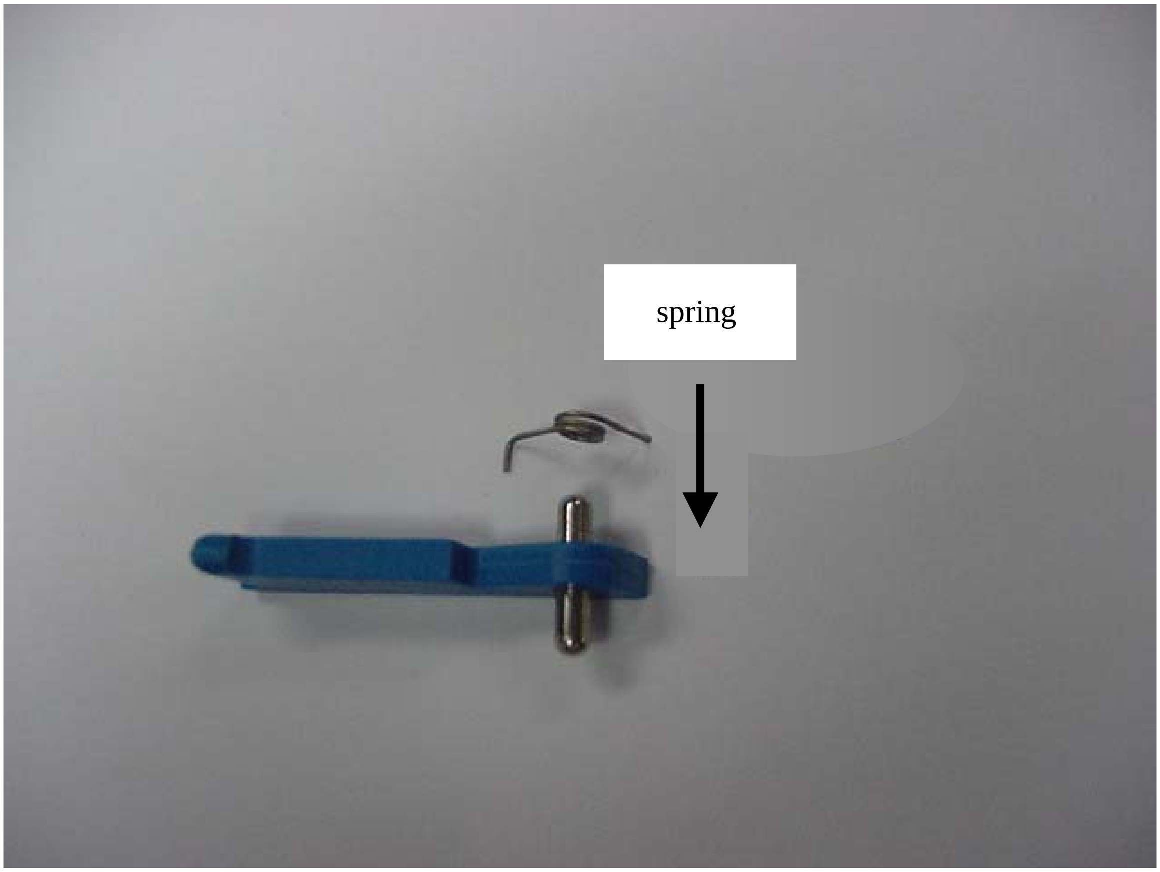


Figure **C-2 -** Position of spring and pivot in the arm.

Figure **C-3** - Placement of arm assembly.

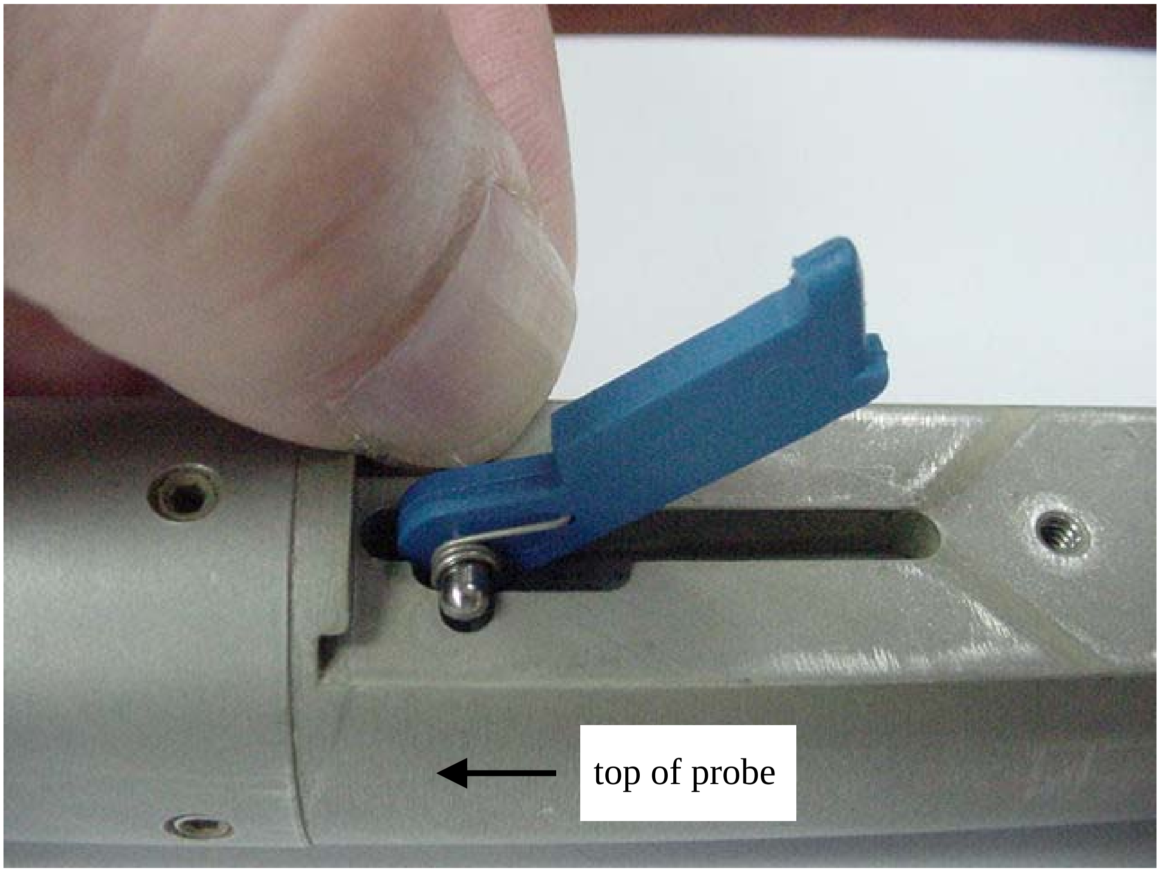
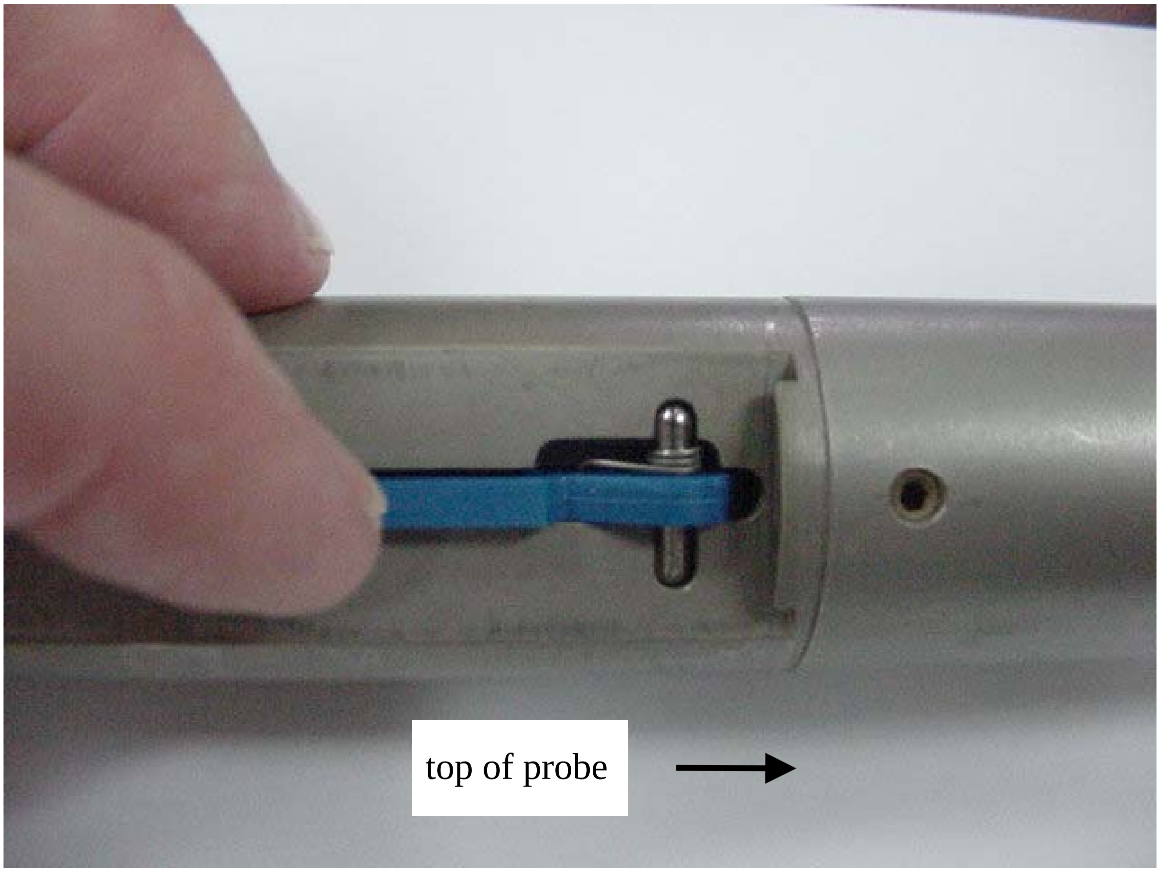


Figure **C-4 -** Top view of arm and spring placement.



Check that the arm is moving freely and the face seal insert and plunger are held securely in place.

4.3.3 Shoe Replacement

Activate the shoe and inspect for damage or wear. The shoe should rotate freely about the pivot pin. When the shoe is retracted it should retract quickly and smoothly back into the probe. The shoe may be replaced in the following manner:

1. Release the location arm and extend the shoe to expose the pivot pin.
2. Unscrew the shoe pivot pin from the lever arm and remove the shoe.
3. Place a new shoe in the lever arm and install the shoe pivot pin.

4.3.4 Actuator Nut

The actuator nut needs to be routinely cleaned to remove particles of grit which can interfere with its movement. Remove the actuator nut in the following manner:

1. Remove the two set screws that hold in the lever arm pivot pin. Using the Allen key, push the lever pivot pin out of the probe body.
2. Remove the set screws on the side of the probe body that holds the plastic support block.
3. Remove the screw closest to the top of the probe.
4. Lift out the lever arm, guide plate, shoe, spring and plastic support block as one unit.
5. Use the Clean Nut Command to remove the actuator nut from the actuator screw. Turn off the MPCI and remove the nut from the probe.
6. Clean the actuator nut with the cleaning tap. Use the Clean Nut Command and clean the actuator screw with a nylon brush. DO NOT use a wire brush.
7. Apply a thin coating of silicone lubricant to the actuator screw. Place the actuator nut in the probe body against the actuator screw and retract the arm to thread the nut onto the actuator screw. Allow the nut to travel along the full length of the screw. YOU MAY HAVE TO REPEAT THIS OPERATION.
8. Install the single unit from Step 4 in the probe body. Install the lever arm pin through the probe body, lever arm, and spring. Lock the pin in position with two set screws.
9. Install the top screw into the guide plate and install the set screws to secure the support block.

5. CALIBRATION

The Westbay System permits frequent or periodic calibration of the transducers used for pressure measurement. Contact Westbay for details.

6. SPARE PARTS LIST

Item	Part No. or Size	Qty
Face Seal Insert	200302	5
Plunger	(see Note 1)	5
Location Arm	252112	5
Shoe	252313	5
Pin 3 (Location Arm)	252320	2
Spring 2 (Location Arm)	252319	2
Pin 1 (Shoe)	252316	2
Spring 1 (Shoe Lever)	252318	2
Pan Head Screw	# 4-40 x 1/4 - inch	2
Pan Head Screw	# 6-32 x 3/16 - inch	2
Pan Head Screw	# 6-32 x 1/2 - inch	2
Hex Socket Head Screw	# 8-32 x 1/8 - inch	4
Hex Socket Head Screw	# 10-32 x 3/16 - inch	4
Hex Socket Set Screw	# 8-32 x 5/16 - inch	2
Allen Key	5/64 - inch	1
Allen Key	3/32 - inch	1
Actuator Nut Tap	208001	1
Cablehead Parts:		
O-ring	# 111 B	2
Termination Sleeve	251805	1
Termination Insert	251806	1
Feedthru Connector	251814	1
Bushing 1	251812	1
Bushing 2	251813	1
O-Ring	# 108 V	1
O-Ring	# 010 V	1
O-Ring	# 004 V	1
Boot	JF0602CF	1
Contact	JF0603CF	1
Cable Heading Tool	208100	1

1. Plunger appropriate to type of measurement port to be accessed.

Groundwater Sampling
Field Data Sheet

Schlumberger WATER SERVICES

Project: ____________________

Monitoring Well No.: ____________________

Sampling Zone No(s).: ____________________

Date: ____________________

Start Time: __________ Atm. Rdg: __________

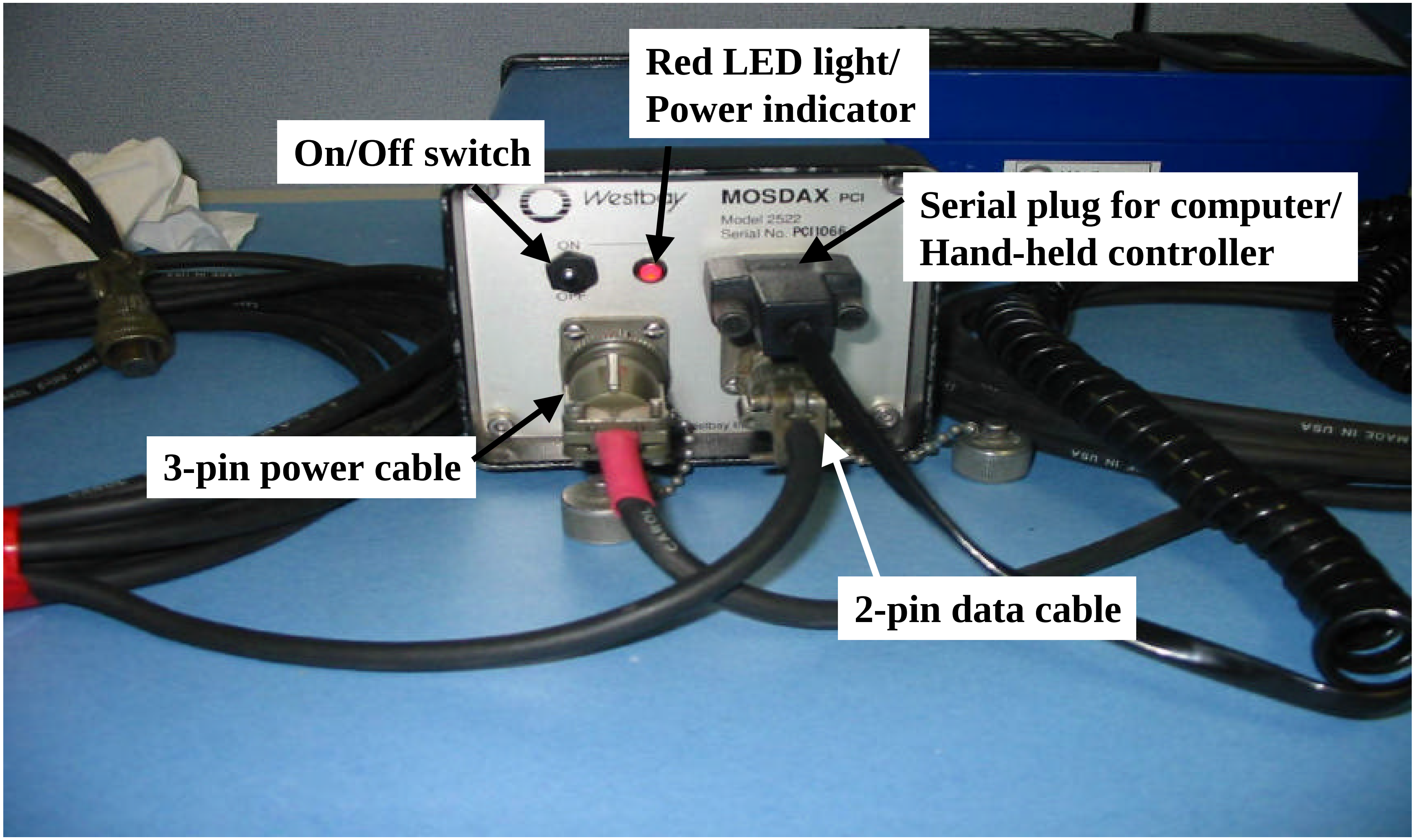
End Time: __________ Atm. Rdg: __________

Operators: ____________________

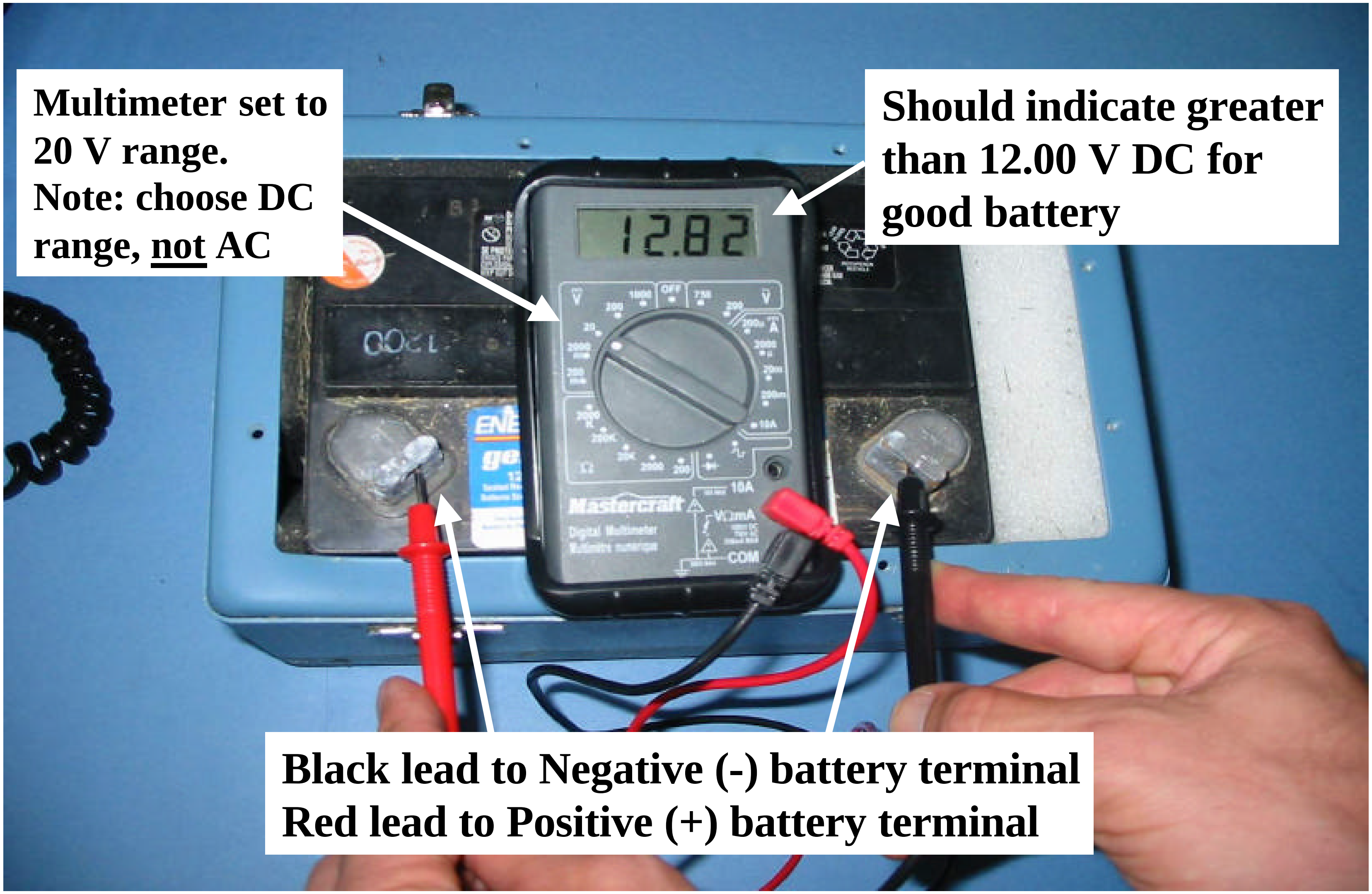
Port No.	Run No.	Surface Function Tests (probe in flushing collar)						Position Sampler			Sample Collection Checks (probe located at sampling zone in Westbay casing)								Comments (volume recovered)
		Shoe Out	Close Valve	Check Vacuum	Open Valve	Apply Vacuum	Close Valve	Locate Port	Arm Out	Land Probe	Pressure in Westbay ( )	Shoe Out	Zone Pressure ( )	Open Valve	Zone Pressure ( )	Close Valve	Shoe In	Pressure in Westbay ( )	

Additional Comments: (pH, turbidity, S.C., etc.)

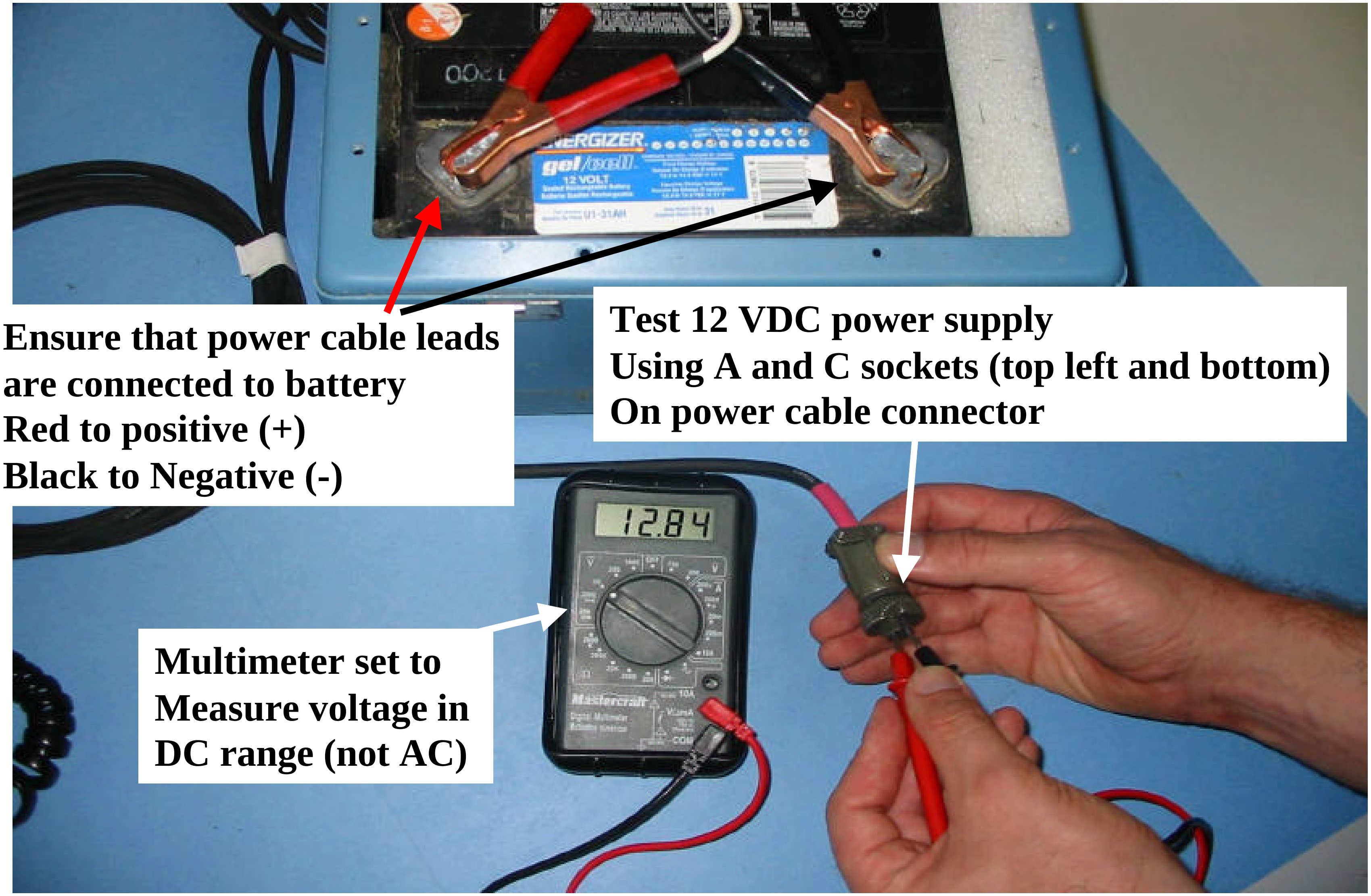
Pic.1 Computer Interface Units, old and new:
MPCI model 2522 (left) and MAGI model 2536 (right)



Pic.2 MPCI unit showing typical set-up configuration

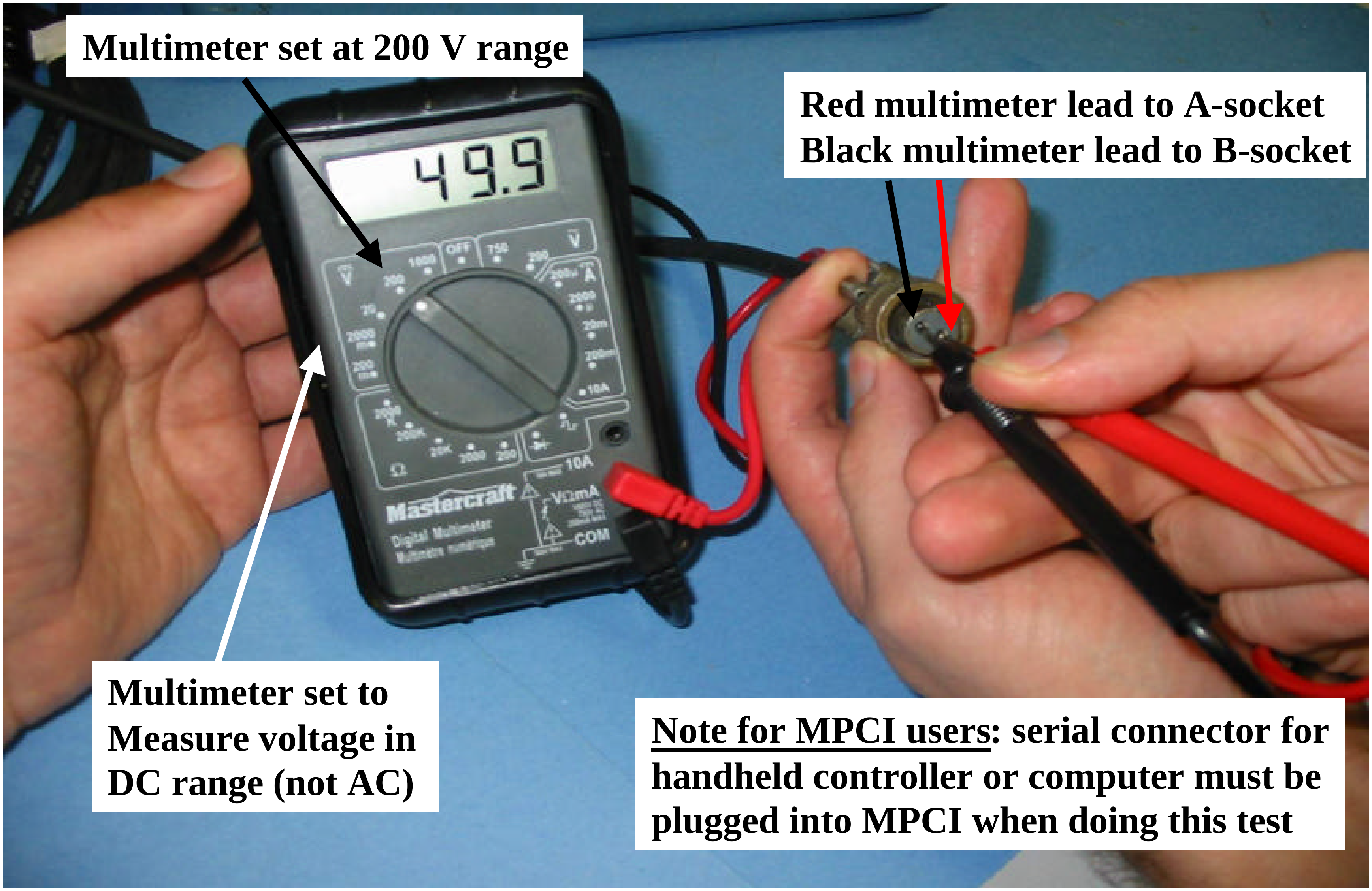


Pic.3 Testing 12 VDC Power Supply using Multimeter

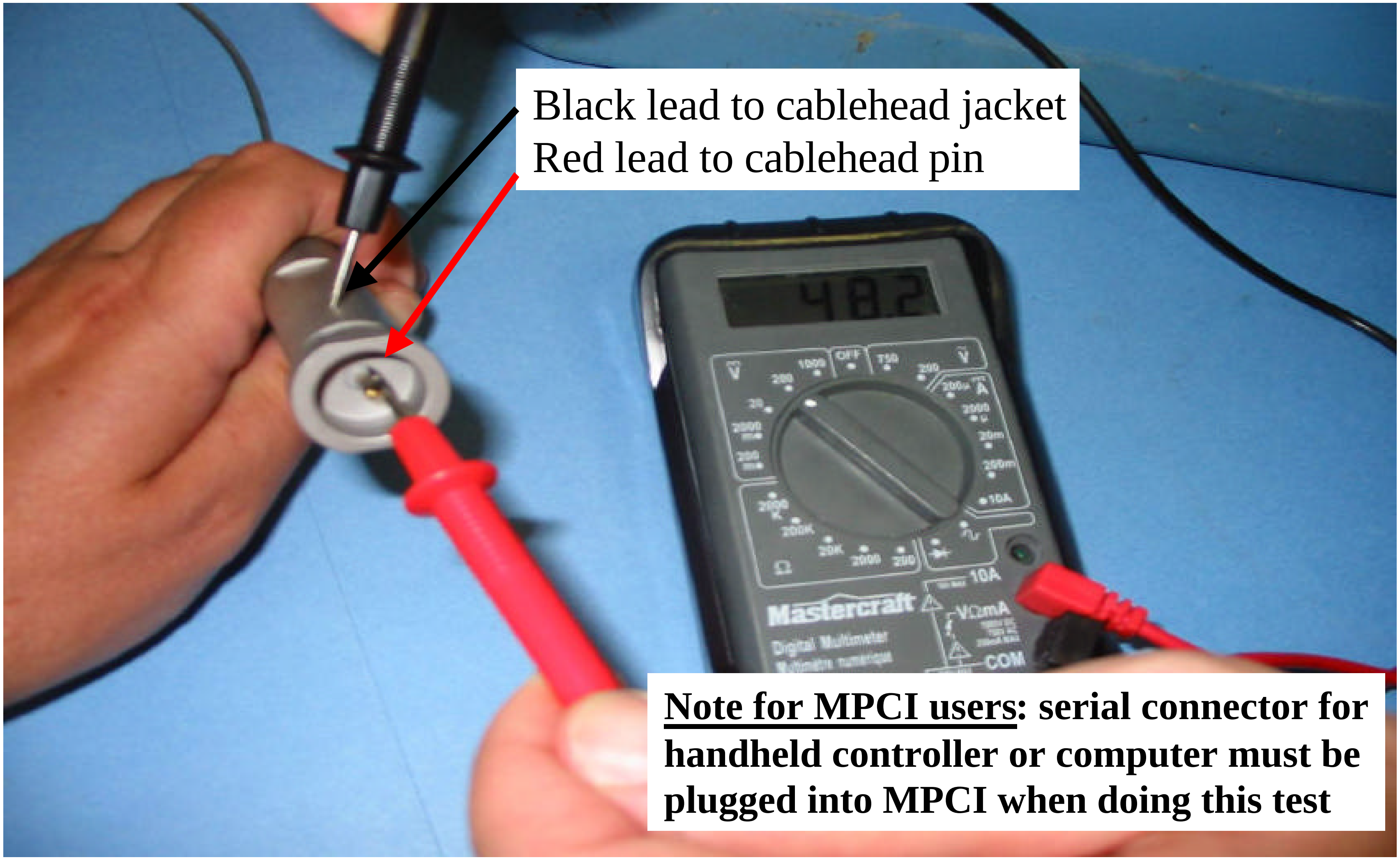


Pic.4 Testing Power Cable Voltage

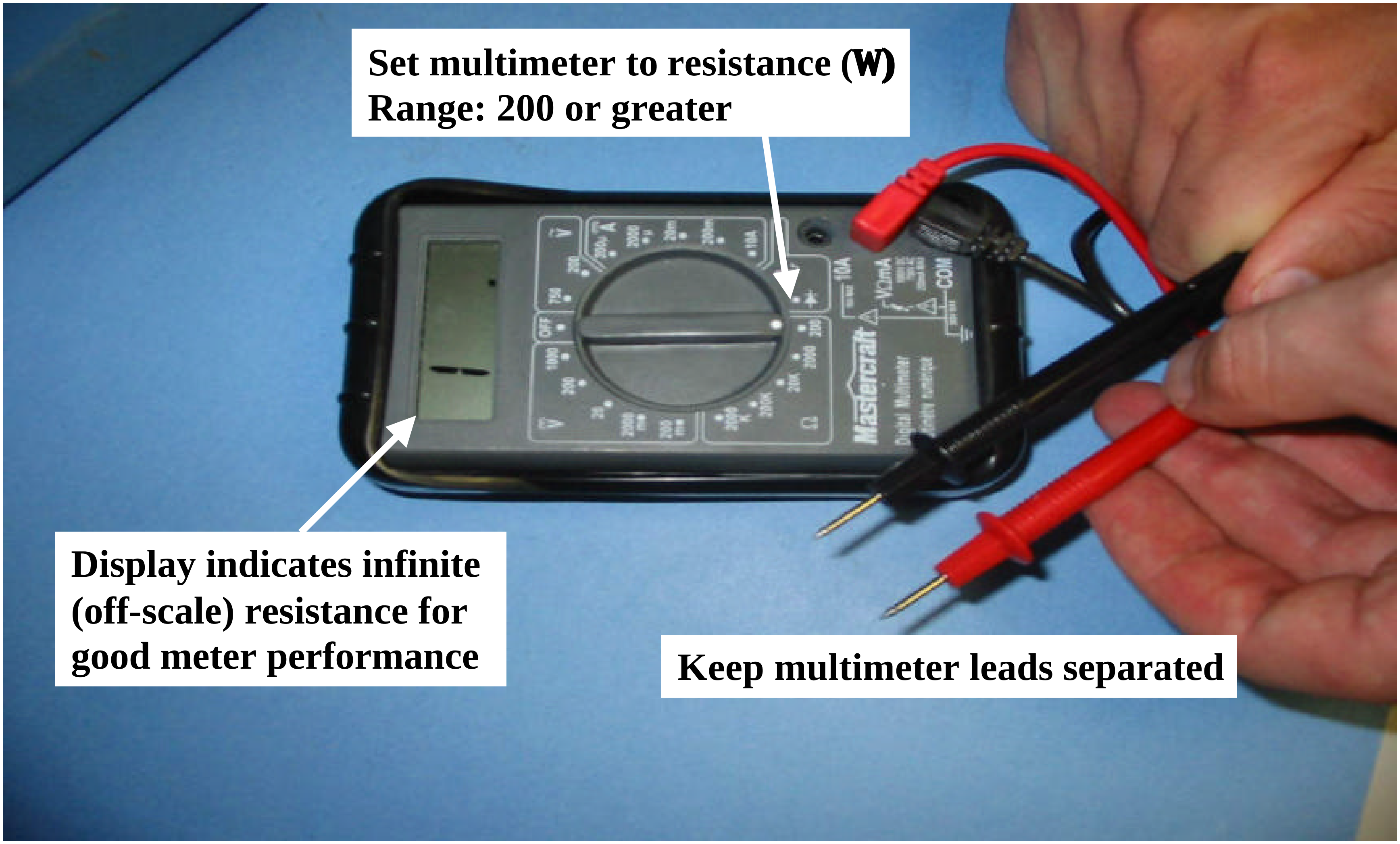
(should indicate greater than 12.00 V DC for good battery and cable)



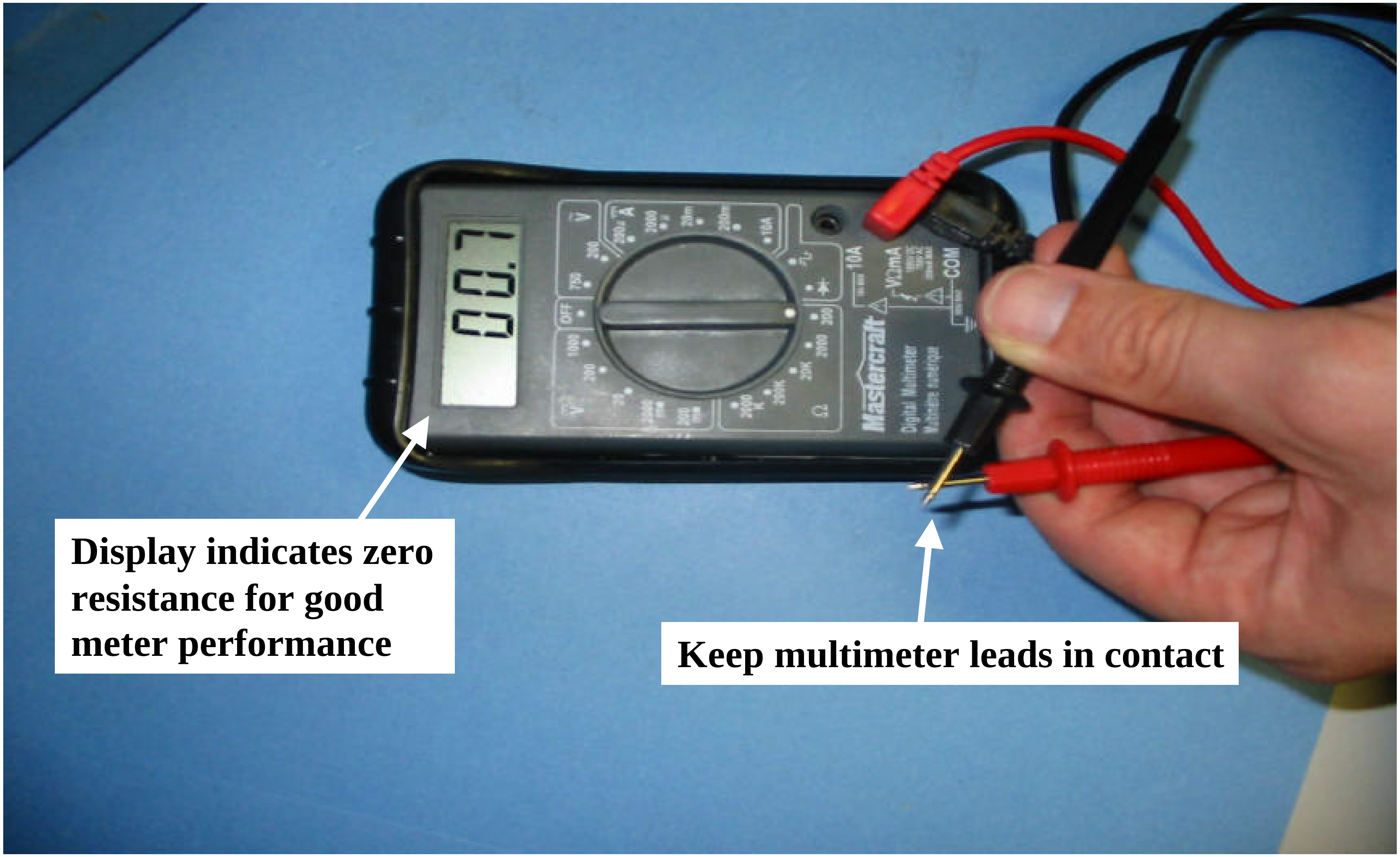
Pic.5 **Testing Power output from MPCI or MAGI using data cable (should be greater than 48 V)** ***Note: MPCI/MAGI must have power 'on' and be connected to power supply.***



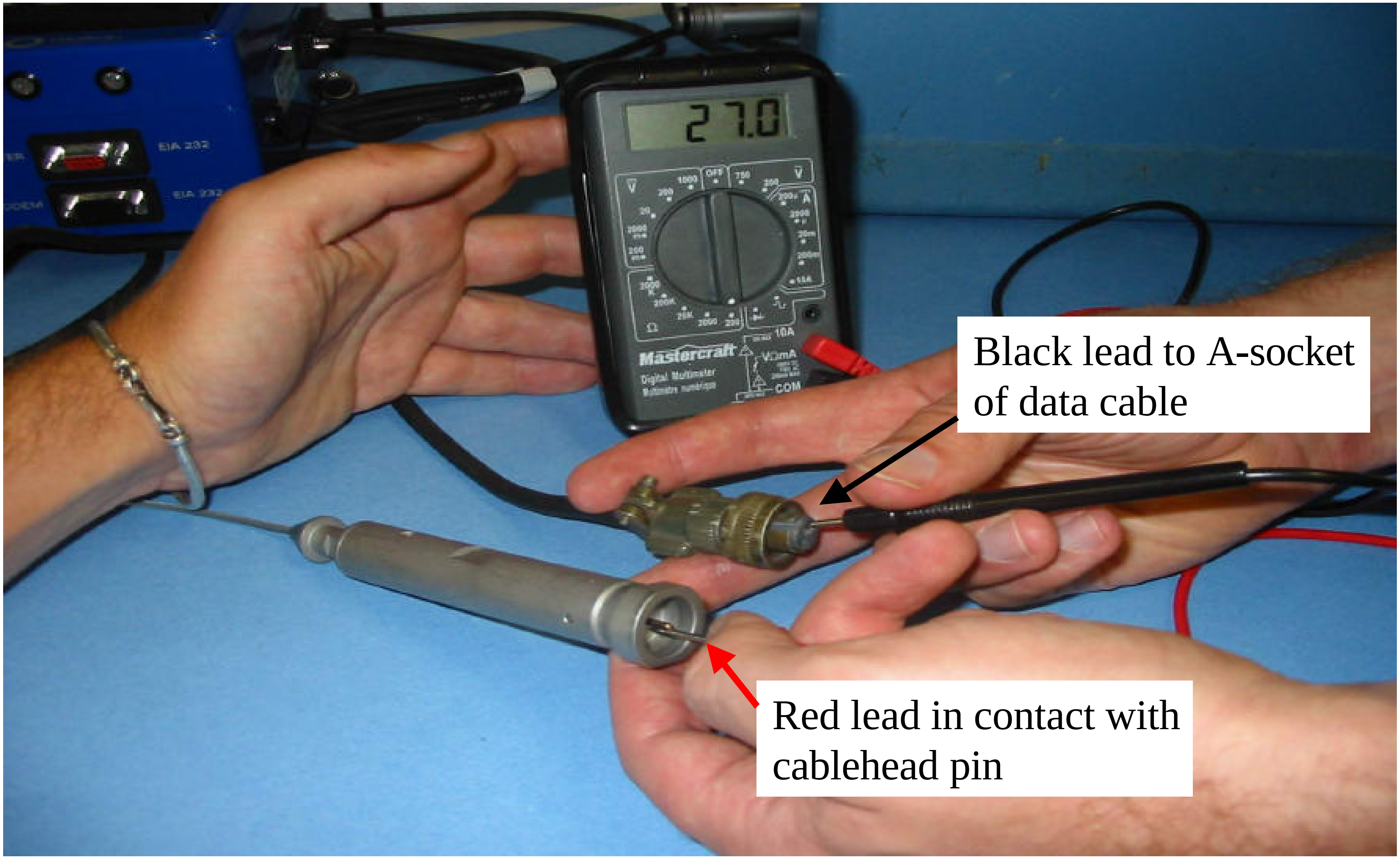
Pic.6 Checking power output at cablehead (should be greater than 48 V)
Note: MPCI/MAGI must have power 'on' and be connected to power supply.



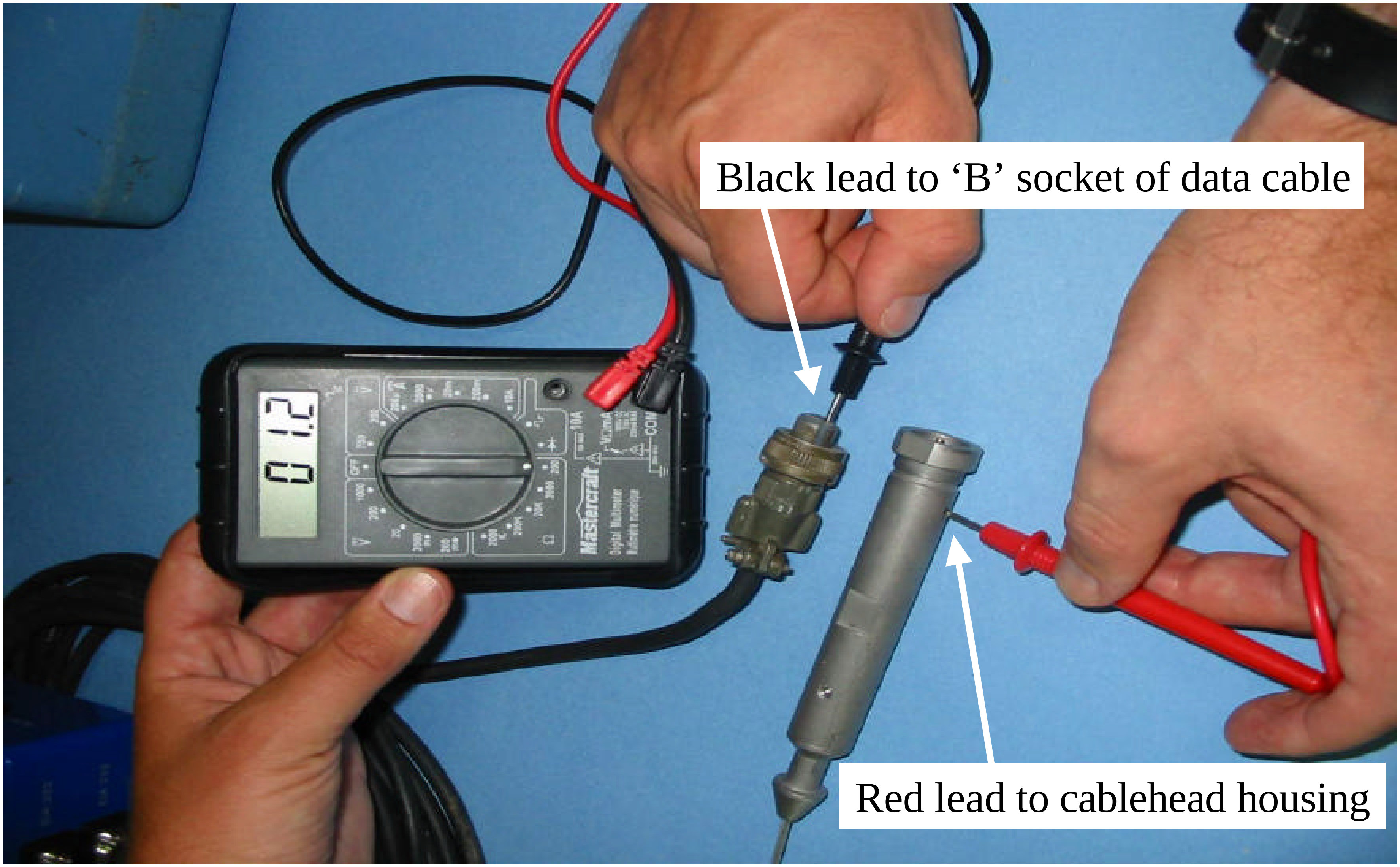
Pic.7 Test multimeter "open" resistence



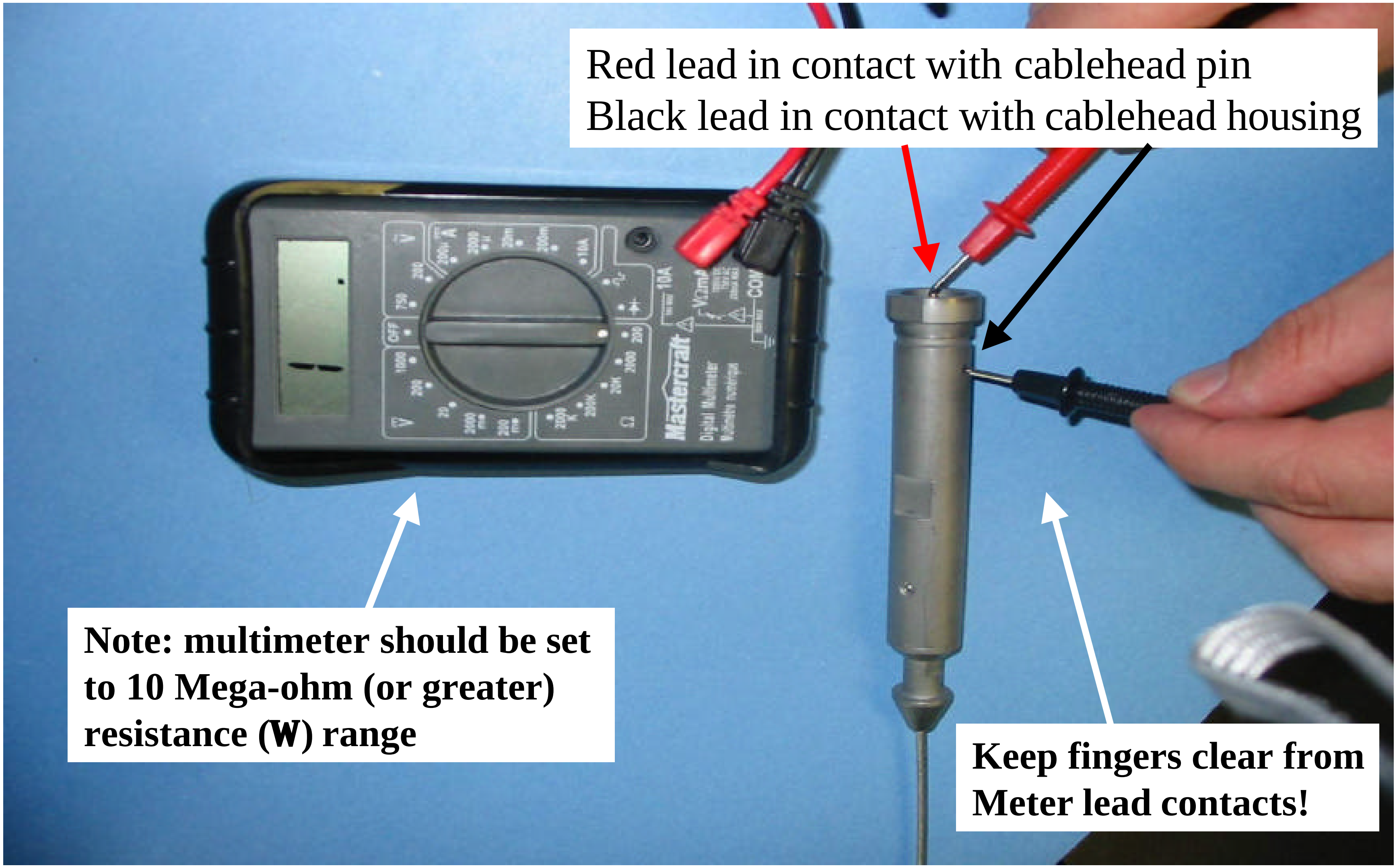
Pic.8 Test multimeter "closed" resistence



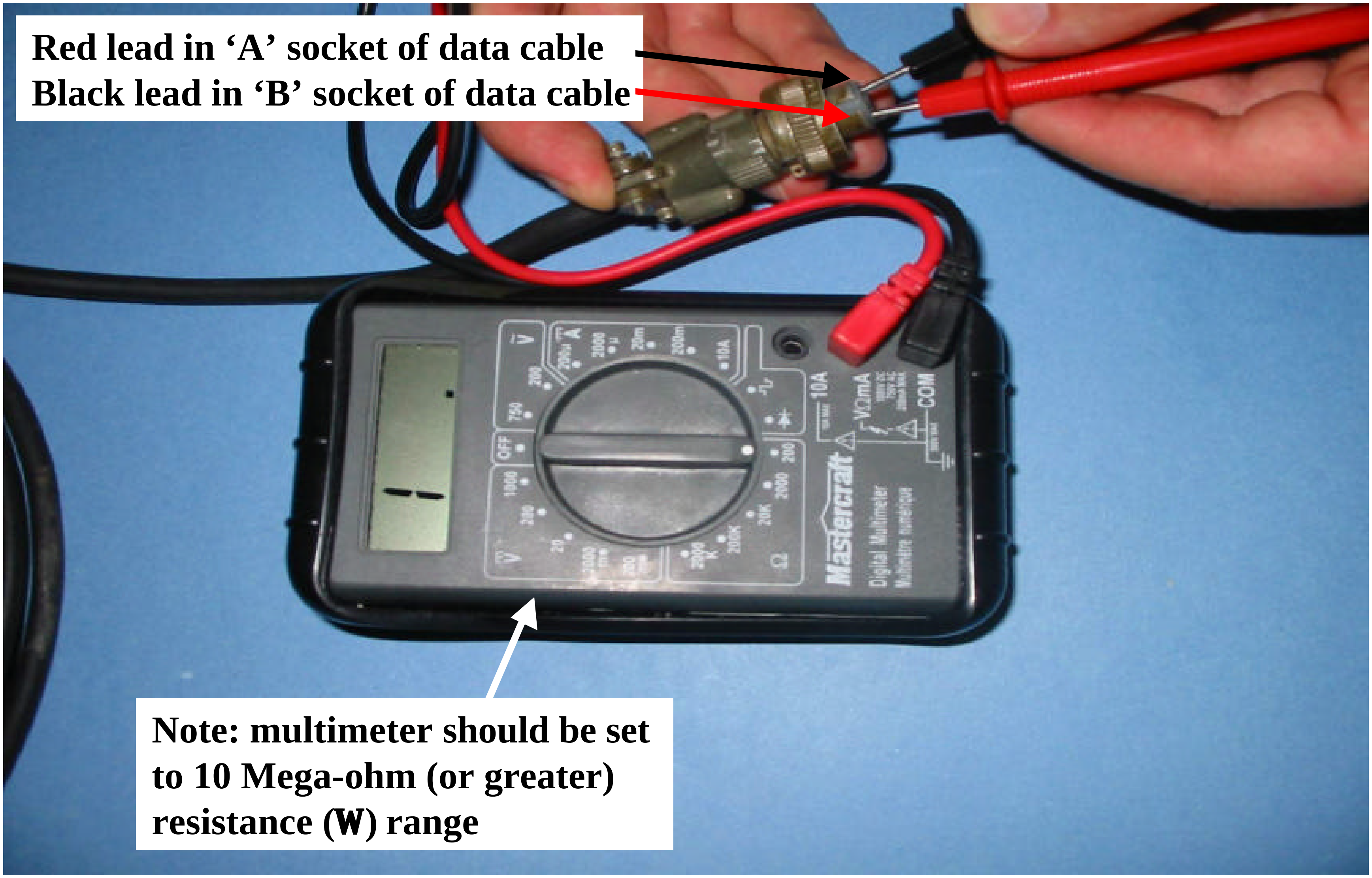
Pic.9 Test wireline ‘A-A’ resistance (approx. 27 W/1000 ft)



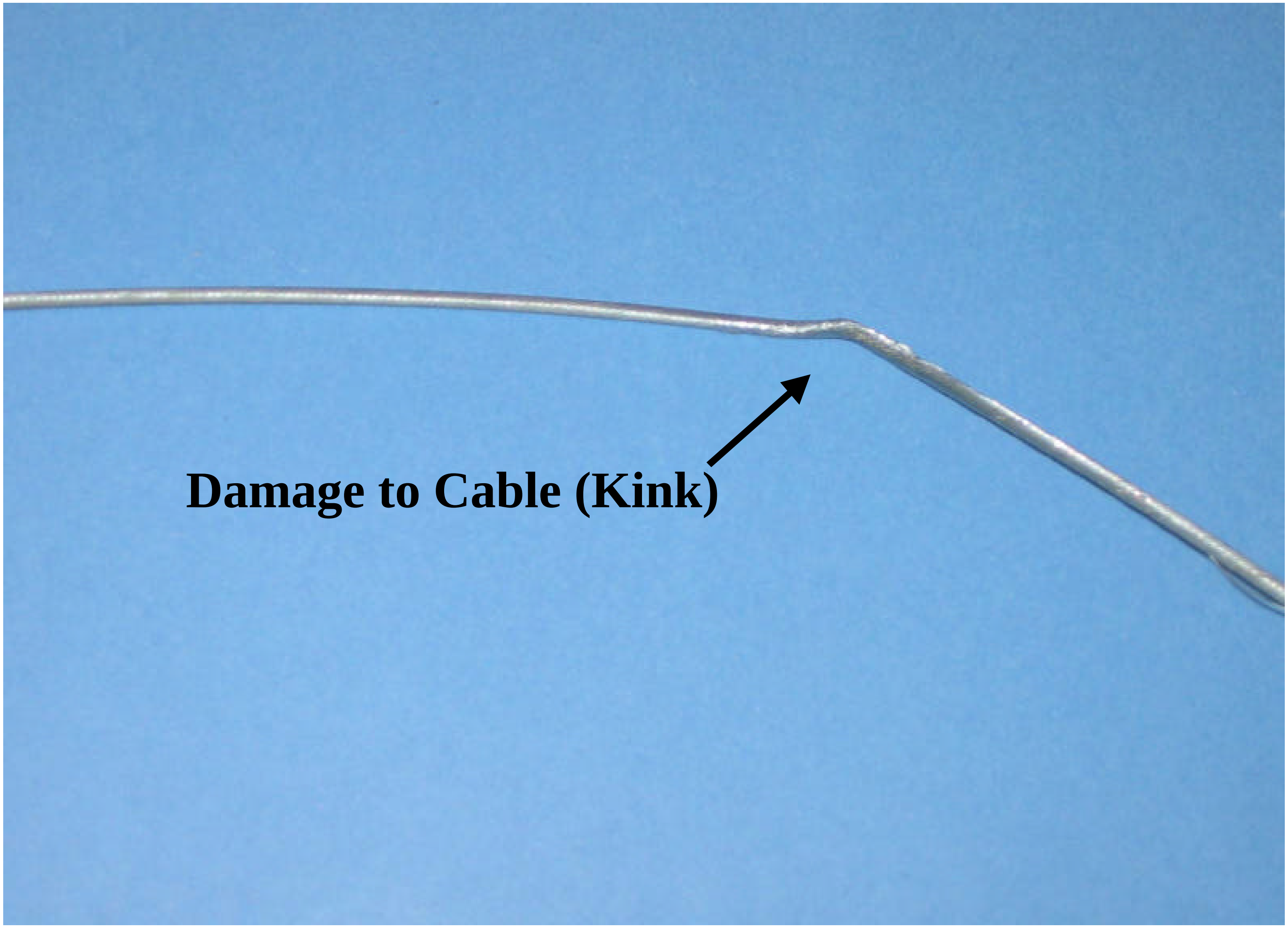
Pic.10 Test wireline 'B-B' resistance (should be less than 'A-A')



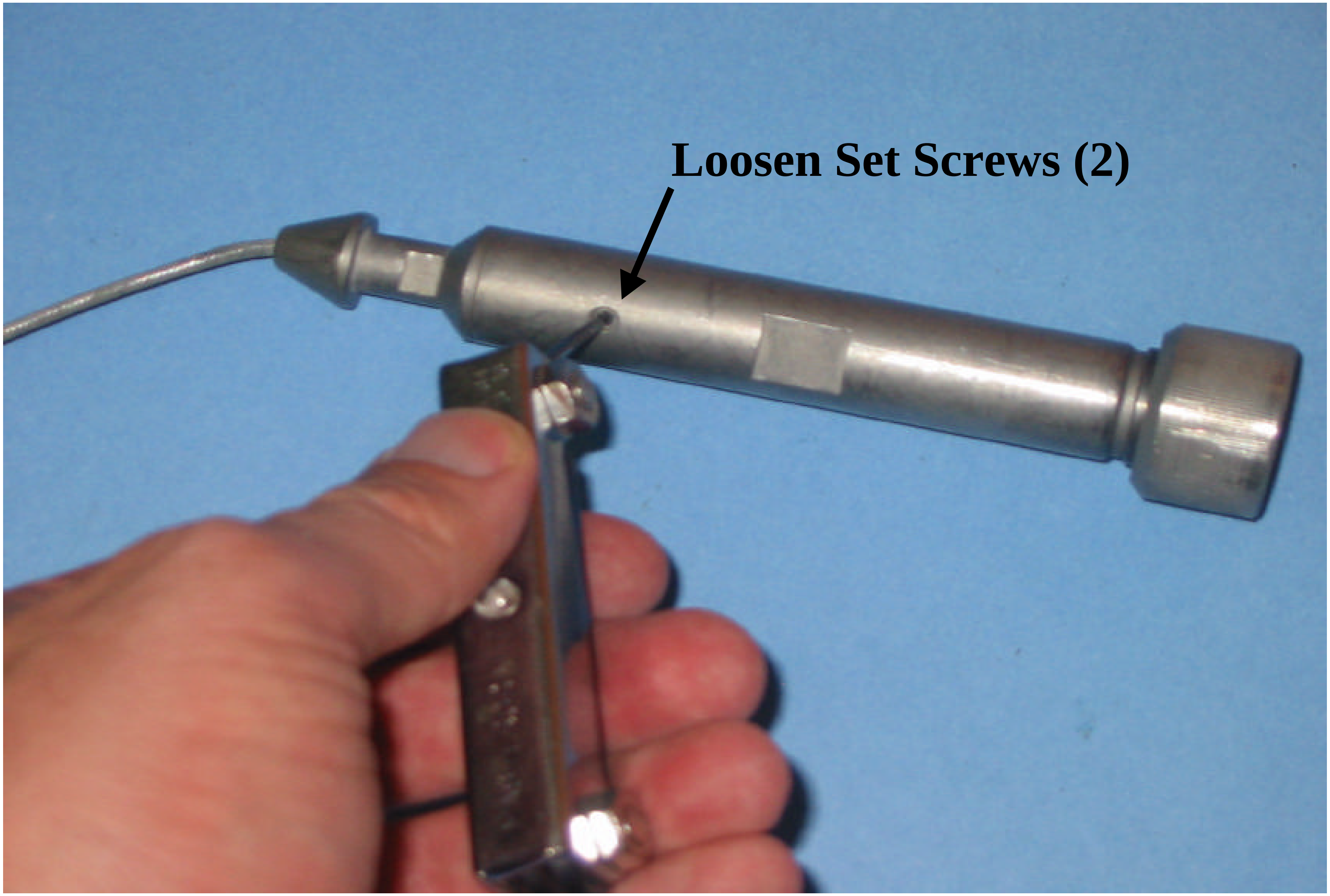
Pic.11 Test wireline 'A-B' resistance at cablehead (should be off-scale)



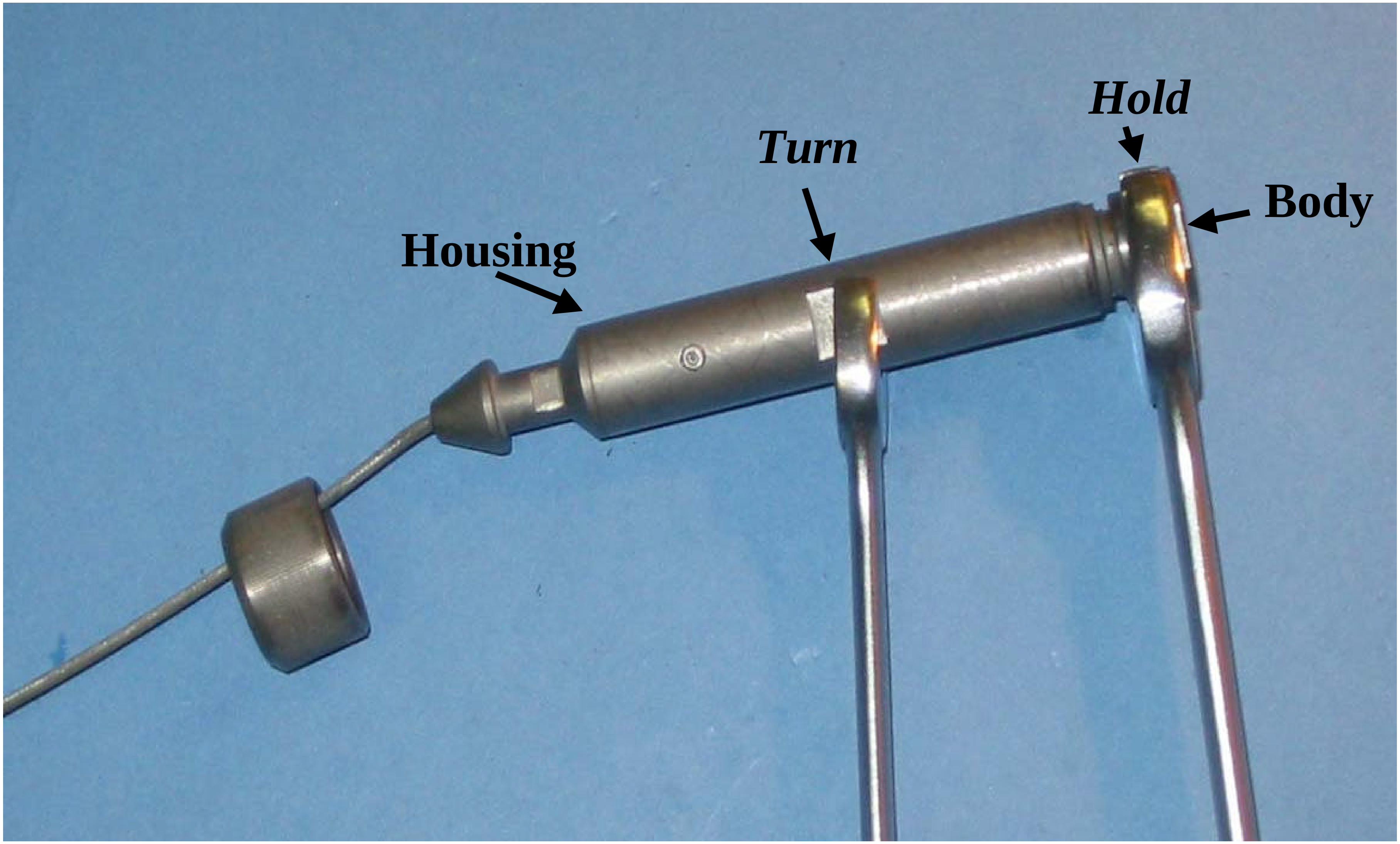
Pic.11 Test wireline ‘A-B’ resistance at data cable (should be off-scale)



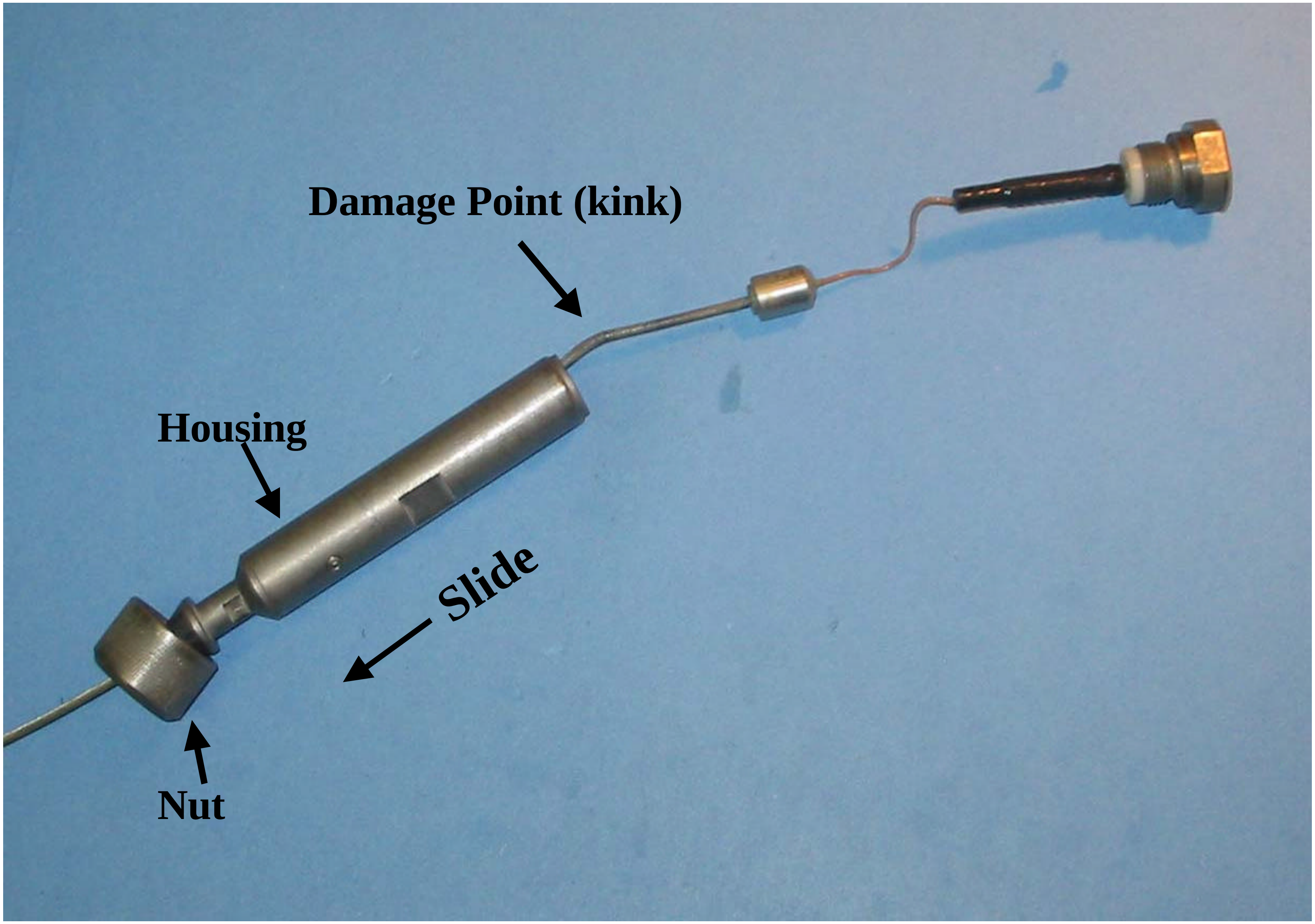
Pic.1 Identification of Cable Damage



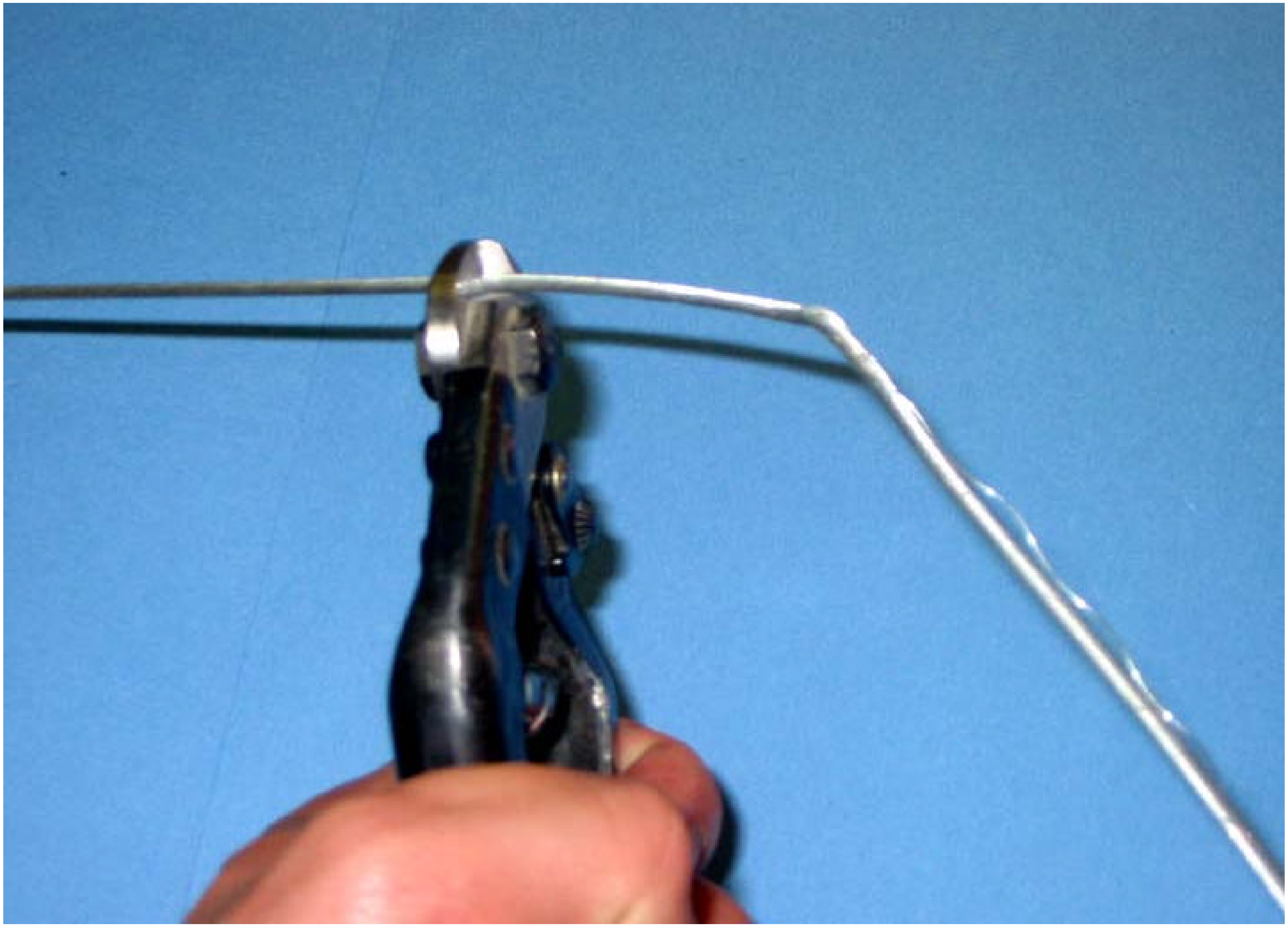
Pic.2 Cablehead Disassembly (1): Loosen set Screws



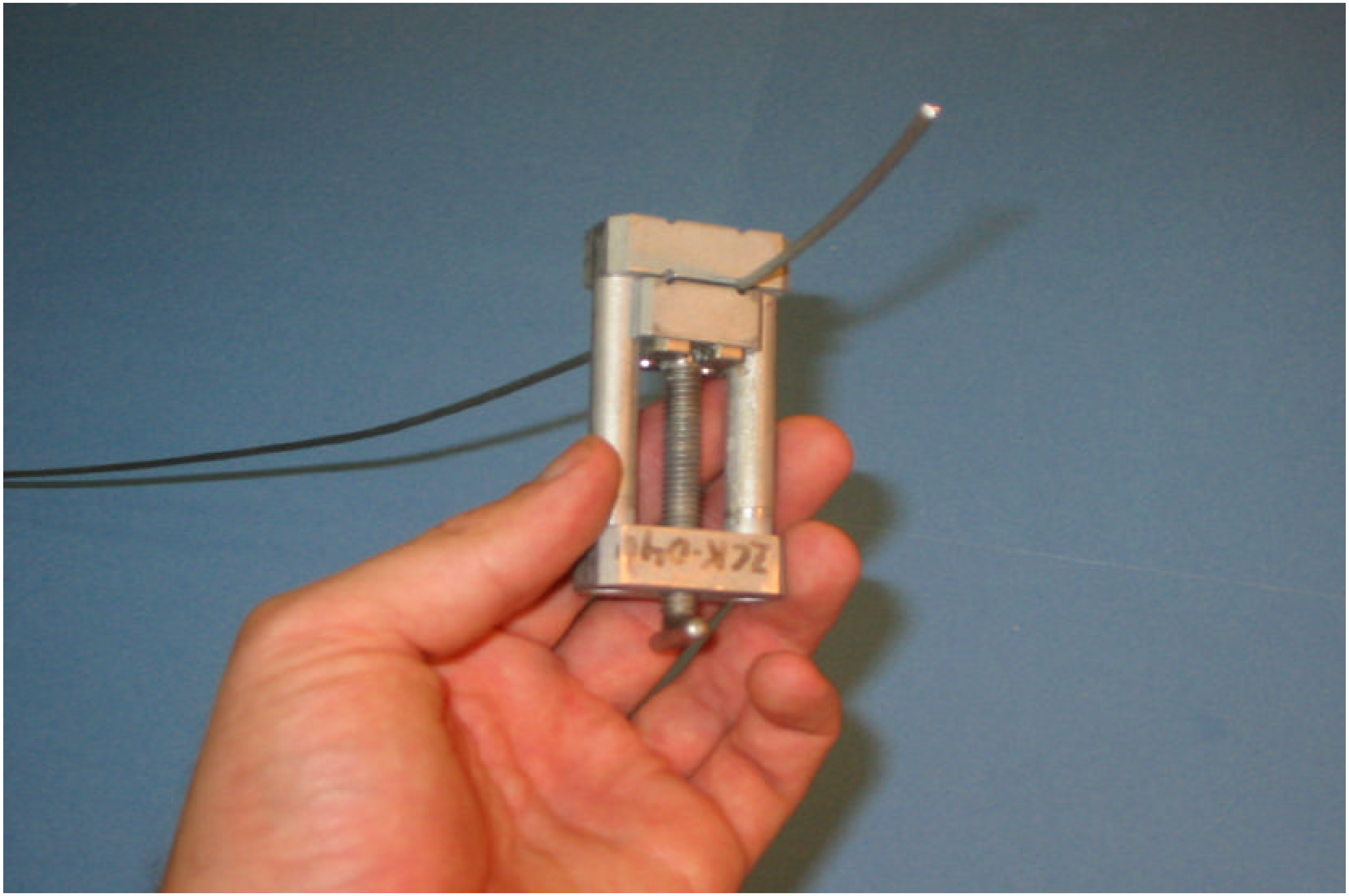
Pic.3 Cablehead Disassembly(2): Unscrew Housing From Body



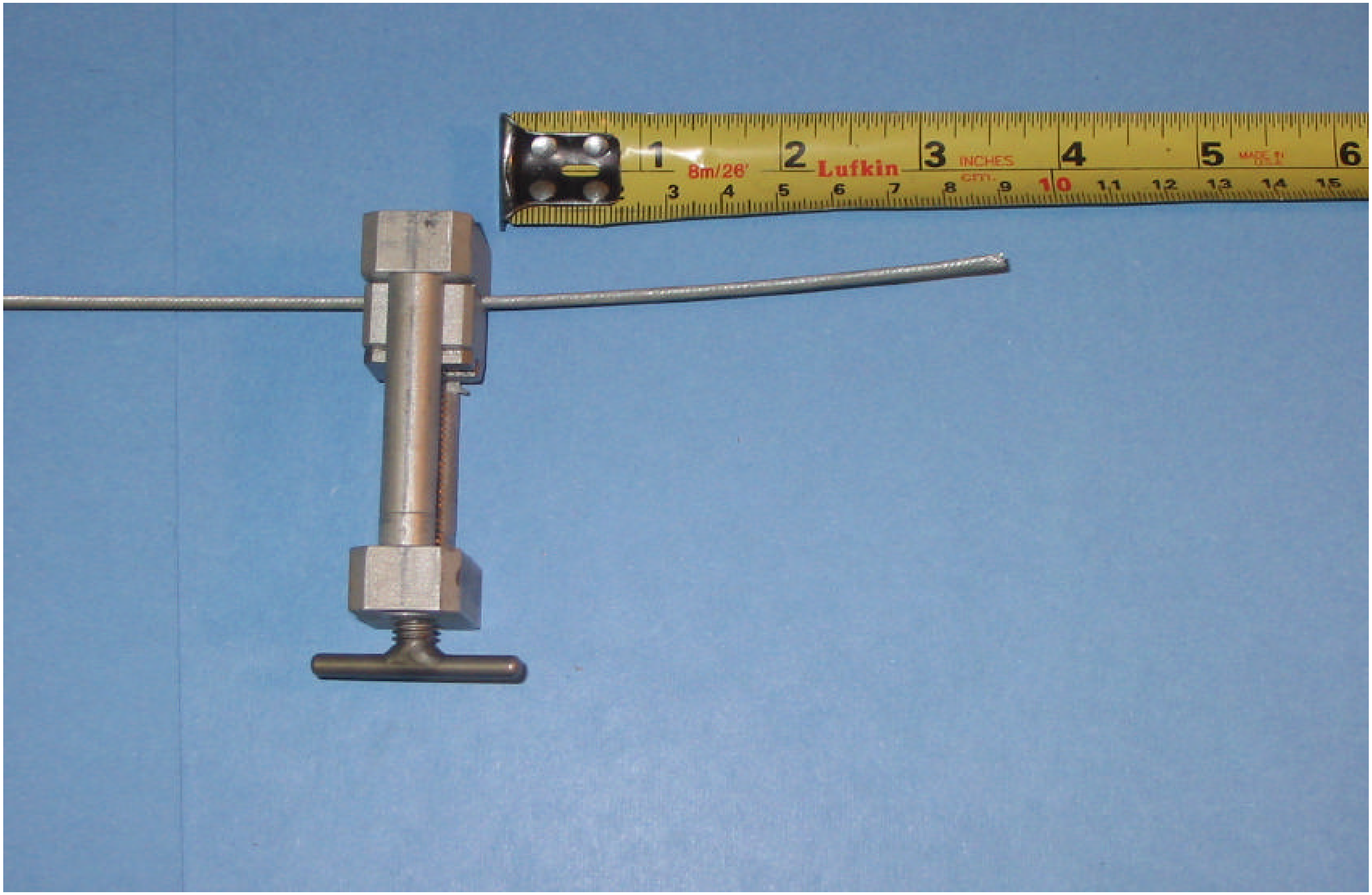
Pic.4 Cablehead Disassembly(3):
Slide Housing and Cablehead Nut Past Damage Point



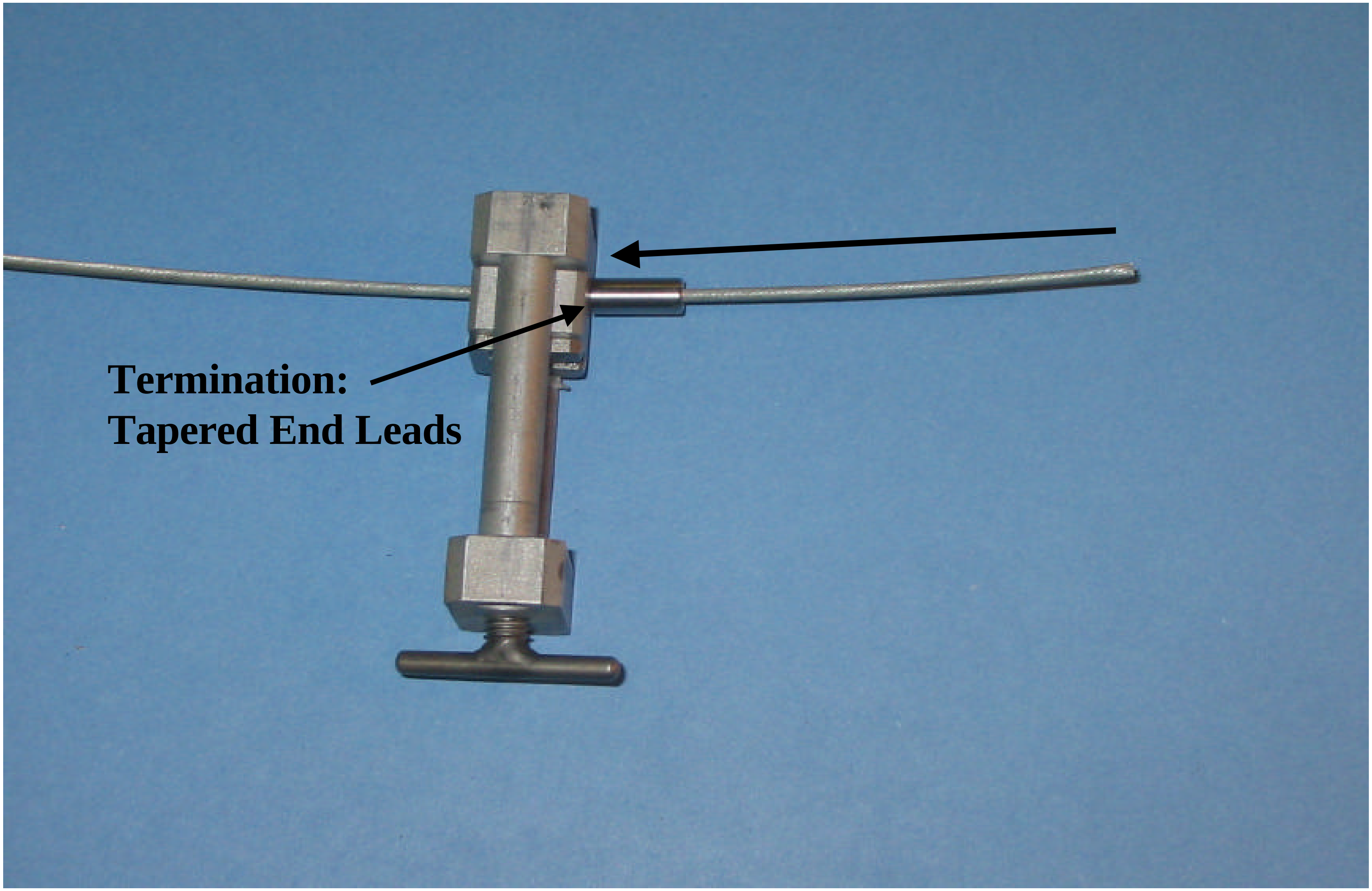
Pic.5 Cut Cable above Damage Point



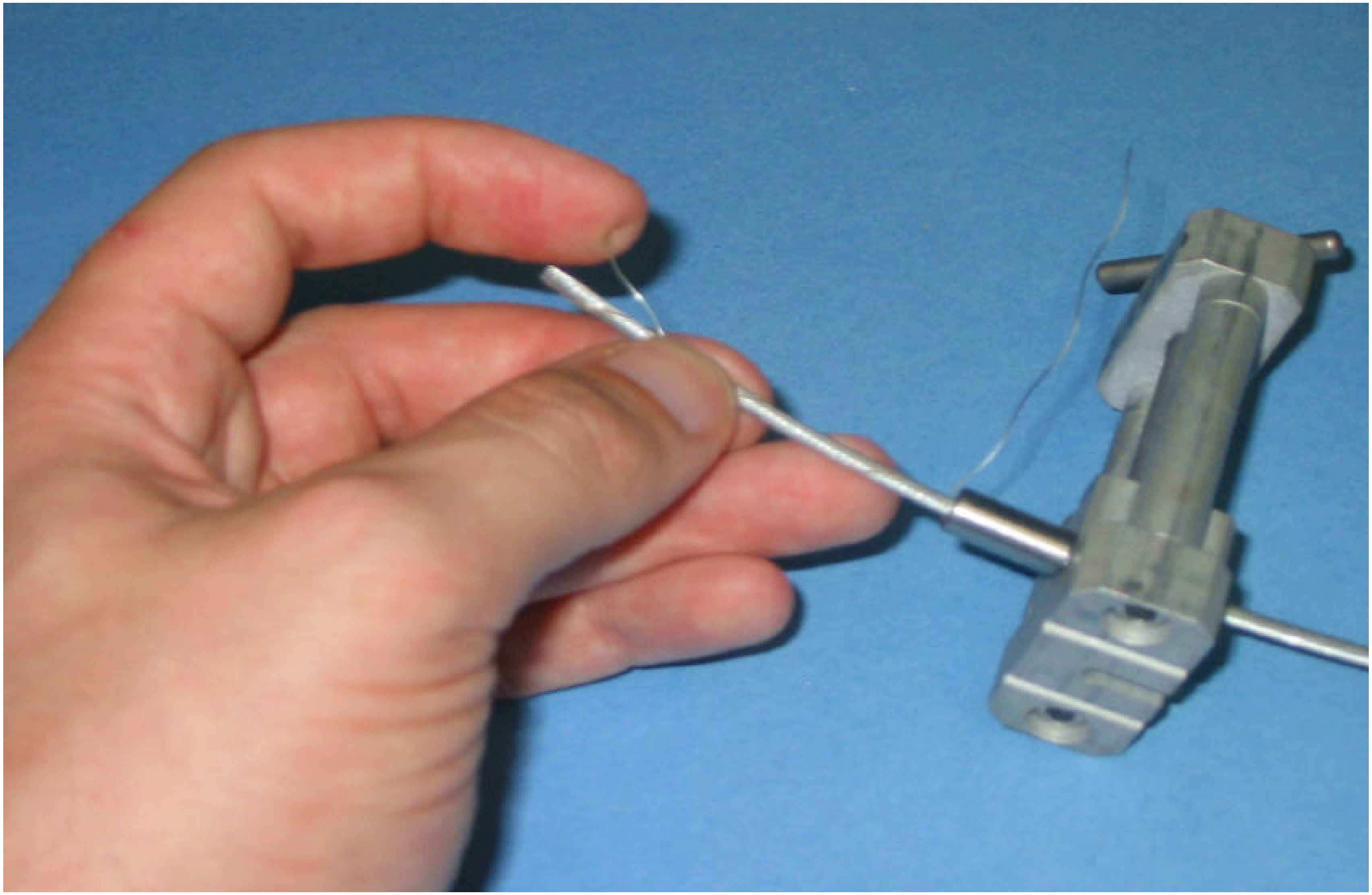
Pic.6a Clamp Cable in Termination Jig



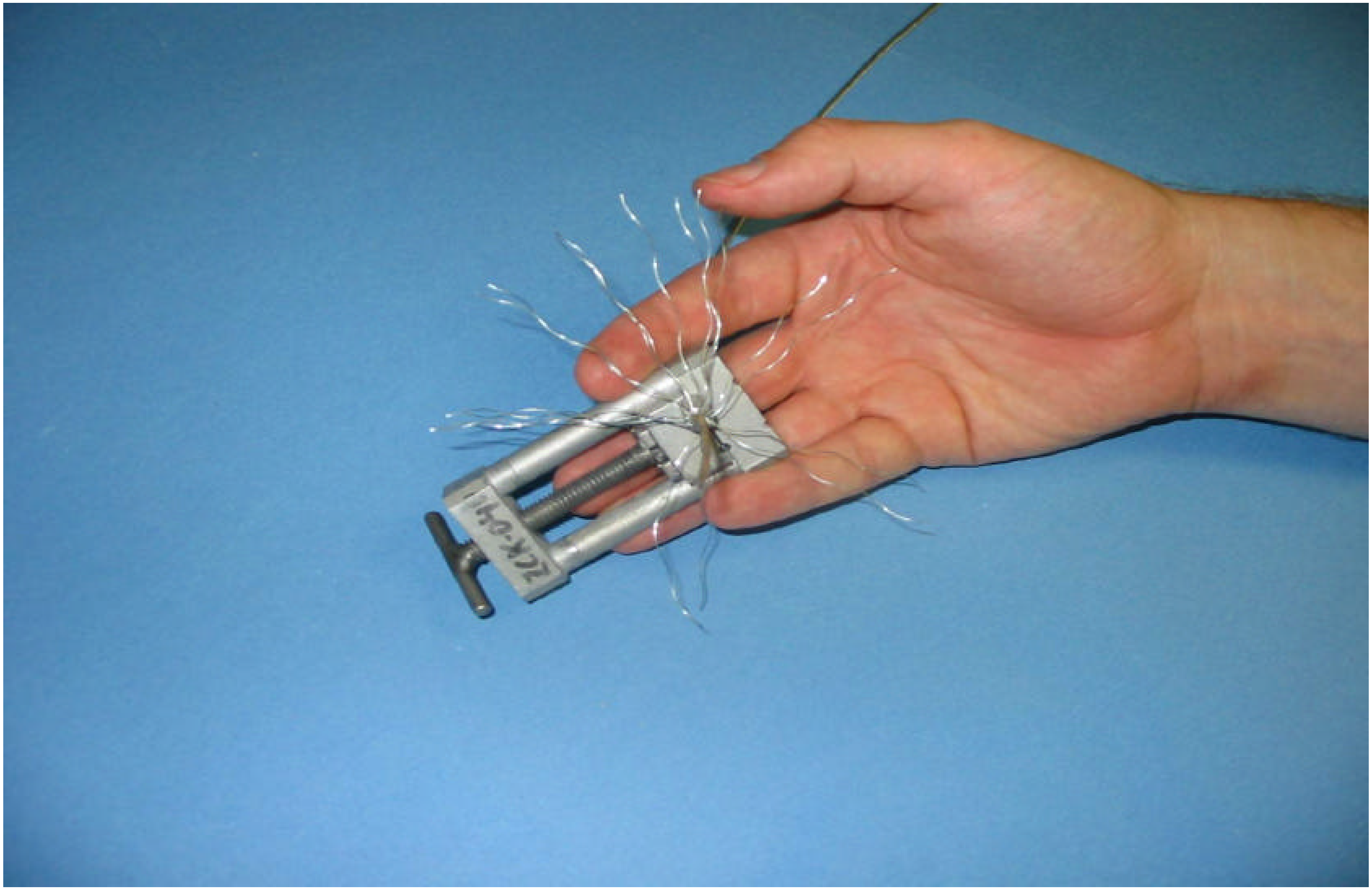
Pic.6b Leave 3.5 inches Cable Exposed



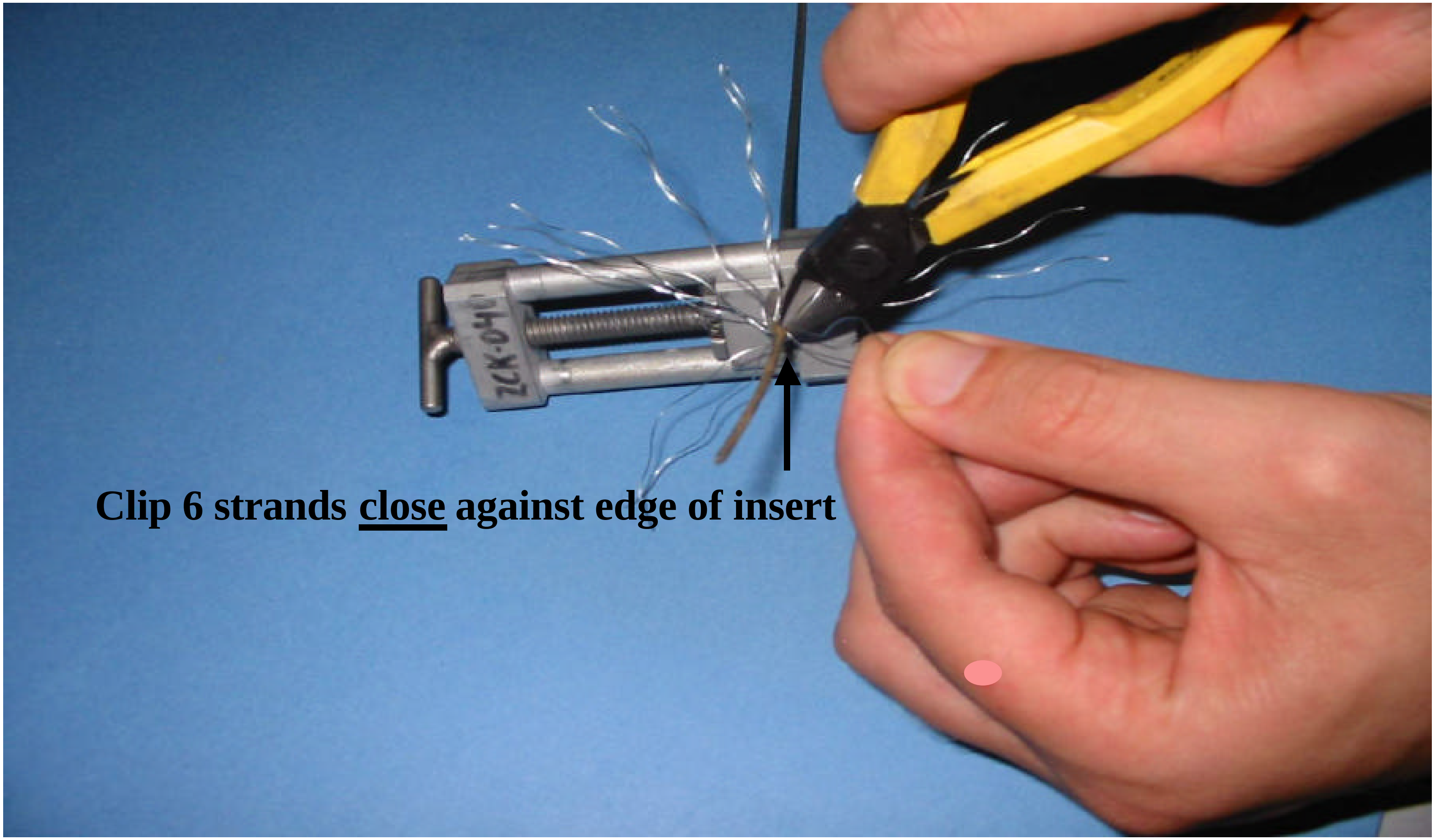
Pic.6c Slide Termination Insert Over Cable



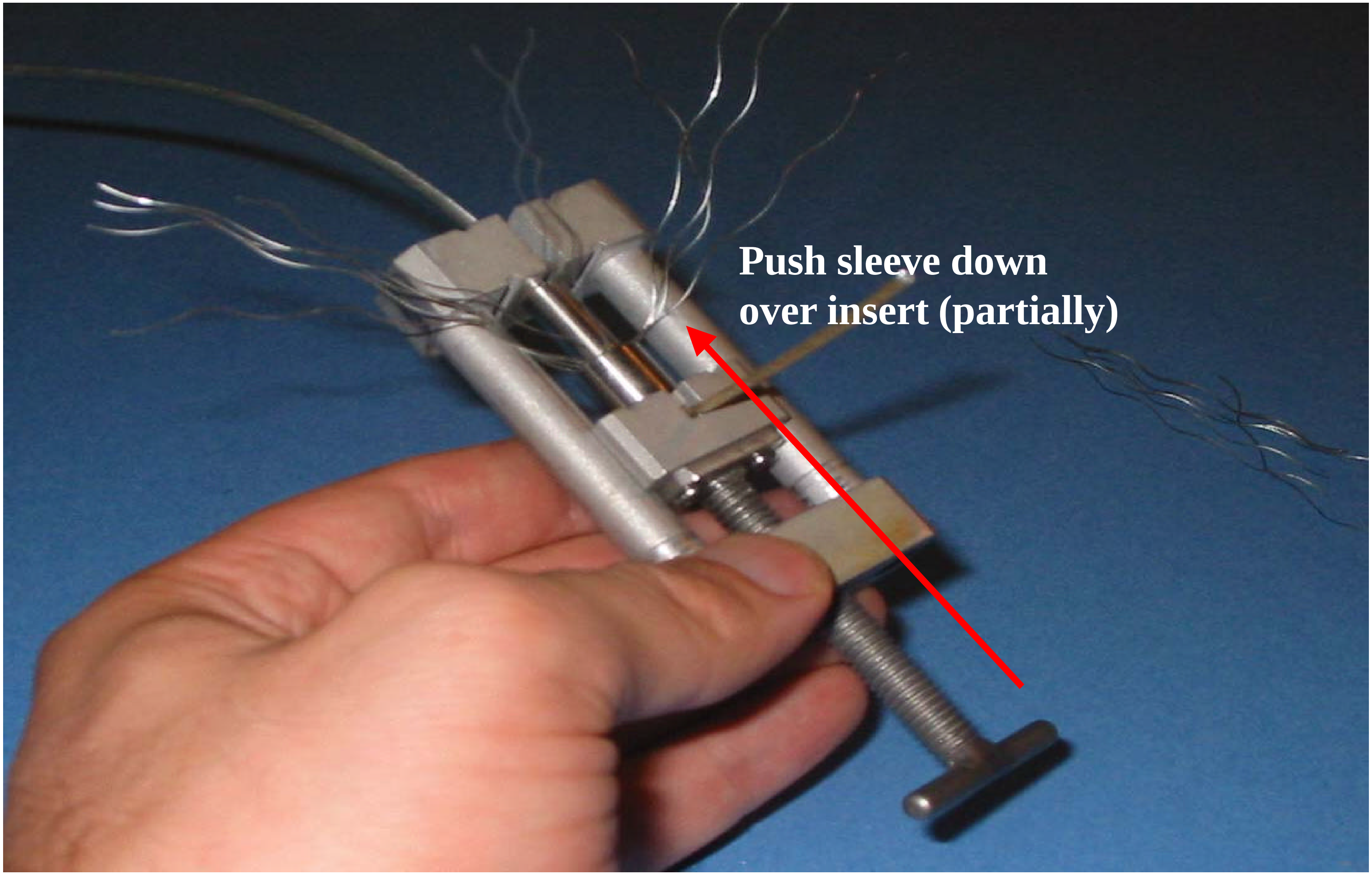
Pic.7a Unwind Outer-layer Strands (start)



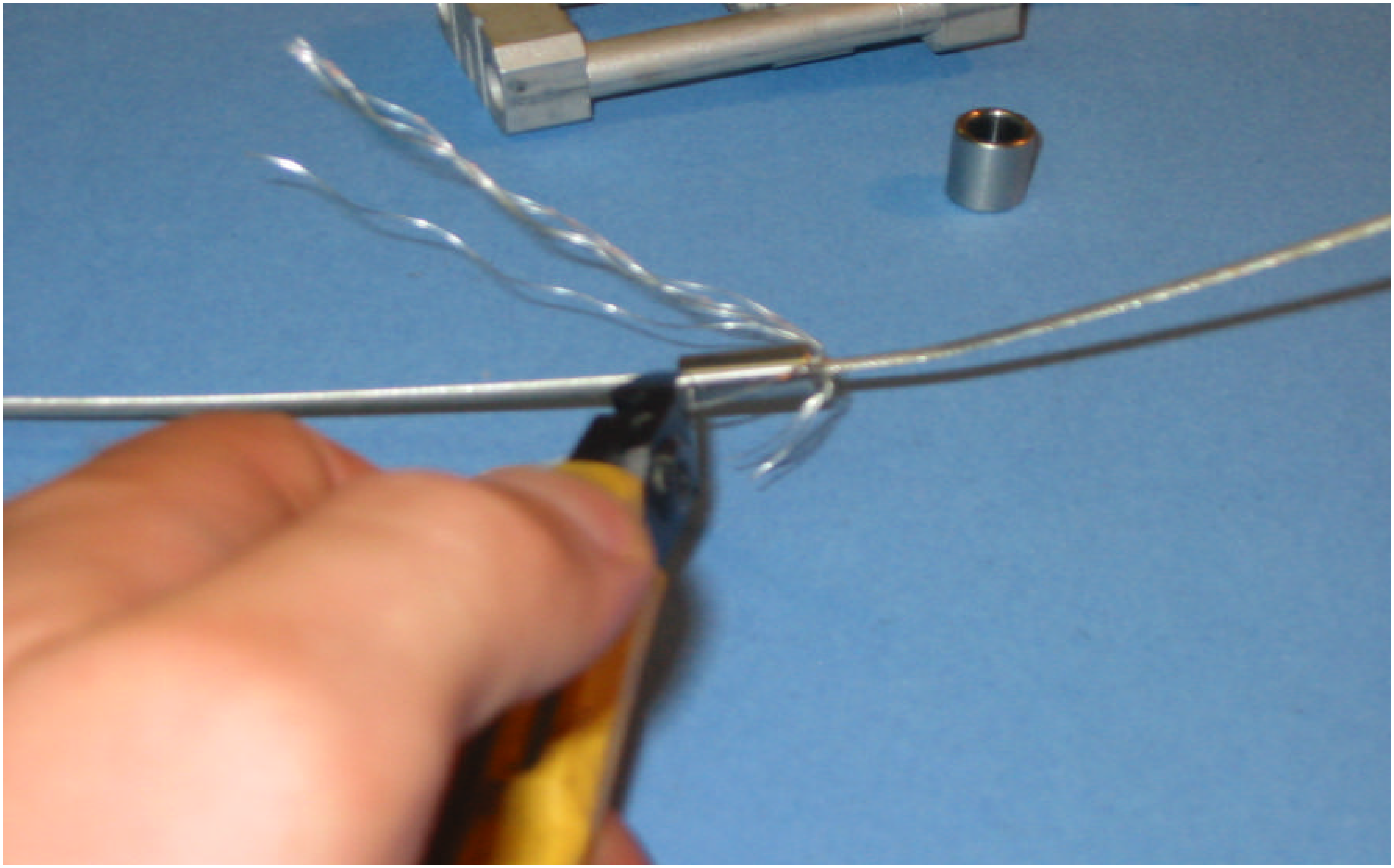
Pic.7b Unwind Outer Layer Strands (finish)



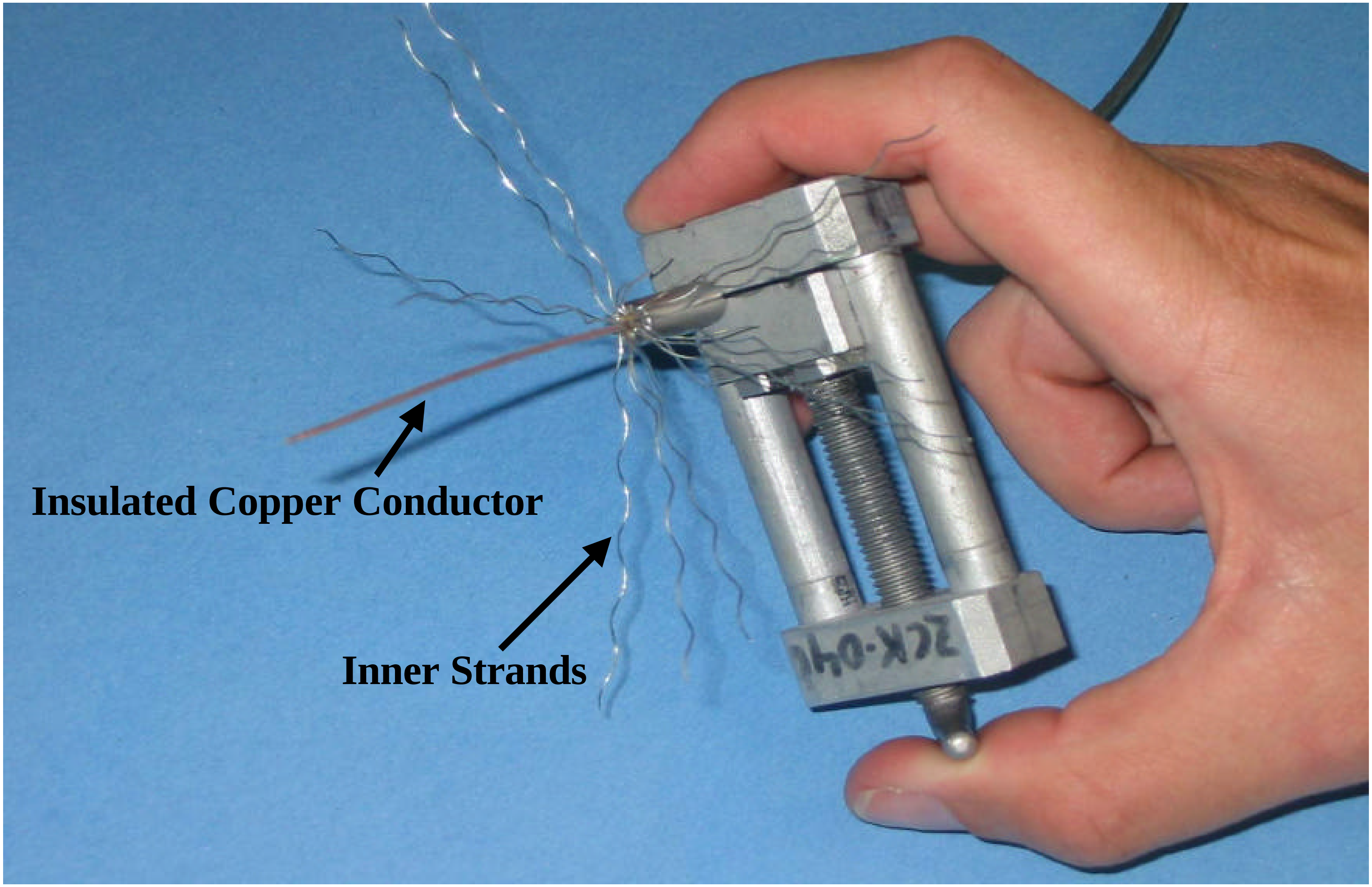
Pic.8 Clipping Outer Wire Strands (6 strands out of 18)



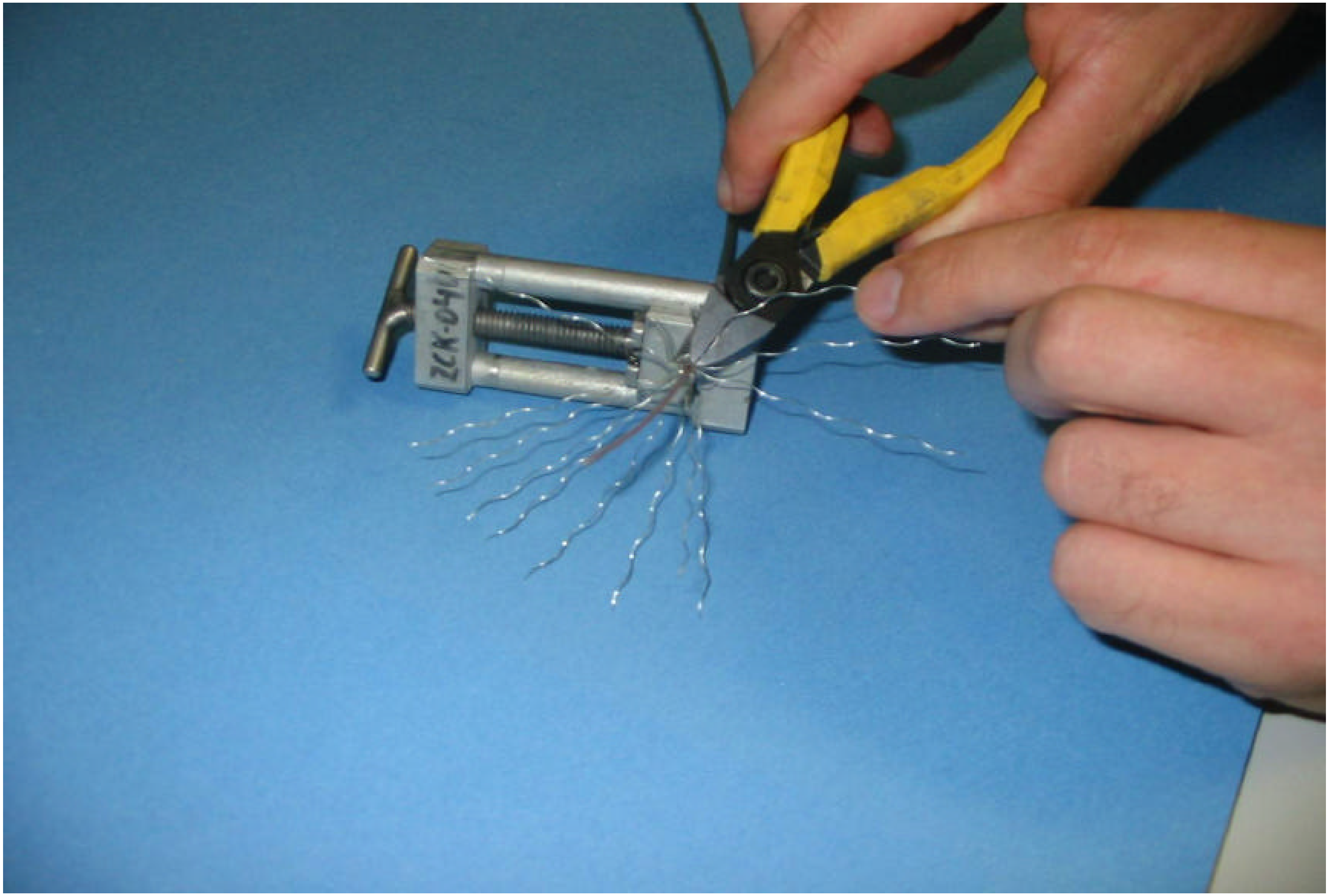
Pic.9 Partially Push Sleeve Down on Insert Using Jig
(enough to bend strands down along insert)



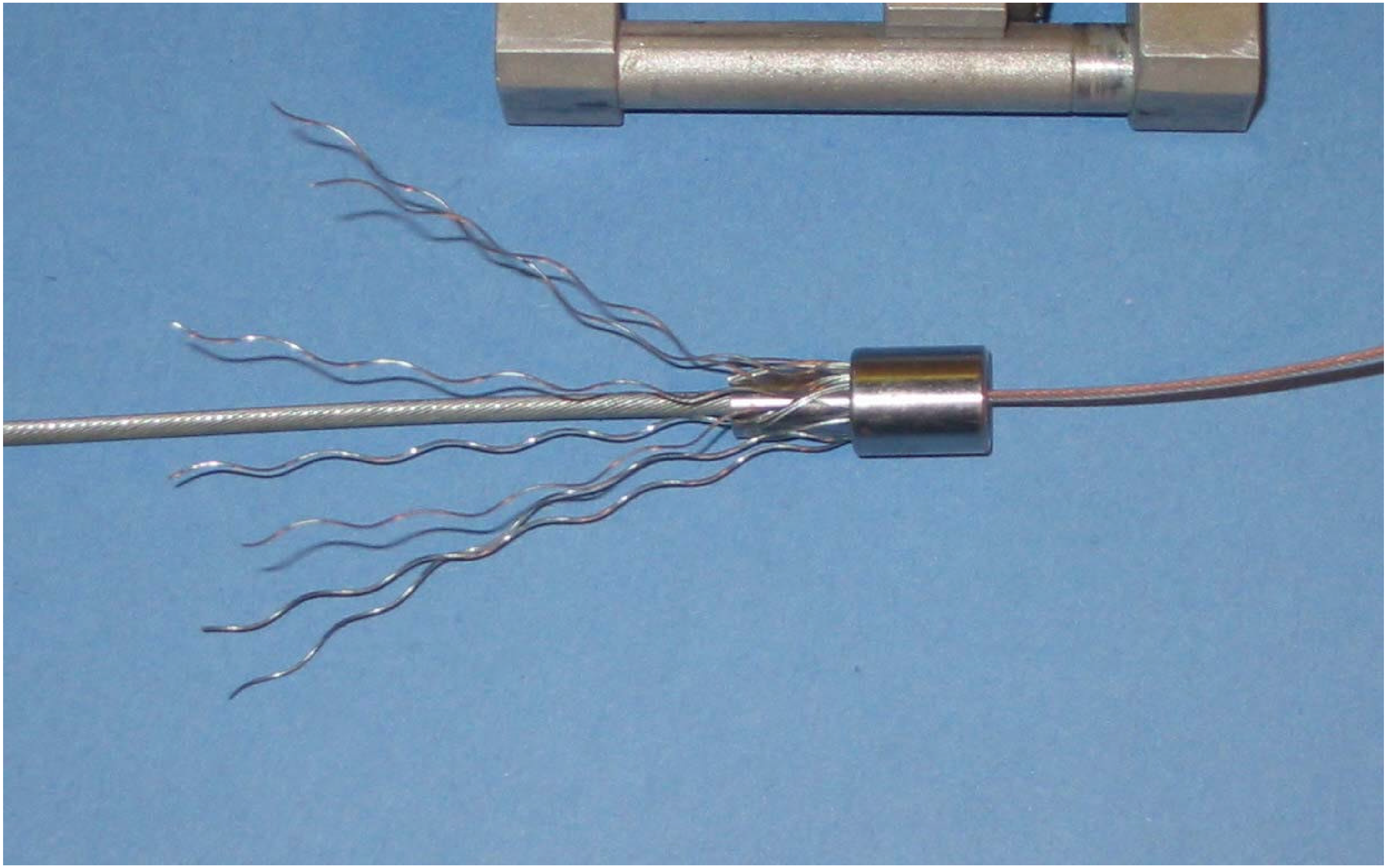
Pic.10 Trim Outer Wire Strands to Base of Insert.



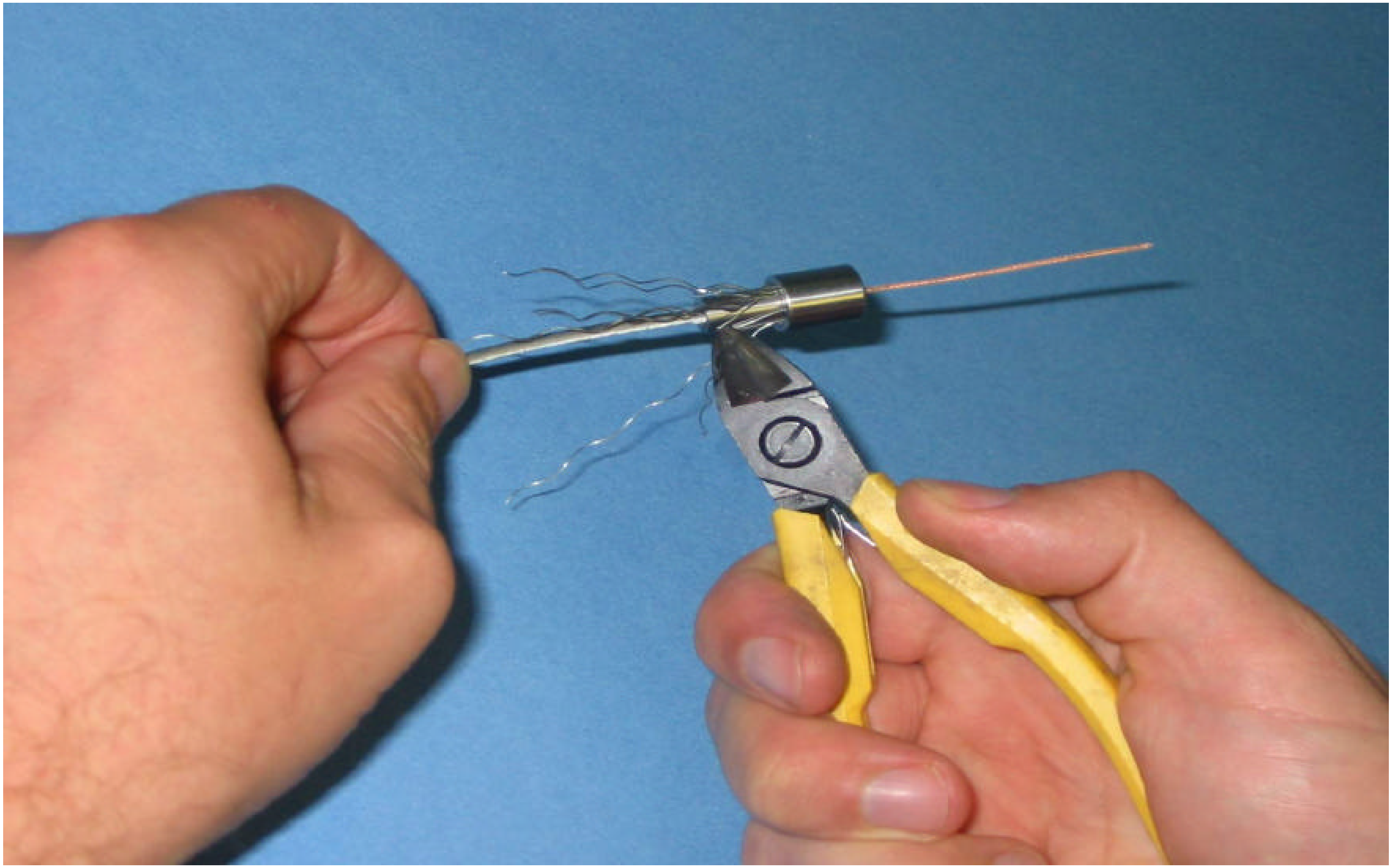
Pic.11 Unwind inner-layer strands of armor (exposing the insulated conductor wire)



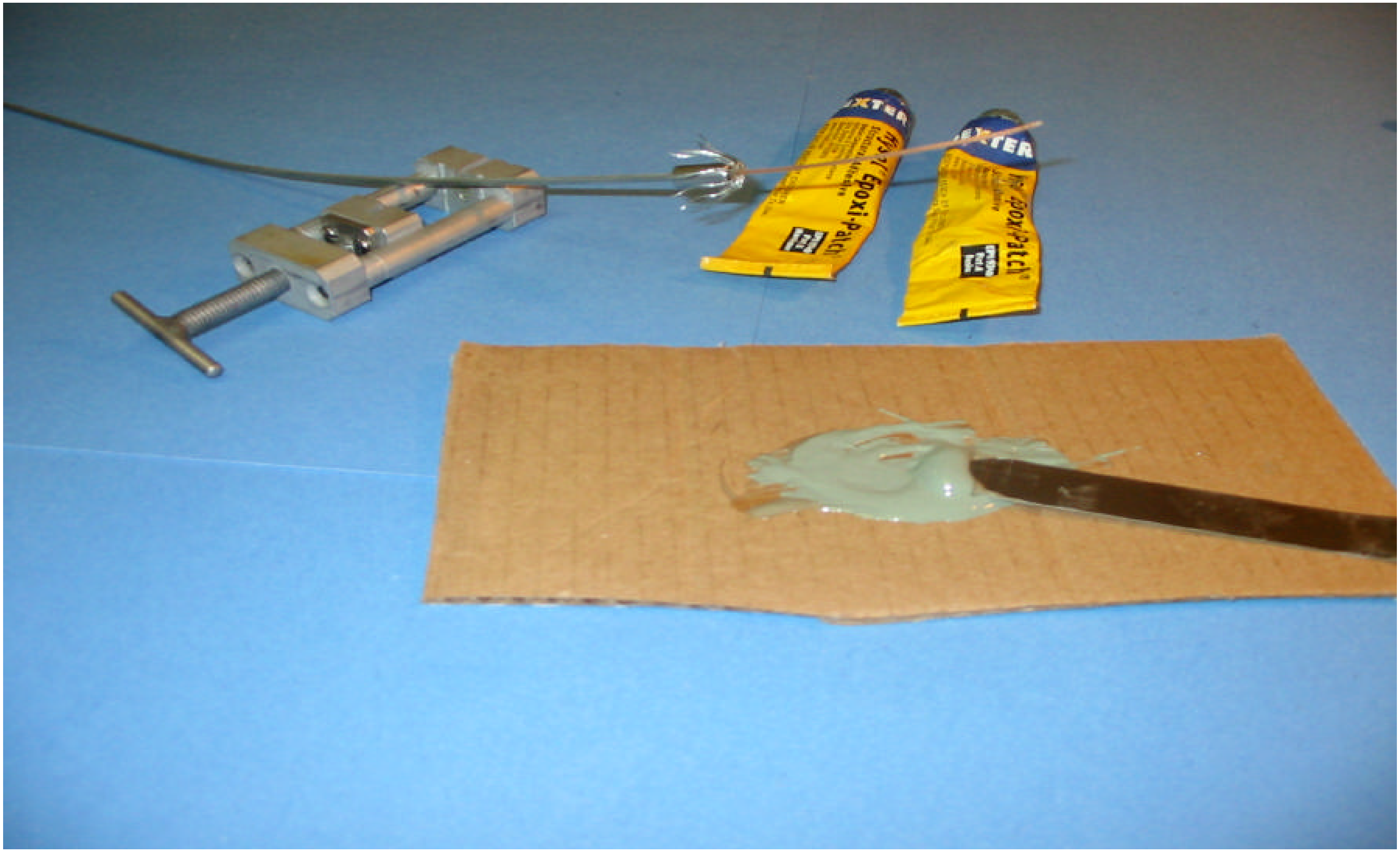
Pic.12 Clip 5 of the 12 inner armor strands close to the top of the insert



Pic.13 Bend down Remaining Inner Wire Strands
(Use jig and termination sleeve)

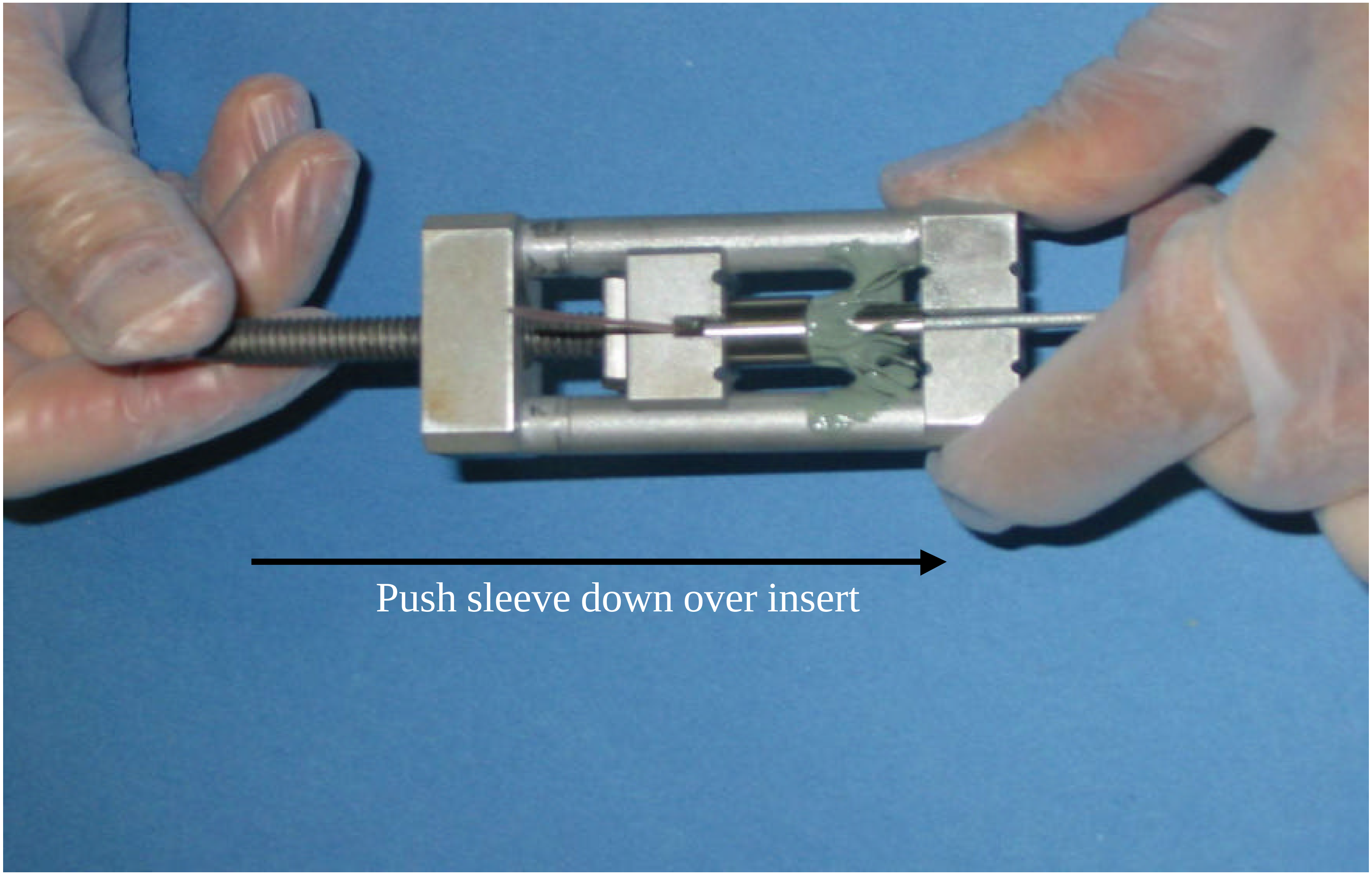


Pic.13 Trim Inner Wire Strands to Base of Insert

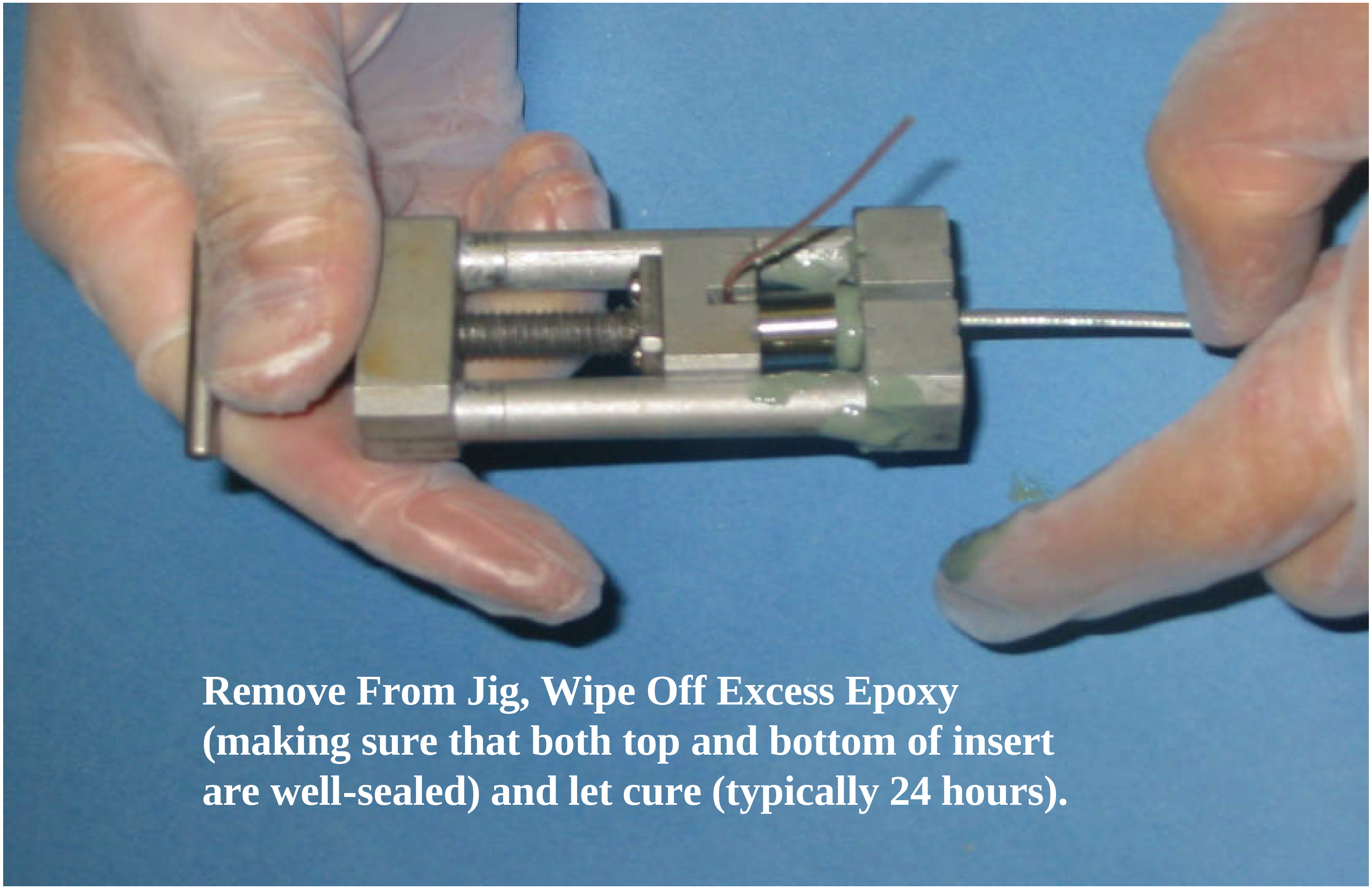


Pic.14 Mix epoxy

Pic.15 Apply epoxy. Cover the trimmed armor strands with epoxy

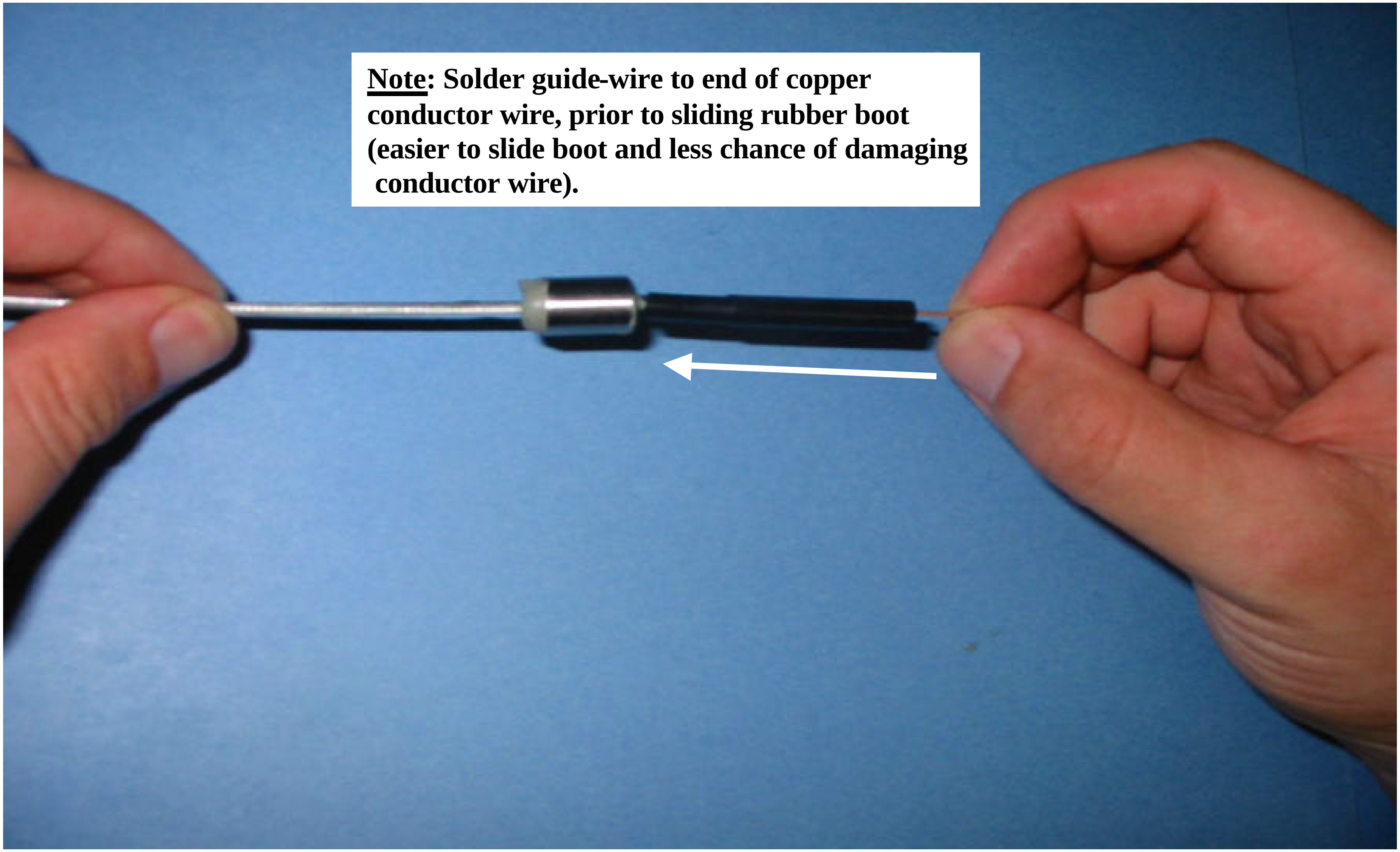


Pic.16 Using the termination jig, push the termination sleeve completely down over the insert

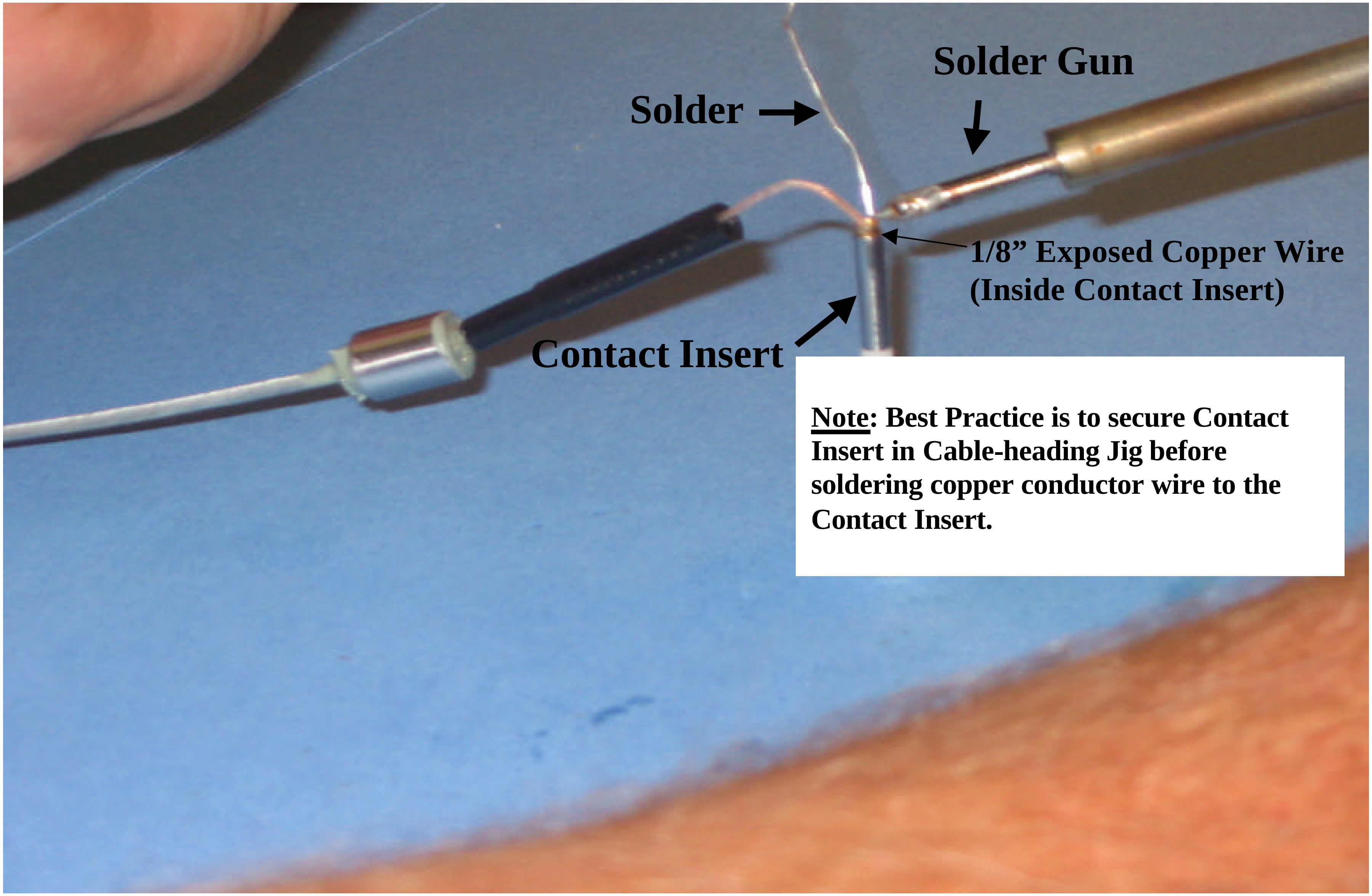


Pic.17 Termination Sleeve completely pushed down over insert

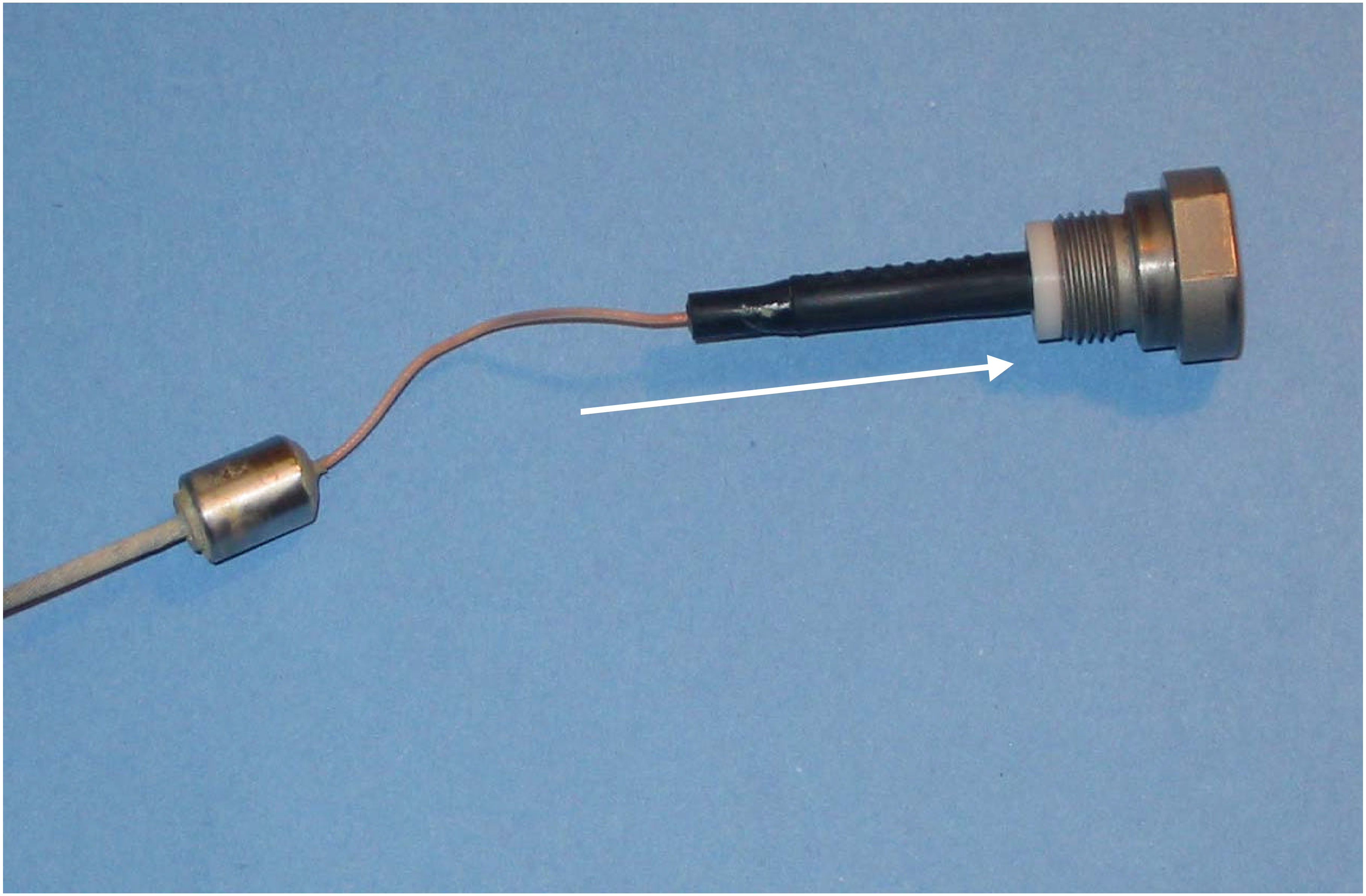
Pic.18 Apply silicon lubricant to the insulated conductor wire



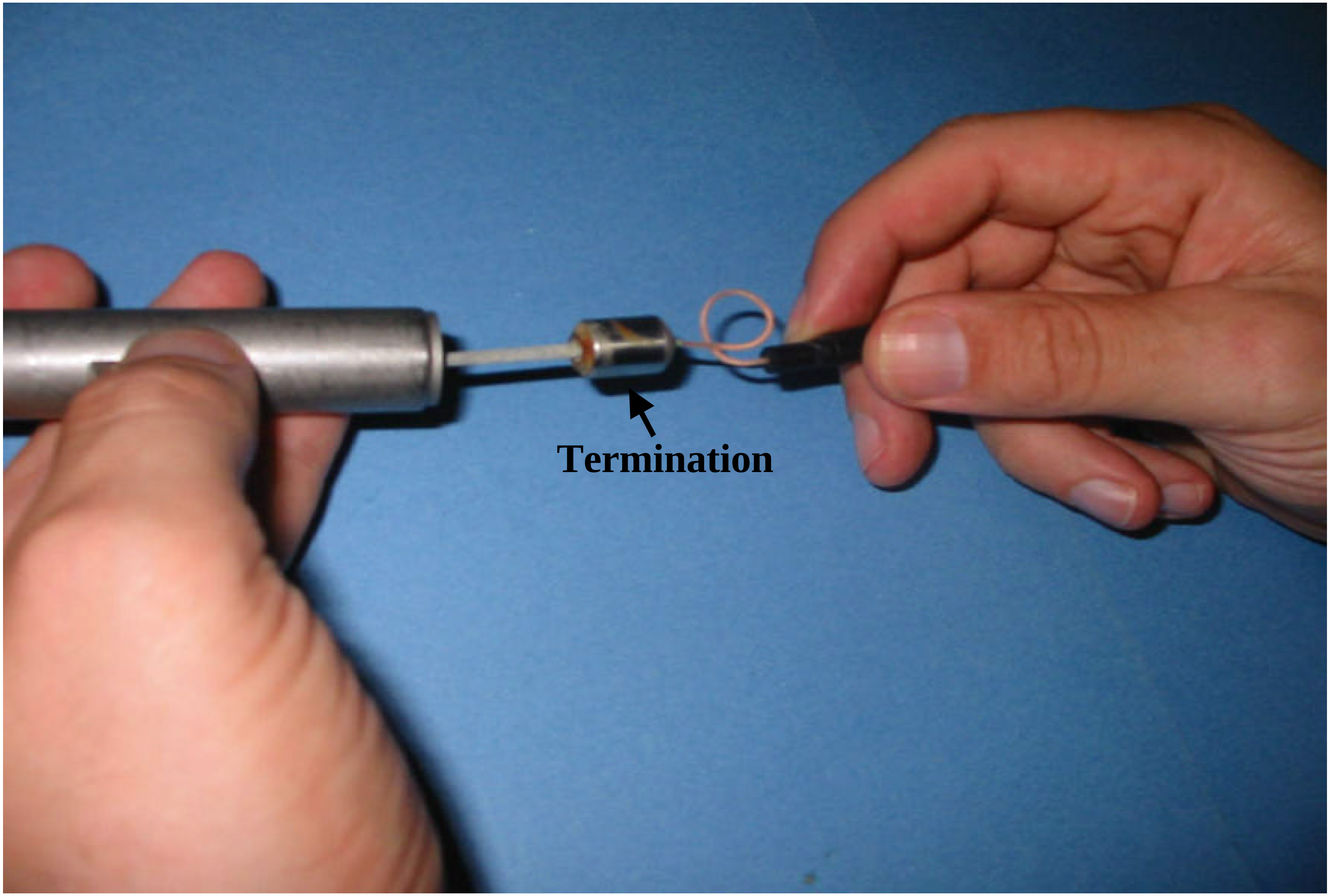
Pic.20 Slide the rubber boot towards the cablehead termination (final position)



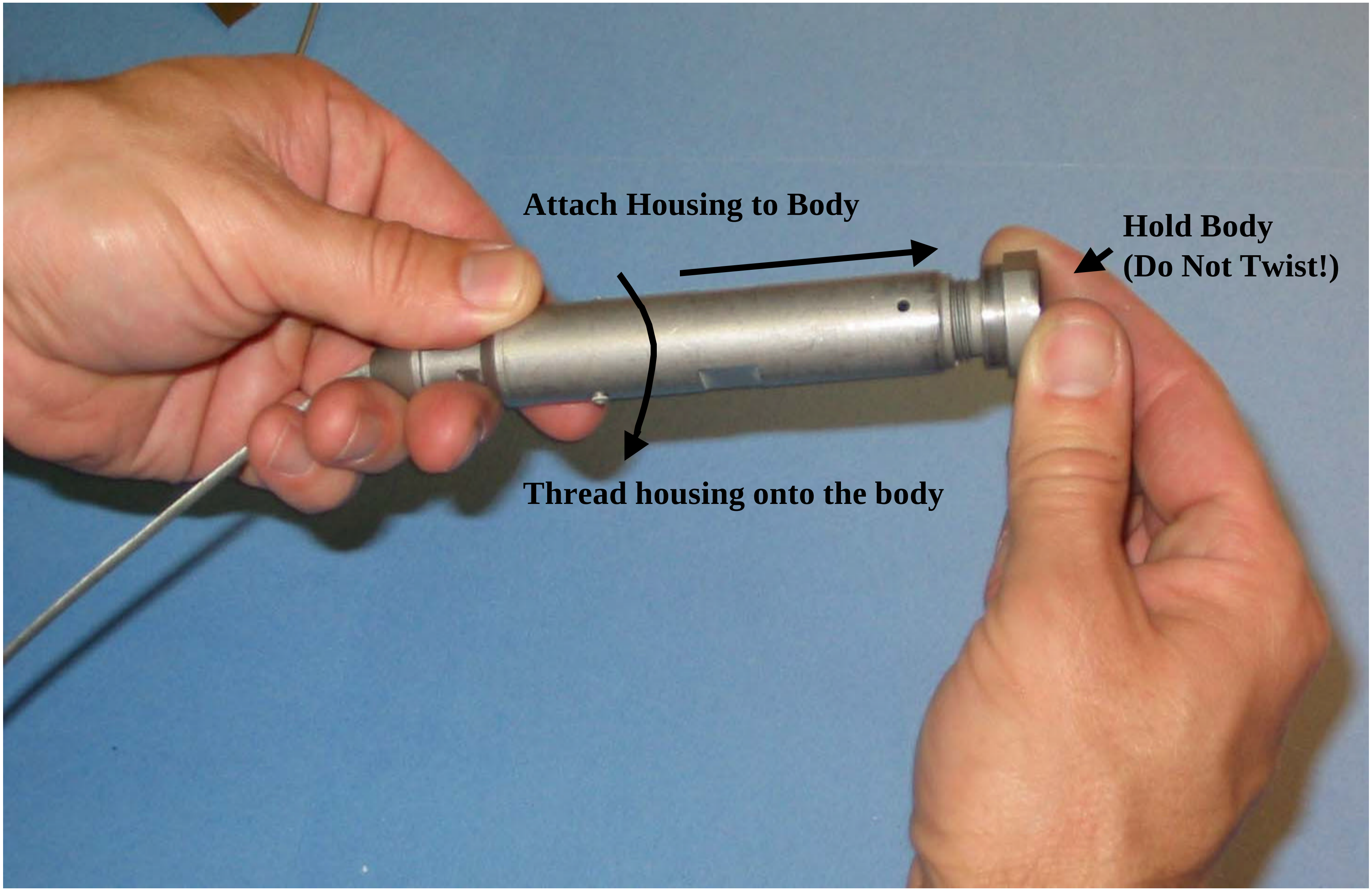
Pic.21 Solder 1/8 inch exposed copper wire (use wire strippers) into contact insert



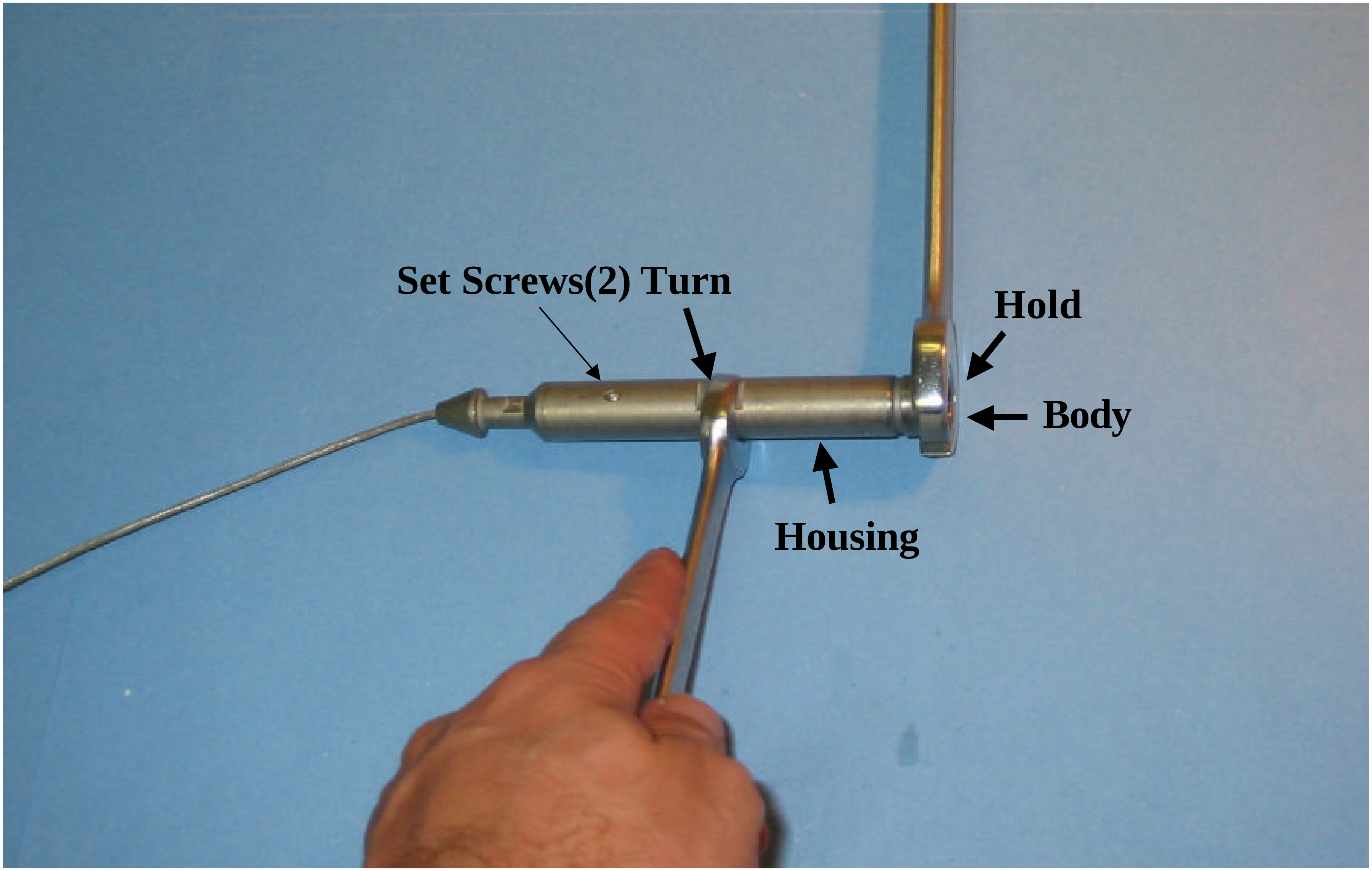
Pic.22 Slide the rubber boot down over the contact insert (when the solder has cooled)



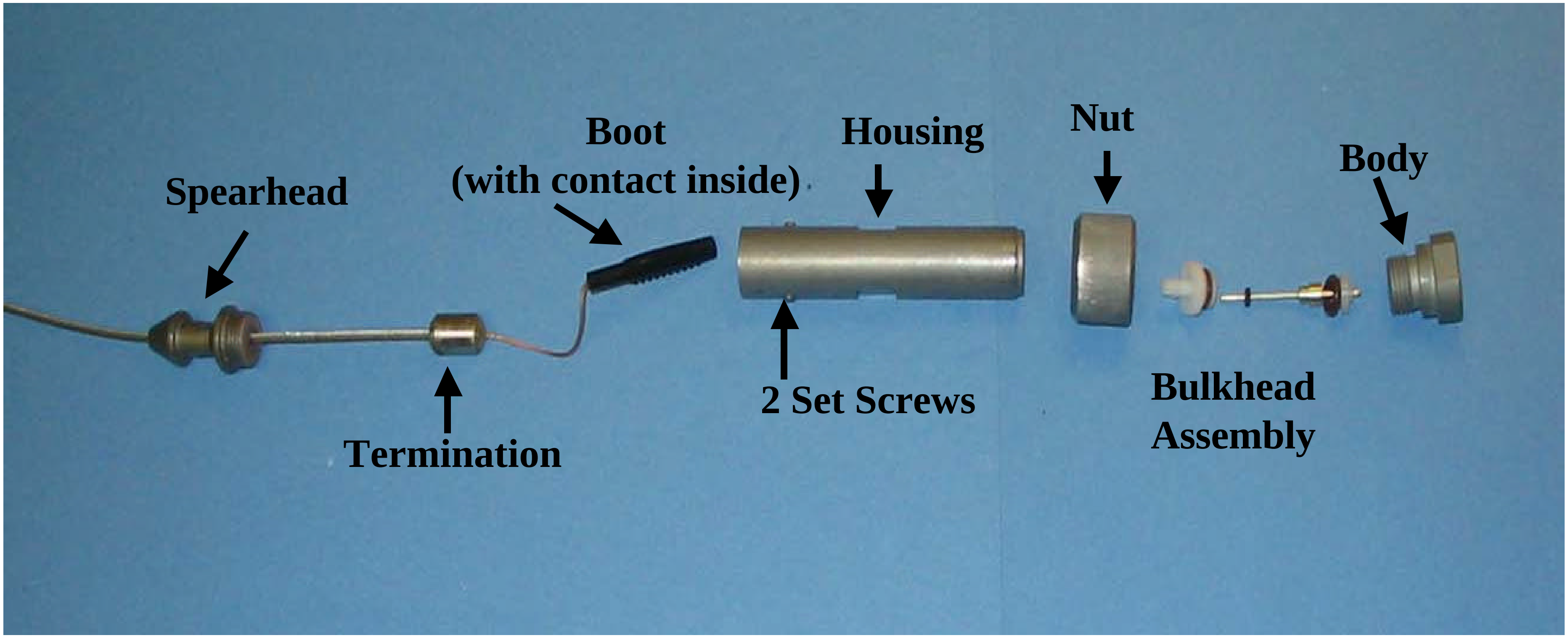
Pic.23 Create a loop in the conductor wire before sliding the cablehead housing down over the termination



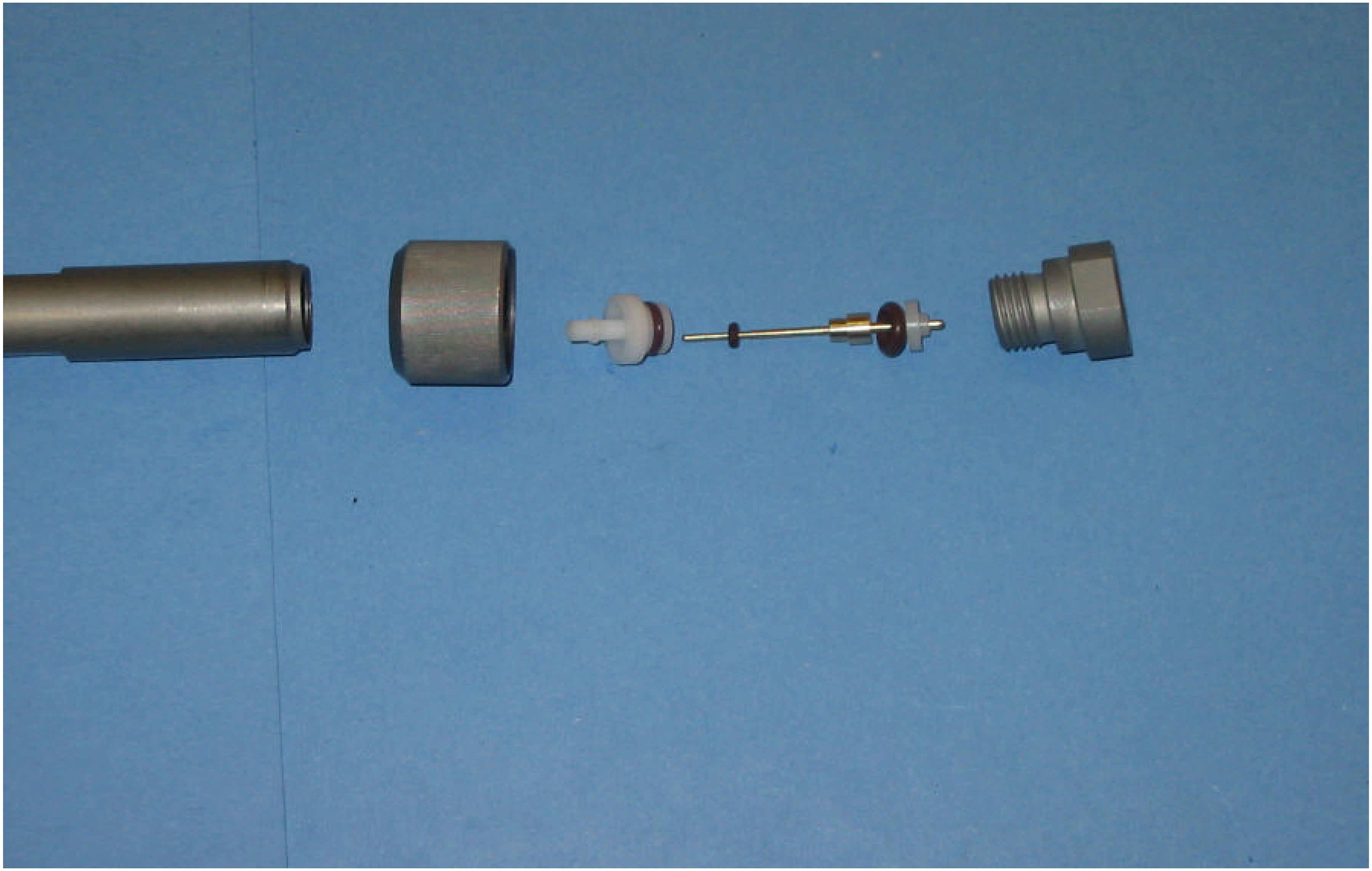
Pic.24 Thread the cablehead housing onto the body
(Do not twist the body! –this can damage the conductor wire)



Pic.25 Tighten the housing to the body
Tighten the set screws to complete re-assembly of the cablehead



Pic.26 Exploded view of cablehead assembly



Pic.27 Exploded view of bulkhead assembly

Attachment A: Standard Operating Procedure (SOP) #2

Passive Diffusion Bag (PDB) Sampling Protocol

1.0 Obtain PDB Sampler Hardware

- The hardware for each well in the sampling program will be custom-made by the PDB manufacturer (EON Products, Inc.) or by field sampling personnel, prior to the initiation of the field program.
- Each hardware kit is labeled for each well, and should closely match the dimensions submitted to the kit manufacturer.
- Open the hardware kit bag and carefully unwind the first few feet of cable or rope, to expose the first PDB station (colored zip ties or metal clips) from which the PDB samplers will hang.

2.0 Install PDB Sampler Hardware (Page 6, USGS, 2001)

- Unseal the appropriate PDB sampler hardware kit (match label to well name) and carefully retrieve hardware.
- Clip the first (bottom) PDB sampler onto the top and bottom PDB station using the available zip ties.
- Record time and bag position in the well.
- If this well is to be profiled, continue attaching PDB samplers to remaining PDB stations for this monitoring well.
- Otherwise, if this well is not scheduled to be profiled and has not yet been profiled, continue unwinding the hardware kit until the uppermost set of plastic disks is exposed and then attach the second PDB sampler.
- Once a well has been profiled and a specific depth has been selected from which to monitor groundwater quality, only one PDB sampler will be installed on the hardware kit – the depth interval will be noted on the field instruction form.
- Once the necessary PDB samplers have been installed, carefully lower the hardware kit until the stainless steel weight touches the well bottom.
- Confirm that the top clip (marker) roughly equals the top of casing and adjust as necessary to ensure a snug fit (slightly taught line) when the well cap is closed.
- Attach the end of the hardware line to the well head hanging device – make sure that the PDB sampler kit does not sag when well cap is closed.
- Secure the well.

3.0 Sample Naming/Recording

- Sample numbers will be generated as specified in the QAPP.
- Field personnel must include a depth for each sampler on the chain-of-custody.

- Record the relative position of each bag – they will be numbered in the order they will be retrieved (i.e., top → #1... #2... #n... → bottom) – in other words, the first PDB sampler to be installed will have the highest number and the last PDB sampler will have the lowest number.

4.0 PDB Sampler Retrieval (Page 9, USGS, 2001)

- Collect the appropriate number of VOA vials for the required number of VOC samples.
- Measure and record the corrected depth to water from the top of casing to ensure PDB are completely submerged below the water level.
- Note the time and begin reeling the PDB sampler hardware line.
- Field personnel must include a depth for each sampler on the chain-of-custody in the form of station number as recorded during bag placement.
- Important - the contents of each bag must be transferred to the VOA vials immediately after PDBs are removed from the well and before addressing any other sampling-related issues to avoid losing volatile compounds to atmosphere. Once the first bag leaves the water, the time limit starts at the same time for all exposed bags. All samples shall be contained in the VOA vials within 15 minutes of the PDB leaving the water.
- Extract the PDB sampler(s) from the well, remove the sampler cap and carefully empty the contents into VOA vials (preferably set up in a bottle holder), taking care not to over agitate the bag or water.
- Apply completed label to each VOA vial to ensure that they are not confused later.
- Repeat until all PDB samplers have been removed and contents transferred.
- QC duplicate samples consist of two separate sets of VOA vials filled from the same diffusion sampler.
- Store all filled VOA vials in Ziploc bags inside a properly cooled container.
- Follow above guidelines to re-install new PDB samplers as scheduled (profile or single-bag scenario).
- Dispose of all used passive diffusion sample bags and components appropriately as either IDW or recyclable material.
- Decontaminate all reusable equipment with clean water and ALCONOX.

5.0 User's Guide for Polyethylene-based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells

(See following pages)

USGS
science for a changing world

USER'S GUIDE FOR POLYETHYLENE-BASED PASSIVE DIFFUSION BAG SAMPLERS TO OBTAIN VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN WELLS

PART 1: DEPLOYMENT, RECOVERY, DATA INTERPRETATION, AND QUALITY CONTROL AND ASSURANCE

Water-Resources Investigations Report 01-4060

Prepared in cooperation with the

U.S. AIR FORCE
U.S. NAVAL FACILITIES ENGINEERING COMMAND
U.S. ENVIRONMENTAL PROTECTION AGENCY
FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE
DEFENSE LOGISTICS AGENCY
U.S. ARMY CORPS OF ENGINEERS and
INTERSTATE TECHNOLOGY AND REGULATORY COOPERATION WORK GROUP

U.S. Department of the Interior
U.S. Geological Survey

Acknowledgments

Technical Advisory Board

U.S. Air Force Base Conversion Agency (AFBCA)
U.S. Air Force Center For Environmental Excellence (AFCEE)
Maj. Jeff Cornell (AFCEE)
Mario Ierardi (AFBCA)
Dr. Javier Santillan (AFCEE)

Defense Logistics Agency (DLA)
Lt. Col. Daniel L. Welch

U.S. Environmental Protection Agency (EPA)
Steve Schmelling, Office of Research and Development (ORD)
Dick Willey, EPA Region 1
Kathy Davies, EPA Region 3
Richard Steimle, Technology Innovation Office (TIO)

U.S. Naval Facilities Engineering Command (NAVFAC)
Cliff C. Casey (Southern Division)
Dennis Howe (Engineering Service Center)
Richard G. Mach, Jr. (Southwest Division)
Nick Ta (Engineering Service Center)

U.S. Army Corps of Engineers (USACE)
Johnette Shockley

Federal Remediation Technologies Roundtable

Interstate Technology and Regulatory Cooperation Work Group (ITRC)
George H. Nicholas (New Jersey) Team Lead
Paul M. Bergstrand (South Carolina)
Chris A. Guerre (California)
David Randolph (Tennessee)

Funding for this Guide was provided by the U.S. AIR FORCE and NAVFAC (Southern and Southwest Divisions). Additionally, the following persons are recognized for their leadership and support to this project: Marty Faile, Joe Dunkle, Kay Wishkaemper, Vince Malott, and the Passive Diffusion Bag Sampler (PDBS) Work Group.

User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells

Part 1: Deployment, Recovery, Data Interpretation, and Quality Control and Assurance

By Don A. Vroblesky

U.S. Geological Survey

Water-Resources Investigations Report 01–4060

Prepared in cooperation with the

U.S. AIR FORCE

U.S. NAVAL FACILITIES ENGINEERING COMMAND

U.S. ENVIRONMENTAL PROTECTION AGENCY

FEDERAL REMEDIATION TECHNOLOGIES ROUNDTABLE

DEFENSE LOGISTICS AGENCY

U.S. ARMY CORPS OF ENGINEERS and

INTERSTATE TECHNOLOGY AND REGULATORY COOPERATION WORK GROUP

USGS
science for a changing world

Columbia, South Carolina
2001

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

Copies of this report can be obtained from:

U.S. Environmental Protection Agency (USEPA)/National Service Center for Environmental Publications (NSCEP)
Box 42419
Cincinnati, OH 45242-0419

and

U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, CO 80225
Phone: 888-ASK-USGS

For additional information, write to:

District Chief
U.S. Geological Survey
Stephenson Center–Suite 129
720 Gracern Road
Columbia, SC 29210-7651

Additional information about water resources in South Carolina is available on the World Wide Web at **http://sc.water.usgs.gov**

Report can be downloaded from **http://www.itrcweb.org** and **http://www.frtr.gov**

CONTENTS

Figures

Table

Conversion Factors, Vertical Datum, Acronyms, and Abbreviations

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
	Area	
square mile (mi^2)	2.590	square kilometer
	Flow	
foot per day (ft/d)	0.3048	meter per day
foot squared per day (ft^2/d)	0.09294	meter squared per day
gallon per minute (gal/min)	0.06308	liter per second
gallon per day (gal/d)	0.003785	cubic meter per day
inch per year (in/yr)	25.4	millimeter per year
	Volume	
gallon (gal)	3.785	liter

Temperature is given in degrees Celsius (°C), which can converted to degrees Fahrenheit (°F) by the following equation: °F = 9/5 (°C) + 32

Sea level refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Chemical concentration in water is expressed in metric units as milligrams per liter (mg/L) or micrograms per liter (µg/L).

Additional Abbreviations	
EDB	1,2-Dibromomethane
AFCEE	Air Force Center for Environmental Excellence
*c*DCE	*cis*-1,2-Dibromoethene
ft^3/d	cubic feet per day
ft^3/mg	cubic feet per milligram
°C	degrees Celsius
g	gram
ITRC	Interstate Technology Regulatory Cooperation
LDPE	low-density polyethylene
L	liter
µg	microgram
µm	micrometer
µL	microliter
mg	milligram
mL	milliliter
mL/min	milliliter per minute
MTBE	Methyl-*tert*-butyl ether
NAVFAC	Naval Facilities Engineering Command
NAPL	non-aqueous phase liquid
PDB	passive diffusion bag
PCE	Tetrachloroethene
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOA	Volatile organic analysis
VOC	Volatile organic compound

User’s Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells

Part 1: Deployment, Recovery, Data Interpretation, and Quality Control and Assurance

By Don A. Vroblesky

EXECUTIVE SUMMARY

Water-filled passive diffusion bag (PDB) samplers described in this report are suitable for obtaining concentrations of a variety of volatile organic compounds (VOCs) in ground water at monitoring wells. The suggested application of the method is for long-term monitoring of VOCs in ground-water wells at well-characterized sites.

The effectiveness of the use of a single PDB sampler in a well is dependent on the assumption that there is horizontal flow through the well screen and that the quality of the water is representative of the ground water in the aquifer directly adjacent to the screen. If there are vertical components of intra-bore-hole flow, multiple intervals of the formation contributing to flow, or varying concentrations of VOCs vertically within the screened or open interval, then a multiple deployment of PDB samplers within a well may be more appropriate for sampling the well.

A typical PDB sampler consists of a low-density polyethylene (LDPE) lay-flat tube closed at both ends and containing deionized water. The sampler is positioned at the target horizon of the well by attachment to a weighted line or fixed pipe.

The amount of time that the sampler should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for the environmental disturbance caused by sampler deployment to return to ambient conditions. The rate that the water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. The concentrations of benzene, *cis*-1,2-dichloroethene, tetrachlorethene, trichloroethene, toluene, naphthalene, 1,2-dibromoethane, and total xylenes within the PDB samplers equilibrated with the concentrations in an aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 degrees Celsius (°C). A subsequent laboratory study of mixed VOCs at 10 °C showed that tetrachloroethene and trichloroethene were equilibrated by about 52 hours, but other compounds required longer equilabration times. Chloroethane, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours, but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed VOC solutions have not yet been thoroughly examined.

The samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. Laboratory and field data suggest that 2 weeks of equilibration probably is adequate for many applications; therefore, a minimum equilibration time of 2 weeks is suggested. In less permeable formations, longer equilibration times may be required. When applying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating data, a side-by-side comparison with conventional methodology is advisable to justify the field equilibration time.

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified time for sampler recovery after initial equilibration. PDB samplers routinely have been left in ground waters having concentrations of greater than 500 parts per million (ppm) of trichloroethene for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers have been left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity. The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations, however. Moreover, in some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices (SPMDs) have shown that the transfer of some compounds across a heavily biofouled polyethylene membrane may be reduced, but not stopped. If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparison to a conventional sampling method before continuing to use PDB samplers for long-term deployment in that well.

Recovery consists of removing the samplers from the well and immediately transferring the enclosed water to 40-milliliter sampling vials for analysis. The resulting concentrations represent an integration of chemical changes over the most recent portion of the equilibration period (approximately 48 to 166 hours, depending on the water temperature and the type of compound).

The method has both advantages and limitations when compared to other sampling methods. Advantages include the potential for PDB samplers to eliminate or substantially reduce the amount of purge water associated with sampling. The samplers are relatively inexpensive and easy to deploy and recover. Because PDB samplers are disposable, there is no downhole equipment to be decontaminated between wells, and there is a minimum amount of field equipment required. The samplers also have the potential to delineate contaminant stratification in the formation across the open or screened intervals of monitoring wells where vertical hydraulic gradients are not present. In addition, the samplers integrate concentrations over time, which may range between about 48 to 166 hours depending on the compound of interest. Because the pore size of LDPE is only about 10 angstroms or less, sediment does not pass through the membrane into the bag. Thus, PDB samplers are not subject to interferences from turbidity. In addition, none of the data collected suggest that VOCs leach from the LDPE material, or that there is a detrimental effect on the VOC sample from the PDB material.

Water-filled polyethylene PDB samplers are not appropriate for all compounds. The samplers are not suitable for inorganic ions and have a limited applicability for non-VOCs and for some VOCs. For example, although methyl-*tert*-butyl ether and acetone and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water. A variety of factors influence the ability of compounds to diffuse through the polyethylene. These factors include the molecular size and shape and the hydrophobic nature of the compound. Unpublished laboratory test data of semivolatile compounds in contact with PDB samplers showed a higher concentration of phthalates inside the PDB sampler than outside the PDB sampler, suggesting that the polyethylene may contribute phthalates to the enclosed water. Thus, the samplers should not be used to sample for phthalates.

VOC concentrations in PDB samplers represent concentrations in the vicinity of the sampler within the well screen or open interval. This may be a limitation for PDB samplers and some other types of sampling, such as low-flow sampling, if the ground-water contamination is above or below the screen or not in the sample intervals providing water movement to the PDB samplers. If there is a vertical hydraulic gradient in the well, then the concentrations in the sampler may represent the concentrations in the water flowing vertically past the sampler rather than in the formation directly adjacent to the sampler. Vertically spaced multiple PDB samplers may be needed in chemically stratified wells or where flow patterns through the screen change as a result of ground-water pumping or seasonal water-level fluctuations.

The purposes of this document are to present methods for PDB sampler deployment, and recovery; to discuss approaches to determine the applicability of passive diffusion samplers; and to discuss various factors influencing interpretation of the data. The intended audience for the methodology sections of this report is managers and field personnel involved in using PDB samplers. The discussion of passive diffusion sampler applicability and interpretation of the data is suited for project managers, technical personnel, and the regulatory community. Part 2 of this report presents case studies of PDB sampler field applications.

INTRODUCTION

The use of PDB samplers for collecting ground-water samples from wells offers a cost-effective approach to long-term monitoring of VOCs at well-characterized sites (Vroblesky and Hyde, 1997; Gefell and others, 1999). The effectiveness of the use of a single PDB sampler in a well is dependent on the assumption that there is horizontal flow through the well screen and that the quality of the water is representative of the ground water in the aquifer directly adjacent to the screen. If there are vertical components of intra-borehole flow, multiple intervals of the formation contributing to flow, or varying concentrations of VOCs vertically within the screened or open interval, then deployment of multiple PDB samplers within a well may be more appropriate for sampling the well.

The samplers consist of deionized water enclosed in a LDPE sleeve (fig. 1) and are deployed adjacent to a target horizon within a screened or open interval of a well. The suggested application is for long-term monitoring of VOCs in ground-water wells. Where the screened interval is greater than 10 feet (ft), the potential for contaminant stratification and/or intra-borehole flow within the screened interval is greater than in screened intervals shorter than 10 ft. It is important that the vertical distribution of contaminants be determined in wells having 10-ft-long well screens, and that both the vertical distribution of contaminants and the potential for intra-borehole flow be determined in wells having screens longer than 10 ft. For many VOCs of environmental interest (table 1), the VOC concentration in water within the sampler approaches the VOC concentration in water outside of the PDB sampler over an equilibration period. The resulting concentrations represent an integration of chemical changes over the most recent part of the equilibration period (approximately 48 to 166 hours, depending on the water temperature and the type of compound being sampled). The approach is inexpensive and has the potential to eliminate or substantially reduce the amount of purge water removed from the well.

A variety of PDB samplers have been utilized in well applications (fig. 1). Although the samplers vary in specific construction details, a typical PDB sampler consists of a 1- to 2-ft-long LDPE tube closed at both ends and containing laboratory-grade deionized water (fig. 1). The typical diameter for PDB samplers used in a 2-inch-diameter well is approximately 1.2 inches; however, other dimensions may be used to match the well diameter. Equilibration times may be longer for larger diameter PDB samplers. On the outside of the PDB sampler, a low-density polyethylene-mesh sometimes is used for protection against abrasion in open boreholes and as a means of attachment at the prescribed depth. The PDB sampler can be positioned at the target horizon by attachment to a weighted line or by attachment to a fixed pipe.

PDB samplers for use in wells are available commercially. Authorized distributors as of March 2001 are Columbia Analytical Services (800-695-7222; www@caslab.com) and Eon Products (800-474-2490; www.eonpro.com). A current list of vendors and PDB-sampler construction details can be obtained from the U.S. Geological Survey Technology Transfer Enterprise Office, Mail Stop 211, National Center, 12201 Sunrise Valley Drive, Reston, Virginia 20192 (telephone 703-648-4344; fax 703-648-4408). PDB samplers employ patented technology (U.S. patent number 5,804,743), and therefore, require that the user purchase commercially produced samplers from a licensed manufacturer or purchase a nonexclusive license for sampler construction from the U.S. Geological Survey Technology Enterprise Office at the above address.

The purposes of this document are to present methods for PDB sampler deployment, and recovery; to discuss approaches for determining the applicability of passive diffusion samplers; and to discuss various factors influencing interpretation of the data. The intended audience for the methodology sections of this report is managers and field personnel involved in using PDB samplers. The discussion of PDB sampler applicability and interpretation of the data is suited for project managers, technical personnel, and the regulatory community. Part 2 of this report presents case studies of PDB-sampler field applications.

Figure 1. Typical water-filled passive diffusion bag samplers used in wells, including (A) diffusion bag with polyethylene mesh, (B) diffusion bag without mesh, and (C) bag and mesh attached to bailer bottom.

Table 1. Compounds tested under laboratory conditions for use with passive diffusion bag samplers

[From Vroblesky and Campbell, 2001]

Tested compounds showing good correlation (average differences in concentration of 11 percent or less between diffusion-sampler water and test-vessel water) in laboratory tests			
Benzene	2 Chlorovinyl ether	*cis*-1,2-Dichloroethene	1,1,1-Trichloroethane
Bromodichloromethane	Dibromochloromethane	*trans*-1,2-Dichloroethene	1,1,2-Trichloroethane
Bromoform	Dibromomethane	1,2-Dichloropropane	Trichloroethene
Chlorobenzene	1,2-Dichlorobenzene	*cis*-Dichloropropene	Trichlorofluoromethane
Carbon tetrachloride	1,3-Dichlorobenzene	1,2-Dibromoethane	1,2,3-Trichloropropane
Chloroethane	1,4-Dichlorobenzene	*trans*-1,3-Dichloropropene	1,1,2,2-Tetrachloroethane
Chloroform	Dichlorodifluoromethane	Ethyl benzene	Tetrachloroethene
Chloromethane	1,2-Dichloroethane	Naphthalene	Vinyl chloride
	1,1-Dichloroethene	Toluene	Total xylenes
Tested compounds showing poor correlation (average differences in concentration greater than 20 percent between diffusion-sampler water and test-vessel water) in laboratory tests			
Acetone*	Methyl-*tert*-butyl ether	Styrene	

*T.M Sivavec and S.S. Baghel, General Electric Company, written commun., 2000

Summary of Passive Diffusion Bag Sampler Advantages and Limitations

Advantages

1. PDB samplers have the potential to eliminate or substantially reduce the amount of purge water associated with sampling.

2. PDB samplers are inexpensive.

3. The samplers are easy to deploy and recover.

4. Because PDB samplers are disposable, there is no downhole equipment to be decontaminated between wells.

5. A minimal amount of field equipment is required.

6. Sampler recovery is rapid. Because of the small amount of time and equipment required for the sampling event, the method is practical for use where access is a problem or where discretion is desirable (that is, residential communities, business districts, or busy streets where vehicle traffic control is a concern).

7. Multiple PDB samplers, distributed vertically along the screened or open interval, may be used in conjunction with borehole flow meter testing to gain insight on the movement of contaminants into and out of the well screen or open interval or to locate the zone of highest concentration in the well. Analytical costs when using multiple PDB samplers sometimes can be reduced by selecting a limited number of the samplers for laboratory analysis based on screening by using field gas chromatography at the time of sample collection.

8. Because the pore size of LDPE is only about 10 angstroms or less, sediment does not pass through the membrane into the bag. Thus, PDB samplers are not subject to interferences from turbidity. In addition, none of the data collected suggest that VOCs leach from the LDPE material or that there is a detrimental effect from the PDB material on the VOC sample.

Limitations

1. PDB samplers integrate concentrations over time. This may be a limitation if the goal of sampling is to collect a representative sample at a point in time in an aquifer where VOC-concentrations substantially change more rapidly than the samplers equilibrate. Laboratory results obtained indicate that a variety of compounds equilibrated within 48 hours at 21 °C (Vroblesky and Campbell, 2001). Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane may require between 93 and 166 hours to equilibrate at 10 °C (T.M. Sivavec and S.S. Baghel, General Electric Company, written commun., 2000). The initial equilibration under field conditions may be longer to allow well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment.

2. Water-filled polyethylene PDB samplers are not appropriate for all compounds. For example, although methyl-*tert*-butyl ether and acetone (Vroblesky, 2000; Paul Hare, General Electric Company, oral commun., 2000) and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water.
A variety of factors influence the ability of compounds to diffuse through the polyethylene membrane. These factors include the molecular size and shape and the hydrophobic nature of the compound. Compounds having a cross-sectional diameter of about 10 angstroms or larger (such as humic acids) do not pass through the polyethylene because the largest (transient) pores in polyethylene do not exceed about 10 angstroms in diameter (Flynn and Yalkowsky, 1972; Hwang and Kammermeyer, 1975; Comyn, 1985). The samplers are not appropriate for hydrophilic polar molecules, such as inorganic ions. A detailed discussion of the relation between hydrophobicity and compound transport through polyethylene can be found in Gale (1998). Unpublished laboratory test data (D.A. Vroblesky, U.S. Geological Survey, written commun., 1998) of semivolatile compounds in contact with PDB samplers showed a higher concentration of phthalates inside the PDB sampler than outside the PDB sampler, suggesting that the polyethylene may contribute phthalates to the enclosed water. Thus, the samplers should not be used to sample for phthalates.

3. PDB samplers rely on the free movement of water through the well screen. In situations where ground water flows horizontally through the well screen, the VOC concentrations in the open interval of the well probably are representative of the aquifer water in the adjacent formation (Gillham and others, 1985; Robin and Gillham, 1987; Kearl and others, 1992; Powell and Puls, 1993; Vroblesky and Hyde, 1997). In these situations, the VOC concentration of the water in contact with the PDB samplers, and therefore, the water within the diffusion samplers, probably represents local conditions in the adjacent aquifer. However, if the well screen is less permeable than the aquifer or the sandpack, then under ambient conditions, flowlines may be diverted around the screen. Such a situation may arise from inadequate well development or from iron bacterial fouling of the well screen. In this case, the VOC concentrations in the PDB samplers may not represent concentrations in

the formation water because of inadequate exchange across the well screen. PDB samplers have not yet been adequately tested to determine their response under such conditions.

4. VOC concentrations in PDB samplers represent ground-water concentrations in the vicinity of the screened or open well interval that move to the sampler under ambient flow conditions. This is a limitation if the ground-water contamination lies above or below the well screen or open interval, and requires the operation of a pump to conduct contaminants into the well for sampling.

5. In cases where the well screen or open interval transects zones of differing hydraulic head and variable contaminant concentrations, VOC concentrations obtained using a PDB sampler may not reflect the concentrations in the aquifer directly adjacent to the sampler because of vertical transport in the well. However, a vertical array of PDB samplers, used in conjunction with borehole flow meter testing, can provide insight on the movement of contaminants into or out of the well. This information then can be used to help determine if the use of PDB samplers is appropriate for the well, and to select the optimal vertical location(s) for the sampler deployment.

6. In wells with screens or open intervals with stratified chemical concentrations, the use of a single PDB sampler set at an arbitrary (by convention) depth may not provide accurate concentration values for the most contaminated zone. However, multiple PDB samplers distributed vertically along the screened or open interval, in conjunction with pump sampling (as appropriate), can be used to locate zone(s) of highest concentration in the well. Multiple PDB samplers also may be needed to track the zone of maximum concentration in wells where flow patterns through the screened interval change as a result of ground-water pumping or seasonal water-table fluctuations.

PASSIVE DIFFUSION BAG SAMPLER DEPLOYMENT

A variety of approaches can be used to deploy the PDB samplers in wells. A typical deployment approach, described in this section, is to attach the PDB samplers to a weighted line. It also is acceptable to attach the weights directly to the PDB sampler if the attachment point is of sufficient strength to support the weight. The weights attached to the bottom of the line are stainless steel and can be reused, but must be thoroughly decontaminated with a detergent before the first use or before using in a different well. Rope, such as 90 pound, 3/16 inch braided polyester, can be used as the line for single-use applications if it is of sufficient strength to support the weight and sampler, is nonbuoyant, and is subject to minimal stretch; however, the rope should not be reused because of the high potential for cross contamination. Stainless-steel or Teflon-coated stainless-steel wire is preferable. The weighted lines should not be reused in different wells to prevent carryover of contaminants. A possible exception is coated stainless-steel wire, which can be reused after sufficient decontamination. An alternative deployment approach, not discussed in this section, is to attach the PDB samplers to a fixed pipe in the well (Vroblesky and Peters, 2000, p. 3; also included in Part 2 of this publication). The PDB samplers should not contact non-aqueous phase liquid (NAPL) during deployment or retrieval to prevent cross contamination. An approach that can be utilized to deploy diffusion samplers through a layer of floating NAPL is described in the field test at Naval Station North Island, California (Vroblesky and Peters, 2000, p. 3-4; also included in Part 2 of this publication).

If the PDB sampler is to be compared with a conventional pumping approach to sampling, then it is suggested that both the pump and the PDB sampler be deployed at the same time, with the sampler attached near (such as directly below) the pump inlet. This approach eliminates potential concentration differences between the two methods that may result from well disturbance during equipment removal and deployment at the time of sampling. An alternative method is to deploy the PDB samplers independently of the pumps and recover the samplers immediately prior to placing the pump down the well.

PDB samplers are available either prefilled (field ready) with laboratory-grade deionized water or unfilled. The unfilled samplers are equipped with a plug and funnel to allow for field filling and sample recovery. To fill these samplers, remove the plug from the sampler bottom, insert the short funnel into the sampler, and pour laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and stands at least half way into the funnel. Remove excess bubbles from the sampler. Remove the funnel and reattach the plug. A small air bubble from the plug is of no concern.

The following steps should be used for deploying PDB samplers in wells:

1. Measure the well depth and compare the measured depth with the reported depth to the bottom of the well screen from well-construction records. This is to check on whether sediment has accumulated in the bottom of the well, whether there is a nonscreened section of pipe (sediment sump) below the well screen, and on the accuracy of well-construction records. If there is an uncertainty regarding length or placement of the well screen, then an independent method, such as video imaging of the well bore, is strongly suggested.

2. Attach a stainless-steel weight to the end of the line. Sufficient weight should be added to counterbalance the buoyancy of the PDB samplers. This is particularly important when multiple PDB samplers are deployed. One approach, discussed in the following paragraphs, is to have the weight resting on the bottom of the well, with the line taut above the weight. Alternatively, the PDB sampler and weight may be suspended above the bottom, but caution should be exercised to ensure that the sampler does not shift location. Such shifting can result from stretching or slipping of the line or, if multiple samplers are attached end-to-end rather than to a weighted line, stretching of the samplers.

3. Calculate the distance from the bottom of the well, or top of the sediment in the well, up to the point where the PDB sampler is to be placed. A variety of approaches can be used to attach the PDB sampler to the weight or weighted line at the target horizon. The field-fillable type of PDB sampler is equipped with a hanger assembly and weight that can be slid over the sampler body until it rests securely near the bottom of the sampler. When this approach is used with multiple PDB samplers down the same borehole, the weight should only be attached to the lowermost sampler. An additional option is to use coated stainless-steel wire as a weighted line, making loops at appropriate points to attach the upper and lower ends of PDB samplers. Where the PDB sampler position varies between sampling events, movable clamps with rings can be used. When using rope as a weighted line, a simple approach is to tie knots or attach clasps at the appropriate depths. Nylon cable ties or stainless-steel clips inserted through the knots can be used to attach the PDB samplers. An approach using rope as a weighted line with knots tied at the appropriate sampler-attachment points is discussed below.

(a) For 5-ft-long or shorter well screens, the center point of the PDB sampler should be the vertical midpoint of the saturated well-screen length. For example, if the well screen is at a depth of 55 to 60 ft below the top of casing, and the measured depth of the well is 59 ft, then the bottom of the well probably has filled with sediment. In this case, the midpoint of the sampler between the attachment points on the line will be midway between 55 and 59 ft, or at 57 ft. Thus, for a 1.5-ft-long sampler, the attachment points on a weighted line should be tied at distances of 1.25 ft (2 ft – 0.75 ft) and 2.75 ft (2 ft + 0.75 ft) from the top of the sediment in the well, or the bottom of the well, making adjustments for the length of the attached weight. When the PDB sampler is attached to the line and installed in the well, the center of the sampler will be at 57-ft depth. If, however, independent evidence is available showing that the highest concentration of contaminants enters the well from a specific zone within the screened interval, then the PDB sampler should be positioned at that interval.

(b) For 5- to 10-ft-long well screens, it is advisable to utilize multiple PDB samplers vertically along the length of the well screen for at least the initial sampling (fig. 2). The purposes of the multiple PDB samplers are to determine whether contaminant stratification is present and to locate the zone of highest concentration. The midpoint of each sampler should be positioned at the midpoint of the interval to be sampled. For 1.5-ft-long samplers, at each sampling depth in the screened interval, make two attachment points on the weighted line at a distance of about 1.5 ft apart. The attachment points should be positioned along the weighted line at a distance from the bottom end of the weight such that the midpoint between the knots will be at the desired sampling depth along the well screen. Sampler intervals are variable, but a simple approach is to use the top knot/loop of one sampler interval as the bottom knot/loop for the overlying sampler interval.

Figure 2. Example of multiple PDB samplers prepared for deployment.

(c) PDB samplers should not be used in wells having screened or open intervals longer than 10 ft unless used in conjunction with borehole flow meters or other techniques to characterize vertical variability in hydraulic conductivity and contaminant distribution or used strictly for qualitative reconnaissance purposes. This is because of the increased potential for cross contamination of water-bearing zones and hydraulically driven mixing effects that may cause the contaminant stratification in the well to differ from the contaminant stratification in the adjacent aquifer material. If it is necessary to sample such wells, then multiple PDB samplers should be installed vertically across the screened or open interval to determine the zone of highest concentration and whether contaminant stratification is present.

4. The samplers should be attached to the weights or weighted line at the time of deployment. For samplers utilizing the hanger and weight assembly, the line can be attached directly to the top of the sampler. PDB samplers utilizing an outer protective mesh can be attached to a weighted line by using the following procedure:

(a) Insert cable ties through the attachment points in the weighted line.

(b) At each end of the PDB sampler, weave the ends of the cable ties or clamp through the LPDE mesh surrounding the sampler and tighten the cable ties. Thus, each end of the PDB sampler will be attached to a knot/loop in the weighted line by means of a cable tie or clamp. The cable ties or clamps should be positioned through the polyethylene mesh in a way that prevents the PDB sampler from sliding out of the mesh.

(c) Trim the excess from the cable tie before placing the sampler down the well. Caution should be exercised to prevent sharp edges on the trimmed cable ties that may puncture the LDPE.

5. When using PDB samplers without the protective outer mesh, the holes punched at the ends of the bag, outside the sealed portion, can be used to attach the samplers to the weighted line. Stainless-steel spring clips have been found to be more reliable than cable ties in this instance, but cable ties also work well.

6. Lower the weight and weighted line down the well until the weight rests on the bottom of the well and the line above the weight is taut. The PDB samplers should now be positioned at the expected depth. A check on the depth can be done by placing a knot or mark on the line at the correct distance from the top knot/loop of the PDB sampler to the top of the well casing and checking to make sure that the mark aligns with the lip of the casing after deployment.

7. Secure the assembly in this position. A suggested method is to attach the weighted line to a hook on the inside of the well cap. Reattach the well cap. The well should be sealed in such a way as to prevent surface-water invasion. This is particularly important in flush-mounted well vaults that are prone to flooding.

8. Allow the system to remain undisturbed as the PDB samplers equilibrate.

PASSIVE DIFFUSION BAG SAMPLER AND SAMPLE RECOVERY

The amount of time that the samplers should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for environmental disturbances caused by sampler deployment to return to ambient conditions. The rate that the water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. The concentrations of benzene, *cis*-1,2-dichloroethene (*c*DCE), tetrachlorethene (PCE), trichloroethene (TCE), toluene, naphthalene, 1,2-dibromoethane (EDB), and total xylenes within the PDB samplers equilibrated with the concentrations in an aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 °C (Vroblesky and Campbell, 2001). A subsequent laboratory study of mixed VOCs at 10 °C showed that PCE and TCE were equilibrated by about 52 hours, but other compounds required longer equilibration times (T.M. Sivavec and S.S. Baghel, General Electric Company, written commun., 2000). Chloroethane, *c*DCE, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours, but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed-VOC solutions have not yet been thoroughly examined.

Under field conditions, the samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. The results of borehole dilution studies show that wells can recover to 90 percent of the predisturbance conditions within minutes to several hours for permeable to highly permeable geologic formations, but may require 100 to 1,000 hours (4 to 40 days) in muds, very fine-grained loamy sands, and fractured rock, and may take even longer in fractured shales, recent loams, clays, and slightly fractured solid igneous rocks (Halevy and others, 1967).

In general, where the rate of ground-water movement past a diffusion sampler is high, equilibration times through various membranes commonly range from a few hours to a few days (Mayer, 1976; Harrington and others, 2000). One field investigation showed adequate equilibration of PDB samplers to aquifer trichloroethene (TCE) and carbon tetrachloride (CT) concentrations within 2 days in a highly permeable aquifer (Vroblesky and others, 1999). In other investigations, PDB samplers recovered after 14 days were found to be adequately equilibrated to chlorinated VOCs (Obrien & Gere Engineers, Inc., 1997a, 1997b; Hare, 2000); therefore, the equilibration period was less than or equal to 14 days for those field conditions. Because it appears that 2 weeks of equilibration probably is adequate for many applications, a minimum equilibration time of 2 weeks is suggested. When applying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating field data, a side-by-side comparison with conventional sampling methodology is advisable to justify the field equilibration time.

In less permeable formations, longer equilibration times may be required. It is probable that water in the well bore eventually will equilibrate with the pore-water chemistry; however, if the rate of chemical change or volatilization loss in the well bore exceeds the rate of exchange between the pore water and the well-bore water, then the PDB samplers may underestimate pore-water concentrations. Guidelines for equilibration times and applicability of PDB samplers in low-permeability formations have not yet been established. Therefore, in such situations, a side-by-side comparison of PDB samplers and conventional sampling methodology is advisable to ensure that the PDB samplers do not underestimate concentrations obtained by the conventional method. A detailed discussion of diffusion rates relevant to diffusion sampler equilibrium in slow-moving ground-water systems can be found in Harrington and others (2000).

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified maximum time for sampler recovery. PDB samplers have routinely been left in ground waters having concentrations of greater than 500 ppm of TCE for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers have been left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity (Paul Hare, General Electric Company, oral commun., 2000). The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations. Moreover, in some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices (SPMDs) have shown that the transfer of some compounds may be reduced, but not stopped, across a heavily biofouled polyethylene membrane (Ellis and others, 1995; Huckins and others, 1996; Huckins and others, in press). If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparing contaminant concentrations from the PDB sampler to concentrations from a conventional sampling method before continuing to use PDB samplers for long-term deployment in that well.

Recovery of PDB samplers is accomplished by using the following approach:

1. Remove the PDB samplers from the well by using the attached line. The PDB samplers should not be exposed to heat or agitated.

2. Examine the surface of the PDB sampler for evidence of algae, iron or other coatings, and for tears in the membrane. Note the observations in a sampling field book. If there are tears in the membrane, the sample should be rejected. If there is evidence that the PDB sampler exhibits a coating, then this should be noted in the validated concentration data.

3. Detach and remove the PDB sampler from the weighted line. Remove the excess liquid from the exterior of the bag to minimize the potential for cross contamination.

4. A variety of approaches may be used to transfer the water from the PDB samplers to 40-mL volatile organic analysis (VOA) vials. One type of commercially available PDB sampler provides a discharge device that can be inserted into the sampler. If discharge devices are used, the diameter of the opening should be kept to less than about 0.15 inches to reduce volatilization loss. Two options are presently available to recover water from the sample using discharge devices. One option involves removing the hanger and weight assembly from the sampler, inverting the sampler so that the fill plug is pointed upward, and removing the plug. The water can be recovered by directly pouring in a manner that minimizes agitation or by pouring through a VOC-discharge accessory inserted in place of the plug. The second approach involves piercing the sampler near the bottom with a small-diameter discharge tube and allowing water to flow through the tube into the VOA vials. In each case, flow rates can be controlled by tilting or manipulating the sampler. Alternatively, the PDB sampler can be cut open at one end using scissors or other cutting devices which have been decontaminated between use for different wells. Water can then be transferred to 40-ml VOA vials by gently pouring in a manner that minimizes water agitation. Acceptable duplication has been obtained using each method. Preserve the samples according to the analytical method. The sampling vials should be stored at approximately 4 °C in accordance with standard sampling protocol. Laboratory testing suggests that there is no substantial change in the VOC concentrations in PDB samplers over the first several minutes after recovery; however, the water should be transferred from the water-filled samplers to the sample bottles immediately upon recovery.

5. A cost-effective alternative when using multiple PDB samplers in a single well is to field screen water from each sampler using gas chromatography. These results can be used to decide which of the multiple PDB samplers should be sent to an EPA-approved laboratory for standard analysis. Typically, at least the sample containing the highest concentration should be analyzed by a laboratory.

6. If a comparison is being made between concentrations obtained using PDB samplers and concentrations obtained using a conventional sampling approach, then the well should be sampled by the conventional approach soon after (preferably on the same day) recovery of the PDB sampler. The water samples obtained using PDB samplers should be sent in the same shipment, as the samples collected by the conventional approach for the respective wells. Utilizing the same laboratory may reduce analytical variability.

7. Any unused water from the PDB sampler and water used to decontaminate cutting devices should be disposed in accordance with local, state, and Federal regulations.

DETERMINING APPLICABILITY OF PASSIVE DIFFUSION BAG SAMPLERS AND INTERPRETATION OF DATA

When attempting to determine whether the use of PDB samplers is appropriate at a particular well, a common approach is to do a side-by-side comparison with a conventional sampling method during the same sampling event. This approach is strongly suggested in wells having temporal concentration variability. In a well having relatively low temporal concentration variability, comparison of the PDB-sampler results to historical concentrations may provide enough information to determine whether the PDB samplers are appropriate for the well. In general, if both PDB and conventional sampling produce concentrations that agree within a range deemed acceptable by local, state, and Federal regulatory agencies and meet the site-specific data-quality objectives, then a PDB sampler may be approved for use in that well to monitor ambient VOC concentrations. If concentrations from the PDB sampler are higher than concentrations from the conventional method, it is probable that concentrations from the PDB sampler adequately represent ambient conditions because there usually is a greater potential for dilution from mixing during sampling using conventional methods than during sampling using PDB samplers.

If, however, the conventional method produces concentrations that are significantly higher than those obtained using the PDB sampler, then it is uncertain whether the PDB-sampler concentrations represent local ambient conditions. In this case, further testing can be done to determine whether contaminant stratification and/or intra-borehole flow is present. Multiple sampling devices can be used to determine the presence of contaminant stratification, and borehole flowmeters can be used to determine whether intra-borehole flow is present. When using flowmeters to measure vertical flow in screened boreholes, however, the data should be considered qualitative because of the potential for water movement through the sand pack. Borehole dilution tests (Halevy and others, 1967; Drost and others, 1968; Grisak and others, 1977; Palmer, 1993) can be used to determine whether water is freely exchanged between the aquifer and the well screen.

Once the source of the difference between the two methods is determined, a decision can be made regarding the well-specific utility of the PDB samplers. Tests may show that VOC concentrations from the PDB samplers adequately represent local ambient conditions within the screened interval despite the higher VOC concentration obtained from the conventional method. This may be because the pumped samples incorporated water containing higher concentrations either from other water-bearing zones induced along inadequate well seals or through fractured clay (Vroblesky and others, 2000), from other water-bearing zones not directly adjacent to the well screen as a result of well purging prior to sampling (Vroblesky and Petkewich; 2000), or from mixing of chemically stratified zones in the vicinity of the screened interval (Vroblesky and Peters, 2000).

The mixing of waters from chemically stratified zones adjacent to the screened interval during pumping probably is one of the more important sources of apparent differences between the results obtained from PDB sampling and conventional sampling because such stratification probably is common. Vertical stratification of VOCs over distances of a few feet has been observed in aquifer sediments by using multilevel sampling devices (Dean and others, 1999; Pitkin and others, 1999), and considerable variation in hydraulic conductivity and water chemistry has been observed in an aquifer in Cape Cod, Massachusetts, on the scale of centimeters (Wolf and others, 1991; Smith and others 1991; Hess and others, 1992). Multiple PDB samplers have been used to show a change in TCE concentration of 1,130 (µg/L over a 6-ft vertical screened interval in Minnesota (Vroblesky and Petkewich, 2000). Tests using PDB samplers in screened intervals containing VOC stratification showed that the PDB-sampler data appeared to be point-specific, whereas the pumped sample integrated water over a larger interval (Vroblesky and Peters, 2000).

The decision on whether to use PDB samplers in such situations depends on the data-quality objectives for the particular site. If the goal is to determine and monitor higher concentrations or to examine contaminant stratification within the screened interval, then the PDB samplers may meet this objective. If the goal is to determine the average concentrations for the entire screened interval, then a pumped sample or an average from multiple diffusion samplers may be appropriate.

As an aid in the decision-making process, the following section examines the influences that hydraulic and chemical heterogeneity of an aquifer can have on sample quality in long-screened wells. Because VOC concentrations from PDB samplers commonly are compared to VOC concentrations from other sampling methodologies, the second section examines the differences in sample quality between these methodologies in situations of hydraulic and chemical heterogeneity.

Influences of Hydraulic and Chemical Heterogeneity on Sample Quality in Long-Screened Wells

Sampling biases and chemical variability in long-screened wells, which can be loosely defined as wells having significant physical and chemical heterogeneity within the screened interval and in the adjacent aquifer (Reilly and Leblanc, 1998), have been the subject of numerous investigations. Sources of chemical variability in such wells include non-uniform flow into wells (Robbins and Martin-Hayden, 1991; Reilly and Gibs, 1993; Chiang and others, 1995; Church and Granato, 1996; Reilly and LeBlanc, 1998), lithologic heterogeneity (Reilly and others, 1989; Robbins, 1989; Martin-Hayden and others, 1991; Gibs and others, 1993; Reilly and Gibs, 1993), and in-well mixing. In a well open across a chemically or hydraulically heterogeneous section of the aquifer, differences in the sampling methodology can produce significant differences in the sampling results.

Long-screened wells have the potential to redistribute chemical constituents in the aquifer where there are vertical hydraulic gradients within the screened interval. Water can move into the well from one horizon and exit the well at a different horizon (Church and Granato, 1996; Reilly and LeBlanc 1998). If there is vertical flow in the screened or open interval, and the zone of low hydraulic head (outflow from the well) is within the contaminated horizon, then the PDB samplers (or any standard sampling methodology) can underestimate or not detect the contamination. The reason is that, in this case, the contaminated horizon does not contribute water to the well under static conditions. Instead, water from other horizons with higher hydraulic head will invade the contaminated horizon by way of the well screen. Under pumped conditions, the majority of the extracted water will be from the most permeable interval, which may not be the contaminated zone. Even when pumping induces inflow from the contaminated interval, much of that inflow will be a reflection of the residual invaded water from other horizons. In this situation, a substantial amount of purging would be required before water representative of the aquifer could be obtained (Jones and Lerner, 1995). Such sampling is not likely to reflect a significant contribution from the contaminated zone, and concentrations in the contaminated zone probably will be underestimated.

Similarly, if VOC-contaminated water is flowing into the well and is exiting the well at a different horizon, then VOCs will be present along the screened interval between the two horizons. In this case, VOC concentrations in the screened interval may be representative of aquifer concentrations at the inflow horizon, but may not be representative of aquifer concentrations near the outflow horizon.

In areas where vertical stratification of VOC concentrations is anticipated, using multiple PDB samplers may more fully characterize the contaminated horizon than using a single PDB sampler. This is particularly true in wells having screens 10 ft or longer; however, significant VOC stratification has been observed over intervals of less than 5 ft (Vroblesky and Peters, 2000). Because of the increased probability of vertical concentration or hydraulic gradients within the open interval of long-screened (greater than 10 ft) wells, it is advisable to determine the zones of inflow and outflow within the screened or open interval of these wells using borehole flowmeter analysis (Hess, 1982; 1984; 1986; 1990; Young and others, 1998).

Comparison of Passive Diffusion Bag Sampling Methodology to Conventional Methodologies

Traditional sampling methodologies, such as the purge-and-sample (or conventional purging method), low-flow or low-volume sampling, and using straddle packers and multilevel samplers, produce VOC concentrations that may differ from VOC concentrations obtained from PDB samplers because the methodologies sometimes are influenced in different ways by aquifer hydraulic and chemical heterogeneity. This section examines potential sources of concentration differences between traditional methodologies and the PDB methodology.

The purge-and-sample approach to ground-water monitoring differs from the diffusion-sampler approach primarily because the area of the screened or open interval that contributes water to the purged sample typically is greater than for the PDB sampler, and the potential for mixing of stratified layers is higher. When pumping three or more casing volumes of water prior to collecting a sample, chemical concentrations in the discharging water typically change as the well is pumped (Keely and Boateng, 1987; Cohen and Rabold, 1988; Martin-Hayden and others, 1991; Robbins and Martin-Hayden, 1991; Reilly and Gibs, 1993; Barcelona and others, 1994; Martin-Hayden, 2000), due to mixing during pumping and other factors, such as the removal of stagnant water in the casing and changing patterns of inflow and outflow under ambient and pumping conditions (Church and Granato, 1996). The induction of lateral chemical heterogeneity during pumping also may produce variations in the sampled concentrations. The amount of mixing during purging can be highly variable (Barber and Davis, 1987; Church and Granato, 1996; Reilly and LeBlanc, 1998; Martin-Hayden, 2000), and may result in concentrations that are not locally representative (Reilly and Gibs, 1993). Substantial vertical hydraulic gradients, even in shallow homogeneous aquifers, have been observed to bias sampling using conventional purging because the majority of the pumped water may come from a particular horizon not related to the contaminated zone and because the intra-well flow that intruded the aquifer may not be adequately removed during purging (Hutchins and Acree, 2000). Thus, differences may be observed between concentrations obtained from a pumped sample and from a PDB sample in a chemically stratified interval if the pumped sample represents an integration of water collected from multiple horizons and the PDB sampler represents water collected from a single horizon.

Low-flow purging and sampling (Barcelona and others, 1994; Shanklin and others, 1995) disturbs the local ground water less than conventional purge-and-sample methods. Thus, samples obtained by PDB samplers are likely to be more similar to samples obtained by using low-flow purging than to those obtained by using conventional purge-and-sample methods. Even under low-flow conditions, however, purging still can integrate water within the radius of pumping influence, potentially resulting in a deviation from VOC concentrations obtained by PDB sampling. One investigation found that in low hydraulic conductivity formations, low-flow sampling methodology caused excessive drawdown, which dewatered the screened interval, increased local ground-water velocities, and caused unwanted colloid and soil transport into the ground-water samples (Sevee and others, 2000). The authors suggest that in such cases, a more appropriate sampling methodology may be to collect a slug or passive sample from the well screen under the assumption that the water in the well screen is in equilibrium with the surrounding aquifer.

Isolating a particular contributing fracture zone with straddle packers in an uncased borehole allows depth-discrete samples to be collected from the target horizon (Hsieh and others, 1993; Kaminsky and Wylie, 1995). Strategically placed straddle packers often can minimize or eliminate the impact of vertical gradients in the sampled interval. However, even within a packed interval isolating inflowing fracture zones, deviations between VOC concentrations in water from PDB samplers and water sampled by conventional methods still may occur if the conventional method mixes chemically stratified water outside the borehole or if the packed interval straddles chemically heterogeneous zones.

The use of multilevel PDB samplers and other types of multilevel samplers (Ronen and others, 1987; Kaplan and others, 1991; Schirmer and others, 1995; Gefell and others, 1999; Jones and others, 1999) potentially can delineate some of the chemical stratification. Diffusion sampling and other sampling methodologies, however, can be influenced by vertical hydraulic gradients within the well screen or the sand pack. When vertical hydraulic gradients are present within the well, water contacting the PDB sampler may not be from a horizon adjacent to the PDB sampler. Rather, the water may represent a mixing of water from other contributing intervals within the borehole. In a screened well, even multilevel samplers with baffles to limit vertical flow in the well cannot prevent influences from vertical flow in the gravel pack outside the well screen. Such vertical flow can result from small vertical differences in head with depth. A field test conducted by Church and Granato (1996) found that vertical head differences ranging from undetectable to 0.49 ft were sufficient to cause substantial flows (as much as 0.5 liters/minute) in the well bore.

QUALITY CONTROL AND ASSURANCE

The sources of variability and bias introduced during sample collection can affect the interpretation of the results. To reduce data variability caused during sampling, a series of quality-control samples should be utilized.

Replicate samples are important for the quality control of diffusion-sampler data. Sample replicates provide information needed to estimate the precision of concentration values determined from the combined sample-processing and analytical method and to evaluate the consistency of quantifying target VOCs. A replicate sample for water-filled diffusion samplers consists of two separate sets of VOC vials filled from the same diffusion sampler. Each set of VOC vials should be analyzed for comparison. Approximately 10 percent of the samplers should be replicated.

The length of the PDB sampler can be adjusted to accommodate the data-quality objectives for the sampling event. The length can be increased if additional volume is required for collection of replicate and matrix spike/matrix spike duplicate samples.

Trip blanks are used to determine whether external VOCs are contaminating the sample due to bottle handling and/or analytical processes not associated with field processing. Trip blanks are water-filled VOA vials prepared offsite, stored and transported with the other bottles used for collecting the environmental sample, and then submitted for analysis with the environmental sample. Consideration also should be given to the collection of a predeployment PDB trip blank to determine if the PDB samplers are exposed to extraneous VOCs prior to deployment. The predeployment trip blank should be a PDB sampler that is stored and transported with the field PDB samplers from the time of sampler construction to the time of deployment in the wells. An aliquot of the predeployment blank water should be collected from the PDB sampler in a VOA vial and submitted for analysis at the time of sampler deployment.

Water used to construct the diffusion samplers should be analyzed to determine the presence of background VOCs. Although many VOCs accidentally introduced into the diffusion-sampler water probably will reequilibrate with surrounding water once the diffusion samplers are deployed, some VOCs may become trapped within the diffusion-sampler water. For example, acetone, which is a common laboratory contaminant, does not easily move through the polyethylene diffusion samplers (Paul Hare, General Electric Company, oral commun., 1999). Thus, acetone inadvertently introduced into the diffusion-sample water during sampler construction may persist in the samplers, resulting in a false positive for acetone after sampler recovery and analysis.

SUMMARY

Water-filled passive diffusion bag (PDB) samplers described in this report are suitable for obtaining a variety of VOCs in ground water at monitoring wells. The suggested application for PDB samplers is for long-term monitoring of VOCs in ground-water wells at well-characterized sites. Where the screened interval is greater than 10 ft, the potential for contaminant stratification and/or intra-borehole flow within the screened interval is greater than in screened intervals shorter than 10 ft. It is suggested that the vertical distribution of contaminants be determined in wells having 10-ft-long well screens, and that both the vertical distribution of contaminants and the potential for intra-borehole flow be determined in wells having screens longer than 10 ft. A typical PDB sampler consists of a 1- to 2-ft-long low-density polyethylene lay-flat tube closed at both ends and containing deionized water. The sampler is positioned at the target horizon by attachment to a weighted line or fixed pipe.

The amount of time that the samplers should be left in the well prior to recovery depends on the time required by the PDB sampler to equilibrate with ambient water and the time required for environmental disturbances caused by sampler deployment to return to ambient conditions. The rate that water within the PDB sampler equilibrates with ambient water depends on multiple factors, including the type of compound being sampled and the water temperature. Concentrations of benzene, *cis*-1,2-dichloroethene, tetrachlorethene, trichloroethene, toluene, naphthalene, 1,2-dibromoethane, and total xylenes within the PDB samplers equilibrated with the concentrations in an

aqueous mixture of those compounds surrounding the samplers under laboratory conditions within approximately 48 hours at 21 °C. A subsequent laboratory study of mixed VOCs at 10 °C showed that tetrachloroethene and trichloroethene were equilibrated by about 52 hours, but other compounds required longer equilabration times. Chloroethane, *cis*-1,2-dichloroethene, *trans*-1,2-dichloroethene, and 1,1-dichloroethene were not equilibrated at 52 hours, but appeared to be equilibrated by the next sampling point at 93 hours. Vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichloroethane were not equilibrated at 93 hours but were equilibrated by the next sampling point at 166 hours. Different equilibration times may exist for other compounds. Differences in equilibration times, if any, between single-solute or mixed-VOC solutions have not yet been thoroughly examined.

The samplers should be left in place long enough for the well water, contaminant distribution, and flow dynamics to restabilize following sampler deployment. Laboratory and field data suggest that 2 weeks of equilibration probably is adequate for many applications. Therefore, a minimum equilibration time of 2 weeks is suggested. In less permeable formations, longer equilibration times may be required. When deploying PDB samplers in waters colder than previously tested (10 °C) or for compounds without sufficient corroborating data, a side-by-side comparison with conventional methodology is advisable to justify the field equilibration time.

Following the initial equilibration period, the samplers maintain equilibrium concentrations with the ambient water until recovery. Thus, there is no specified maximum time for sampler recovery after initial equilibration. PDB samplers have routinely been left in ground waters having concentrations of greater than 500 ppm of TCE for 3 months at a time with no loss of bag integrity, and at one site, the PDB samplers were left in place in VOC-contaminated ground water for 1 year with no reported loss of sampler integrity. The effects of long-term (greater than 1 month) PDB-sampler deployment on sampler and sample integrity have not yet been thoroughly tested for a broad range of compounds and concentrations. In some environments, development of a biofilm on the polyethylene may be a consequence of long-term deployment. Investigations of semipermeable membrane devices (SPMDs) have shown that the transfer of some compounds across a heavily biofouled polyethylene membrane may be reduced, but not stopped. If a heavy organic coating is observed on a PDB sampler, it is advisable to determine the integrity of the sample by comparing sampler results to a conventional sampling method concentrations before continuing to use PDB samplers for long-term deployment in that well.

PDB methodology is suitable for a broad variety of VOCs, including chlorinated aliphatic compounds and petroleum hydrocarbons. The samplers, however, are not suitable for inorganic ions and have a limited applicability for non-VOCs and for some VOCs. For example, although methyl-*tert*-butyl ether and acetone and most semivolatile compounds are transmitted through the polyethylene bag, laboratory tests have shown that the resulting concentrations were lower than in ambient water. The samplers should not be used to sample for phthalates because of the potential for the LDPE to contribute phthalates to the water sample.

When attempting to determine whether the use of PDB samplers is appropriate at a particular well, a common approach is to do a side-by-side comparison with a conventional sampling method. This approach is strongly suggested in wells having temporal concentration variability. In a well having relatively low temporal concentration variability, comparison of the PDB-sampler results to historical concentrations may provide enough information to determine whether the PDB samplers are appropriate for the well. In general, if the two approaches produce concentrations that agree within a range deemed acceptable by the local, state, and Federal regulatory agencies, then use of a PDB sampler in that well will provide VOC concentrations consistent with the historical record. If concentrations from the PDB sampler are higher than concentrations from the conventional method, then it is probable that the concentrations from the PDB sampler are an adequate representation of ambient conditions. If, however, the conventional method produces concentrations that are substantially higher than the concentrations found by using the PDB sampler, then the PDB sampler may or may not adequately represent local ambient conditions. In this case, the difference may be due to a variety of factors, including mixing or translocation due to hydraulic and chemical heterogeneity of the aquifer within the screened or open interval of the well and the relative permeability of the well screen.

REFERENCES

Barber, C., and Davis, G.B., 1987, Representative sampling of ground water from short screened boreholes: Ground Water, v. 25, no. 5, p. 581-587.

Barcelona, M., Wehrmann, H.A., and Varljen,. M.D., 1994, Reproducible well-purging procedures and VOC stabilization criteria for ground-water sampling: Ground Water, v. 32, p. 12-22.

Chiang, C.C., Raven, Gary, and Dawson, Clint, 1995, The relationship between monitoring well and aquifer solute concentrations: Ground Water, v. 32, no. 5, p. 718-126.

Church, P.E., and Granato, G.E., 1996, Effects of well design and sampling methods on bias of water-quality samples: Ground Water, v. 34, no. 2, p. 262-273.

Cohen, R.M., and Rabold, R.R., 1988, Simulation of sampling and hydraulic tests to assess a hybrid monitoring well design: Ground Water Monitoring Review, v. 8, no. 1, p. 55-59.

Comyn, J., 1985, Polymer Permeability: New York, Elsevier Applied Science Publishers Ltd, 383 p.

Dean, S.M., Lendvay, J.M., Barcelona, M.J., Adriaens, P., and Katopodes, N.D., 1999, Installing multilevel sampling arrays to monitor ground water and contaminant discharge to a surface-water body: Ground Water Monitoring and Remediation, Fall 1999, p. 90-96.

Drost, W., Klotz, D., Koch, A., Moser, H., Neurnaier, F., and Rauert, W., 1968, Point dilutions methods of investigating ground water flow by means of radioisotopes: Water Resources Research, v. 4, no. 1, p. 125-146.

Ellis, G.S., Huckins, J.N., Rostad, C.E., Schmitt, C.J., Petty, J.D., and MacCarthy, Patrick, 1995, Evaluation of lipid-containing semipermeable membrane devices for monitoring organochlorine contaminants in the upper Mississippi River: Environmental Science and Technology, v. 14, no. 11, p. 1875-1884.

Flynn, G.L., and Yalkowsky, S.H., 1972, Correlation and prediction of mass transport across membrane I: Influence of alkyl chain length on flux determining properties of barrier and diffusant: Journal of Pharmaceutical Science, v. 61, p. 838-852.

Gale, R.W., 1998, Three-compartment model for contaminant accumulation by semipermeable membrane devices: Environmental Science and Technology, v. 32, p. 2292-2300.

Gefell, M.J., Hamilton, L.A., and Stout, D.J., 1999, A comparison between low-flow and passive-diffusion bag sampling results for dissolved volatile organics in fractured sedimentary bedrock, *in* Proceedings of the Petroleum and Organic Chemicals in Ground Water--Prevention, Detection, and Remediation Conference, November 17-19, 1999, Houston, Texas, p. 304-315.

Gibs, Jacob, Brown, G.A., Turner, K.S., MacLeod, C.L., Jelinski, J.C., and Koehnlein, S.A., 1993, Effects of small-scale vertical variations in well-screen inflow rates and concentrations of organic compounds on the collection of representative ground water quality samples: Ground Water, v. 35, no. 2, p. 201-208.

Gillham R.W., II, Robin, M.J.L., Barker, J.F., and Cherry, J.A., 1985, Field evaluation of well flushing procedures: Washington, D.C., American Petroleum Institute Publication 4405.

Grisak, G.E., Merritt, W.F., and Williams, D.W., 1977, A fluoride borehole dilution apparatus for ground water velocity measurements: Canadian Geotechnical Journal, v. 14, p. 554-561.

Halevy, E., Moser, H., Zellhofer, O, and Zuber, A., 1967, Borehole dilution techniques: A critical review, Isotopes in Hydrology: Vienna, Austria, International Atomic Energy Agency, p. 531-564.

Hare, P.W., 2000, Passive diffusion bag samplers for monitoring chlorinated solvents in ground water: The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle, May 22-25, 2000, Monterey, California.

Harrington, G.A., Cook, P.G., and Robinson, N.I., 2000, Equilibration times of gas-filled diffusion samplers in slow-moving ground-water systems: Ground Water Monitoring and Remediation, Spring 2000, p. 60-65.

Hess, A.E., 1982, A heat-pulse flowmeter for measuring low velocities in boreholes: U.S. Geological Survey Open-File Report 82-699, 44 p.

_____ 1984, Use of a low-velocity flowmeter in the study of hydraulic conductivity of fractured rock: Proceedings of National Water Well Association Conference on Surface and Borehole Geophysics, San Antonio, Texas, p. 812-831.

_____ 1986, Identifying hydraulically conductive fractures with a slow-velocity borehole flowmeter: Canadian Geotechnical Journal, v. 23, no. 1, p. 69-78.

_____ 1990, A thermal flowmeter for the measurement of slow velocities in boreholes: U.S. Geological Survey Open-File Report 87-121.

Hess, K.M., Wolf, S.H., and Celia, M.A., 1992, Large-scale natural gradient tracer test in sand and gravel, Cape Cod, Massachusetts, 3. Hydraulic conductivity variability and calculated macrodispersivities. Water Resources Research, v. 28, no. 8, p. 2011-2027.

Hsieh, P.A., Shapiro, A.M., Barton, C.C., Haeni, F.P., Johnson, C.D., Martin, C.W., Paillet, F.L., Winter, T.C., and Wright, D.L., 1993, Methods of characterizing fluid movement and chemical transport in fractured rocks, *in* Field Trip Guidebook for the Northeastern United States: 1993 Boston GSA, Cheney, J.T., and Hepburn, J.C., eds., RI-R30. Amherst: University of Massachusetts, Department of Geology and Geography.

Huckins, J.N., Petty, J.D., Lebo, J.A., Orazio, C.E., Prest, H.F., Tillitt, D.E., Ellis, G.S., Johnson, B.T., and Manuweera, G.K., 1996, Semipermeable membrane devices (SPMDs) for the concentration and assessment of bioavailable organic contaminants in aquatic environments, *in* Ostander, G.K., ed., Techniques in Aquatic Toxicology: Boca Raton, Fla., CRC-Lewis Publishers, p. 625-655.

Huckins, J.N, Petty, J.D., Prest, H.F., Clark, R.C., Alverez, D.A., Orazio, C.E., Lebo, J.A., Cranor, W.L., and Johnson, B.T., in press, A guide for the use of semipermeable membrane devices (SPMDs) as samplers of waterborne hydrophobic organic contaminants: Report for the American Petroleum Institute (API), Washington, DC., API publication number 4690.

Hutchins, S.R., and Acree, S.D., 2000, Ground water sampling bias observed in shallow, conventional wells: Ground Water Monitoring and Remediation, Winter 2000, p. 86-93.

Hwang, S.T., and Kammermeyer, K., 1975, Membranes in Separations: Malabar, Fla., Robert E. Krieger Publishing Company, Inc., 559 p.

Jones, Ian, and Lerner, D.N., 1995, Level-determined sampling in an uncased borehole: Journal of Hydrology, v. 171, p. 291-317.

Jones, Ian, Lerner, D.N., and Baines, O.P., 1999, Multiport sock samplers: Alow cost technology for effective multilevel ground water sampling: Ground Water Monitoring and Remediation, v. 19, no. 1, p. 134-142.

Kaminsky, J.F., and Wylie, A.H., 1995, Vertical contaminant profiling of volatile organics in a deep fractured basalt aquifer: Ground Water Monitoring and Remediation, v. 15, no. 2, p. 97-103.

Kaplan, Edward; Banerjee, Sujit; Ronen, Daniel; Margaritz, Mordeckai; Machlin, Alber; Sosnow, Michael; and Koglin, Eric, 1991, Multilayer sampling in the water-table region of a sandy aquifer: Ground Water, v. 29, no. 2, p. 191-198.

Kearl, P., Korte, N., and Cronk, T., 1992, Suggested modifications to ground water sampling procedures based on observations from the colloidal borescope: Ground Water Monitoring Review, v. 12, no. 2, p. 155-166.

Keely, J.F., and Boateng, K., 1987, Monitoring well installation, purging, and sampling techniques - Part 1: Conceptualizations: Ground Water, v. 25, no. 3, p. 3300-313.

Martin-Hayden, J.M, 2000, Sample concentration response to laminar wellbore flow: Implications to ground water data variability: Ground Water, v. 38, no. 1, p. 12-19.

Martin-Hayden, J.M., Robbins, G.A., and Bristol, R.D., 1991, Mass balance evaluation of monitoring well purging. Part II: Field tests at a gasoline contamination site: Journal of Contaminant Hydrology, v. 8, no. 3/4, p. 225-241.

Mayer, L.M., 1976, Chemical water sampling in lakes and sediments with dialysis bags, Limnology and Oceanography: v. 21, p. 909-912.

Obrien & Gere Engineers, Inc, 1997a, Passive bag sampling results, JMT Facility, Brockport, New York: Consultant's report to General Electric Company, Albany, New York, October 10, 1997, 10 p.

_____ 1997b, Passive bag sampling results, JMT Facility, Brockport, New York: Consultant's report to General Electric Company, Albany, New York, December 12, 1997, 10 p.

Palmer, C.D., 1993, Borehole dilution tests in the vicinity of an extraction well: Journal of Hydrology, v. 146, p. 245-266.

Pitkin, S.E., Ingleton, R.A., and Cherry, J.A., 1999, Field demonstrations using the Waterloo Ground Water Profiler: Ground Water Monitoring and Remediation, v. 19, no. 2, Spring 1999, p. 122-131.

Powell, R.M., and Puls, R.W., 1993, Passive sampling of ground water monitoring wells without purging: Multilevel well chemistry and tracer disappearance: Journal of Contaminant Hydrology, v. 12, p. 51-77.

Reilly, T.E., Frank, O.L., and Bennet, G.D., 1989, Bias in ground water samples caused by wellbore flow: ASCE, Journal of Hydraulic Engineering, v. 115, p. 270-276.

Reilly, T.E., and Gibs, J., 1993, Effects of physical and chemical heterogeneity of water-quality samples obtained from wells: Ground Water, v. 31, no. 5, p. 805-813.

Reilly, T.E., and LeBlanc, D.R., 1998, Experimental evaluation of factors affecting temporal variability of water samples obtained from long-screened wells: Ground Water , v. 36, no. 4, p. 566-576.

Robin, M.J.L., and Gillham, R.W., 1987, Field evaluation on well purging procedures: Ground Water Monitoring Review, v. 7, no. 4, p. 85-93.

Robbins, G.A., 1989, Influence of using purged and partially penetrating monitoring wells on contaminant detection, mapping and modeling: Ground Water, v. 27, no. 2, p. 155-162.

Robbins, G.A., and Martin-Hayden, J.M., 1991, Mass balance evaluation of monitoring well purging. Part I: Theoretical models and implications for representative sampling: Journal of Contaminant Hydrology, v. 8, no. 3/4, p. 203-224.

Ronen, Daniel, Magaritz, Mordeckai, and Levy, Itzhak, 1987, An *in situ* multilevel sampler for preventive monitoring and study of hydrochemical profiles in aquifers: Ground Water Monitoring and Remediation, Fall, p. 69-74.

Schirmer, M., Jones, I., Teutsch, G., and Lerner, D.N., 1995, Development and testing of multiport sock samplers for ground water: Journal of Hydrology, v. 171, p. 239-257.

Shanklin, D.E., Sidle, W.C., and Ferguson, M.E., 1995, Micro-purge low-flow sampling of uranium-contaminated ground water at the Fernald Environmental Management Project: Ground Water Monitoring and Remediation, v. 15, no. 3, p. 168-176.

Sevee, J.E., White, C.A., and Maher, D.J., 2000, An analysis of low-flow ground water sampling methodology: Ground Water Monitoring and Remediation, Spring 2000, v. 20, no. 2, p. 87-93.

Smith, R.L., Harvey, R.W., and LeBlanc, D.R., 1991, Importance of closely spaced vertical sampling in delineating chemical and microbial gradients in ground water studies: Journal of Contaminant Hydrology, v. 7, p. 285-300.

Vroblesky, D.A., 2000, Simple, inexpensive diffusion samplers for monitoring VOCs in ground water: The Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-25, 2000, Monterey, California.

Vroblesky, D.A., and Campbell, T.R., 2001, Equilibration times, stability, and compound selectivity of diffusion samplers for collection of ground-water VOC concentrations: Advances in Environmental Research, v. 5, no. 1, p. 1-12.

Vroblesky, D.A., and Hyde, W.T., 1997, Diffusion samplers as an inexpensive approach to monitoring VOCs in ground water: Ground Water Monitoring and Remediation, v. 17, no. 3, p. 177-184.

Vroblesky, D.A., Nietch, C.T., Robertson, J.F., Bradley, P.M., Coates, John, and Morris, J.T., 1999, Natural attenuation potential of chlorinated volatile organic compounds in ground water, TNX flood plain, Savannah River Site, South Carolina: U.S. Geological Survey Water-Resources Investigations Report 99-4071, 43 p.

Vroblesky, D.A., and Peters, B.C., 2000, Diffusion sampler testing at Naval Air Station North Island, San Diego County, California, November 1999 to January 2000: U.S. Geological Survey Water-Resources Investigations Report 00-4812, 27 p.

Vroblesky, D.A., and Petkewich, M.D., 2000, Field testing of passive diffusion bag samplers for volatile organic compound concentrations in ground water, Naval Industrial Reserve Ordnance Plant, Fridley, Minnesota, November 1999 and May 2000: U.S. Geological Survey Water-Resources Investigations Report 00-4246, 10 p.

Wolf, S.H., Celia, M.A., and Hess, K.M., 1991, Evaluation of hydraulic conductivities calculated from multiport permeameter measurements: Ground Water, v. 29, no. 4, p. 516-552.

Young, S.C., Julian, H.E., Pearson, H.S., Molz, F.J., and Boman, G.K, 1998, Application of the electromagnetic borehole flowmeter: U.S. Environmental Protection EPA/600/R-98/058, 56 p.

HYDRASleeve

Simple by Design

US Patents No. 6,481,300; No. 6,837,120; others pending

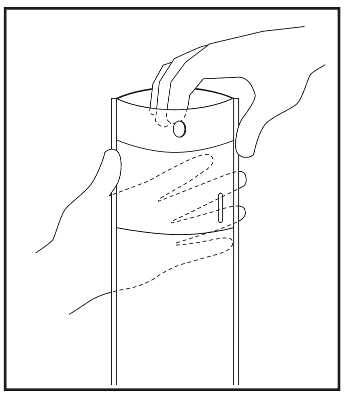
Field Manual

Introduction

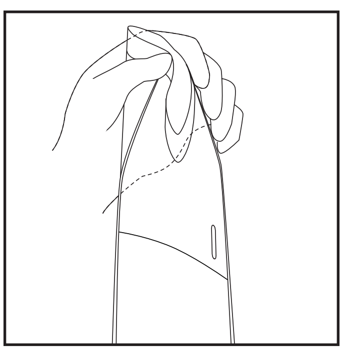
The HydraSleeve groundwater sampler can be used to collect a representative sample for most physical and chemical parameters without purging the well. It collects a whole water sample from a user-defined interval (typically within the well screen), without mixing fluid from other intervals. One or more HydraSleeves are placed within the screened interval of the monitoring well, and a period of time is allocated for the well to re-equilibrate. Hours to months later, the sealed HydraSleeve can be activated for sample collection. When activated, HydraSleeve collects a sample with no drawdown and minimal agitation or displacement of the water column. Once the sampler is full, the one-way reed valve collapses, preventing mixing of extraneous, non-representative fluid during recovery.

Assembly

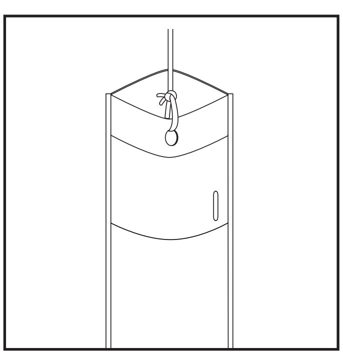
Assembling the HydraSleeve is simple, and can be done by one person in the field, taking only a minute or two.



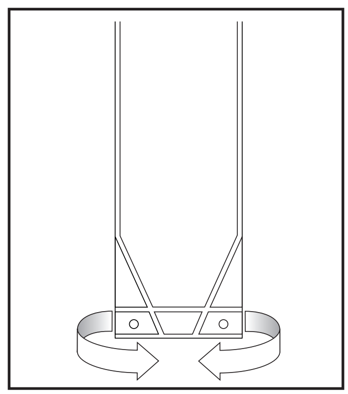
1 Remove HydraSleeve from package and grasp top to "pop" open.



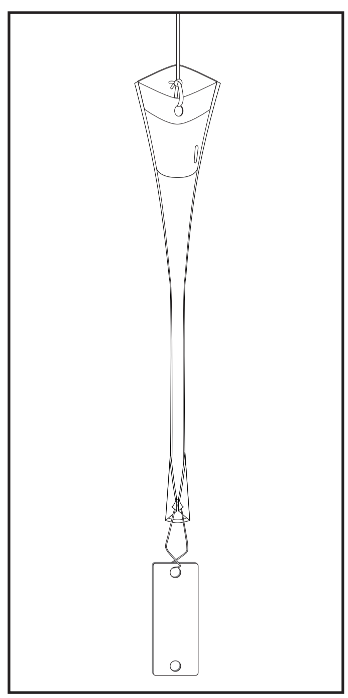
2 Squeeze side fins together at top to bend reinforcing strips outward.



3 Attach line to hole at top of HydraSleeve.



4 Fold the two holes at bottom of HydraSleeve together and attach weight



5 Sampler is ready to insert into the well.

Placing the HydraSleeve(s)

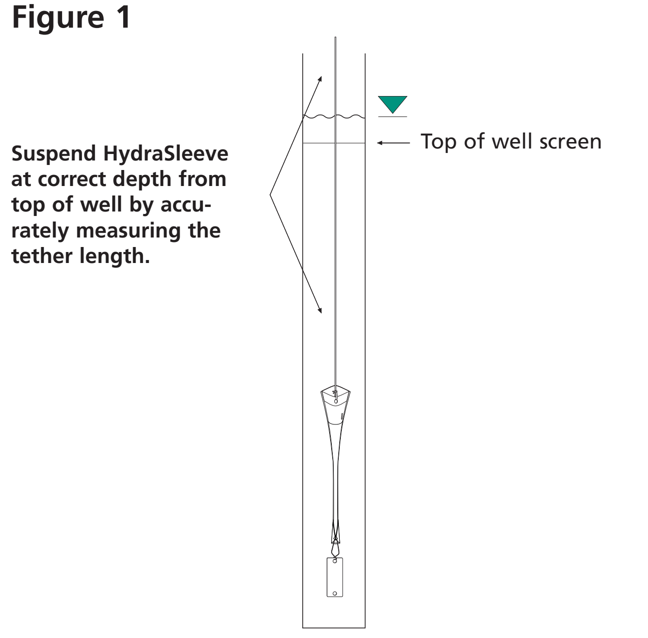
To collect a representative groundwater sample without purging, the well must be allowed time to re-equilibrate after placement of the sampler. When any device is lowered into a well, some mixing of the water column occurs. The diameter of the device and its shape greatly affect the degree of mixing. The flat cross-section of the empty HydraSleeve minimizes the disturbance to the water column as the sampler is lowered into position, reducing the time needed for the well to return to equilibrium.

There are three basic methods for holding a HydraSleeve in position as the well equilibrates.

TOP DOWN DEPLOYMENT (Figure 1)
Measure the correct amount of suspension line needed to "hang" the top of the HydraSleeve(s) at the desired sampling depth (in most cases, this will be at the bottom of the sampling zone). The upper end of the tether can be connected to the well cap to suspend the HydraSleeve at the correct depth until activated for sampling.

Note: For deep settings, it may be difficult to accurately measure long segments of suspension line in the field. Factory prepared, custom suspension line and attachment points can be provided.

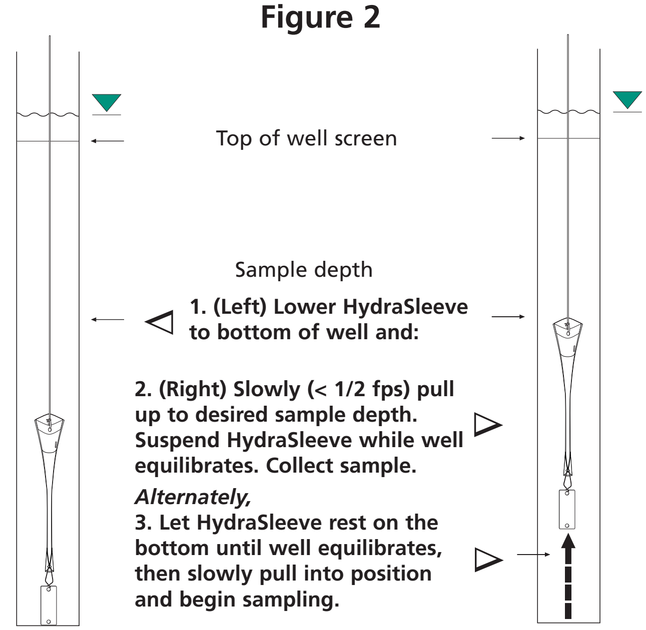
Figure 1



BOTTOM DEPLOYMENT (Figure 2)
Sound the well to determine the exact depth. Lower the weighted HydraSleeve into the well and let it touch the bottom. <u>Very slowly</u> (less than 1/2 foot per second) raise the sampler to the point where the check valve is at the depth the sample is to be collected. Attach the suspension line to the top of the well to suspend it at this depth. (It is often easier to measure a few feet from the bottom of the well up to the sample point, than it is to measure many feet from the top of the well down.)

Alternately, the sampler can be left on the bottom until the well re-equilibrates. For sampling, it can be very slowly pulled (< 1/2 fps) to sampling depth, then activated (see "Sample Collection," p. 6) to collect the sample, and retrieved to the surface.

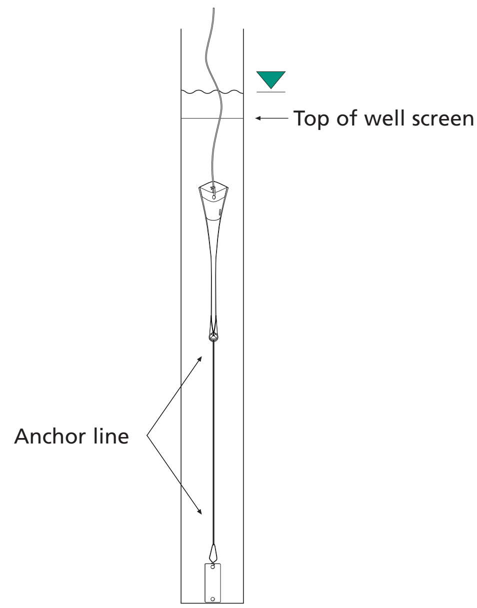
Figure 2



BOTTOM ANCHOR (Figure 3)

Determine the exact depth of the well. Calculate the distance from the bottom of the well to the desired sampling depth. Attach an appropriate length anchor line between the weight and the bottom of the sampler and lower the assembly until the weight rests on the bottom of the well, allowing the top of the sampler to float at the correct sampling depth.

Figure 3



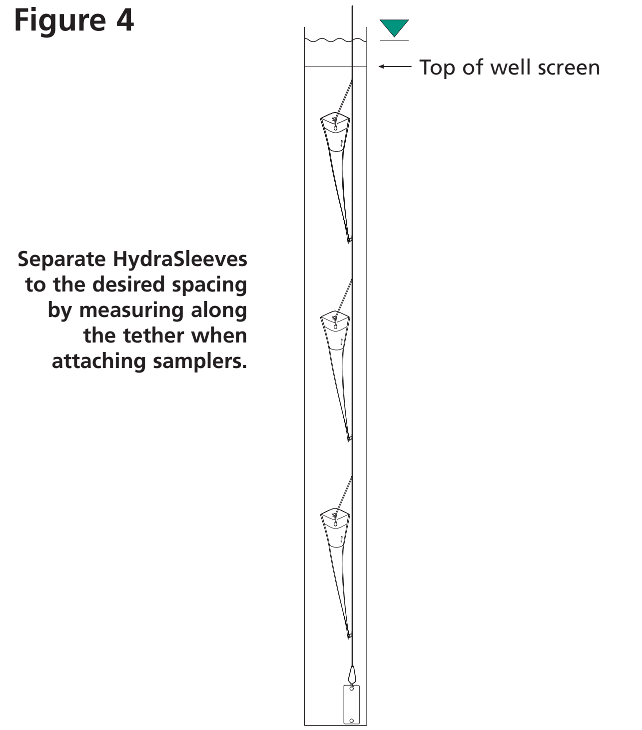
Multiple Interval Deployment

There are two basic methods for placing multiple HydraSleeves in a well to collect samples from different levels simultaneously.

ATTACHED TO A SINGLE TETHER (Figure 4)

To use 3 or more samplers simultaneously, we recommend attaching them all to a tether for support to prevent the sampling string from pulling apart. The weight is attached to a single length of suspension line and allowed to rest on the bottom of the well. The top and bottom of each HydraSleeve are attached to the tether at the desired sample intervals. Cable tie or stainless steel clips (supplied) work well for attaching the HydraSleeves to the line. Simply push one end of the clip between strands of the rope at the desired point before attaching the clip to the HydraSleeve.

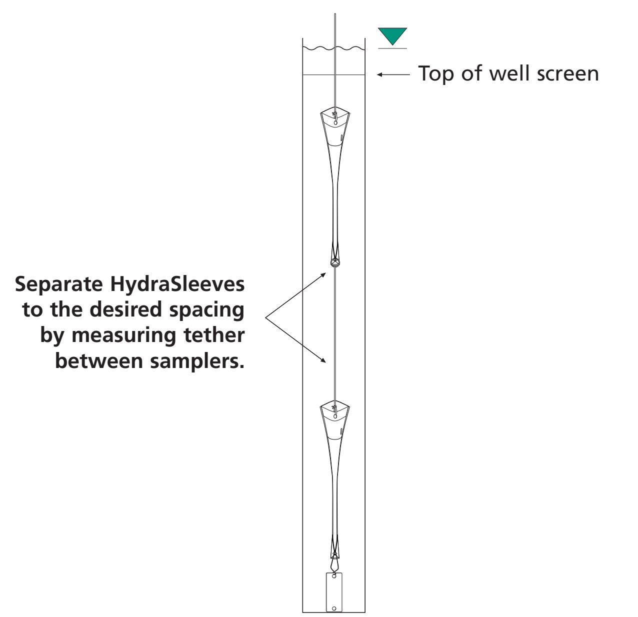
Figure 4



ATTACHED END TO END (Figure 5)

To place 2 or 3 stacked HydraSleeves for vertical profiling, use one of the methods described above to locate the bottom sampler. Attach the bottom of the top sampler to the top of the following HydraSleeve(s) with a carefully measured length of suspension cable. Connect the weight to the bottom sampler. Note: if many HydraSleeves are attached to a tether, more weight may be required than with a single sampler.

Figure 5



Sample Collection

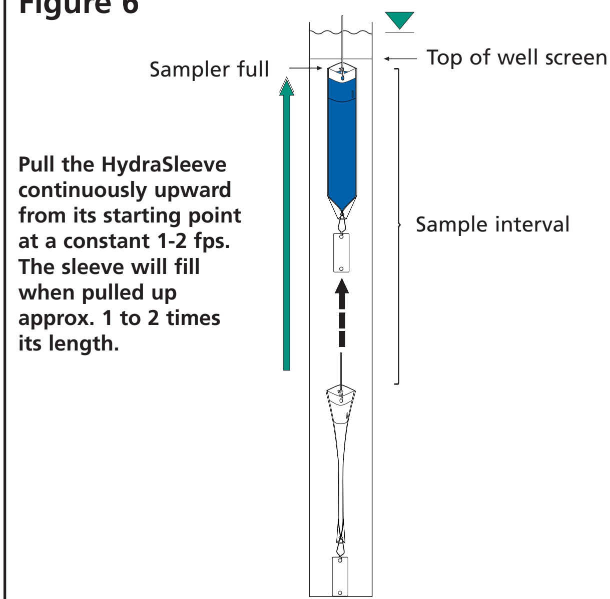
The HydraSleeve must move upward at a rate of one foot per second or faster (about the speed a bailer is usually pulled upward) for water to pass through the check valve into the sample sleeve. The total upward distance the check valve must travel to fill the sample sleeve is about 1 to 2 times the length of the sampler. For example, a 24-inch HydraSleeve needs a total upward movement of 24 to no more than 48 inches to fill. The upward motion can be accomplished using one long continuous pull, several short strokes, or any combination that moves the check valve the required distance in the open position. A special technique is used for sampling low-yield wells.

CONTINUOUS PULL (Figure 6)

Pull the HydraSleeve continuously upward from its starting point at a constant 1 to 2 feet per second until full. This method usually provides the least turbid samples and is analogous to coring the water column from the bottom up.

Note: When using this method, the screen interval should be long enough so the sampler fills before exiting the top of the screen.

Figure 6

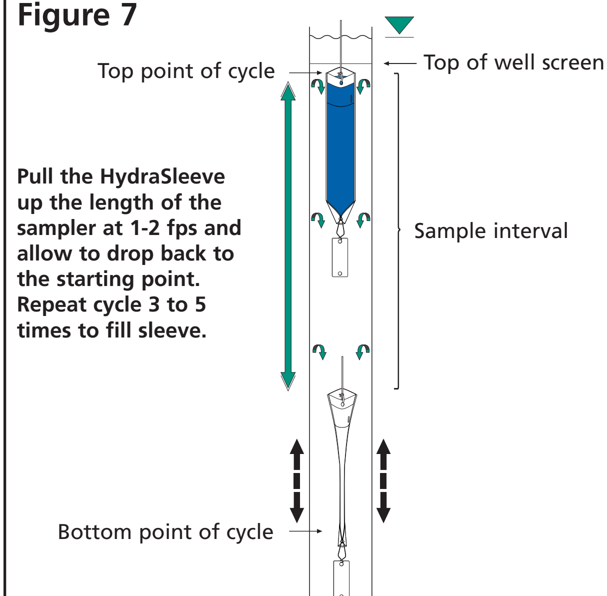


SHORT STROKES (Figure 7)

Pull the sampler upward at about 1 to 2 feet per second for the length of the sampler and let it drop back to the starting point. Repeat the cycle 3 to 5 times.

This method provides a shorter sampling interval than the continuous pull method (above), and usually reduces the turbidity levels of the sample below that of numerous rapid, short cycles (below). The sample comes from between the top of the cycle and the bottom of the sampler at its lowest point.

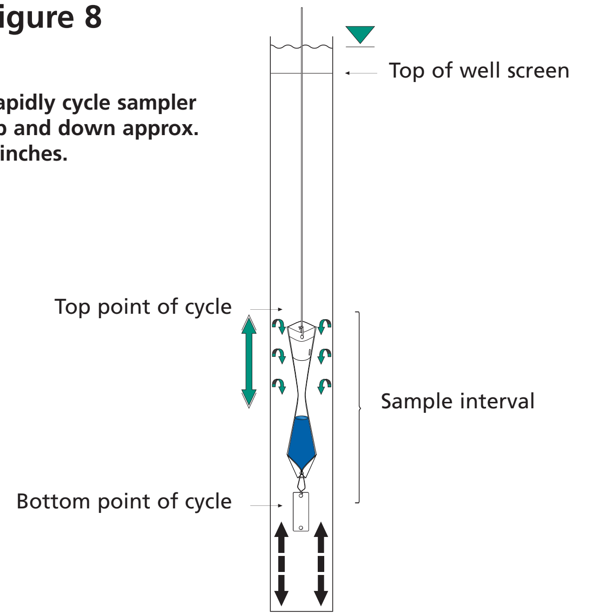
Figure 7



RAPID, SHORT CYCLES (Figure 8)

Cycle the HydraSleeve up and down using rapid, short strokes (6-inch cycle at a minimum of 1 cycle per second) 5 to 8 times. This method provides the shortest sampling interval. Dye studies have shown that when using this method the sample flows into the check valve from along the length of the sampler and immediately above the check valve. The sample interval is from the bottom the sampler at its lowest point in the cycle to the top of the check valve at the peak of the cycle.

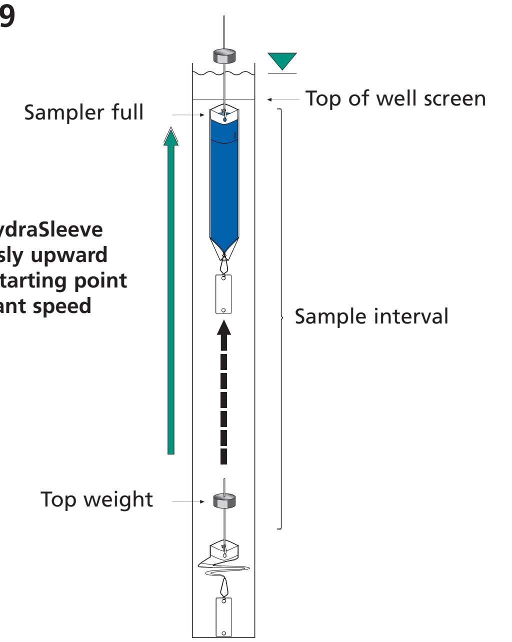
Figure 8



SAMPLING LOW-YIELD WELLS (Figure 9)

HydraSleeve provides the best available technology for sampling low yield wells. When pulled upward after the well re-equilibrates, the HydraSleeve will collect a water core from the top of the sampler to about its own length above that point. The sample is collected with no drawdown in the well and minimal sample agitation. An optional top weight can be attached to compress the sampler in the bottom of the well if needed for an extremely short water column. With a top weight, the check valve is pushed down to within a foot of the bottom of the well.

Figure 9



Sample Discharge

The best way to remove a sample from the HydraSleeve with the least amount of aeration and agitation is with the short plastic discharge tube (included).

First, squeeze the full sampler just below the top to expel water resting above the flexible check valve. (Photo 1, top left)

Then, push the pointed discharge tube through the outer polyethylene sleeve about 3-4 inches below the white reinforcing strips. (Photo 2, middle left)

Discharge the sample into the desired container. (Photo 3, bottom left)

Raising and lowering the bottom of the sampler or pinching the sample sleeve just below the discharge tube will control the flow of the sample. The sample sleeve can also be squeezed, forcing fluid up through the discharge tube, similar to squeezing a tube of toothpaste. With a little practice, and using a flat surface to set the sample containers on, HydraSleeve sampling becomes a one-person operation.

1680 Hickory Loop, Suite B • Las Cruces, NM 88005
Phone: 1.800.996.2225 • 1.505.523.5799 • Fax: 1.505.523.0789
www.geoinsightonline.com • KentCordry@aol.com

Attachment A: Standard Operating Procedure (SOP) #4 Supply and Irrigation Well Sampling Protocol

1.0 Sample Collection

Samples are collected from three former Fort Ord supply wells (Well 29(A), 30 (B), and 31 (C)[1]) operated by the Marina Coast Water District (MCWD), and on private off post irrigation well (Mini-Storage). Samples from these wells are analyzed for VOCs by EPA Test Method 8260 SIM (selected ion monitoring) OUCTP A-Aquifer COC list on a quarterly basis[2]. Samples are collected in three 40 milliliter (mL) VOA vials pre-preserved with hydrochloric acid (HCl). The water from these wells is collected prior to treatment or chlorination; therefore, the addition of sodium thiosulfate as a preservative is not needed.

2.0 Sample Techniques

Upon arriving at the supply well, the MCWD field technician will inform the sampler if the well is on (pumping) or off. If the pump is off, the sampler should remain outside the building until the MCWD field technician has started the pump due to noise associated with the pump's initial start-up. Once the pump is running, the sampler must open the sampling port, a small Teflon or copper tube coming from the main water flow pipe. The MCWD filed technician can help locate the sampling port if the sampler is unable to identify it. Let the spigot run approximately one minute at high flow to flush the sampling port tube. A drain located in the floor near the spigot collects the discharge water. Adjust the flow rate downward until you are able to fill the 40mL VOA vials with no splashing or bubbling, letting the water flow down the side of the container. Do not overfill or rinse the container or the preservative will be lost. The 40m: VOA vials should be completely filled to the point where the water's meniscus forms a convex shape above the lip of the container. Replace the container's cap and secure snugly making sure not to over tighten, and check for headspace or bubbles. VOA vials are zero headspace and therefore if a bubble appears inside the bottle after capping, a new sample must be collected. The sample bottles are to be labeled, stored in a Ziploc bag, and placed on ice in a sample cooler immediately. The chain of custody (COC) and daily field logbook shall be filled out completely prior to moving on to the next well.

The Mini-Storage well is located in the Marina Mini-Storage yard on the north side of Reservation Road in Marina. The pump head is located just north of the parking area in the main lot. Two spigots are on the top of the pump head just outside a small garden box container. A hose may be attached to one or both spigots. The spigot where the sample will be collected should be turned on and the water allowed to flow for at least a minute. A pressure gauge is located on the pipe and will indicate when the pump has been activated. After the pump has turned on, allow the water to run for another one to one and a half minutes. Remove any hoses attached to the spigot, adjust the flow as low as reasonable, and collect the sample in the same fashion as described for the Supply Wells. When finished replace any hoses that have been removed from the spigots. The sample bottles are to be labeled, stored in Ziploc bags, and placed on ice in a sample cooler immediately. The COC and daily field logbook shall be filled out completely prior to moving on to the next well.

[1] These wells are identified as FO-29, FO-30, and FO-31, respectively.
[2] Unless a well is inoperable.

Attachment A: Standard Operating Procedure (SOP) #5

OU2 and Sites 2/12 GWTSs and OUCTP EISB Extraction Well Sample Handling and Custody Requirements

Table of Contents

1.0 Sample Types

Project samples may be extraction well groundwater samples, Groundwater Treatment Plant (GWTP) process water samples, or quality control/quality assurance samples. Standard operating procedures for the collection of these water samples are described in this document.

1.1 Extraction Well Samples

Extraction well samples (standard field samples) will be generated to evaluate the effectiveness of the remedial action in containing the groundwater contamination plume, removing contaminant mass from the groundwater, and achieving remedial action objectives. Data generated will be applied to decision rules identified in the QAPP to determine operational status and sampling frequency for individual extraction wells.

1.2 GWTP Process Samples

GWTP process samples (standard field samples) will be generated to evaluate the effectiveness and efficiency of GWTP components in removing chemicals of concern (COCs) from extracted groundwater, determining the timing for replacing granular activated carbon (GAC) in the GAC vessels, and maintaining discharge limits for COCs in treated water.

1.3 Quality Control (QC)

Field QC samples will be generated to evaluate the precision, accuracy, and integrity of field sampling and laboratory analytical procedures. Quality control samples are introduced into the sample analysis stream along with environmental samples. The frequency of field QC sample generation is based on project Data Quality Objectives (DQOs), as well as the total number of samples submitted and the nature and intensity of the investigative process that is being monitored or evaluated. The following QC samples will be employed during the field program.

1.3.1 Trip Blanks

Trip blanks are prepared by the laboratory using contaminant-free water (e.g., nitrogen purged deionized water) which is poured into Volatile Organic Analysis (VOA) vials and shipped to Ahtna Environmental Inc. (Ahtna) by the laboratory. The laboratory also provides pre-cleaned and hydrochloric acid (HCl) acid-preserved sample containers for collecting water samples for Volatile Organic Compound (VOC) analysis. Trip blanks will accompany sample containers into the field and will be shipped back to the laboratory with every cooler that contains samples for VOC analyses. Trip blanks will be analyzed for all VOC analytes specified for environmental samples in the corresponding cooler.

1.3.2 Field Duplicate Samples

Duplicate samples are submitted to the contract laboratory for the purpose of assessing the effect of the sample matrix on analytical measurement precision.

The laboratory will not be informed as to the identity of duplicate samples and no special sample handling protocol will be employed during collection, shipment, or analysis of these samples. These “blind” duplicate samples will be submitted and analyzed on a frequency of one in ten of the total environmental sampling effort for each matrix sampled. Areas of known contamination or critical sampling points may be preferentially selected for submittal as blind duplicates. Duplicate samples will be analyzed for the same parameters as the corresponding primary sample.

2.0 Field Documentation

Field activities and sample collection will be documented using the following forms and information as appropriate: sample label, chain of custody form, groundwater sampling form, well completion details, well development form, cooler receipt form, waste management label, and hazardous waste label. The purpose of standardized field documentation and sampling procedures is to maintain integrity of field documentation and field samples throughout the remediation process. Each field sample will be labeled and sealed immediately after collection. Sample identification documents will be carefully prepared to maintain control of sample disposition. Field sample custody procedures are described in Section 4.1. Standard procedures for documentation of field activities are presented below.

2.1 Field Logbooks

Field procedures relevant to sample collection and field activities will be recorded daily in permanently bound notebooks. Each individual in the field will maintain a bound field logbook with serially numbered pages. The logbook is signed and dated prior to daily initiation of field work. If logbook duties are transferred, the individuals relinquishing and receiving will both sign and date the logbook and record the transfer time. Logbook corrections are made by a single line strikeout of the incorrect entry and entering the correct information that is initialed by the person making the entry. If the correction is made at a later time or date, the correction date is also entered. Unused partial or whole logbook pages are crossed out and unused pages signed and dated at the end of each workday. All entries must be legible, in ink, and primarily factual in content. Hypothetical information can be entered but should be noted accordingly. Logbook entries may include the following information as necessary:

- Project name and number.
- Site name and location.
- Arrival and departure date/time.
- Name and affiliation of personnel onsite (including site visitors), and personnel contacted.
- Author name and date.
- Field instrument calibration methods and identification number.
- Chronology and location of activities.
- Sampling locations.
- Sample identification numbers, amount collected, sampling method and container (size/type) for each sample collected, including QC samples. Sample processing techniques such as filtration, compositing, and preservation techniques should be noted. Alternatively, this information may be contained on the COC form, groundwater sampling form, or other field form. The logbook will then contain a unique identifier linking the field log book entry to the field form.
- Date and time of sample collection, name of sampler.
- Field observations including weather conditions and applicable comments.

- Number of shipping coolers packaged and sent.
- Name and address of all receiving laboratories.
- Any modifications or deviations from quality assurance project plan.

Written reports of all significant non-routine events for field and laboratory work will be sent to the USACE Contracting Officer within 48 hours of occurrence. These reports will identify the problem, corrective action, and verbal written instructions from the USACE Project Manager (PM) to Ahtna regarding corrective action. Significant non-routine events are occurrences that impact cost of work, work schedule, work quality, and analytical data quality.

2.2 Sample Identification and Labels

2.2.1 Sample Identification

Two sample identifiers, the sample number and the station number, will be used to designate samples and sampling locations. Sample numbers will be used for coding, tracking, and reporting chemical data. Station numbers will encode sample type, site identification, and boring number or monitoring well sequence. Conventions for generating sample and station numbers are presented below.

The sample number is a coded identification designed to satisfy project and database criteria. Each sample number:

- Will contain up to 12 characters.
- Will be unique.
- Will be traceable to a specific sampling event.
- Will be traceable to a specific sampler.
- Will incorporate a specific site designation.
- Will not obviously indicate to the laboratory the sample depth, station number, or type of sample (i.e., original sample and duplicate).

All chemical data produced by the contract laboratory will be reported using the sample number. Samples will be numbered as follows (no spaces in actual sample numbers):

YR WK X SSS 000 Z

Where:

YR = Calendar year

WK = Week of the year

X = One-letter ID code assigned to each field sampler

SSS = Three-character site identification code: “OU2” or “212”

000 = Three-digit sequence number for each sample

Z = Assigned QC sample code

Assigned sample QC codes are as follows:

- A = Trip blank

- B = Not used for groundwater treatment system (GWTS) sampling
- C = Not used for GWTS sampling
- D = Field duplicate
- E = Not used for GWTS sampling
- F = Standard field sample

For example, sample number 1704M212015A represents the fifteenth sample collected by sampler "M" and is a trip blank (QC code A) collected at Sites 2/12 during Week 4 of 2017. Each sample collector will start with sequence number 001 and continue consecutively through 999. Field personnel are responsible for keeping track of their own sequence in the field logbook. Field audits will include checks of this sample numbering system to ensure that correct procedures are being followed.

Week numbers are assigned to week-long periods ending on Friday. For example, Week 4 of 2017 is the week ending January 27, 2017. Week numbers below 9 must contain a zero (i.e., 01 through 08). For aqueous samples, multiple sample containers for each discrete sample may be required to fulfill analytical requirements. In these instances, the same sample number will be used on all sample containers.

The station description is a sequence of characters designed to identify site-specific samples. Station descriptions will not be included on the laboratory copy of the chain of custody form. The station description field on the chain of custody form will be used to record the site, sample type, sequence number, and other relevant sample characteristics.

The convention for station description naming is as follows:

ST-SSS-000-XXX

Where:

ST = Sample type

SSS = Three-character site identification code (same as for sample numbering scheme)

000 = Station number unique to each station

XXX = Sample depth or aquifer

Station description names will not include spaces. Example sample type codes are as follows:

- EW = Extraction well
- MP = Multi-port well
- MW = Monitoring well
- SG = Soil gas
- SL = Sludge
- PZ = Piezometer
- TS = Treatment system
- WW = Wastewater
- VE = Vapor extraction

Sample depth may indicate the actual depth the sample was collected relative to ground surface or top of well casing (e.g. the pump intake depth), the port the sample was collected from in a multi-port well, or the aquifer the sample was collected from. Example sample depth codes for aquifers at the former Fort Ord are as follows:

- A = A-Aquifer
- 180 = Upper or Lower 180-Foot Aquifer

For example, station name EW-OU2-13-A represents an extraction well station 13 at the OU2 site with a sample depth in the A-Aquifer.

2.2.2 Sample Label

All samples will be properly labeled to prevent misidentification of samples. Preprinted sample labels will be provided. The label will be affixed to the sample container prior to transportation to the laboratory and will contain the following information:

- Project name, number, and location
- Site name
- Name of collector
- Date and time of collection
- Sample identification number
- Preservative, if any
- Requested test methods or analyses

2.3 Chain of Custody Record

A chain of custody (COC) record will be filled out for and will accompany every sample to the analytical laboratory for documentation of sample possession from the time of collection to sample receipt. A carbonless copy of the chain of custody form will be retained in the investigation files according to project number. The primary laboratory will upload copies of the cooler receipt forms and associated chain of custody forms to its LabLink website for review by the Project Chemist within 24 hours of sample receipt. The forms will contain the following information:

- Sample number or identification
- Name and signature of collector, sampler, or recorder
- Name, number, and location of project
- Project manager's name
- Date of collection
- Place of collection (station description)
- Sample type
- Analyses requested
- Dates and times of possession changes

- Signature of persons relinquishing and receiving sample
- Laboratory sample number, where applicable
- Date and time of laboratory sample receipt

2.4 Transfer and Review of Field Documentation

During site-specific field operations, copies of each field logbook page will be telefaxed or hand delivered to the Task Manager on a daily basis. In the absence of a facsimile, field staff will be in contact with the Task Manager, via mobile telephones.

At the end of each week of field operations, all field documentation will be copied, and originals sent to the Task Manager or Project Manager for review and verification. Original field documents will be kept in the project files. Verification and review of field documentation will include at a minimum, the following checks:

- Consistency of dates and times of activities; among the various field records and forms
- Consistency of sample location and identification documentation among the various field records and forms
- Accuracy and correctness of well completion details
- Correctness of sample preservation techniques

Errors or inconsistencies identified during the review process will trigger a nonconformance investigation to be conducted by the Project Chemist or Quality Control System Manager (QCSM). Appropriate corrective action will be implemented and documented if systemic errors are identified.

3.0 Groundwater Sampling

This section describes groundwater sampling procedures to be followed prior to, during, and after groundwater sample collection from monitoring wells. Procedures for collecting grab groundwater samples are described at the end of this section.

3.1 Sampling Preparation

Prior to sampling, the well vault or GWTS process sampling port will be examined for signs of tampering or deterioration and observations noted. After a well vault is opened, the Activity Hazard Analysis (AHA) may call for the air in the wellhead vicinity to be tested for organic vapors with the Photo Ionization Detector (PID) or Flame Ionization Detector (FID) and/or for explosive atmospheres with an oxygen/combustible gas indicator (see Appendix E of the Site Safety and Health Plan). Results will be recorded in the field notebook. (Note: well vault air testing is not required for routine groundwater sampling as long as previous results indicate that organic vapors or explosive atmosphere are not present). All measuring and sampling equipment will be decontaminated prior to use in any well (see Section 3.5).

Extraction wells that are not normally operated will be run to purge a minimum of three well volumes prior to sample collection. Pumped purge volumes will be estimated using the flow meter in the well vault. The volume of water purged and the withdrawal rates will be recorded. Purge rates will be sustainable and executed at a rate that minimizes drawdown to prevent water from cascading into the well. Prior to sample collection, ports for extraction well and process sampling will be purged with the port valve completely open for a minimum of 1 minute to ensure stagnant water and any foreign matter or debris are discharged so a representative sample may be collected.

If a well is purged dry before three casing volumes have been removed, VOC samples will be collected immediately. Other samples will be taken after the well has recovered to within 80 percent of the static water level prior to purging, or after 4 hours, or when sufficient water volume is available to meet analytical requirements, whichever occurs first.

Pre-cleaned sample containers will be provided by the laboratory. The containers for each sample will be labeled in advance of the sampling event with the date, sample number, project name, sampler's name or initials, parameters for analysis (method numbers where possible), and preservation.

3.2 Sampling Procedures

After purging, samples will be collected using designated sampling ports in extraction well vaults or designated GWTS process sampling ports. Water samples will be collected carefully by discharging directly from the sample port to the appropriate sample containers.

Water samples for VOC analysis will be collected in VOA vials, which will be filled by inserting the sample port spout to the bottom of the VOA vial and keeping the spout beneath the surface of the liquid as it fills the vial until there is a convex meniscus over the neck of the bottle. The Teflon side of the septum (in the cap) will be positioned against the meniscus, and the cap screwed on tightly; the sample will be inverted, and the vial tapped lightly. The absence of an air bubble indicates a successful seal; if a bubble is evident, the sample will be discarded and the process repeated.

All sample bottles and equipment will be kept away from fuels and solvents. Gasoline (used in generators) will be transported in a different vehicle from the vehicle containing sampling equipment, sample bottles, etc. If possible, one person should be designated to handle samples and another person should operate the generators and refuel equipment, if required. Disposable gloves will be worn for each separate activity and then properly disposed. Care will be taken to avoid fuel spillage.

All samples will be packaged and transported appropriately, as described in Section 4.3.

3.3 Water-Level Measurement

The methods presented below are intended to produce water-level measurements that are consistent over multiple measurement events. Calibration and precision requirements for water-level measurements are summarized in Section 3.4.

Groundwater levels may be measured using an electrical sounder, a steel tape, or a pressure transducer. All water-level measurements will be taken from an obvious survey mark at the top edge of the well casing. Water levels will be measured using the following procedures.

Electrical Sounder

The standard equipment for making individual water-level measurements will be a battery-powered sounder. The sounder must have firmly affixed or permanent marks on the sounder line at regular intervals (minimum interval of 0.01 foot).

Calibration checks on the electrical sounder will be made periodically. The sounder markings will first be checked for the proper spacing by physically comparing the spacing with a graduated steel tape. Accuracy rechecks will be made after any incident that might alter the measuring capability of the instrument, such as cable stretching, entanglement, or sensor tip replacement.

Portions of the cable that are inserted in wells will be decontaminated after use according to the procedure described in Section 3.5. Sounders will be maintained in a clean and functional condition.

Steel Tape

A graduated steel tape (with 0.01-foot graduations) can be used for water-level measurements in conjunction with other methods and, when required, for a quality control check of other methods. The steel tape will be periodically checked for kinks, and if kinked tapes are found, the tape will be labeled as unusable and taken out of service. Portions of the tape that are inserted in wells will be cleaned after use according to the procedure described in Section 3.5. Tapes will be maintained in a clean and functional condition.

3.4 Sampling Equipment Calibration Procedures

Included is a description of the procedure or a reference to an applicable standard operating procedure, the calibration frequency, and the calibration standards used. All instruments and manufacturers' instructions and specifications are maintained in the project files. All instruments are calibrated prior to being sent to the field. Field calibration procedures will be documented in the Field Logbook.

Water-Level Measurement Instruments

Electrical sounder: Checked against steel surveyor's tape prior to initial use. Battery and sensitivity checked daily.

Graduated steel tape: Referred to new steel tape; manufacturer-supplied temperature correction is applied if appropriate for field conditions.

Pressure transducer: Factory calibrated once, in-house calibration checked with water columns prior to aquifer tests, and weekly field checks made against steel tape or electrical sounder.

3.5 Decontamination Procedures

All reusable equipment that may come in contact with potentially contaminated soil, sediment, or water will be decontaminated prior to use to reduce the potential for cross-contamination during field activities. Decontamination will consist of steam cleaning (high pressure, hot water washing); non-phosphate detergent wash; solvent rinse; distilled, deionized (DI), or clean water rinse; pesticide-grade methanol rinse; and final rinse with DI water, as appropriate.

The procedures for decontaminating sampling equipment are described below:

- Wash steel tapes, well sounders, transducers, and water quality probes in a non-phosphate detergent solution, and rinse in distilled or DI water, or wipe clean after each use, depending upon site conditions. Clean the portion of these devices inserted into wells with a mild non-phosphate detergent solution.

4.0 Sample Handling Procedures

Appropriate sample handling techniques are necessary to protect the samples and maintain sample custody protocol requirements following collection. Sample handling includes custody, container/preservative type, transfer, storage, and disposal.

4.1 Field Sample Custody

Standardized sample custody procedures will be followed through sample collection, transfer, storage, analysis, and ultimate disposal. Sample custody begins with shipment of the empty sample container sent to the office or site. All sample containers are shipped from the laboratory in sealed containers or cartons with appropriate seals and custody information. Sample quantities, types, and locations will be specified before the actual field work commences.

A sample is considered under custody if one or more of the following criteria are met:

- The sample is in the sampler's possession
- The sample is in the sampler's view
- The sample is in a designated secure area after being in the sampler's possession

4.2 Sample Containers and Preservation

Samples should be collected and containerized in order of the analyte volatilization sensitivity. A preferred collection order is listed below:

- Volatile organic compounds
- Sulfate and chloride

Methods of sample preservation are intended to retard biological action, retard hydrolysis, and reduce sorption effects. Preservation methods are generally limited to pH control, chemical addition, refrigeration, and protection from light.

All sample containers will be properly labeled (see Section 2.2) and monitored for temperature control in the field and during laboratory transport and storage. Temperature blanks will be used in all coolers containing samples requiring preservation at reduced temperature (4°C).

4.3 Sample Transfer and Shipment

Samples will always be accompanied by a chain of custody record. When transferring samples, both the individuals relinquishing and receiving the samples will sign, date, and note the transference time on the chain of custody record. Samples will be packaged properly for shipment, including isolation of samples suspected of high chemical concentrations, and dispatched to the appropriate laboratory for analysis. Custody seals will be used when samples are shipped via courier service, and must be placed on the container so that the seals have to be broken before the container can be opened. The seal must be signed and dated by the field personnel. Custody seals are not deemed necessary when the samples will be in the continuous possession of project, field, or laboratory personnel. The chain of custody record(s) will accompany each sample shipment. Samples will be packaged for shipment as follows:

- Print the following information clearly in waterproof ink on the label; the test methods requested, the preservative(s) used (if any), the sample number, the project number, the initials of the sample collector, and the date and time the sample was collected.

- Fill out field sample log and chain of custody record as described in Sections 1.2.1 and 1.2.3, respectively.
- Place each sample bottle or set of VOA vials in a separate plastic bag and seal the bag. Squeeze air from the bag before sealing.
- If using a plastic cooler as a shipping container, tape shut the drain plug from the inside and outside, and line the cooler with a large plastic bag. If sample containers are glass, place approximately 3 inches of inert packing material, such as asbestos-free vermiculite, perlite, or Styrofoam beads in the bottom of the container or wrap the sample containers in other appropriate protective packing material (e.g., bubble wrap. Other commercial shipping containers (cardboard or fiber boxes complete with separators and preservatives) may be used but should be preapproved by the USACE.
- Place the bottles upright in the lined plastic cooler and position to avoid contact during shipment. Cardboard separators may be placed between the bottles at the discretion of the shipper.
- Transport all samples to the laboratory on ice chilled to 4°C ± 2°C.
- Place additional inert packing material in the cooler to partially cover the sample bottles (more than halfway). If samples are required to be shipped to the laboratory with ice, place ice in double bags around, among, and on top of the sample bottles, fill the cooler with inert packing material, and tape the liner shut.
- Place paperwork going to the lab inside a plastic bag. Seal the bag and tape to the inside of the cooler lid. Include the original of the COC form in the paperwork sent to the laboratory. The last block on the COC form should indicate the over-night carrier and air bill number, if applicable. Fill out the air bill before the samples are handed over to the carrier. Notify the laboratory if the shipper suspects that the sample contains any other substance that would require laboratory personnel to take additional safety precautions.
- Close the cooler and tape it securely shut.
- Place at least two signed custody seals on the cooler, one on the front and one on the side. Additional seals may be used if the sampler or shipper deems necessary. Affix "fragile" and "this end up" labels on coolers, as appropriate.
- Samples may be hand delivered to the laboratory, transported by commercial or laboratory couriers, or shipped to the laboratory using an overnight shipper.

4.4 Laboratory Custody

A designated laboratory sample custodian will accept custody of the samples and verify that the information on the sample label matches that on the chain of custody form(s). Pertinent information as to sample condition, shipment, pickup, and courier will also be checked on the chain of custody form(s). In addition, a Cooler Receipt Form (e.g., cooler receipt form) will also be completed by the custodian and copies will be sent to the project chemist within 24 hours of sample receipt. On receiving samples at the laboratory, the temperature inside the cooler and of the temperature blank will be measured immediately after opening the cooler and the results recorded on the cooler receipt form. Information on the date and time of receipt, method of shipment, and sample condition also will be recorded on this form. The custodian will then enter the appropriate data into the laboratory sample tracking system. The laboratory custodian will use the sample number on the sample label as well as assign a unique laboratory number to each sample. The custodian will then transfer the sample(s) to the proper analyst(s) or store the sample(s) in the appropriate secure area.

Laboratory personnel are responsible for the care and custody of samples from the time they are received through sample disposal. Data sheets and laboratory records will be retained by the laboratory as part of the permanent documentation for a period of at least 3 years.

Attachment A: Standard Operating Procedure (SOP) #6
Low Flow Groundwater Quality Parameter Collection

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating the field equipment necessary for collecting groundwater stabilization parameters by low flow. Groundwater stabilization parameters are obtained by using electronic equipment and are required to meet calibration standards.

2.0 Equipment List

- Decontamination equipment including soap, de-ionized and tap water
- Health and safety equipment including safety glasses and nitrile/latex exam gloves
- Field logbook, indelible ink pens and field forms
- Tools to open wells
- Horiba U-50 Series multi-meter or equivalent
- Electronic water level meter such as the Solinst Model 101 or equivalent
- Rinse water receptacle and disposal area
- Horiba pH4 multi-calibration solution or equivalent
- Horiba oxygen-reduction potential (ORP) standard powder No. 160-22 or No. 160-51 or equivalent.
- Flow-through-cell/chamber for Horiba
- Dedicated or non-dedicated submersible low flow 12 volt Geosquirt pump or equivalent
- Vehicle battery to power pump with pump controller
- Sample tubing (dedicated or non-dedicated) 3/8 inch (”) or ½” inner diameter (ID) Polyethylene

3.0 Procedures

3.1 Multi-Meter Calibration

Water parameters are primarily recorded with the **Horiba U-50 Series** (Horiba) multi-meter (or equivalent). A wide variety of measurements can be obtained, but for groundwater stabilization parameter purposes only temperature, specific conductivity, dissolved oxygen (DO), pH, ORP, and turbidity are needed. All these parameters require calibration with the exception of temperature. According to the Horiba manual utilize approximately 200 milliliters (mL) of calibration fluid in the calibration cup. While calibrating turbidity, the lower fill line in the calibration cup is used. Remember to remove any protective caps from the sensors prior to calibration and use of the meter.

The Horiba instrument utilizes simultaneous Auto Calibration of **DO, pH, conductivity, and turbidity** with the standard pH 4 calibration solution. At a standard temperature of 25 degrees Celsius (°C); pH is calibrated to 4.01, conductivity is calibrated to 4.49 milliSiemens per centimeter (mS/cm), DO is calibrated to 8.92 milligrams per liter (mg/L), and turbidity calibrated to 0 nephelometric turbidity units (NTU). Be sure the calibration solution is approximately the same temperature as the ambient air, if this cannot be confirmed, allow a one hour equilibration time. To perform auto calibration of the parameters listed above, follow the steps below:

1. Turn the Horiba unit on and let it warm up for approximately 20 minutes.
2. Remove the sensor guard and wash the sensor probe two to three times with deionized (DI) water.
3. Remove the transparent calibration cup.
4. Fill the transparent calibration cup to the “With TURB” labeled lower line with pH 4 standard solution.
5. Press the Horiba’s “CAL” key or navigate to the Calibration menu to set the calibration mode.
6. Select “Auto Calibration”.
7. Immerse the sensor probe in the transparent calibration cup.
8. Check that there are no air bubbles and the appropriate sensors are submerged.
9. Place the transparent cup with probe into the black calibration cup.
10. When all the sensor values have stabilized, press the “ENTER” key to start calibration.
11. Calibration is finished when the message “Cal complete. MEAS to measure” appears.
12. Press “MEAS” to begin reading parameters.
13. Finally, remove the calibration cup and rinse sensors and cup with DI water.

ORP is calibrated with another set of steps and materials as described below. ORP standard solution is not stable for more than an hour and therefore cannot be stored. For measuring low concentrations measurements may not be repeatable, start the measurement immediately after submersion.

1. Fill a clean beaker with one bag of ORP standard powder No. 160-22 or No. 160-51.
2. Add 250 mL of DI water and agitate the solution thoroughly (there will be some excess quinhydrone [a black powder] that floats on the surface when agitating the solution).
3. Fill the transparent calibration cup to the reference line (the upper line “Without TURB”) with this ORP solution.
4. Wash the sensor probe two to three times with DI water then submerge probe into the transparent calibration cup.
5. Press the Horiba’s “CAL” key or navigate to the Calibration menu to set the calibration mode.
6. Select “Manual Calibration”.
7. Select “ORP”.
8. Set the millivolts (mV) value of the ORP standard solution appropriate for specific temperature conditions as specified in the table below.

Temperature (°C)	ORP Powder 160-22	ORP Powder 160-51
5	+274	+112
10	+271	+107
15	+267	+101
20	+263	+95
25	+258	+89
30	+254	+83
35	+249	+76
40	+244	+69

9. Once the value has stabilized, press “ENTER” to start calibration.
10. Calibration is finished when the message “Cal complete. ENT to manual cal menu” appears.
11. Press “ENT” and then “MEAS” to begin reading parameters.
12. Finally, remove the calibration cup and rinse sensors and cup with DI water.

The auto multi-calibration and the ORP calibration of the Horiba should be performed daily. Record the auto multi-calibration and ORP calibrations were performed in the daily field logbook and other paperwork as necessary. Remember to replace any protective caps on the sensors following calibration or use of the meter and decontamination.

3.2 Site Control

- Upon arrival at groundwater monitoring well or sample station, position field vehicle in location convenient to access well as necessary for use of pump and field equipment while collecting parameters. Consider using the field vehicle to provide safety from traffic or shade from the sun.
- Establish a work area as needed. Lay out equipment in an orderly manner so as to avoid creating trip hazards. This is an important consideration in regards to cords and tubing. If necessary, use traffic cones or caution tape to define a work area and do not allow the public or subcontractors to enter your work area. Control activities in the sample collection work area so as to preserve the quality and integrity of the parameters being collected.

3.3 Water Level Measurement

Water level indicators (sounders) need to be calibrated and checked for accuracy. If more than one instrument is to be used, they should be checked by measuring a single well using both instruments to assure that measurements are consistent. A single water level meter can be checked against another tape (i.e. 100 foot reel measuring tape). Turn on unit and test the audible detector by depressing button on the site of unit before use.

Prior to leaving field office or before beginning water level measurements, decontaminate the probe and cable. Inspect well casing and locking cap for tampering, damage, maintenance needs or rust and make note of the conditions on the appropriate *Well Maintenance Form* and in the field logbook.

Use care when removing the well cap or J-plug and observe if there is a pressure difference between the closed well and atmospheric pressure. If project groundwater wells tend to build pressure attach a lanyard to well cap to eliminate the potential for injury from rapid pressure release. Never place body, face or head directly over a well while opening the well cap. Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed. In the event a marking is not visible or well is not yet surveyed, take the water level reading from the north-side top of casing.

Don disposable silicone or nitrile exam gloves before lowering well sounder probe and measuring tape into the well. After decontaminating the sounder following water level measurement, properly dispose of exam gloves. A fresh pair of exam gloves should be used for each well or monitoring station.

Slowly lower probe into the monitoring well until contact with the water surface. An audible alarm on the water level meter will occur when the probe touches the water. Gently lift and lower the probe until an accurate measurement can be determined. Adjust well sounder sensitivity as necessary to get a good reading. Obtain the reading from the established mark on the well casing and measure to the nearest 0.01 foot. Record water level on the appropriate field forms.

After a water level measurement is collected at a groundwater monitoring well, decontaminate the measuring tape and reel. After decontamination is completed, properly secure the sounder in the sampling vehicle before moving on to the next location.

3.4 Equipment Setup

- Lie out and connect electric cords to vehicle battery from the pump. Lie out and connect pump discharge tubing from pump to flow-through-cell and from flow-through-cell to purge water storage tank. Keep tubing and equipment in shade whenever possible.
- Check the specifications for the well and place the pump at the specified depth after collecting a depth to water measurement, collecting any necessary analytical samples, and removing any hardware in the well. Make sure the pump is decontaminated accordingly with deionized water and soap between locations. Discharge tubing should be securely attached to the pump head and decontaminated or replaced between locations. Secure the pump electrical line and discharge tubing to the top of the well in a manner to avoid kinking once the desired depth has been reached. Record depth to water and depth to pump in the field log.
- Attach the end of the discharge tubing to the flow through cell that has been setup with the calibrated Horiba multi-meter. Attach the discharge of the flow through cell to a bucket for collecting purge water.
- Attach the end of the pump's electrical connector to the controller and connect the controller to the battery. The pump should start running once the controller is on and hooked up but it may

take a few minutes for water to come up to the surface. Adjust the flow accordingly if no water is being produced. Allow the flow through cell to fill before taking the first reading.

- Measure and monitor the flow rate with a graduated cylinder and record it as milliliters per minute (mL/min). Also record the cumulative volume purged as liters (L) and the water quality parameters temperature, pH, conductivity, dissolved oxygen, oxidation reduction potential, and turbidity.

Low-flow dedicated pump purging and sampling will consist of low flow 12 volt Geosquirt, or equivalent, low flow type pump to purge wells. This pump type is meant to pull water from approximately 120 feet below ground surface or shallower. If the well is too deep to pump adequately, lift the pump in the water column and record the pump depth on the field log.

The pumping rate will be maintained within the range of 0.25 to 1.0 liters per minute, limited to minimize the drawdown of the water table. Water level measurements will be collected before purging and after purging to ensure that drawdown in the well is not causing the well to go "dry". Any well that should go "dry" during the course of sampling will be noted in the field notebook as well as on the appropriate field monitoring data sheet. After recharge time is allowed purging may be reattempted at a slower rate.

3.5 Groundwater Quality Parameter Collection

Parameters are measured from the wells by low-flow dedicated or non-dedicated pumping with a Horiba multi-meter or equivalent. Begin well documentation by filling out the top half of the water sampling log as needed.

The Horiba will be connected to a flow through cell. Parameter measurements are recorded on the sample log as follows:

- Time of measurement
- Pump intake depth (feet below top of casing)
- Flow rate (mL/min)
- Cumulative volume (L)
- Temperature (°C)
- Conductivity (mS/cm)
- DO (mg/L)
- pH (unitless)
- ORP (mV)
- Turbidity (NTU)
- Additional comments, if any

Each successive measurement will be recorded within 3-5 minutes. At least three measurements will be taken but there must be three successive readings stabilized according to the requirements below:

- pH: ± 0.1 units
- Electrical conductivity: ± 3% mS/cm

- ORP: ± 10 mV
- Dissolved oxygen: ± 10 percent mg/L
- Temperature: ± 1.0 °C
- Turbidity: ± 10% or less than 10.0 NTU

Well purging will be continued until the field parameters meet the criteria above, or until a maximum of three well volumes have been purged. An additional water level measurement should also be taken after monitoring is completed to assure the drop in water level is not excessive. Complete paperwork as needed.

3.6 Demobilization and Equipment Decontamination

- Stop purging the well, remove pump if non-dedicated and tubing and electrical line from the well. Re-install hardware and deploy passive diffusion bag (PDB) for next sampling event as necessary.
- Install the well cap or J-plug. Store dedicated discharge tubing in well or contain on vehicle as applicable. Decontaminate non-dedicated pump and tubing with water and soap, purging tubing by operating the pump.
- If possible, purge wells in order of lowest to highest contaminant of concern (COC) concentrations to reduce the chance of carryover from non-dedicated equipment.
- For wells located in a busy street, once all sampling equipment is packed, travel to the next scheduled location before decontaminating field equipment.
- Pumps should not be stored in an area where volatile sources (e.g., household cleaning chemicals, fuels, oils) are present; pumps shall not be stored without appropriate decontamination. Prior to use, the outside of the pump and tubing should be thoroughly rinsed with reagent grade water. Decontaminate all other equipment that contacted the well discharge water, including the water level sounder and the field meter flow-through-cell and probes.
- Collect all cords, tubing, tools and equipment and store in field vehicle in an orderly manner. Police site for trash and investigative derived waste and place in a trash bag.
- Collect any traffic control equipment while paying attention to potential traffic hazards. Never turn your back to oncoming traffic while on the street or when de-mobilizing traffic control from your work area.

3.7 Waste Management

Purged groundwater will be collected in temporary storage tanks, buckets or drums and transferred to proper storage tank for disposal at the Sites 2 and 12 groundwater treatment plant (2/12 GWTP). Non-hazardous solid wastes such as latex and nitrile gloves, plastic bags and paper towels will be collected and discarded to an approved municipal solid waste collection container.

Attachment A: Standard Operating Procedure (SOP) #7 Downhole Meter Groundwater Quality Parameter Collection

1.0 Scope and Application

This Standard Operating Procedure (SOP) describes the procedures for calibrating and operating the field equipment necessary for collecting groundwater quality parameters by downhole meter.

2.0 Equipment List

- Decontamination equipment including soap, de-ionized and tap water
- Health and safety equipment including safety glasses and nitrile/latex exam gloves
- Field logbook, indelible ink pens and field forms
- Rinse water receptacle and disposal area
- Water level meter
- Tools to open wells
- YSI 6-Series (6920) Multi-parameter Water Quality Sonde or equivalent downhole multi-parameter probe
- Calibration cup
- Probe guard
- Battery if required
- Ruler
- Barometer recommended
- Calibration solutions:
    - Conductivity: 10 milliSiemen per centimeter (mS/cm) YSI 3163 or 1 mS/cm YSI 3165 or equivalent
    - pH: pH 7 and pH 10 buffer solutions or pH 4 and pH 7 buffer solutions
    - Oxygen-reduction potential (ORP): Zobell standard recommended
    - Turbidity: two standards 0 nephelometric turbidity unit (NTU) and 100 NTU of formazin prepared by YSI, Hach, or other approved vendor.
    - Water for dissolved oxygen (DO)
- Ring stand recommended
- YSI 200 foot Sonde cable (for deeper wells)
- YSI 100 foot Sonde cable (for shallower wells)

3.0 Procedures

3.1 Downhole Meter Calibration

If the Sonde did not come with the sensors installed, install and activate the appropriate sensors per manufacturer’s instructions. Remove protective caps on the sensors before calibration or use of the meter. If the meter is rented, calibration has already been performed by the vendor and field calibration is not necessary during field events lasting less than 1 month. If the meter is rented, it is assumed that, unless warranted by erroneous field data, the meter will not require any maintenance.

To perform calibration of the Sonde, follow the general procedures below or specific manufacturer directions.

1. If installed, remove the Sonde probe guard.
2. Use the calibration cup supplied with the Sonde for all calibrations.
3. Rinse the Sonde probe and calibration cup with water and shake off excess.
4. Rinse the Sonde probe and calibration cup with a small amount of calibration solution if there is sufficient volume.
5. While calibrating the Sonde can be upright or inverted, but the sensors should be fully submerged.
6. Turn on the YSI meter and select Calibrate on the menu.

The following approximate volumes of calibration solution are to be used (check calibration solution and meter directions).

- Conductivity: 320 milliliters (mL) upright (150 mL inverted)
- Dissolved Oxygen: 1/8 inch (”) water vented to air
- pH/ORP: 200 mL upright (150 mL inverted)
- Optical sensors (turbidity): 225 mL upright (do not calibrate inverted)

7. Fill the calibration cup with the appropriate amount and type of calibration standard.
    a. For conductivity, be sure the probe is dry prior to immersing and no salt deposits. Make sure the sensor is completely immersed past the vent hole. Rotate the Sonde to remove air bubbles from sensor. Allow the temperature to equilibrate for approximately one minute after submersion.
    b. When calibrating dissolved oxygen, place 3 millimeters (mm) or 1/8” of water in the calibration cup. Engage only one or two threads of the calibration cup to vent to air. Loosen the bottom cap if the probe is inverted. Do not immerse DO or temperature sensors in the water. Wait approximately 10 minutes for the air in the calibration cup to become water saturated and for temperature equilibration.
    c. For pH, allow approximately one minute for temperature stabilization.
8. Screw the cup onto the probe. It is recommended to use a ring stand to prevent the probe from falling over.
9. In the Sonde Menu select “Calibrate”.
10. Input the calibration type you are performing (i.e., conductivity, Dissolved Oxygen, pH, ORP, Turbidity).
    a. Select Specific Conductivity for Conductivity calibration.
    b. Calibrating for percent (%) DO will also calibrate for milligrams per liter (mg/L) DO.
    c. For pH, enter 2-point calibration for two buffer solutions.
    d. For turbidity, enter 2-point calibration.

11. Once a parameter is selected, some will have a number that appears in parenthesis, which is the default value to be used for calibration.
12. Check the number is correct on the calibration standard being used, and press Enter or change the calibration value accordingly.
    a. For pH you must enter the calibration value, which is usually temperature dependent.
    b. For DO, you must enter the current barometric pressure. If you do not have a barometer, check the local weather station and calculate according to actual elevation. Barometric pressure must be entered in mm Hg. If given in in Hg, multiply by 25.4. To calculate for elevation take the barometric pressure at sea level in your area and subtract the following; divide your location's altitude in feet above sea level by 100 and multiply by 2.5.
    c. For turbidity, the 0 NTU standard must be calibrated first.
13. A real time value will display, with all enabled sensors reading values, not just the sensor currently being calibrated.
    a. For turbidity activate the wiper function to remove any bubbles if necessary.
14. Observe the stabilization of the sensor value being calibrated. When the reading stabilizes for approximately 30 seconds, press Enter to accept calibration.
15. Press Enter to return to the Calibration menu, and proceed to the next calibration. Repeat steps 3-13 for each calibration standard. For pH and turbidity 2-point calibrations, the Sonde will prompt you for the second calibration solution. Dry the Sonde between readings.
16. Once completed rinse and dry the Sonde.

The Sonde is now ready to be used for readings throughout the day. Recalibrate as necessary if field conditions present erroneous data or the Sonde experiences mechanical issues. Record the calibrations were performed in the daily field logbook and other paperwork as necessary. Remember to replace any protective caps on the sensors following calibration or use of the meter and decontamination.

3.2 Site Control

- Upon arrival at groundwater monitoring well or sample station, position field vehicle in location convenient to access well as necessary for use of pump and field equipment while collecting parameters. Consider using the field vehicle to provide safety from traffic or shade from the sun.
- Establish a work area as needed. Lay out equipment in an orderly manner so as to avoid creating trip hazards. This is an important consideration in regards to cords and tubing. If necessary, use traffic cones or caution tape to define a work area and do not allow the public or subcontractors to enter your work area. Control activities in the sample collection work area so as to preserve the quality and integrity of the parameters being collected.

3.3 Water Level Measurement

Water level indicators (sounders) need to be calibrated and checked for accuracy. If more than one instrument is to be used, they should be checked by measuring a single well using both instruments to assure that measurements are consistent. A single water level meter can be checked against another tape (i.e. 100 foot reel measuring tape). Turn on unit and test the audible detector by depressing button on the site of unit before use.

Prior to leaving field office or before beginning water level measurements, decontaminate the probe and cable. Inspect well casing and locking cap for tampering, damage, maintenance needs or rust and make note of the conditions on the appropriate *Well Maintenance Form* and in the field logbook.

Use care when removing the well cap or J-plug and observe if there is a pressure difference between the closed well and atmospheric pressure. If project groundwater wells tend to build pressure attach a lanyard to well cap to eliminate the potential for injury from rapid pressure release. Never place body, face or head directly over a well while opening the well cap. Each well shall be marked with a permanent, easily identified reference point for water level measurements whose location and elevation have been surveyed. In the event a marking is not visible or well is not yet surveyed, take the water level reading from the north-side top of casing.

Don disposable silicone or nitrile exam gloves before lowering well sounder probe and measuring tape into the well. After decontaminating the sounder following water level measurement, properly dispose of exam gloves. A fresh pair of exam gloves should be used for each well or monitoring station.

Slowly lower probe into the monitoring well until contact with the water surface. An audible alarm on the water level meter will occur when the probe touches the water. Gently lift and lower the probe until an accurate measurement can be determined. Adjust well sounder sensitivity as necessary to get a good reading. Obtain the reading from the established mark on the well casing and measure to the nearest 0.01 foot. Record water level on the appropriate field forms.

After a water level measurement is collected at a groundwater monitoring well, decontaminate the measuring tape and reel. After decontamination is completed, properly secure the sounder in the sampling vehicle before moving on to the next location.

3.4 Equipment Setup

Remove any sample or hardware from the well and allow settling time before deployment of the downhole meter, approximately five minutes. Remove hardware and take water level readings in a manner to minimize disturbance of the water column in the monitoring well, lower and remove equipment slowly.

Be sure the Sonde and cables have been decontaminated prior to deployment in the monitoring well. Connect the Sonde to the power source if needed and connect communication cable from the Sonde to the probe.

Remove the probe guard and any protective sensor caps before using the Sonde. After calibration of the meter, confirm the sensors and parameters that are needed (turbidity, temperature, DO, ORP, and conductivity) are all reading on the instrument display. Replace the probe guard and keep in place during deployment. Check the pump intake depth for the current monitoring well and attach the correct length of Sonde cable to the meter (100 foot or 200 foot cable available).

Deploy the meter into the monitoring well and secure at the top of the well once the appropriate depth has been reached as to avoid kinking. Attempt to not disturb the water column too much while deploying by lowering the meter slowly. Allow settling time before collecting parameters, approximately two minutes.

3.5 Groundwater Quality Parameter Collection

On the YSI meter menu, Select Run. Choose Discrete Sampling on the meter's menu. Discrete sampling is used for spot sampling and short term sampling. In the Discrete Sampling Menu, set the appropriate sample interval sample time length. The default sample interval is four seconds and is appropriate for most discrete sampling. Optionally, identify the location by entering a filename and site name. Then select Start Sampling. Once the sample interval time has passed (4 seconds), the data will be displayed and it can be saved by selecting Log Last Sample.

When using the downhole meter, place the meter at the specified pump depth and record one measurement on the field paperwork once stabilized. If no other readings are required, remove the Sonde and cable from the monitoring well. Replace the hardware and deploy a passive diffusion bag (PDB) as necessary for the next sampling event. Replace the well cap and secure well.

3.6 Equipment Decontamination and Waste Disposal

Decontaminate the Sonde, meter cables, and all sensor probes with deionized water and a mild detergent. A small brush may be used on the sensors if necessary. The cable connector port must always be covered to prevent moisture from entering. If the cable is not connected cover the port with the pressure cap.

For short term storage place approximately 0.5 inches of water in the calibration or storage cup and place it on the Sonde. The use of a moist sponge is also acceptable instead of water. Do not immerse the sensors. The purpose is to keep the air in the cup at 100% humidity. Any type of water may be used such as tap water, distilled water, or deionized water. Make sure the cup is on tight to prevent evaporation. Check periodically to make sure there is still water/moisture present. For Sondes with level sensors, keep the tube sealed and dry.

Containerize any decontaminate water and dispose at the Sites 2 and 12 groundwater treatment plant (2/12 GWTP). Bag up any non-hazardous solid wastes, such as disposable gloves and paper towels, for disposal in a garbage receptacle.

Analytical SOPs

MS010.7	Analysis of Volatile Organics by GC/MS Select Ion Monitoring (SIM) (VOCs by 8260 SIM)
MET108.03	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) (Metals by 6010D)
GN228.9	Determination of Inorganic Anions by Ion Chromatography (Chloride by 9056A)
SAM101.19	Sample Receipt and Storage
SAM108.10	Sample and Laboratory Waste Disposal

ANALYSIS OF VOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

Prepared by: Norm Farmer Date: 08/28/17

Approved by: Juan Garcia Date: 08/30/17

Annual Review

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Document Control

Issued to: QA Department Date: 09/01/17

Issued to: MS Volatile Department Date: * 09/01/17

Issued to: MS Volatile Soil Lab Date: 09/01/17

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: ANALYSIS OF VOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

REFERENCES: SW846 8260B

REVISED SECTIONS: 1.1.8, 4.6, 7.5.2.2-7.5.2.4 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of various volatile organic compounds in water utilizing a gas chromatograph equipped with a mass spectrometer detector. This SOP was written primarily for the analysis of 1,4-dioxane but the analytes listed in Table 1 have also been validated by this method.

1.1.2 Unlike conventional full scan 8260, this method utilizes the instrument's selected ion monitoring (SIM) capabilities. By monitoring for a few specific ions the sensitivity can be increased 10 to 20 fold.

1.1.3 Utilizing a heated purge greatly improves the purge efficiency of 1,4-dioxane from water.

1.1.4 The Lower Limit of Quantitation (LLOQ) or Reporting limits (RL) are based on the sample amount and the lowest calibration standard. LLOQs may vary depending on matrix complications and sample volumes. The LLOQ for 1,4-dioxane by this method are 1.0 ug/l for aqueous samples and 5.0 ug/kg for solid samples. The LLOQs for the additional analytes listed in Table 1 are 0.1 to 0.5ug/l for aqueous samples and 5 to 25ug/kg for methanol soils. Solid matrices are reported on a dry weight basis.

1.1.5 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the LLOQ. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported LLOQ.

1.1.6 The LLOQ for each analyte is evaluated on an annual basis for each matrix and instrument. The LLOQ verifications are prepared by spiking a clean matrix at 0.5 to 2 times the current LLOQ level. This LLOQ verification is carried through the same preparation and analytical procedures as the samples. Recovery of the analytes should be within the established limits. The DOD QSM requirements for Limit of Detection (LOD) and Limit of Quantitation (LOQ) verifications are different. See SOP QA020 for complete requirements for MDL, LOD, LOQ, and LLOQ.

1.1.7 Compounds detected at concentrations between the LLOQ and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the LLOQ be reported.

1.1.8 For DOD projects refer to QSM 4.2, Table F4; QSM 5.0, Table 4; or QSM 5.1, Table B-4 for additional method requirements and data qualifying guidance.

1.2 Summary

1.2.1 This method is adapted from SW846 method 8260B.

1.2.2 Samples are received, stored, and analyzed within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with SGS Accutest - Orlando SOP OP020 and OP021.

1.2.4 The samples are analyzed on a gas chromatograph equipped with mass spectrometer detector.

1.2.5 The peaks detected are identified by comparison to characteristic ions and retention times specific to the known target list of compounds.

1.2.6 Library searches cannot be performed on data acquired in SIM mode because data was only acquired for selected ions.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

Aqueous Samples:

2.1.1 Samples should be preserved to a pH < 2. The pH should be checked and recorded immediately after the sample analysis. If the sample is not preserved to a pH < 2, it must be noted on the report.

2.1.2 The samples must be stored in capped vials, with minimum headspace, at ≤ 6 °C in an area free of solvent fumes. The size of any bubble caused by degassing upon cooling should not exceed 5-6mm.

Solid Samples:

2.1.3 Special 40ml vials for purge-and-trap of solid samples, as well as the collection and preservation options are described in OP020.

2.1.4 Low level soil samples are preserved by storing them in sealed VOA vials at temperatures between –10 °C to –20 °C. High level soil samples are preserved by storing them in methanol at a ratio of 1 gram of soil to 1ml of methanol.

2.2 Holding Time

2.2.1 Aqueous samples are to be analyzed within 14 days of collection, unless otherwise specified by the contract. Samples that are not preserved should be analyzed within 7 days of collection; however, the preservation deficiency must be noted in the report.

2.2.2 Solid and waste samples must be analyzed within 14 days of collection.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Impurities in the purge gas, organic compounds out-gassing from the plumbing ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running laboratory blanks. The use of non-TFE tubing, non-TFE thread sealants, or flow controllers with rubber components in the purging device should be avoided.

3.3 Samples can be contaminated by diffusion of volatile organics (particularly methylene chloride and fluorocarbons) through the septum seal into the sample during shipment and storage. A trip blank can serve as a check on such contamination.

3.4 Contamination by carry-over can occur whenever high level and low-level samples are sequentially analyzed. Whenever an unusually concentrated sample is encountered, it should be followed by an analysis of reagent water to check for carry-over.

3.5 SIM may provide a lesser degree of confidence in compound identification unless multiple ions are monitored for each compound. In general, SGS Accutest monitors 3 ions per compound.

3.6 Historically 1,4-dioxane was used as a stabilizer for various chlorinated solvents such as trichlorethene and tetrachloroethene. Samples that contain 1,4-dioxane often contain trichloroethene and/or tetrachloroethene at orders of magnitude higher concentrations. Because of this, it is best to analyze samples for 1,4-dioxane on a system dedicated to only the analysis of 1,4-dioxane.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or samples loaded on an instrument within the same 12-hour shift, whichever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all MS methods, a CCV must be analyzed at the beginning of each analytical run. For DoD QSM 5 and 5.1 projects, an additional CCV must be analyzed at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Internal Standards: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Internal standards for mass spec methods are often deuterated forms of target analytes. Internal standards are used to compensate for retention time and response shifts during an analytical run.

4.6 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the LLOQ.

4.7 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.8 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.9 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.12 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.13 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the purge efficiency.

4.14 Trip Blank: A sample of analyte-free matrix taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organic samples.

5.0 REAGENTS

5.1 Reagent water – distilled or deionized water free of interferences

5.2 Methanol – purge-and-trap grade or equivalent

5.3 Hydrochloric acid (HCl) – ACS reagent grade or equivalent

5.4 Inert Gas – UHP Helium or UHP Nitrogen

5.5 1,4-Dioxane stock standards – traceable to Certificate of Analysis

5.6 4-Bromofluorobenzene (BFB) – instrument tuning mix

5.7 Surrogate standards – (varies based on analytes being reported)

Dibromofluoromethane
1,2-Dichloroethane-d_4
Toluene-d_8

5.8 Internal standards – (varies based on analytes being reported)

Fluorobenzene
Chlorobenzene-d_5
1,4-Dioxane-d_8

6.0 APPARATUS

6.1 Gas Chromatograph – Agilent Technologies 6890 or 7890

6.1.1 Gas Chromatograph

The analytical system that is complete with a temperature programmable gas chromatograph and all required accessories, analytical columns, and gases.

6.1.2 The injection port is designed for split-splitless injection with capillary columns. The injection port must have an appropriate interface for sample introduction.

6.2 Mass Spectrometer– Agilent Technologies 5973 or 5975

The mass spectrometer must be capable of scanning from 35-300 amu every second or less, utilizing 70-volt (nominal) electron energy in the electron impact ionization mode. It must also be capable of producing a mass spectrum that meets all the criteria in section 7.5.1.1 when injecting 50 ng of bromofluorobenzene (BFB).

6.3 Purge and Trap – OI Analytical 4560 or 4660 with OI Analytical 4552 or 4551

6.3.1 The following autosampler models are used for purging, trapping and desorbing the sample onto GC column.

- O.I. Model 4560 sample concentrator with 4552 Water/Soil multisampler
- O.I. Model 4660 sample concentrator with 4552 Water/Soil multisampler
- O.I. Model 4660 sample concentrator with 4551 Water multisampler

6.3.2 The sample purge vessel must be designed to accept 5 ml samples with a water column at least 3 cm deep.

6.3.3 The multisampler or concentrator is equipped with a heater capable of maintaining the purge chamber at 60 °C to improve purging efficiency.

6.3.4 The desorber should be capable of rapidly heating the trap to the manufacturer recommended desorb temperature.

6.4 Data System – Agilent Technologies MS Chemstation rev. DA 02.0x, DA 03.0x or EA 02.0x.

6.4.1 A computer system interfaced to the mass spectrometer that allows for the continuous acquisition and storage of all mass spectral data obtained throughout the duration of the chromatographic program.

6.4.2 The computer utilizes software that allows searching any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP).

6.4.3 The software should allow for integrating the abundances in any EICP between specific time or scan number limits. See Table 2.

6.4.4 Data is archived to a backup server for long term storage.

6.5 Trap – OI #10 or equivalent: Tenax, Silica Gel, and Carbon Molecular Sieve. The trap should be conditioned according to the manufacturer's recommendations.

6.6 Columns – RTX-624 or equivalent: 60m X 0.25mm 1.4um.
– RTX-VMS or equivalent: 40m X 0.18mm 1.0um

6.7 Gas-tight syringes and class “A” volumetric glassware for dilutions of standards and samples.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Volatile Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at temperatures between –10 °C and –20 °C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, preparation information, and vendor part numbers can be found in the MSVOA STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold time is reduced to six months (one month for gases) or the vendor’s expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methanol. The hold time for intermediate standards is one month (one week for gases) or the vendor’s expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the volatile organics are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard concentration is at or below the LLOQ, and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 Instrument Conditions

Gas Chromatograph/ Mass Spectrometer

Carrier gas flow	1.0-1.3 ml/min
Transfer line temperature	220 - 280 °C
Analyzer temperature	150 °C

Oven program – 45 °C for 2.5 minutes (RTX-VMS 40m)
10 °C/min to 80 °C for 0 minutes
15 °C/min to 185 °C for 0 minutes
30 °C/min to 240 °C for 2.5 minutes

Oven program – 35 °C for 2.5 minutes (RTX-VMS 40m)
4 °C/min to 60 °C for 0 minutes
25 °C/min to 220 °C for 0 minutes
30 °C/min to 240 °C for 1.2 minutes

Oven program – 45 °C for 2.0 minutes (RTX-624)
10 °C/min to 80 °C for 0 minutes
14 °C/min to 210 °C for 0 minutes
16 °C/min to 240 °C for 4.2 minutes

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

MS Descriptors – Monitor 3 characteristic ions for each target analyte, and 2 characteristic ions for each surrogate and internal standard. Each descriptor may have up to 30 ions; however, the more ions in a descriptor, the less the sensitivity. Therefore, it is beneficial to use multiple descriptors for longer analytes lists. Refer to the specific instrument methods for actual descriptors.

7.3 Purge and Trap Device conditions

Purge Gas:	Helium or Nitrogen at 30-45 ml/min
Sample Temp:	Aqueous (60°C)
	Soils (40°C)
Trap Temp:	<25°C
Purge Time:	6 or 11 min
Desorb:	1 min. at 190°C
Bake:	5 min. at 210°C

Purge and Trap conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

NOTE: Due to the poor purge efficiency of 1,4-dioxane, purge times of less than 11 minutes should not be used when analyzing for 1,4-dioxane.

7.4 Sample Preparation

7.4.1 Water Samples

A 5ml aliquot of sample is loaded onto the purge-and-trap device and purged for 6 or 11 minutes at 60°C. Detailed procedures are described in SOP OP021.

7.4.2 Solid Samples

A 5-gram aliquot of sample is loaded onto the purge-and-trap device. 5mls of reagent water is added along with internal standards and surrogates. The sample is then purged for 6 or 11 minutes while heated to 40°C and mechanically agitated. Detailed procedures are described in SOP OP020.

Alternatively a methanol aliquot from the sample is loaded onto the purge-and-trap device. 5mls of reagent water is added along with internal standards and surrogates. The sample is then purged for 6 or 11 minutes. Detailed procedures are described in SOP OP020 and OP021.

7.5 Gas Chromatographic Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.5.1 Initial Calibration Procedures

Before samples can be run, the GC/MS system must be tuned, the injection port inertness must be verified, and the instrument must be calibrated.

7.5.1.1 Tune Verification (BFB)

The instrument should be hardware tuned per manufacturer's instructions. Verify the instrument tune by injecting 50ng of BFB solution onto the instrument. The BFB standard may also be purged. The resulting BFB spectra should meet the criteria in the following table.

BFB KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
50	15-40% of mass 95
75	30-60% of mass 95
95	Base peak, 100% relative abundance
96	5-9% of mass 95
173	<2% of mass 174
174	>50% of mass 95
175	5-9 % of mass 174
176	>95% and <101% of mass 174
177	5-9% of mass 176

Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background. This procedure is performed automatically by the MS Chemstation software by running "autofind" on the BFB peak.

Select the scans at the peak apex and one to each side of the apex. Calculate an average of the mass abundances from the three scans.

Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peak and no more than 20 scans prior to the elution of BFB. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

Alternatively, the average spectra over the entire peak may be used. **All subsequent tune evaluations must use the same procedure that was used for the Initial Calibration.**

If the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are met.

Analysis must not begin until the tuning criteria are met. The injection time of the acceptable tune analysis is considered the start of the 12-hour clock. The same mass spec settings must be used for the calibration standards and samples that were used for the tune evaluation standard. The exception being that the tune evaluation standard must be acquired in full scan mode and all others in SIM mode.

7.5.1.2 Internal Standard Calibration

A minimum 5-point calibration curve is created for the volatile organic compounds and surrogates using an internal standard technique. SGS Accutest Laboratories routinely performs a 6-point calibration to maximize the calibration range.

Historically, many analytical methods have relied on linear models of the calibration relationship, where the instrument response is directly proportional to the amount of a target compound. The linear model has many advantages including simplicity and ease of use. However, given the advent of new detection techniques and because many methods cannot be optimized for all the analytes to which they may be applied, the analyst is increasingly likely to encounter situations where the linear model neither applies nor is appropriate. The option of using non-linear calibration may be necessary to address specific instrumental techniques. However, it is not EPA's intent to allow non-linear calibration to compensate for detector saturation or avoid proper instrument maintenance.

NOTE: Because of this concern, select programs including SC DHEC do not support the use of non-linear regressions.

The low point may be omitted from the calibration table for any compound with an LLOQ set at the level two standard. Additionally, the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

An entire level may be omitted provided that a minimum of 5 points remain. There must be technical justification to omit an entire level. This should be documented in the run log.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{analyte} \mathbf{X} C_{istd})/(A_{istd} \mathbf{X} C_{analyte})$$

$A_{analyte}$ = area of the analyte
A_{istd} = area of the internal standard
$C_{analyte}$ = concentration of the analyte
C_{istd} = concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 15%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. Alternatively, a calibration curve of response vs. amount can be plotted. This method allows for the use of average response factors, linear regressions, and non-linear regressions. Linear regressions may be unweighted or weighted as 1/x or $1/x^2$. If the correlation coefficient (r) is $\geq$0.995 (r^2 $\geq$0.990) then the curve can be used to quantitate target analytes in the samples. Regardless of which calibration model is chosen, the laboratory should visually inspect the curve plots to see how the individual calibration points compare to the plot.

Alternatively, either of the two techniques described below may be used to determine whether the calibration function meets acceptable criteria. These involve refitting the calibration data back to the model. Both % Error and Relative Standard Error (RSE) evaluate the difference between the measured and the true amounts or concentrations used to create the model.

Calculation of the % Error

% ERR = (xi-x'i) / xi * 100

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

Percent error between the calculated and expected amounts of an analyte should be ≤ 30% for all standards. For some data uses, ≤50% may be acceptable for the lowest calibration point.

Calculation of Relative Standard Error (%RSE)

$$RSE = 100 \times \sqrt{\sum_{i=1}^{n} \left[\frac{x_i' - x_i}{x_i}\right]^2 \Big/ (n-p)}$$

x'i = Measured amount of analyte at calibration level i, in mass or concentration units.

xi = True amount of analyte at calibration level i, in mass or concentration units.

p = Number of terms in the fitting equation. (average = 1, linear = 2, quadratic = 3)

n = Number of calibration points.

The %RSE acceptance limit criterion is ≤15% for good performing compounds and ≤30% for poor performing (PP) compounds.

7.5.1.3 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 20%. If the %D > 20%, the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 20% in the ICV, the sample will need to be reanalyzed on a system with a passing ICV for that analyte.

NOTE: For any DoD QSM project, the %D for all target compounds should be ≤ 20%. If samples must be analyzed with an analyte of interest having a %D > 20%, then the data must be qualified accordingly.

If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.5.2 Continuing Calibration Verification (CCV)

7.5.2.1 Inject 2ul of the tune evaluation mix at the beginning of each 12-hour shift. Evaluate the resultant peaks against the criteria in section 7.5.1.1. The injection time of this standard starts the 12-hour window.

When the analyst is running an unattended second 12-hour window, they may opt to purge the BFB standard. This can be performed by purging an additional blank (which contains BFB) just prior to the second CCV.

7.5.2.2 Analyze a continuing calibration check standard. The CCV should be at or below the mid-point of the calibration curve.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 20% for each analyte.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated. If the second standard meets criteria then the system is considered in control and results may be reported.

Rationale for second standard such as instrument maintenance, clipped column, remade standard, etc should be documented in the run log or maintenance log. Reanalysis of second standard without valid rationale may require the analysis of a third standard (in which case both the second and third standard would have to pass).

NOTE: For any DoD QSM project, if the second standard meets criteria, then a third standard must be analyzed. If the third standard also meets criteria then the system is considered in control and results may be reported.

If the |%D| is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported, i.e., the CCV failed high, the associated QC passed, and the samples were ND.

NOTE: For any DoD QSM project, if samples must be reported with a target analyte having a %D > 20%, then the data must be qualified accordingly, regardless of whether the analyte was detected or not.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

7.5.2.3 For DoD QSM 5.0 and 5.1 compliance, an additional CCV must be analyzed at the end of each run. The closing CCV should be within the 12-hour Tune window.

The %D for all target compounds in this CCV should be ≤ 50%. If the %D > %50 for any target compound, then the samples should be reanalyzed at least once at the appropriate dilution. If the %D > %50 for the analytes in the reanalysis, the department supervisor shall review the data and determine what further action is necessary. This may include reanalyzing the samples at a higher dilution or qualifying the data.

NOTE: If samples are ND and an analyte in the CCV fails high, then the sample does not need to be reanalyzed.

7.5.2.4 If any of the internal standard area change by a factor of two (-50% to +100%) or retention time changes by more than 30 seconds (10 seconds for DOD QSM 5.1 compliance) from the midpoint standard of the last initial calibration or from the daily CCV, the mass spectrometer must be inspected for malfunctions and corrections made, as appropriate. Corrective action may include re-calibration (initial Calibration) of the instrument.

7.5.3 Sample Analysis

7.5.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Tune Evaluation Mix
Initial Calibration Standards (or CCV)
QC Samples
Samples

7.5.3.2 One microliter of internal standard/surrogate solution is added to every 5ml of sample in the sparge vessel. Generally, 5ml of sample are transferred to the sparge vessel.

7.5.3.3 After purging, the system will automatically reverse flow and rapidly heat the trap to desorb the sample analytes onto the GC column.

7.5.3.4 Qualitative identification

The target compounds shall be identified by analysts with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria required for a positive identification are:

The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

The sample component must elute at the same relative retention time (RRT) as the daily standard. The RRT of sample component must be within ± 0.06 RRT units of the standard.

All ions monitored in the standard mass spectra should be present in the sample spectrum.

The relative intensities of these ions must agree within ± 30% between the daily standard and sample spectra, (e.g., for an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%).

Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

If peak identification is prevented by the presence of interferences, the sample must be diluted so that the interference does not mask any analytes.

7.5.3.5 Quantitative analysis

When a target compound has been identified, concentration will be based on the integrated area of the quantitation ion, which is normally the base peak.

The sample matrix may produce an interference with the primary ion. This may be characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. The interference could also, severely inhibit the response of the internal standard ion.

If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that samples be diluted so that the response falls into the middle of the calibration curve.

7.6 Maintenance and Trouble Shooting

7.6.4 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.6.5 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.6.6 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.6.7 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Internal Standards

9.1.1 Fluorobenzene, Cclorobenzene-d_5, and 1,4-dioxane-d_8 may be used as the internal standards for this method. The response of the internal standard in all subsequent runs should be within a factor of two (-50% to +100%) of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard response should be compared to the internal standard response for the mid-point standard.

9.1.2 If the internal standard response is not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.1.3 If no problem is found, prepare a second aliquot of sample and reanalyze the sample. If there is insufficient sample for reanalysis, footnote this on the report.

9.1.1.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference. The sample may need to be diluted or the results qualified.

9.2 Surrogates

9.2.1 Dibromofluoromethane, 1,2-dichloroethane-d_4 and toluene-d_8 may be used as the surrogate standards to monitor the efficiency of the purge-and-trap system.

A known amount of surrogate standard is added to each sample including the QC set prior to purging. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for all surrogates for the results to be acceptable.

9.2.2 If any surrogate recovery is not within the established control limits, the following are required.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, surrogate solutions or internal standard solutions. If errors are found, recalculate the data accordingly.

9.2.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.2.2.3 If no problem is found, reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then reanalysis may not be necessary. For any DoD QSM projects, the resulting data must be qualified accordingly. If there is insufficient sample for reanalysis, footnote this on the report.

9.2.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

9.3 Method Blank

9.3.1 The method blank is de-ionized water or de-ionized water with 5 grams of Teflon chips (depending upon sample matrix) to which the surrogate standard has been added. An appropriate aliquot of methanol should also be added. The method blank is then purged along with the other samples to determine any contamination from the system or ambient sources. The method blank must be free of any analytes of interest or interferences at ½ the required LLOQ level to be acceptable. Common laboratory contaminants such as methylene chloride must be below the LLOQ if present. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be reanalyzed for confirmation. If there is insufficient sample to reanalyze, or if the sample is reanalyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Blank Spike

9.4.1 The blank spike is de-ionized water or de-ionized water with 5 grams of Teflon chips (depending upon sample matrix) to which the surrogate standard and spike standard have been added. An appropriate aliquot of methanol should also be added. The blank spike is then processed along with the other samples to monitor the efficiency of the purge-and-trap procedure. The percent recovery for each analyte is calculated as follows:

$$\% \text{ Recovery} = (\text{Blank Spike Amount} / \text{Amount Spiked}) \times 100$$

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable.

NOTE: A secondary check against 70-130% limits should be performed for all analytes reported to SC DHEC.

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions, or internal standard solutions. If errors are found, recalculate the data accordingly.

9.4.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. For any DoD QSM projects, the resulting data must be qualified accordingly.

9.4.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples or qualifying the results as estimated.

9.4.2.5 If there is insufficient sample to reanalyze, or if the sample is reanalyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then processed along with the other samples to monitor the precision and accuracy of the purge-and-trap procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = ([Spike Amount – Sample Amount] / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions, or internal standard solutions. If errors are found, recalculate the data accordingly.

9.5.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for reanalysis, but are an indication of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

$$RPD = (|\text{MS Result} - \text{MSD Result}| / \text{Average Result}) \times 100$$

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the department supervisor shall review the data and determine if any corrective action is necessary. RPD failures are generally not grounds for batch reanalysis.

10.0 CALCULATIONS

The concentration of each target compound in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (5 / W_I)] / \%solids$ (*low level soils)*

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / V_A) \times (5 / W_I) \times DF] / \%solids$ (*high level soils)*

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean RF or curve fit.
DF	=	Dilution Factor
V_F	=	Volume of methanol extract (ul)
V_A	=	Volume of methanol aliquot (ul)
W_I	=	Weight of sample (g)
%solids	=	Dry weight determination in decimal form

For high level soils, V_F is calculated as follows:

V_F = {ml of solvent + [(%moisture X W_I) / 100]} X 1000 ul/ml

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the SGS Health and Safety Program, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis, methanol extraction, and standards preparation are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Old stock standards are disposed of in the waste vial drum.

Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining aqueous and soil samples are transferred to the appropriate drums for disposal.

12.0 REFERENCES

SW846 Method 8000D Revision 4, July 2014

SW846 Method 8260B Revision 2, December 1996

TABLE 1

Routine Target Analytes

Benzene	cis-1,3-Dichloropropene
Carbon Tetrachloride	trans-1,3-Dichloropropene
Chloroform	1,4-Dioxane
1,1-Dichloroethane	Methyl Chloride
1,2-Dichloroethane	Methylene Chloride
1,1-Dichloroethylene	Tetrachloroethylene
cis-1,2-Dichloroethylene	1,1,1-Trichloroethane
trans-1,2-Dichloroethylene	Trichloroethylene
1,2-Dichloropropane	Vinyl Chloride

TABLE 2

Characteristic Ions

Analyte	Quant. Ion	Q1	Q2	Q3
Fluorobenzene IS	96	70		
Methyl Chloride	50	52		
Vinyl Chloride	62	64		
1,1-Dichloroethene	61	96	98	63
Methylene Chloride	49	84	86	51
trans-1,2-Dichloroethene	61	96	98	63
1,1-Dichloroethane	63	65		
cis-1,2-Dichloroethene	96	61	98	63
Chloroform	83	85	47	
Dibromofluoromethane Surr	113	111	192	
Carbon Tetrachloride	117	119	121	82
1,1,1-Trichloroethane	97	99	61	
Benzene	78	51		
1,2-Dichloroethane-d4 Surr	65	67	102	
1,2-Dichloroethane	62	49	64	
Trichloroethene	95	130	97	132
1,2-Dichloropropane	63	62	41	76
cis-1,3-Dichloropropene	75	77	39	
Chlorobenzene-d_5 IS	117	82		
Toluene-d_8 Surr	98	100		
trans-1,3-Dichloropropene	75	77	39	49
Tetrachloroethene	166	164	129	131
1,1,2-Trichloroethane	83	97	61	99
1,4-Dioxane-d_8 IS	96	64		
1,4-Dioxane	88	58	43	

METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

Prepared by: David Metzgar III Date: 02/22/2018

Approved by: Svetlana Izosimova Date: 02/22/2018

Annual Review

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Document Control

Issued to: QA Department Date: 02/22/2018

Issued to: Metals Date: * 02/22/2018

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

REFERENCES: SW846 6010D, 2014

INSTRUMENT: THERMO 6500, SERIAL # 20100903 SSTRACE 1
INSTRUMENT: THERMO 6500, SERIAL # 20103825 SSTRACE 2
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 031038A520 SSTRACE 1
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 041048A520 SSTRACE 2

SUGGESTED WAVELENGTH (S): TABLE 2

REVISED SECTIONS: removed all references to Accutest

1.0 SCOPE AND APPLICATION SUMMARY

SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.1 This method is applicable for the determination of metals in water, sludges, sediments, and soils. Elements that can be reported by this method include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Titanium, Thallium, Tin, Vanadium, and Zinc.

1.2 Sample matrices are pretreated following SW846 and EPA methods for digestion of soil, sediment, sludge or water samples. Refer to specific metals department digestion SOP's for more information on digestion techniques.

1.3 This inductively coupled argon plasma optical emission spectrometer (s) (ICP-OES) uses an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis. Control of the spectrometer is provided by PC based iTEVA software. In the instrument, digested samples are introduced into the Thermo 6500 ICP, passed through a nebulizer and transported to a plasma torch. The element-specific emission spectra are produced by a radio frequency inductively coupled plasma. The spectra are dispersed by a spectrometer, and the intensities of the emission lines are monitored with the solid state detector.

1.4 Reporting limits (RL)(LLOQ) are based on the extraction procedure. Reporting limits may vary depending on matrix complications, volumes and by client needs, but the reporting limits must always be verified with a low check which meets the criteria outlined in this SOP. Solid matrices are reported on a dry weight basis. Refer to table 1 of this SOP for SGS - Orlando typical reporting limits. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits.

1.5 MDLs must be established for all analytes, using a solution spiked at approximately 3 to 5 times the estimated detection limit. To determine the MDL values, take seven replicate aliquots of the spiked sample and process through the entire analytical method. The MDL is calculated by multiplying the standard deviation of the replicate analyses by 3.14, which is the student's t value for a 99% confidence level. MDLs must be determined approximately once per year for each matrix and instrument. Please refer to SGS - Orlando QA SOP QA020, current version for further information regarding method performance criteria and experimental method detection limits.

MDLs are generated for each matrix on both ICP instruments. The higher of the two statistically calculated MDL's is entered into LIMS as the MDL. The verified MDLs are stored in the LIMS and must be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.6 LLOQ verification. LLOQ is the lowest point of quantitation. The LLOQ is initially verified by the analysis of 7 replicate samples, spiked at the LLOQ and processed through all preparation and analysis steps of the method. The mean recovery should be within +/- 35 percent of the true value with an RSD $\leq$ 20 percent.

1.7 Ongoing Lower limit of quantitation (LLOQ) check sample. The lower limit of quantitation check sample should be analyzed on a quarterly basis to demonstrate the desired detection capability. The LLOQ sample is carried through the entire preparation and analytical procedure. The mean recovery should be within +/- 35 percent of the true value with an RSD $\leq$ 20 percent.

1.8 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.9 Instrument Detection Limits (IDL). It is suggested that IDL's be completed upon initial instrument installation, whenever instrument conditions have significantly changed, or at a minimum annually. Instrument detection limits can be estimated as the mean of the blank results plus 3 times the standard deviation of 10 replicate analyses of the reagent blank solution. (use zero for the mean if the mean is negative) Each IDL measurement shall be performed as though it were a separate analytical sample. IDLs shall be determined and reported for each wavelength used in the analysis of the samples.

2.0 PRESERVATION AND BOTTLEWARE

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction. Final pH of TCLP extracts are checked and recorded in SGS - Orlando Extractions Department. Please refer to TCLP (1311) fluid determination logbook and SPLP (1312) fluid determination logbook for further information. TCLP extracts received from SGS - Orlando Extractions Department are prepared as soon as possible, no longer than 24 hours from time of receipt. If precipitation is observed during the sample preparation process the sample(s) are immediately re-prepped on dilution until no precipitation is observed. Samples received for dissolved metals analysis should be filtered and preserved to pH<2 as soon as possible and held for 24 hours prior to digestion. Refer to SGS - Orlando Sample Filtration Logbook for further information.

All soil samples must be stored in a refrigerator at $\leq$ 6°C upon receipt. Refer to SOP SAM101, current revision for further instruction.

All bottleware used by SGS - Orlando is tested for cleanliness prior to shipping to clients. Analysis results must be less than one half the reporting limit (LLOQ) to be acceptable. Refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME AND BATCH SIZE

All samples must be prepared and analyzed within 6 months of the date of collection. Refer to appropriate SGS - Orlando digestion SOP, current revision for batch size criteria.

4.0 INTERFERENCES

Several types of interferences can cause inaccuracies in trace metals determinations by ICP. These interferences are discussed below.

4.1 Spectral interferences are caused by overlap of a spectral line from another element, unresolved overlap of molecular band spectra, background contribution from continuous or recombination phenomena, and background contribution from stray light from the line emission of high concentration elements. Corrections for these interferences can be made by using interfering element corrections, by choosing an alternate analytical line, and/or by applying background correction points. The locations selected for the measurement of background intensity will be determined by the complexity of the spectrum adjacent to the wavelength peak. The locations used for routine measurement must be free of off-line spectral interference or adequately corrected to reflect the same change in background intensity as occurs at the wavelength peak.

Note: Refer to section 17.0 of this SOP for further instruction regarding interfering element correction factor generation.

4.2 Physical interferences can be caused by changes in sample viscosity or surface tension, by high acid content in a sample, or by high dissolved solids in a sample. These interferences can be reduced by making sample dilutions.

4.3 Matrix interferences in high solid samples can be overcome by using an internal standard. Yttrium/Indium mix is used for the Thermo 6500 ICP. The concentration must be sufficient for optimum precision but not so high as to alter the salt concentration of the matrix. The element intensity is used by the instrument as an internal standard to ratio the analyte intensity signals for both calibration and quantitation.

4.4 Chemical interferences are not pronounced with ICP due to the high temperature of the plasma, however if they are present, they can be reduced by optimizing the analytical conditions (i.e. power level, torch height, etc.).

5.0 APPARATUS

5.1 Currently there are two solid state ICPs available for use in the lab. Both are Thermo 6500 ICP units. These units have been optimized to obtain lower detection limits for a wide range of elements. Since they are solid state systems, different lines may be included for elements to obtain the best analytical results. However, the lines which are normally included in the normal analysis program are shown in Table 2.

5.2 Instrument auto samplers. For random access during sample analysis.

5.3 Class A volumetric glassware and pipettes.

5.4 Polypropylene auto sampler tubes.

5.5 Eppendorf Pipette (s) - Pipette (s) are checked daily for accuracy and to ensure they are in good working condition prior to use. Volumes are checked at 100% of maximum volume (nominal volume). Pipettes are checked within the metals department and results are stored electronically in the “Pipette Calibration Log”. Refer to SOP QA006, current revision for further information regarding pipette calibration. BIAS: mean must be within 2% of nominal volume. Precision: RSD must be $\leq$ 1% of nominal volume based on three replicates.

5.6 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be less than one half the reporting limit(LLOQ) to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be less than one half the reporting limit (LLOQ)to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.

5.8 Data System

Microsoft Windows XP Professional Version 2002
Instrument software SST1 – Thermo iTEVA version 2.8.0.89

Instrument software SST2 – Thermo iTEVA version 2.7.0.87

5.8.1 A computer system interfaced to the Thermo 6500 ICP that allows for the continuous acquisition and storage of all data obtained throughout the duration of the analytical run sequence.

5.8.2 Data is archived to a backup server for long term storage.

6.0 REAGENTS

All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificates of Analysis and compliance with the specifications of the grade listed. SGS - Orlando produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. De-ionized (DI) water should be used whenever water is required. Refer to SOP QA037, current revision for more information regarding testing and monitoring. Refer to the Metals Department Standard Prep Logbook for the make-up and concentrations of standards and stock solutions being used within this SOP. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date. Standards and prepared reagents must be prepared every 6 months or before stock standard expiration date, whichever comes first. Refer to tables 3 through 7 of this SOP for concentration levels of standards used. Unless otherwise approved, the calibration curve must contain 3 points determined by a blank and a series of standards representing the elements of interest.

6.1 2.5 ppm Yttrium and 10 ppm Indium internal standard, made from ICP quality standard.

6.2 Hydrochloric acid, trace metals grade.

6.3 Nitric Acid, trace metals grade.

6.4 ICP quality standard stock solutions are available from Inorganic Ventures, Spex, Plasma Pure, Ultra, Environmental Express, or equivalent.

6.5 Calibration Standards. These can be made up by diluting the stock solutions to the appropriate concentrations. The calibration standards should be prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

6.5.1 For calibration and quantitation an internal standard (Yttrium/Indium) is used to limit nebulization problems. If it is known that the samples contain a significantly different acid matrix, the samples must be diluted so that they are in a similar matrix to the curve. All sample results are referenced to the initial calibration blank (ICB) Internal Standard counts. The criteria is 60-125 percent of the initial calibration blank (ICB) counts. If the internal standard counts fall outside these criteria matrix effects must be suspected and the sample diluted until it meets the criteria or footnoted in LIMS as suspected matrix interference.

6.5.2 Standards must be prepared so that there is minimal spectral interference between analytes.

Note: All Ag stock and intermediate solutions must be stored away from direct sunlight.

6.6 Analytical Quality Control Solutions.

All of the solutions below are prepared by adding either mixed or single element metals solutions to a solution prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

6.6.1 Blank (Calibration, ICB, CCB)

This reagent blank contains Nitric Acid at 3 percent and Hydrochloric Acid at 5 percent.

6.6.2 Initial Calibration Verification solution.

This standard solution must be made from a different source than the calibration curve. The concentrations for each element must be within the range of the calibration curve and should be approximately at the midpoint of the curve. This solution is used to verify the accuracy of the initial calibration. Levels for the ICV standard are shown in Table 4.

6.6.3 Continuing Calibration Verification solution.

The metals concentrations for this standard should be at approximately the mid-point of the calibration curve for each element. This standard should be prepared from the same source that is used for the calibration curve. Levels for the CCV standard are shown in Table 5.

6.6.4 Spectral Interference Checks (SIC). Two types of SIC checks are used. Individual element SIC are performed when the instrument is initially set up, and every six months thereafter. The mixed element SIC solution is used daily to check that the instrument is free from interference from elements typically observed in high concentration and to check that interference corrections (IEC) are still valid.

6.6.4.1 Single element interference checks – At a minimum, single element SIC checks should be performed for the following elements: Aluminum 500 mg/l; Barium 4 mg/l; Calcium 500 mg/l; Copper 4 mg/l; Iron 500 mg/l; Magnesium 500 mg/l; Manganese 4 mg/l; Molybdenum 4 mg/l; Sodium 1000 mg/l; Nickel 4 mg/l; Selenium 4 mg/l; Silicon 50 mg/l; Tin 4 mg/l; Vanadium 4 mg/l and Zn 4 mg/l.

Mixed element SIC solution – The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 200 mg/l; Magnesium 500 mg/l.

The absolute value of the concentration observed for any unspiked analyte in the single element SIC checks must be less than 2 times the analytes LLOQ. The concentration of the SIC checks are suggested, but become the highest reportable concentration in the sample analysis and cannot be higher than the highest established linear range. Samples with concentrations of elements higher than the SIC check must be diluted until the concentration is less than the SIC check solution. Reanalysis of a diluted sample is required even if the high concentration element is not required to be reported for the specific sample, since the function of the SIC check is to evaluate spectral interferences on other elements. The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been demonstrated and documented as contaminants in the SIC solutions. Levels for the SIC and mixed SIC can be found on tables 9 and 10.

6.7 CRIA Standard Solution (Also referred to as LLCCV)

The CRIA standard contains the elements of interest at levels equal to SGS - Orlando quantitation limits (RL). Please refer to Table 6 for list of elements of interest and concentration levels for the CRIA. If special client reporting limits are requested, then low checks corresponding to those reporting limits must also be analyzed.

6.8 Matrix Spike, Matrix Spike duplicate, and Spike Blank Solution.

This solution is prepared by adding either mixed or single element metals solutions to a solution containing 3 percent nitric acid and 5 percent hydrochloric acid and diluting to a fixed final volume with this acid mixture. Spiking solution (s) must be added to the spike blank, matrix spike, and the matrix spike duplicate prior to digestion. Levels for the MS and MSD and Spike Blank standard are shown in Table 7.

6.9 Liquid Argon or Argon Gas. (99.999% purity)

7.0 ANALYTICAL PROCEDURE

Note: Please refer to section 8 of this SOP for further detail on quality control standards. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

7.1 General procedure on how to operate the Thermo 6500 is described below. Refer to the Thermo 6500 operation manual for further details.

7.2 Before starting up the instrument, make sure that the pump tubing is in good condition, the torch assembly, the nebulizer, and the spray chamber are clean, the dehumidifier (if used) is filled with DI water up to the level between Minimum and Maximum, and that there are no leaks in the torch area.

7.3 Turn on the recirculating cooler. Verify that the argon is turned on and there is enough for the entire days analytical run.

7.4 Tighten the pump platens and engage the peristaltic pump. Make sure sample and internal standard solutions are flowing smoothly.

7.5 Put a new solution of acid rinse into the rinse reservoir. The composition of the rinse solution may be periodically changed to minimize sample introduction problems and sample carryover. If internal standard is being used, make sure that sufficient amount of internal standard is prepared for the entire analytical run.

7.6 Start up the instrument following the sequence show below.

7.6.1 Double click the **iTEVA Control Center** Icon on the desktop. Type ***admin*** in User Name field, and then click **OK**.

7.6.2 Once the iTEVA Control Center window is opened, click on **Plasma** Icon at status bar area. Then click on **Instrument Status** to check the interlock indicators (torch compartment, purge gas supply, plasma gas supply, water flow and exhaust should be in green; drain flow and busy should be in gray) and the Optics Temperature. (It should be around 38^{o}C.) Click on the Close box.

7.6.3 Click **Plasma On**. When the plasma is on, click close. Let the instrument warm up for 15 to 20 minutes before starting the analysis. New tubing may take an hour to stabilize.

7.7 Torch Alignment and Auto Peak

7.7.1 If the torch has been cleaned, then the torch alignment procedure must be performed.

7.7.2 Open the method and then click on **Sequence** tab, then click on **List View** Icon until you reach rack display.

7.7.3 Go to S-6 position (you can assign any position in the rack for torch alignment), then right click to select **Go** to empty sample S:6. (Now, the auto sampler tip moves from Rinse to this position).

7.7.4 Click on **Analysis** tab, then select **Torch Alignment** from Instrument drop down menu. There will be a pop up dialog box present. Click **Run**. Then there will be another dialog pop up box (This is a reminder for Torch Alignment Solution (2 ppm Zn)), click **Ok**. Now, the instrument is initializing an automated torch alignment. It takes about 7 minutes to complete this step. Progress is indicated in the progress bar.

7.7.5 After torch alignment is complete, click **Close**. Click on **Sequence** tab, then followed by **List View** Icon.

7.7.6 Go to Rinse position at rack display, right click to select Go to rinse and let it rinse for approximately 5 minutes.

7.7.7 Perform Auto Peak

7.7.8 It is recommended that the Auto Peak Adjust procedure be performed daily prior to calibration. A standard that contains all of the lines of interest is used and the system automatically makes the appropriate fine adjustments. (High standard solution should be used for this process.)

7.7.9 Click **Sequence** tab, then click on **List View** Icon until the rack is displayed.

7.7.10 Go to S-5 position (you can assign any position in the rack for auto peak adjust), then right click to select **Go** to empty sample S:5. (Now, the auto sampler tip moves from the Rinse position to this position). Click on **Analysis** tab. All elements result is shown in the display area. From Instrument drop down menu, select **Perform Auto Peak**. There will be a pop up dialog box present. Highlight “All Elements”, and then click **Run**. Then there will another pop up dialog box (This is a reminder for Auto Peak Solution), click **Ok**. Now, the instrument is performing auto peak adjust. It takes about 5 minutes to complete this process. The Auto Peak dialog box will show a green check mark in front of “All Elements”, which indicates Auto Peak is complete.

7.8 Open the method and start up the run.

7.8.1 Click on **Analyst** Icon at the workspace. Go to the method and choose Open from the drop down menu. Select the method with the latest revision number.

7.8.2 Go to **Method** tab at the bottom of left hand corner to click on **Automated Output** at the workspace area. Type a filename in Filename field in the data display area (i.e. : SA101010M1, starts with SA, then followed by MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs.) Click on **Apply To All Sample Types**.

7.8.3 Click on **Sequence** tab at the bottom of left hand corner. From Auto Session drop down menu bar, click on **New Auto sampler** to create a sequence. This will pop up a dialog box, then click on **New** and fill in number of samples (i.e.: 100) in the Number of Samples field and the sample I.D. (leave this field empty) in Sample Name field. Type a sequence name (i.e. : SEQ101010M1, starts with SEQ, then MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs) in the Sequence Name field. Click Ok, then put in “0” as settle time between sequences, and click **Ok**.

7.8.4 Right click on **Untitled** (Cetac ASX-520 Enviro 5 Named Rack is the rack that is currently used) at the workspace area, click on **Auto-Locate All** to locate all sample positions.

7.8.5 Double click on **Untitled** again, then click on the sequence name (i.e. : SEQ101010M1), on the data display area, type the sequence in Samplename column, dilution factor (if needed) in CorrFact column, check the box in front of Check column, and select an appropriate check table.

7.8.6 Once done with creating sequence, go to **Method** drop down menu and save all changes as **Save As**. There will be a Save a Method dialog box present, go to the save option to check on “Overwrite Method and bump revision number” box, and then click **Ok**.

7.8.7 Go to Sequence tab, click on List View Icon from tool bar, then click on Connect Autosampler to PC and Initialize Icon.

7.8.8 See table 8 for a typical run sequence.

7.9 Calibrate the instrument as outlined below. See table 3 for calibration standards concentrations. This calibration procedure is done a minimum of once every 24 hours. The calibration standards may be included in the auto sampler program or they may be run manually from the **Calibrate Instrument (graduated cylinder)** icon located on the Analyst tab. The instrument may be calibrated using a single point standard and a calibration blank or a multipoint calibration. If a multipoint calibration is used a minimum of three standards are required. All curves must be determined from a linear calibration prepared in the normal manner using the established analytical procedure for the instrument. Refer to instrument manual for further detail. Three exposures will be used with a percent relative standard deviation of less than 5 percent. The resulting correlation coefficient must be $\geq$0.995. If the calibration curves do not meet these criteria, analysis must be terminated, the problem corrected, and instrument re-calibrated. Correlation coefficients, slopes, and y-intercepts for each wavelength are printed and included in each analytical data package.

7.10 Initial Calibration Verification Standard (ICV).

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010D. If the ICV is outside these criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.

7.11 After analyzing the ICV, the ICB must be analyzed. The results of the ICB must be less than one half the reporting limit (LLOQ). The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.

7.12 Before analyzing any real world samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

7.13 Before analyzing any real world samples, the Mixed element SIC solution must be analyzed. The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 500 mg/l; Magnesium 500 mg/l.

The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been demonstrated and documented as contaminants in the SIC solutions. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

7.14 After the initial analytical quality control has been analyzed, the samples and the preparation batch matrix quality control shall be analyzed. Each sample analysis must be a minimum of 3 readings using at least a 5 second integration time. Between each sample, flush the nebulizer and the solution uptake system with a blank rinse solution for at least 60 seconds or for the required period of time to ensure that analyte memory effects are not occurring.

7.15 Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010D, the CCV shall be reanalyzed to confirm the initial value. If the CCV is not within criteria after the reanalysis, no samples can be reported in the area bracketed by the failing CCV. Immediately following the analysis of the CCV the CCB shall be analyzed. The results of the CCB must be less than one half the reporting limit (LLOQ) for all elements. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.

7.16 One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5

dilution must be made on the sample. The results of the 1:5 dilution shall agree within 20 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the LLOQ). If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must recover within ± 25 percent for method SW846-6010D. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

7.17 The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the “linear range”. Sample results above the linear range shall be diluted under the linear range and reanalyzed. Following calibration, the laboratory may choose to analyze a standard (or mixed standard solution) at a higher concentration than the high standard used in the calibration curve. The standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with, but may be analyzed anywhere in the run. Samples following a sample with high concentrations of analyte (s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.

7.18 After the instrument is optimized and all initial QC has been run, click on **Run Auto-Session** Icon to start the analytical run sequence.

7.18.1 If you need to add or delete samples once the run is started, follow the steps shown below.

7.18.2 Click on **Sequence** tab, then click on **List View** Icon at the tool bar. There is the sequence table shown on the display area.

7.18.3 Click on **Add Samples** Icon. This will pop up a dialog box, and then fill in number of samples that need to be added. Click **Ok**. By doing this, samples will be added to the end of the current sequence without a rack location.

7.18.4 On the Samplename column type in the sample I.D., correction factors, and check tables. **Click on Auto Locate All.**

7.18.5 The added samples will be analyzed at the end of the original sequence run order unless they are assigned a different run order.

7.18.6 Deleting Samples

7.18.7 Click on **Sequence** tab, and then click on **List View** Icon under the sequence display area.

7.18.8 Highlight all samples that need to be deleted and then click on the **Delete Samples** icon.

7.19 When the analysis is completed export the data to LIMS following the procedure outlined below.

7.19.1 Double click on **ePrint** Icon on desktop. There will be a **LEADTOOLS ePRINT** pop up box, click on **Finish Jobs** and **OK** boxes.

7.19.2 Double click the **PDF** Icon on the desktop; the PDF file will be present as Document_#. Right click on that file, select **rename** to change the filename to an assigned analytical run I.D. (i.e.: MA9000). This is the raw data file for MA9000.

7.19.3 Drop the raw data to the **LIMS Data Drop** icon located on the desktop.

7.19.4 By completing the above steps, the raw data (i.e.: MA9000) can be viewed and/or printed from the Raw Data Search function.

7.19.5 Go to **Analysis** tab, right click on sample header, and select export all samples. A pop up dialog box will come up, type in the analytical run I.D. (i.e.: SA101010M1) and click **Ok**. Go to **Lims Export** folder located on the desktop, right click on analytical run and change extension from .TXT to .ICP. Open the analytical file and make any necessary changes, such as deleting any samples that need to be re-run on dilution. **Save** the file. Drop the data file to the **LIMS Data Drop** icon located on the desktop. This will then send the export file to LIMS for review.

7.20 The data can be evaluated by running an automated data evaluation program, which will help to generate quality control summary pages. Each run must be evaluated as quickly as possible to make sure that all required quality control has been analyzed. With each data package include: cover sheet, copies of all prep sheets, autosampler run sequence, dilution sheets, and raw data. Label each folder with MA#, instrument run I.D., instrument used, and date.

7.21 At the end of the analysis day the ICP must be shutdown using the following sequence.

7.21.1 Place the auto sampler tip in the rinse cup and rinse in a mixed solution of approximately 5 percent nitric acid and 5 percent hydrochloric acid for 10 minutes and then in DI water for 20 minutes.

7.21.2 Turn off the plasma by clicking on the **Plasma** Icon and then by clicking **Plasma Off.**

7.21.3 Close all iTeva programs/windows.

7.21.4 Release the tension on the sample pump platens.

7.21.5 Turn off recirculating chiller.

8.0 QUALITY CONTROL

This section outlines the QA/QC operations necessary to satisfy the analytical requirements for method SW846 6010D. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements. Check with the area supervisor or lab manager for any non-compliant quality control for further information.

8.1 Initial Calibration Verification Standard (ICV).

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010D. If the ICV is outside these criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.

8.2 Continuing Calibration Blank/Initial Calibration Blank.

Analyze the Initial calibration blank solution at the beginning of each run and the continuing calibration blank after every tenth sample and at the end of the sample run. The ICB/CCB must be less than one half the reporting limit (LLOQ) for each element. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit (LLOQ) for all samples to greater than two times the background concentration.

8.3 Low Standard Check (CRIA or LLCCV).

Before analyzing any real world samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

8.4 ICSA (Mixed SIC Solution)

Before analyzing any real world samples, the Mixed element SIC solution must be analyzed. The mixed element SIC solution is used as an ongoing daily check of freedom from spectral interferences. The mixed element SIC contains the following elements: Aluminum 500 mg/l; Calcium 500 mg/l; Iron 500 mg/l; Magnesium 500 mg/l.

The daily mixed element SIC solution is analyzed daily after calibration. The concentration measured for any target analytes must be less than +/- the LLOQ. For spiked elements, the analyzed results must be within 20 percent of the true value for SIC check and within 10 percent for linear range check. If this criterion cannot be met then sample analysis may not proceed until the problem is corrected, or the LLOQ is raised to twice the concentration observed in the SIC solution. The only exceptions are those elements that have been demonstrated and documented as contaminants in the SIC solutions. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

8.5 Continuing Calibration Verification.

Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010D the CCV must be reanalyzed to confirm the initial value. If the CCV is not within criteria after reanalysis no samples can be reported in the area bracketed by the failing CCV.

8.6 Method Blank.

The laboratory must digest and analyze a method blank with each batch of samples. The method blank must contain elements at less than one half the reporting limit (LLOQ) for each element. The exception to this rule is when the samples to be reported contain greater than 10 times the method blank level. In addition, if all the samples are less than a client required limit and the method blank is also less than that limit, then the results can be reported as less than that limit. Samples associated with the contaminated blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-digesting and reanalyzing the samples, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit (LLOQ) to greater than two times the background concentration,

8.7 Blank Spike Sample.

The laboratory must digest and analyze a spike blank sample with each batch of samples. Blank Spikes must be within 20 percent of the true value for method SW846-6010D. If the lab control is outside of the control limits for a reportable element, all samples must be re-digested and reanalyzed for that element. The exception is if the lab control recovery is high and the results of the samples to be reported are less than the reporting limit (LLOQ). In that case, the sample results may be reported with no flag. For solid standard reference materials (SRMs) $\pm$ 20 percent accuracy may not be achievable and the manufacturer’s established acceptance criterion should be used for all soil SRMs.

8.8 Matrix Spike and Matrix Spike Duplicate Recovery.

The laboratory must digest and analyze a matrix spike and matrix spike duplicate with each batch of samples. The matrix spike recovery is calculated as shown below and must be within 20 percent of the true value for method SW846-6010D. If a matrix spike is out of control, then the results must be flagged with the appropriate footnote. If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and must be footnoted to that effect.

Note: Both the matrix spike amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{\text{(Spiked Sample Result - Sample Result)}}{\text{Amount Spiked}} \times 100 = \text{matrix spike recovery}$$

8.9 Matrix Duplicate/Matrix Spike Duplicate Relative Percent Difference.

The laboratory must digest a duplicate with each batch of samples. The relative percent difference (RPD) between the duplicate and the sample must be assessed and must be $\leq$ 20 percent for sample results at or above the reporting limit (LLOQ). If the RPD is outside the 20 percent criteria the results must be qualified in LIMS. RPD's are also calculated in LIMS for sample results below the reporting limit (LLOQ). RPD's outside the 20 percent criteria are not considered failing and LIMS automatically footnotes these as "RPD acceptable due to low duplicate and sample concentrations."

Note: Both the duplicate amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{(|\text{Sample Result - Duplicate Result}|) \times 100}{(\text{Sample Result + Duplicate Result})/2} = \text{Duplicate RPD}$$

8.10 Serial Dilution Analysis and Post Digestion Spike.

One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution shall agree within 20 percent of the true value as long as the analyte concentration is within the linear range of the instrument and sufficiently high (minimally, a factor of 25 times greater than the LLOQ). If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must recover within $\pm$ 25 percent for method SW846-6010D. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

$$\frac{(\text{Sample Result - Serial Dil. Result})}{\text{Sample Result}} \times 100 = \text{Serial Dilution RPD}$$

8.11 Linear Calibration ranges.

The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the "linear range". Sample results above the linear range shall be diluted under the linear range and reanalyzed. Following calibration, the laboratory may choose to analyze a standard (or mixed standard solution) at a higher concentration than the high standard used in the calibration curve. The standard must recover within 10 percent of the true value, and if successful, establishes the linear range. The linear range standards must be analyzed in the same instrument run as the calibration they are associated with, but may be analyzed anywhere in the run. Samples following a sample with high concentrations of analyte (s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.

8.12 Sample RSD

For samples containing levels of elements greater than five times the reporting limits (LLOQ), the relative standard deviation for the replicates should be less than 5%. If not, reanalyze the sample. If upon reanalysis, the RSD's are acceptable then report the data from the reanalysis. If RSD's are not acceptable upon reanalysis, then the results for that element should be footnoted that there are possible analytical problems and/or matrix interference indicated by a high RSD between replicates.

8.13 Interelement Spectral Interference Correction Validity

For the interelement spectral interference corrections to remain valid during sample analysis, the interferent concentration must not exceed its linear range. If the interferent concentration exceeds its linear range or its correction factor is big enough to affect the element of interest even at lower concentrations, sample dilution with reagent blank and reanalysis is required. In these circumstances, analyte dilution limits are raised by an amount equivalent to the dilution factor.

8.14 Internal Standard (Yttrium/Indium)

For any readings where the internal standard is outside of the range 60-125 percent of the internal standard level in the reference standard (Initial Calibration Blank), then the sample must be diluted until the internal standard is within range and all sample results must be footnoted in LIMS.

8.15 MSA (Method of Standard Additions)

SGS - Orlando uses the internal standard technique as an alternative to the MSA per SW846-6010D section 4.4.2. However, in certain circumstances MSA may be needed by some project specific requirements. SGS - Orlando may perform an MSA when sample matrix interference is confirmed through the post digestion spike process or may qualify the results in LIMS. SGS - Orlando will use a single addition method as described in SW846-7000B.

9.0 GLASSWARE CLEANING

All glassware must be washed with soap and tap water and then rinsed with 5 percent nitric acid. It must then be rinsed at least 3 times with DI water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

10.0 DOCUMENTATION REQUIREMENTS

Refer to the Laboratory Quality Assurance Manual for documentation requirements. All raw data is printed to .PDF format and archived to a backup server for long term storage.

11.0 SAFETY

The analyst must follow normal safety procedures as outlined in the SGS - Orlando Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor. Follow proper safety precautions when working with gas cylinders.

12.0 CALCULATIONS

For water samples, the following calculations must be used. Refer to the QC section for the calculations to be used for the QC samples.

Original sample concentration of metal (ug/l) =

$$\frac{\text{(conc. in the digestate (ug/l)) x (final digestate volume (ml))}}{\text{(initial sample volume (ml))}}$$

For soil samples, the following calculations must be used.

Concentration of the metal in the dry sample (mg/kg) =

$$\frac{\text{(conc. in the digestate (mg/l) x final digestate volume(L))}}{\text{(sample wt. (kg)) x (\% solids/100)}}$$

13.0 INSTRUMENT MAINTENANCE

Recommended periodic maintenance includes the items outlined below. All maintenance must be recorded in the instrument maintenance log.

13.1 Change the pump tubing as needed.

13.2 Clean the filter on the recirculating pump approximately once a month and dust off the power supply vents as needed.

13.3 Clean or replace the nebulizer, torch assembly, and injector tube as needed.

13.4 Change the sampler tip as needed.

13.5 Clean the recirculating pump lines and internal sock filter every 3 months or as needed.

13.6 Clean the radial view quartz surface weekly or more often if needed.

14.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

14.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 14.2.

14.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

15.0 GENERIC DEFINITIONS

15.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours whichever comes first.

15.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

15.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

15.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

15.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the reporting level.

15.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

15.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the performance of a method in a given sample matrix.

15.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and performance of a method in a given sample matrix.

15.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

15.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

15.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

16.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

17.0 GENERATION OF INTERFERING ELEMENT CORRECTION FACTORS

17.1 It is recommended that all IEC's be verified and updated approximately every 6 months or whenever instrument conditions change significantly. It is also recommended that elements with frequent high concentrations or with large IEC's should be checked more frequently.

17.2 Calculate the IEC correction factors and enter them into the method (refer to Thermo 6500 instrument manual). Calculate the correction factor using the equation shown below. This correction factor must be added to the correction factor already in place in the method for a given element.

$$\text{IEC} = \frac{\text{Concentration Result of the element with the interference}}{\text{Concentration result of the interfering element}}$$

17.3 Verify the new correction factors by reanalyzing the ICSA/ICSAB solutions and/or the SIC solutions or by reloading and recalculating the previously stored results. If the reanalysis is not within QC limits, make additional changes to the IEC factors and then re-verify both the individual and combined solution values.

17.4 Save and update the method.

17.5 Interfering element correction factors are saved as raw data along with the run printouts on a daily basis so that the IEC's for a given run are traceable.

TABLE 1: REPORTING LIMIT BY ELEMENT

Analyte	Water Reporting Limit(LLOQ) (ug/L)	Soil Reporting Limit(LLOQ)(mg/kg)	TCLP Reporting Limit(LLOQ) (mg/L)/MCL
Tin	50	5	
Aluminum	200	20	
Antimony	5	1	
Arsenic	10	0.5	0.10 / 5.0
Barium	200	20	10 / 100
Beryllium	4	0.5	
Cadmium	5	0.4	0.05 / 1.0
Calcium	1000	500	
Chromium	10	1	0.10 / 5.0
Cobalt	50	5	
Copper	25	2.5	
Iron	300	10	
Lead	5	1	0.5 / 5.0
Magnesium	5000	500	
Manganese	15	1.5	
Nickel	40	4.0	
Potassium	5000	500	
Selenium	10	1	0.5 / 1.0
Silver	10	1	0.10 / 5.0
Sodium	5000	500	
Thallium	10	1	
Vanadium	50	5	
Zinc	20	2	
Molybdenum	50	2.5	
Strontium	10	0.5	
Titanium	10	0.5	

TABLE 2. THERMO 6500 ANALYSIS LINES

Element	Wavelength
Al	396.1
As	189.042
Ca	317.933
Fe	259.9
Mg	279.078
Mn	257.610
Pb	220.353
Se	196.026
Tl	190.864
V	292.402
Ag	328.068
Ba	455.4
Be	313.042
Cd	226.502
Co	228.616
Cr	267.716
Cu	324.753
K	766.491
Na	589.5
Ni	231.604
Sb	206.838
Zn	206.2
Mo	202.030
Sn	189.900
Sr	407.7
Ti	334.9

TABLE 3: LOW, MID AND HIGH STANDARD LEVELS
Single Point Calibration (blank and high standard) may be used

Element	Low	Mid	High
	ug/l	**ug/l**	**ug/l**
Al	10000	40000	80000
As	500	2000	4000
Ca	10000	40000	80000
Fe	10000	40000	80000
Mg	10000	40000	80000
Mn	500	2000	4000
Pb	500	2000	4000
Se	500	2000	4000
Tl	500	2000	4000
V	500	2000	4000
Ag	62.5	250	500
Ba	500	2000	4000
Be	500	2000	4000
Cd	500	2000	4000
Co	500	2000	4000
Cr	500	2000	4000
Cu	500	2000	4000
K	10000	40000	80000
Na	10000	40000	80000
Ni	500	2000	4000
Sb	500	2000	4000
Zn	500	2000	4000
Mo	500	2000	4000
Sn	500	2000	4000
Sr	500	2000	4000
Ti	500	2000	4000

TABLE 4: ICV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

TABLE 5: CCV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

TABLE 6: CRIA(LLCCV) STANDARD LEVELS

Element	CRIA
	ug/l
Al	200
As	10
Ca	1000
Fe	300
Mg	5000
Mn	15
Pb	5
Se	5
Tl	10
V	50
Ag	10
Ba	200
Be	5
Cd	5
Co	50
Cr	10
Cu	25
K	5000
Na	5000
Ni	40
Sb	5
Zn	20
Mo	50
Sn	50
Sr	10
Ti	10

TABLE 7: BLANK SPIKE, MATRIX SPIKE AND MATRIX SPIKE DUPLICATE LEVELS

Element	Concentration
	ug/l
Al	27000
As	2000
Ca	25000
Fe	26000
Mg	25000
Mn	500
Pb	500
Se	2000
Tl	2000
V	500
Ag	50
Ba	2000
Be	50
Cd	50
Co	500
Cr	200
Cu	250
K	25000
Na	25000
Ni	500
Sb	500
Zn	500
Mo	500
Sn	500
Sr	500
Ti	500

TABLE 8: TYPICAL RUN SEQUENCE

BLANK
LOW
MID
HIGH
HIGH STD
ICV
ICB
CRIA
ICSA
ICSAB
CCV
CCB
MB
SB
SAMPLE1
DUPLICATE
SERIAL DILUTION
MATRIX SPIKE
MATRIX SPIKE DUPLICATE
POST DIGESTION SPIKE
SAMPLE2
SAMPLE3
CCV
CCB
SAMPLE4
SAMPLE5
SAMPLE6
SAMPLE7
SAMPLE8
SAMPLE9
SAMPLE10
SAMPLE11
SAMPLE12
SAMPLE13
CRIA CLOSING
ICSA CLOSING
ICSAB CLOSING
CCV
CCB

TABLE 9: ICSA (Mixed SIC) SOLUTION LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	500
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Sr	0
Ti	0

TABLE 10: SINGLE ELEMENT INTERFERENCE CHECK SOLUTION (SIC) LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	500
Mg	500
Mn	4
Pb	0
Se	4
Tl	0
V	4
Ag	0
Ba	4
Be	0
Cd	0
Co	0
Cr	0
Cu	4
K	0
Na	1000
Ni	4
Sb	0
Zn	4
Mo	4
Sn	4
Si	50
Sr	0
Ti	0

DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

Prepared by: Jenna Kravitz Date: 11/28/2017

Approved by: Svetlana Izosimova Date: 04/04/2018

Annual Review

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Document Control

Issued to: QA Department Date: 04/04/2018

Issued to: General Chemistry Department Date: * 04/04/2018

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

REFERENCES: EPA 300.0, Revision 2.1, 1993; SW846 9056A; 40CFR, part 136, App. B – MDL procedure

REVISED SECTIONS: Apparatus and Reagents sections 7 and 8 are revised to accommodate transition to carbonate-bicarbonate eluent; updated references sec. 17.

1.0 SCOPE AND APPLICATION

1.1 This method is for the measurement of anions such as bromide, chloride, fluoride, nitrate, nitrite and sulfate by ion chromatography. The method is applicable to potable and non-potable water, solids after extractions, and neutral leachates.

2.0 SUMMARY OF METHOD

2.1 A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, and analytical column, a suppressor, and a conductivity detector.

2.2 Detection limits vary with the instrument conditions and calibration levels used.

REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Reporting Limit. The normal reporting limit for this method is normally established at or above the lowest non-zero concentration standard in the calibration curve. Detected concentrations below this concentration are not reported unless MDL reporting is being done. Reporting limits were set as follows:

ANALYTE	REPORTING LIMIT
Bromide	0.50 mg/l
Chloride	2.00 mg/l
Fluoride	0.20 mg/l
Nitrate	0.10 mg/l
Nitrite	0.10 mg/l
Sulfate	2.00 mg/l

3.2 Method Detection Limit. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B. This value represents the lowest reportable concentration of an individual compound that meets the method qualitative identification criteria.

Experimental MDLs must be determined semiannually for this method, as outlined in EPA 300.0. Refer to SOP QA020, current revision, for further details.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or samples loaded on an instrument within the same 12-hour shift, whichever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Method Detection Limits (MDLs) MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. This definition is qualitative in nature and does not evaluate an acceptable quantitative limit for method performance. MDLs should be determined semiannually for every matrix in this method. Refer to SOP QA020, current revision.

4.11 Reagent Blank: The reagent blank is a blank that has the same matrix as the samples, i.e., all added reagents, but did not go through sample preparation procedures. The reagent blank is an indicator for contamination introduced during the analytical procedure. For methods requiring no preparation step, the reagent blank is equivalent to the method blank.

4.12 Reagent Grade: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents, which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

4.13 Reagent Water: Water that has been generated by any method, which would achieve the performance specifications for ASTM Type II water.

4.14 Reference Material: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

4.15 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.16 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 HEALTH & SAFETY

5.1 The analyst should follow normal safety procedures as outlined in the SGS Accutest Health and Safety Program which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

6.0 COLLECTION, PRESERVATION, AND HOLDING TIME

6.1 Samples must be cooled to <6°C at the time of collection.

6.2 Bromide, chloride, fluoride, and sulfate must all be analyzed within 28 days. Nitrite and nitrate must be analyzed within 48 hours for aqueous samples. For solids, the same hold time applies, after the samples are prepared (see section 10.1.)

Note: State of West Virginia requires 48 hours from collection to completion for NO2/NO3, regardless of matrix.

7.0 APPARATUS AND MATERIALS

7.1 Ion Chromatograph with a guard column, an analytical column, a suppressor column, and a conductivity detector. This SOP is written for the use with the Dionex ICS-2000 or ICS-2100 instrument. The ICS-2000 is run using prepared eluent. The columns used are listed below. Alternate columns may be used if all method requirements can be met.

Maintenance and troubleshooting procedures are described in detail in operation manual. Most basic procedures include checking connections for leaks, cleaning and/or replacing tubing, monitoring and recording the pressure. See Sec.12.0.

7.1.1 Suppressor, AERS 500 Carbonate 4mm. Dionex part number 085029

7.1.2 Guard Column, IONPAC AG22 4 mm. Dionex part number 064139

7.1.3 Analytical Column, IONPAC AS22. Dionex part number 064141

7.1.4 Data System **Chromeleon 6.80 SR 10, build 2818**. Data system's revisions will be updated during annual SOP revisions. Data system changes prior to the date of revision are to be recorded in Maintenance log.

7.2 Top loading balance, capable of weighing to 0.01g. Calibrated and serviced annually by outside vendor and verified daily with Class 1 weights.

7.3 Analytical balance capable of accurately weighing to the nearest 0.0001 g.

7.4 Centrifuge Centra CL2, or equivalent

7.5 Class 1 weights

7.6 Volumetric glassware, class A.

7.7 IC vials and caps

7.8 Volumetric pipettes, class A or autopipetters. Note: If autopipetters are used, make sure that the calibration is checked before use as specified in the autopipetter SOP QA006, current revision.

7.9 Helium tank and regulator. On the ICS-2000 and ICS-2100 instruments, helium is used only for head pressure on the water reservoirs. The pressure should be set at approximately 6 psi.

7.10 Nylon 0.45µm membrane filters or equivalent.

7.11 Disposable syringes, for sample filtering.

7.12 Conductivity meter to pre-determine dilutions for possible interferences.

8.0 REAGENTS

All chemicals listed below are reagent grade unless otherwise specified. Deionized water must be used whenever water is required.

8.1 Stock Standard Solutions, custom mix standards that contain all target anions with a concentration range from 500mg/L to 10000mg/L: This custom standard can be purchased from various manufacturers such as High Purity Standard cat. # SM-205-001 and Inorganic Ventures cat.# acuttest-19.

Note: Levels shown below are suggested levels and may be changed to meet different reporting limit requirements.

8.1.1 The final concentrations of suggested standards are shown in the table below. All units are in mg/L.

Anion	STD A	STD B	STD C	STD D	STD E	STD F	STD G
F	.1	.5	1.5	2.5	5	7.5	10
CHL	2	10	30	50	100	150	200
NO2	.1	.5	1.5	2.5	5	7.5	10
BRO	.5	2.5	7.5	12.5	25	37.5	50
SO4	2	10	30	50	100	150	200
NO3	.1	.5	1.5	2.5	50	7.5	10

8.1.2 The volume of stock added to 100mL volumetric flask are shown in the table below. All volume units are in mL.

Anion	STD A	STD B	STD C	STD D	STD E	STD F	STD G
Custom mix	0.02	0.10	0.30	0.50	1.00	1.50	2.00

8.2 CCV. Same concentration as standard D.

8.3 ICV (External Check Solution.) The ICV can be made in the same manner as the standard D from a separate source than the ICAL standards. It must be within the range of the curve. Alternatively, it can be purchased from an outside supplier.

8.4 Stock Eluent (450mM Na2CO3, 140mM NaHCO3): In a 1000mL flask, add approximately 300mL of DI H20. Using oven dried reagent, dried at 105˚C, (temperature should not exceed 110 ˚C) weigh 47.6955g of Na2CO3 and 11.7614g of NaHCO3, and add to flask. Bring this solution to volume. This solution is stable for 6 months stored refrigerated.

8.5 Eluent Solution (4.5mM Na2CO3, 1.4mM NaHCO3): Dilute Stock Eluent –Sec. 8.4 using 20mL of stock in a 2000mL flask and bring up to volume. This solution is stable for a week stored refrigerated.

8.6 0.2N H_2SO_4 for suppressor regeneration: Pipet 1.0 mL of concentrated H_2SO_4 into 100 mL DI and dilute to final volume of 200mL with DI.

8.7 0.1M Oxalic Acid for metals column clean-up: Dissolve 6.3g of oxalic acid into approx. 300mL of DI water. Bring to final volume of 500mL with DI water.

8.8 10X eluent concentrate for hydrophilic ionic contamination clean-up.

8.9 Acetonitrile, reagent grade

8.10 1M HCl: Add 8.3 mL of concentrated hydrochloric acid to approximately 70 mL of deionized water. Dilute to a final volume of 100 mL and mix well.

9.0 INTERFERENCES

9.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. This interference is especially important at low concentrations.

9.2 The acetate anion elutes early during the chromatographic run and can cause elution times of other anions to vary when large amounts of acetate are present. High levels of acetate also can cause interference with the fluoride peak. Therefore, this method is not recommended for leachates containing acetic acid.

9.3 Large amounts of an anion can interfere with the peak resolution of an adjacent anion. High concentrations of an anion can also cause the peak to be misidentified on the chromatograph due to the large width of the peak. Sample dilution and fortification can be used to correct most interference problems connected with peak resolution.

9.4 Samples that contain particles greater than 0.45μm and reagents with particles larger than 0.2μm must be filtered to prevent damage to instrument columns and flow systems.

10.0 SAMPLE PREPARATION PROCEDURE

10.1 For soil samples, follow the preparation outlined below.

10.1.1 Mix the sample well and remove any artifacts as discussed in SOP QA034, current revision. Weigh approximately 5g of sample and add 50mL of DI water. Mix or shake the resulting slurry for 10 minutes. Record the weight to the nearest 0.01g on preparation log.

10.1.2 For matrix spikes, make sure to spike the aliquot of the sample directly and then add the volume of DI water needed to make the volume of liquid being added to the soil sample equal to 50 mL including the volume of the spike solutions. In most cases this will be 49.75 mL of DI.

10.1.3 Prepare blank QC (Method Blank and Blank Spike) using a clean solid matrix, using approximately 5g aliquot and 50mL of DI water. Record the weight to nearest 0.01g.

10.1.4 Check with the lab supervisor if there is insufficient sample to use a 5g aliquot. Smaller aliquots may be used if a homogeneous portion of the sample can be obtained. The sample must always be extracted with 10 times the sample weight of DI water.

10.1.5 Centrifuge samples and QC for 10 minutes at 2000 RPM, then pre-filter through 0.45µm filters before analysis.

10.2 For aqueous samples, pre-filter water samples through 0.45µm filters only if they contain sediment or appear cloudy before analysis. Matrix spikes must be spiked before filtration. Pre-filter method blanks and blank spikes to act as QC check of the filters, only if there are samples in the batch that have been filtered. Record which samples have been filtered and the lot number of the filters in the run log. An unfiltered Method Blank and unfiltered Blank Spike are required for every batch of samples.

11.0 ION CHROMATOGRAPHY ANALYSIS PROCEDURE

11.1 Check to make sure that the helium tank pressure is > 100 PSI and the pressure gauge by the eluent bottles is set at 6 PSI.

11.2 Fill the eluent generation bottle(s) that are to be used with Eluent Solution- Sec. 8.5, making sure that they are pressurized with helium. On the instrument panel (or in the software) set the water volume at the level in the bottles and adjust the flow rate up to 1.0 mL/min.

11.3 Check the lines coming out of the suppressor for air bubbles. Bubbles should be present. If not, then check to make sure the current is on and the suppressor is working properly.

11.4 Check the pump waste line and see if bubbles are present. If they are present, then prime the pump using the procedure described below.

11.4.1 Verify that the priming valve on the primary pump head (right side) is closed. Hit the prime button on the front panel.

11.4.2 Follow the screen prompts. When prompted, open the waste valve by turning the knob ¼ to ½ turn counter-clockwise.

11.4.3 Check for air bubbles on the pump waste line. Continue priming until no air bubbles are exiting the waste line. Turn the pump off and then close the waste valve.

11.4.4 Allow the instrument conditions to settle and then check the pressure and check for air bubbles. If there is still a problem, the priming procedure may be repeated.

11.5 In the software, go to the browser and go to the correct instrument panel (1 or 2). Then connect the instrument. Monitor the baseline until it is stable.

11.6 Go to the template sequences and edit a sequence for the samples in the run. If a calibration is being used from an earlier run, make sure to copy the calibration into the front of the sequence. After the sequence is generated, then save it using the file name (instrument, date, run). Refer to the instrument manuals or help screens in the program for help in using the software. A summary of the instrument conditions required for the analysis of anions is shown below. Note: the retention time for each anion must not exceed ±10% of that anions retention time from the calibration. Refer to section 14.7 for more discussion of the proper application of retention time.

Column: IonPac AG22, AS22
Eluent: 4.5mM Na2CO3, 1.4mM NaHCO3
Suppressor setting: approximately 30mAmps. This setting will be autogenerated.
Flow Rate: 1.0mL/min
Inj. Volume: 12.5µl
Pump pressure – should be around 1600 psi
Detection: Suppressed conductivity, SRS Ultra II, external water mode

11.7 Check sample conductivity with a conductivity meter to determine if dilutions are needed. Refer to spreadsheet of possible dilutions stored on LAN in GenChem directory.

11.8 Load the autosampler and turn it on. The autosampler should then move to the first sample. A print-out of the autosampler table should be generated showing the order that the samples are loaded into the autosampler.

11.9 Start the run. Monitor the results as the run is going to make sure that problems are identified quickly. Note: the initial demonstration of capability, including instrument MDL's and linear calibration ranges, must be completed before samples can be run.

11.9.1 Data files should be saved using the naming scheme of instrument, year (last 2 digits), month, day, run number followed by the extension of .txt. For example, the first IC run on instrument 2 on May 20, 2005 would be named 205052001.txt. This name should always be used in the workgroup description in the LIMS system.

11.9.2 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 or greater is required. If this correlation coefficient is not met, than the instrument must be recalibrated. Force to Origin (aka Force to Zero) is not permitted.

11.9.2.1 Using weighed regression 1/concentration is also acceptable. Same correlation coefficient of 0.995 or better is required for this calibration model. *For greater details refer to SOP QA042, current revision.*

11.9.3 After the calibration, a low check at the reporting limit must be run. This low check must have the levels in standard A or at the reporting limit for the calibration outlined in this SOP and recoveries must be in the range of 50–150%. On a daily basis, it is recommended that an external check is analyzed and recoveries must be within a range of 90-110%. (This check must be analyzed at a minimum with each new calibration.) Continuing calibration checks and continuing calibration blanks must be run every 10 samples. The continuing calibration checks must have recoveries in the range of 90-110%. Refer to the quality control section of this SOP for more detail on these quality control samples.

11.10 After the run is completed, review all of the chromatograms and check for overlapping peaks, dilutions, etc.

11.10.1 If the retention time of any anion in the ICV or CCV check standards has shifted more than 10% from the original calibration curve retention time, then no results can be reported for that anion. The column should be reconditioned, if necessary, and the instrument recalibrated before any more samples are reported for that anion. Affected samples are reanalyzed after the problem has been corrected.

11.10.2 If a sample peak has shifted significantly from the original retention time (and the ICV and CCV check standards are within the 10% retention time window), then verify the reported result using post-digest spike on that sample. Do not report results from peaks where the retention time has shifted more than 10 percent unless the peak can be verified using a post-digest spike.

11.10.3 For large or overlapping peaks, make dilutions. If at all possible, make dilutions and reruns on the same run as the original sample.

11.10.4 Refer to section 14.7 for information on how to determine the appropriate retention time window.

11.11 Review all data and update the appropriate tests in the LIMS system. A write-up including a run log, a calibration summary, batch quality control summary, and copies of all chromatograms should be turned into the area supervisor for each batch.

11.11.1 If edits are needed in the calibration after the data has been calculated, the run can be reprocessed using the batch function in the software. Refer to the instrument manuals or on-screen help for addition information.

12.0 INSTRUMENT MAINTENANCE

12.1 Whenever a new suppressor is put in place or when the baseline is unstable or very high, the suppressor should be regenerated. The procedure below is for the Ultra 4mm suppressor.

12.1.1 Using a disposable plastic syringe, push approximately 3mL if 0.2(200mN) H_2SO_4 through the ELUENT OUT port and 5mL of 0.2N H_2SO_4 through the REGIN IN port respectively.

12.1.2 Allow the suppressor to sit for approximately 20 minutes to fully hydrate the suppressor screens and membranes.

12.1.3 Re-connect the suppressor to the system in the recycle mode.

12.2 Periodically, due to the matrix of samples, both guard and analytical columns become degraded and cleaning them becomes necessary. This is evidenced in changing retention times, round-shaped peaks, tailing peaks and overall poor integration. The metals cleanup should be done a minimum of once per month, while the others should be done a minimum of once per quarter.

12.2.1 There are 3 recommended cleanup solutions for the AS22 and AG22 columns.

12.2.2 Metal contamination column clean-up: Use 500mL of 0.2M oxalic acid solution.

12.2.3 Low valency hydrophilic ionic contamination column clean-up. Use 500mL of 10X eluent concentrate (300 mM KOH).

12.2.4 High valency hydrophobic ion 200mM HCl in 80% acetonitrile: The acetonitrile solution is stored in a separate eluent bottle because acetonitrile slowly breaks down in acidic aqueous solutions. Prepare 2 bottles (E1 and E2) with the following 500-mL solutions: E1: 100% Acetonitrile and E2: 1M HCl using DI water.

12.3 Column Clean-up Procedure.

12.3.1 Prepare 500mL solution of the appropriate cleanup solution from 12.2.1

12.3.2 Disconnect the suppressor from the IonPac AS22 Analytical column. **Make sure to reverse the order of the guard and analytical column in the eluent flow path.** Contaminants that have accumulated on the guard column can be eluted onto the analytical column and irreversibly damage it. Cleaning each column separately is recommended. Double check that the eluent flows in the direction designated on each of the column labels.

12.3.3 Set the pump flow rate to 1.0mL/min for an AS22 4-mm analytical or guard column.

12.3.4 Rinse the column for 15 minutes with DI water before pumping the chosen cleanup solution over the columns.

12.3.5 Pump the cleanup solution through the column for at least 60 minutes.

12.3.6 Rinse the column for 15 minutes with DI water before pumping eluent over the column.

12.3.7 Equilibrate the columns with eluent before resuming normal operation for at least 30 minutes.

12.3.8 Reconnect the suppressor and place the guard column in line between the injection valve and the analytical column.

13.0 METHOD PERFORMANCE

Method performance (accuracy and precision) is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

Filtered method blanks and blank spikes to act as QC check of the filters. Unfiltered method blanks and blank spikes are used to monitor overall method performance.

14.0 QC REQUIREMENTS

14.1 A method detection limit study must be done semiannually, or when new operator begins work, or whenever there is a significant change in the background or instrument response. The MDL study is done following the procedure outlined in the SGS Accutest - Orlando SOP QA020, current revision. A minimum of seven replicates spiked at 3 to 5 times the MDL must be taken through the procedure for each anion. If instrument conditions (columns, etc.) are modified, then a new MDL must be done.

14.2 A method blank and a spike blank are required to be run with every batch of 20 samples. Additionally a matrix spike and a matrix duplicate are required for every 10 samples. In some cases a matrix spike duplicate may be required in place of a duplicate.

14.2.1 The method blank must contain <½ RL of each anion that is reported and this sample must be run with each set of samples in a batch. If the blank contains more than the reporting level, then all samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged. (The exception is if the sample results are less than the reporting limit.)

Note: West Virginia state specific requirement for method blank must contain analyte at <MDL

14.2.1.1 Although the method states that values greater than the MDL should be suspect, this is not appropriate for the concentration levels being applied for this analysis. MDL's are generally up to 10 times lower than reporting limits for all analytes and values over the MDL do not impact data usability.

14.2.2 The recovery of the spike blank must be within the limits of 90-110% recovery for each anion that is reported and this sample must be run with each set of samples in a batch. If the recoveries are outside of this range, then all associated samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged.

14.2.3 The matrix spike is spiked with all anions of interest. Method limits of 90 -110 % recovery must be applied. Control limits must be generated from laboratory data to support method limits. If the recoveries are outside of this range, and all other method quality control is within limits, then matrix interference should be suspected.

14.2.4 For matrix duplicates control limits of 10% RPD must be applied for all sample values within the calibration range (up to 10 times the reporting limit). If the RPD values are outside of this range, and all other method quality control is within limits, then sample non-homogeneity should be suspected.

14.3 An external source standard (ICV) must be analyzed after every new calibration and its recovery must be within 10% of the true value. If the ICV is not within ±10%, a second ICV should be prepared and analyzed. If the ICV is still outside of the limits, sample analysis must be discontinued and the cause determined (preparation of ICV from third source, instrument recalibration, etc)

14.4 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 is required.

14.4.1 A new calibration is required when standard retention times shift by more than 10% from the original calibration.

14.5 A low check at the reporting limit (CCV2) for each anion must be run after each calibration. Acceptance criteria is 50–150%.

14.6 Continuing Calibration Verification (CCV) Checks at or near the mid-level of the curve must be run at the beginning and the end of the run and after every 10 samples throughout the run. Every CCV must be followed by a continuing calibration blank (CCB). The CCV must have results within 90-110% of the true value. If the CCV results are outside of the acceptance criteria range, analyst must demonstrate acceptable performance with two CCVs analyzed immediately (started within 1 hour), with no samples between failing CCV and the two additional CCVs. The results for the CCB must be <1/2 RL for an analyte. If they are not, then all bracketed samples for that analyte must be reanalyzed.

14.7 Retention time windows must be established whenever a new column/guard column is installed in an instrument or whenever a major change has been made to an instrument. Retention time shift is checked weekly with a CCV to ensure it does not exceed 10%, and the data is stored on LAN in GenChem directory.

Retention time windows are established by injecting standard mix three times over the course of 24 hours and calculating the standard deviation of the retention times of each analyte. Plus or minus three times the standard deviation of the retention times is defined as the retention time window of that compound.

Peak identification is based on the retention time of an analyte in the standard (initial or continuing) being used as the mid-point of the retention time window. The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known standard peaks throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.10 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential "hits". The analyst will then review these "hits" and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

14.8 The Linear Calibration Range (LCR) is the concentration range the instrument response is linear and must be initially determined and verified every 6 months or whenever a significant change in the instrument is observed or expected. Initially, enough standards must be used to insure the curve is linear. The linearity verification must use at a minimum, a blank and 3 standards. The verification data must be within ±10% of the assigned values. If the data falls outside of this range, then the linearity of the instrument must be reestablished. If any portion of the curve is nonlinear, then sufficient standards must be used to clearly delineate the nonlinear portion of the curve.

NOTE: Samples with detections within 10% of highest calibration standard must be diluted.

14.9 ***Contingencies for handling out-of-control QC***. Upon certain circumstances data can be reported from batches with QC non-conformances. Such samples are to be qualified accordingly. Examples include:

- If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results reported with appropriate qualifiers and footnotes. If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. *This must be approved by the department supervisor.* Samples with hits <10 times contamination are reprepped and reanalyzed. If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor*
- Similarly, if the recovery of LCS or CCV is high and the associated sample is non-detect, the data may be reportable with appropriate qualifiers and footnotes. If the recovery of LCS or CCV is below lower acceptance limit, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, reprepping and/or reanalyzing the samples, or qualifying the results as estimated. *This must be approved by the department supervisor.* If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor.*

If the matrix spike recoveries are not within the established control limits, compare the recoveries to those of the LCS to assess method performance in clean QC matrix. Matrix spike recovery failures are not grounds for reanalysis but are an indication of the sample matrix effects

15.0 DOCUMENTATION REQUIREMENTS

15.1 All reagents must be recorded in a reagent logbook with manufacturers, lot numbers, and expiration dates. All reagent information must be cross referenced on the sample worksheet.

15.2 All instrument data must be exported to the LIMS system and a copy of the run log must be included in the logbook by the instrument.

15.3 A data package consisting of a manual run log, a LIMS run log, a calibration summary, batch quality control summary, and copies of all chromatograms must be turned into the area supervisor for each batch. The analyst should also complete the preliminary review in the LIMS system.

15.4 Refer to SOP QA029, current revision, for procedures and documentation that must be followed when peaks are manually integrated.

16.0 POLLUTION PREVENTION & WASTE MANAGEMENT

16.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 16.2.

16.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

17.0 ADDITIONAL REFERENCES

17.1 Dionex Instrument and column manuals

17.2 QA020 Method performance SOP, current revision

17.3 QA029 Manual Integration SOP, current revision.

17.4 QA042, General Chemistry Calculations, current revision

17.5 TNI 2009 standards.

17.6 DoD QSM, Rev. 5.1, 2017

Table 1 QC Criteria

Quality Control	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration: r = coefficient of correlation	At least quarterly	≥0.995	Rerun calibration standards, and/or prepare new calibration standards and recalibrate the instrument, or document why the data are acceptable. See 11.9.2.
Initial Calibration Verification standard (ICV)	One per calibration	90-110% of the standard's true value	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable. See 14.3
Continuing Calibration Verification standard (CCV)	Every tenth sample	90-110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable. See 14.6
Low-level Standard	One per calibration	50-150% of the standard's true value	Rerun standards, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Method blank (MB) and Calibration Blank (CCB)	MB: One per batch CCB: Every tenth sample	< ½ RL **Note**: West Virginia state specific requirement for method blank must contain analyte at <MDL	Reanalyze, and/or stop the run and determine the source of contamination, or document why the data are acceptable.
Retention time	Checked weekly	90-110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Blank Spike (BS or LCS)	One per batch	90-110%	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
MS/MSD	10% of matrix	90-110%	Determine and correct the problem, reanalyze samples and MS/MSD, or document why data are acceptable
Linear Calibration Range (LCR)	Bi-annually	± 10% of the standard's true value	Rerun and/or prepare new series of standard, and/or recalibrate instrument

SAMPLE RECEIPT AND STORAGE

Prepared by: Svetlana Izosimova Date: 10/25/2018

Approved by: Heather Wandrey Date: 10/29/2018

Annual Review

Reviewed by: ____________________ Date: __________

Reviewed by: ____________________ Date: __________

Reviewed by: ____________________ Date: __________

Document Control

Issued to: QA Department Date: 10/29/2018

Issued to: Sample Management Date: * 10/30/2018

Issued to: ____________________ Date: __________

Issued to: ____________________ Date: __________

Issued to: ____________________ Date: __________

Issued to: ____________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: SAMPLE RECEIPT AND STORAGE

REFERENCES: TNI Standards 2009 and 2016, State of Florida DEP SOPs, 40 CFR Part 136, DoD QSM 5.1 and 5.1.1

REVISED SECTIONS: Removed Accutest references throughout the document; Added Access Receipt program throughout the document; added verification of correction factors to 2.2.2; discussed recording temperature to first decimal place in 2.2.3; added section 2.4.8; added green labels to 2.11.2; removed 2.5 as redundant to 2.2.4; edited 2.10;

1.0 SCOPE AND APPLICATION

To maintain documentation of custody of all bottle sets, samples (domestic and foreign), digestates, distillates, and extracts that fall under the responsibility of SGS North America, Inc. - Orlando.

2.0 EXTERNAL CHAIN-OF-CUSTODY PROCEDURE

2.1 Samples are received via commercial carrier, client delivery, or are picked up by SGS - Orlando employees. Upon receipt, sample management inspects the outside of the container for signs of tampering, such as a torn or missing custody seal. The staff reviews Chain Of Custody (CoC) document for the following information:

2.1.1 Client Information- Name / Address, Phone and Fax contact numbers

2.1.2 Facility Information- Project name, Location, Project Number.

2.1.3 Field ID / Point of Collection- Date- Time- (HOLD TIMES) Samplers Initials- # of containers Shipped, Preservative types.

2.1.4 Matrix of samples: WW- water, GW-ground water, SW-surface water, DW-drinking water, SO-Soil, SOL-other solid, LIQ-other liquid, OI- Oil, AIR-air, WP- Wipe, FB-field blank, TB-trip blank.

2.1.5 Analytical Information- Samples with hold times of 72 hrs or less remaining on analyses upon receipt are considered Short Hold Samples and are listed on Short Hold Notification form in order of hold times, from ASAP to 7 days with less than 3 days left. These samples are processed immediately. Job Numbers are assigned, and the samples are given directly to the appropriate lab. Copy of CoC and completed Short Hold Notification Form are relinquished to the appropriate lab by the sample receiving technician. Laboratory personnel accept the samples, time of transfer is recorded, both parties sign SHNF and a copy of the SHNF is attached to CoC. (See Attachment I, Short Hold Notification Form)

2.1.5.1 VOC soil sample vials must be frozen within 48 hours of collection. Receiving technicians review sample times and deliver samples with a

SHNF if sufficient hold-time remains to process the samples. If samples are close to expiring the samples are immediately placed in the freezer with a card notating the time they were placed in the freezer.

2.1.6 TURN AROUND TIME- Samples with a 6 day or less TAT are processed as soon as possible, depending on samples with short hold status.

2.1.7 Sample custody documentation signatures – relinquished/received in Client – Carrier – Laboratory sequence. Per FL DEP SOPs signature shall consist of full signature – no initials allowed – and business affiliation.

2.1.8 Special Requirements and or comments - Compositing, filtering or preservation of samples, Extended sample storage etc.

2.2 Samples are processed by a two-technician team, The sample custodian(s) accepts sample custody upon receipt of samples and verifies that the custody document is correct. Sample conditions, sample temperature, and other observations, including custody seal condition, are documented in detail on the electronic Sample Receipt Confirmation form (p-note).

2.2.1 Temperature is measured using IR thermometer against white label on temperature blank, or on the sample container, if temperature blank is absent. **NOTE: For jobs originated in West Virginia every sample container must be checked.** This thermometer is calibrated measuring the temperature off of white sample label against NIST-traceable liquid-in-glass thermometer – see SOP QA002, current revision. When recording the cooler temperature with the use of an IR gun the following needs to be documented on Sample Receipt Confirmation Form:

2.2.1.1 IR gun used.
2.2.1.2 Correction factor.
2.2.1.3 Observed cooler temperature.
2.2.1.4 Corrected cooler temperature.

2.2.2 Verify IR thermometer correction factor gains Correction factor recorded in Receipt utility to make sure it is correct in both locations. Notify QA/Department Manager if these values are not the same. Apply temperature correction factor for a face value – positive number to be added to direct reading temperature, negative correction factor to be subtracted.

2.2.3 **Samples must remain in coolers full of ice until it is time to process the job for login. Coolers received out of temperature range have initial temperature recorded and are then placed into a Walk-In cooler until resolution from client is received.** 40 CFR part 136, TNI Standards 2009, 2016 revision and DoD QSM 5.1 all designate acceptable temperature as “above freezing and below 6°C”. Temperature is measured and recorded to first decimal place due to state-specific and client-specific requirements.

2.2.4 Any discrepancies or non-compliant situations are documented on the Sample Receipt Confirmation Form (p-note) which is automatically e-mailed to the SGS - Orlando Project Manager (PM) team. PM assigned to the particular client contacts the client for resolution. Major issues require the client to be contacted before the samples can be logged in, such as but not limited to missing COC's, samples being out of hold, insufficient sample volume, bottles received not on COC or out of temperature range. If resolution of the problem is taking time, the samples are labeled as is and placed into refrigerated storage until the problems are resolved. Samples are then removed and processed according to client's instructions. Minor issues identify discrepancies that do not interfere with log-in and/or analysis of the samples, such as 1 of 2 PAH bottles received broken or supplied. The resolution is documented and communicated to sample management for execution.

2.2.5 Once the sample custodian(s) is (are) satisfied with the information on the chain of custody document, the job number is generated from Receipt access-based utility with the next available SGS - Orlando sequential job ID in FXXXXXX convention.

2.2.6 First technician arranges samples on the counter in the order of CoC. Every different point of collection must have a different fraction number, i.e. -1, -2, etc. The assigned fraction number must be written on the chain of custody, to the left of the line identifying the point of collection (Client ID) unless there is insufficient space. The custodian then assigns a unique sample identifier to each sample container, i.e. FAXXXXX-1.4, where 4 is a unique container designation.

2.2.7 The same technician enters samples in the sample location database and prints the labels for the samples. A second technician then attaches the labels to the samples and re-verifies sample client ID and Lab fraction number against CoC. After all the steps in Sec. 3 are completed, first technician closes the Sample Receipt Confirmation Form and second technician reviews it for completeness and accuracy of recorded information.

2.2.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers

2.2.8 **After Hours Delivery Procedure**. Upon return to the lab SGS - Orlando-employed couriers will visually inspect the coolers and add ice if needed. Coolers will then be placed into Refrigerated storage until Sample Receiving Technicians can process the coolers. Sample Receiving technicians will arrive first thing in the morning to verify Short Holds, Rushes etc as per sec. 3.1.5 and 3.1.6.

2.3 When assigning a job number, the following information from the chain of custody is entered in the Access Receipt utility:

2.3.1 SGS - Orlando Assigned Job #
2.3.2 Client Name
2.3.3 Project Name
2.3.4 Date and Time Samples Received.
2.3.5 # of coolers Received.

2.3.6 Courier Information
2.3.7 Skif # (Sample Kit Information Sheet)
2.3.8 Technician Initials

2.4 The sample custodian then checks the samples' preservation, except for the volatile samples, which are checked by the analyst after the sample is analyzed. Should a sample be received preserved incorrectly the following actions are taken:

2.4.1 pH and residual chlorine: For samples requiring preservation (HNO3, H2SO4, NAOH and NAOH/Zn Acetate) each container is tested by applying the sample with disposable capillary to narrow-range pH paper. Residual chlorine presence/absence is measured using potassium iodide/starch paper in samples for all EPA 600 series and samples originated in North Carolina (one bottle per well). 45-ml VOC vials are exempt from this procedure and are being tested in the lab after the requested tests are completed (purge-and-trap GC and GC/MS, TOC/TC and EPA 504/8011).

2.4.2 Organochlorine pesticides and PCBs by EPA 608 - samples that are not extracted within 72 hours of collection need to have pH checked and adjusted, if necessary, to a pH within 5.0-9.0 using H2SO4 or NaOH. Coordinate with Extraction department.

2.4.3 Pesticides/PCB's/Semivolatile Organic aqueous samples with residual chlorine present: Add 1 ml of 8% sodium thiosulfate solution per 1liter (0.008%) to all containers except VOA. Record event on Sample Receipt Confirmation Form and in preservative adjustment log.

2.4.4 Cyanide is preserved to pH $\geq$ 12 using 10N NaOH, prepared by WetChem personnel.

2.4.5 Sulfide is preserved to pH $\geq$ 9 using 10N NaOH and Zn acetate, prepared by WetChem personnel.

2.4.6 Aqueous samples for metals are preserved to pH $\leq$ 2 with nitric acid, prepared by WetChem Personnel. These samples are marked with colored label "**Metals Sample Received Unpreserved. Preserved Date_____Time_____ Analyze after 24 hours".** For correctly preserved aqueous metals sampling date and time from COC is recorded as date and time of preservation.

2.4.7 Aqueous samples for TRPH and some WetChem parameters are preserved to a pH of $\leq$2 with H2SO4, prepared by WetChem Personnel.

2.4.8 To avoid using expired preservatives, in the beginning of the calendar month obtain no more than 100 ml of currently used preservative reagents from Shipping area, appropriately label the container with reagent identity and expiration date and discontinue its use at the end of the month. Turn unused portion to the Waste room for further disposal.

2.5 .

2.6 Incorrectly preserved samples have the proper amount of preservative added, upon confirmation from PM or client, volume added is recorded on the Sample Receipt Confirmation form and in preservative adjustment log. The same volume and type of preservative is then added to the Equipment Blank and/or Field Blank, regardless of pH reading. Volume added is recorded on the Sample Receipt Confirmation form and in the preservative adjustment log. Also see Sec. 3.4.5.

Job Number, Sample ID, Bottle Number, Parameter, Preservative Type, Preservative Lot, and Amount of Preservative Added, Date/Time Added and the technician's initials.

2.7 All bottles must be labeled. Each bottle will be labeled both on the cap and on the bottle. VOA vials have the label wrapped around the top of the vial, just below the cap. The labels are generated by the electronic sample receipt log. The following information is entered into the electronic log:

2.7.1 Job #:
2.7.2 Client Name and Project
2.7.3 Date and time samples were received.
2.7.4 The number of coolers received
2.7.5 The temperature of each cooler
2.7.6 Initials of custodian logging in the job
2.7.7 Number of samples
2.7.8 Number of bottles
2.7.9 Bottle type
2.7.10 Preservative by code. Preservatives codes are:

"1" = preservative is checked by analyst
"2" = not applicable
"3" = correctly preserved for the analysis requested

2.7.11 Bottle storage location
2.7.12 Department to do the analysis
2.7.13 The information is saved and labels can be printed.

2.8 The following information must be on the bottle:

2.8.1 The sample number and bottle number
2.8.2 Storage location
2.8.3 The preservative used during sampling as indicated on the chain
2.8.4 Any hazard the Sample Custodian may be aware of

2.9 The samples must be placed in their assigned locations and kept at above freezing and below 6.0°C until preparation and/or analysis. Water samples preserved with HNO_3 for metals analyses are stored at room temperature. Access to the area is limited.

2.10 The original chain of custody and any additional documented information relative to the job is handed to Log-in technician for further processing as described in SOP QA048, current revision, for entry in LIMS.

2.11 **Foreign samples** are referred to samples originated outside of continental United States. These samples must be segregated from domestic samples in storage, processing and disposal. Objective of such segregation is to keep agricultural pests and pathogens from entering continental US territory and interfering with animal and plant health.

2.11.1 Foreign Samples shall be shipped in securely closed watertight containers and free of debris and macro organisms (insects, mollusks, worms, ticks and mites).

2.11.2 Foreign samples are stored in lockable cage in WI#3 to prevent accidental disposal. This cage is clearly marked *for foreign samples only*. Sample labels are colored green to stand out in the lab departments.

2.11.3 Keep lids tightly closed while in storage.

2.11.4 All unconsumed samples and containers must be separately collected for disposal. SGS - Orlando employs outside contractor to sterilize and dispose of foreign samples – see SOPs SAM108 and SAM109, current revision.

3.0 SAMPLE STORAGE TEMPERATURE AND CROSS-CONTAMINATION MONITORING

3.1 While in the laboratory, samples shall be stored in limited-access, temperature –controlled areas. Refrigerators shall be monitored for temperature daily. Acceptance criteria for the temperature of refrigerator is 0.5 to 6.0 °C * and is listed in the refrigerator log. Thermometers that have been calibrated with a NIST traceable thermometer monitor all cold storage areas. As indicated by the finding of the calibration, a correction factor is applied to each thermometer for a face value. Records that include acceptance criteria shall be maintained.

*According to TNI 2009 and 2016, V1M2, sec. 5.8.9.a.i) temperature should be above freezing point and below 6.0°C, when specified storage temperature is 4°C. Lowest temperature that can be practically read above freezing point is 0.5°C.

3.2 Samples for volatile organics determination shall be stored separately from other samples, standards, and sample extracts. Acceptance criteria for the temperature of a volatile refrigerator is 0.5 to 6.0 °C and is listed in the refrigerator's log. VOC Soil freezers are maintained between –10.0°C and -20.0°C per SW-846 5035A. For further details refer to SOP QA004, current revision.

3.3 Sample storage area for volatile organics shall be monitored for cross contamination using refrigerator blanks. Refrigerator blanks shall be analyzed every other week.

3.3.1 If contamination of the refrigerator is confirmed, the samples must be removed from the refrigerator and placed in coolers with ice, or in alternate refrigerated storage.

3.3.2 All samples received after the date of the last clean refrigerator blank must be checked for the same contaminants. If present, they must be reported and flagged with a qualifier indicating possible lab contamination.

3.3.3 The source of the contamination must be located and removed.

3.3.4 A new refrigerator blank is then placed in the refrigerator and analyzed after 24 hours.

3.3.5 Samples may be returned to the refrigerator when all contaminants are removed as indicated by the analysis of a refrigerator blank without contamination.

4.0 DOCUMENTATION

All samples received by SGS - Orlando must come with a chain-of-custody (COC). Special attention shall be paid to client-specific COCs.

SGS - Orlando personnel MUST record dates and time in **mm/dd/yy 24:00** format, and both observed and corrected temperatures.

Current revisions of forms and label templates used in sample receipt process are maintained as controlled documents in limited access directory on LAN.

Attachment I

SHORT HOLD NOTIFICATION FORM JOB #________________

HOLD TIME	ANALYTE	CHECK COC	COMMENTS
ASAP	RedOx		
	Bacteria- Total Coliform/Fecal Coliform		
24 hrs	XCr / Hexachrome / Cr +6		
	Dissolved/Filtered Metals		
	Odor		
	Salinity (SCON+ Field Temp & Presure)		
48 hrs	BOD		
	CBOD		
	MBAS		
	Turbidity		
	Color		
	Nitrate (NO3)		
	Nitrite (NO2)		
	TN (NO2/NO3)		
	OPO4 / Orthophos		
	SS (Settleable Solids)		
	Chlorophyl A (Subcontract)		
72 hrs	Acrolein/Acrylonitrile (VOA from Alaska)		
	Formaldehyde (Subcontract)		
7 days Only for samples received after 5 days	Unpreserved Voa Vials		
	TDS/TSS/TS		
	Sulfide		
	8141 pesticides in soil		
	All the Water extractables		
Soils			
48 Hours	5035 Field Kit (DI vials)		
	Encore Sampler VOA/VPH/GRO		
	Soil Jar (Bulk Sample) VOA/VPH/GRO		
	NO2/NO3 from WV (IC analysis)		

Relinquished by:______________________Date/Time relinquished:_______________

Received by:__________________________Date/Time received:__________________

SAMPLE AND LABORATORY WASTE DISPOSAL

Prepared by: Svetlana Izosimova Date: 12/30/2015

Approved by: Randy Shields Date: 01/21/2016

Annual Review

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Reviewed by: ______________________ Date: __________

Document Control

Issued to: QA Department Date: 01/21/2016

Issued to: Sample Management (Shipping) Date: * 01/21/2016

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Issued to: ______________________ Date: __________

Effective 7 days after "*" date

CONTROLLED COPY
DO NOT DUPLICATE

TITLE: SAMPLE AND LABORATORY WASTE DISPOSAL

REFERENCES: Florida DEP Hazardous Waste; 40 CFR, Part 261

REVISED SECTIONS: Segregation of Foreign soils – see 4.2.6; Storage and Disposal of samples in "HOLD" status – sec. 4.7 (new), corrected facility name throughout the document.

1.0 SCOPE AND APPLICATION

The disposal of samples and lab waste adhering to Florida State and Federal Regulations.

2.0 SUMMARY

This SOP describes the procedures used by SGS Accutest - Orlando to properly and safely dispose of samples and laboratory wastes; hazardous and non-hazardous; domestic and foreign.

3.0 DEFINITIONS

3.1 Foreign sample: Samples from sites that are outside the continental United States.

3.2 Hazardous Sample or Waste: A material is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity.

4.0 PROCEDURE

Sample Disposal: Samples are kept in appropriate storage for a minimum of 30 days after the report is sent to the client unless otherwise specified by client. The samples are divided into three categories: Aqueous, Soil, and Non-aqueous liquid.

4.1 Aqueous Samples

4.1.1 A disposal list is generated by computer, based on either reporting dates or sample number range (see attached).

4.1.2 Samples are then removed from the refrigerators and/or cabinets, and are separated as non-hazardous (non-detected or normal) and hazardous (positive result) samples.

4.1.3 Non-hazardous samples are emptied into a drum. Once full, the drum is sampled and screened for metals. If screening results are within TCLP limits, the drum is then pumped into a large holding tank. If TCLP limits are exceeded, the drum should be disposed of via the contracted waste disposal company. Once the large holding tank is full, the contracted waste disposal is contacted to arrange for an on-site transfer. The contents are profiled annually unless a major change to the waste stream occurs.

4.1.4 VOA vials are processed through a glass crusher and into an open-top drum. The solid material (glass, plastic, and septa) is separated from the liquid and is drummed separately. The liquid drum, when full, is then handled in the same way as described in section 4.1.3. The crushed glass drum is handled as described in section 4.2.2.

4.1.5 SGS Accutest - Orlando contract Disposal Company segregates hazardous aqueous samples into the appropriate waste drums for disposal.

4.1.6 Samples containing PCB in excess of 50 ppm are automatically flagged by LIMS on disposal list. These samples are labeled with distinct PCB label and segregated from the rest of waste samples to be disposed of in LabPak.

4.1.7 Some samples, on a case by case basis, are returned to the client for disposal.

4.2 Soil Samples

4.2.1 Domestic Soil Samples (DSS) are placed in drums after the storage period, either in a hazardous or non-hazardous drum per the samples' status on the disposal sheets.

4.2.2 When the drums are full, they are then sampled and analyzed to determine their hazardous constituents (Full TCLP, RCI, and PCBs).

4.2.3 Based on the results of analysis, the drums are then either disposed of as hazardous or non-hazardous by our contract disposal company.

4.2.4 Samples containing PCB in excess of 50 ppm are automatically flagged by LIMS on disposal list. These samples are labeled with distinct PCB label and segregated from the rest of waste samples to be disposed of in LabPak.

4.2.5 Some samples, on a case by case basis, will be returned to the client for disposal.

4.2.6 Foreign soil samples (FSS) come in vials (volatile organic analysis) or jars. These soils are segregated in WI#3 in lockable cage (see also SAM101 and SAM109, current revisions)

4.2.7 After minimum 60-day hold period, but not to exceed 6 months, these FSS are disposed of in the following manner.

4.2.7.1 FSS vials: Vial samples are preserved either with methanol or DI water. Vials with water are uncapped and placed into a drum labeled specifically for foreign soils. No more than six months may elapse form the accumulation start date on the drum before the drum must be disposed. The contracted disposal company must be certified to handle and dispose of foreign soils. Vials with methanol must be filtered. The filtrate (methanol) is disposed of in the non-chlorinated solvent waste drum. The soil is then drummed per the hazard status on the disposal sheets.

4.2.7.2 FSS Solids: FSS in jars are emptied into drum labeled specifically for foreign soils. Once full, the drum is disposed of via the contracted disposal company. No more than six months may elapse from the accumulation start date on the drum to disposal.

4.3 Non-aqueous liquid samples

4.3.1 Non-aqueous samples are placed in drums after the hold period.

4.3.2 When the drums are full, they are then sampled and analyzed to determine their hazardous constituents (PCBs). Drums have a 6 month expiration time. If the drum is not full by then it is analyzed and picked up by our contract disposal company.

4.3.3 Based on the results of analysis, the drums are then either disposed of as hazardous or non-hazardous by our contract disposal company.

4.3.4 Samples, on a case by case basis, will be returned to the client for disposal.

4.4 Sample Containers

4.4.1 Containers from samples deemed Non-Hazardous are immediately disposed of into a waste container provided by waste management services specifically for SGS Accutest - Orlando direct use. A lock and key has been installed to keep the containers use limited to Accutest only.

4.4.2 Containers from samples deemed hazardous are disposed of into the Hazardous waste solids drum.

4.4.3 Waste Management services picks the container up on a weekly basis and brings to the local sort facility where contents are destroyed -recycled.

4.5 Laboratory Waste Disposal:

4.5.1 All materials determined to be hazardous are containerized in appropriate vessels (i.e. drums). A waste is considered hazardous if it is listed in the Code of Federal Regulations, 40 CFR, Part 261 or it demonstrates any of the hazardous characteristics including, ignitability, corrosivity, reactivity, or has demonstrated toxicity. Our contract disposal company disposes of the drums.

4.5.2 WASTE DRUMS are separated by type:

Chlorinated Waste (Closed Top Steel) - Methylene Chloride

Non-Chlorinated Waste (Closed Top Steel) - Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal (Open Top Steel) - Charcoal and paper filters used in the filtering of samples.

Non Hazardous Aqueous Vials (Open Top Poly) - Primarily Acid Vials.

Hazardous Flammable Vials (Open Top Poly) - Methylene Chloride, Hexane.

Hazardous Aqueous waste (Closed Top Poly) - High Odor Samples, Lachat Waste.

Non Hazardous Soil (Open Top Steel)- Soils.

Hazardous Solid Waste - (Open Top Steel).

Non-Aqueous/Oil Samples- (Closed Top Steel)

Difference between Open and Closed type of drums is whether it is possible to remove entire lid or just threaded stopper. Drums are closed at all times while in storage.

4.5.3 Disposal is done as conscientiously as possible following guidelines set forth by both the State of Florida and our contract disposal company. Management and proper handling is necessary to avoid any violation. The guidelines change depending on how much waste is generated on a monthly basis:

4.5.3.1 Less than 220 pounds (100 kilograms or about half a drum) is a "Conditionally Exempt Small Quantity Generator".

4.5.3.2 A "Small Quantity Generator" generates 220-2,200 pounds (100-1,000 kilograms or about half a drum to 5 drums)

4.5.3.3 More than 2,200 pounds (100-1,000 kilograms or more than about 5 drums) is a "Large quantity Generator".

4.5.3.4 SGS Accutest - Orlando is considered a "Small Quantity Generator".

4.6 Waste Containers and Storage

4.6.1 Containers must be maintained in good condition at all times. Care must be taken to prevent leaks, ruptures, and the accumulation of rainwater on tops of the drums.

4.6.2 Waste containers must be kept closed at all times, except when waste is being transferred to drum.

4.6.3 The containers must be compatible with the waste being stored (i.e. acids should not be stored in metal drums). Never store incompatible wastes in the same container (i.e. acids and bases). Containers must be stored in such a way to accommodate inspection for leaks and damage from all sides

4.6.4 Each waste container must be labeled with the following information.

4.6.4.1 Type and nature of waste (soil, oil, hazardous, non-hazardous)

4.6.4.2 Waste generator's name and address

4.6.4.3 Manifest document number

4.6.4.4 Proper DOT shipping name and identification number

4.6.4.5 Accumulation start date (change to storage date when container is full)

4.6.4.6 In addition, a hazardous waste must have the words "HAZARDOUS WASTE. FEDERAL LAW PROHIBITS IMPROPER DISPOSAL. IF FOUND, PLEASE CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY" prominently displayed on the container.

4.6.5 Inspection and Records

4.6.5.1 Containers must be inspected weekly. All records must be kept on file for three years. The records, which must be kept on file, include:

4.6.5.1.1 A written log of the inspections
4.6.5.1.2 Manifests and shipping receipts
4.6.5.1.3 Results of laboratory analyses of the wastes
4.6.5.1.4 Land Disposal Restriction form

4.7 Samples in "HOLD" status

4.7.1 Wherever samples are designated to be put on hold by the client, labels on these samples are highlighted in bright pink and additional bright pink **"HOLD – Do Not Dispose"** label is attached to the individual containers.

4.7.2 Additionally, all Foreign Soils are kept in lockable cage in WI#3 regardless of status (see 4.2.6).

4.7.3 When samples are removed from the temperature controlled storage and boxed for extended storage these boxes also receive same bright pink label as individual containers.

4.7.4 Samples are segregated into a designated quarantine area with clear signs to the nature of the stored samples.

4.7.5 Prior to removal and disposal from this area, written permission should be obtained from the Project Manager, addressed to Sample Management Supervisor and CC'd to the Laboratory Director.

4.7.5.1 Due to 6-months storage restriction on Foreign soils samples (see 4.2.7.1) Project Manager's input must be requested by Sample Management department in a timely manner.

5.0 HEALTH AND SAFETY

5.1 All employees who handle waste materials should wear full protective clothing including safety glasses &/or face shield, gloves, boots, lab coat or a Tyvek suit, and air-purifying respirator. Direct skin contact with waste materials should be avoided.

5.2 If an employee has accidentally been exposed to a hazardous waste, the individual should rinse the affected areas thoroughly under a safety shower for at least 15 minutes. If the individual begins to exhibit any adverse effects from the exposure, he should be immediately transported to the nearest hospital emergency room. Employees are referred to the Material Safety Data Sheets for specific instructions on exposure to hazardous substances.

ATTACHMENT B

Resumes

Ahtna

Holly Dillon

Environmental Scientist/SSHO

EDUCATION

MS, Coastal and Watershed Science and Policy (watershed emphasis), 2010, California State University

BA, Environmental Science (Public Policy Minor), 2005, Mills College

CERTIFICATIONS, LICENSES, TRAINING

Safety, Health, and Environmental Program (SHEP), 2015

Leading Cultural Change, 2014

Management Conference, 2014

Biennial American Red Cross CPR / First Aid

Confined Spaces for Construction, 2009 / Respiratory Protection, 2009

HAZWOPER 40-Hour, 2005 / Annual 8-Hour Refresher

Hazardous Waste Management, 2004 / Hazard Communication, 2005

OSHA 30-Hour Construction Safety, 2009

HAZWOPER Supervisor, 2009 / Health and Safety Leadership, 2009

DOT Hazmat, 2013

Laboratory, 2008 / Compressed Gas, 2008 / Fire Extinguisher, 2010 / Defensive Driving Safety, 2014

U.S. Army Corps of Engineers Construction Quality Management for Contractors, 2011

US Army AKO READ and ERIS, 2013

Incident Management and Reporting Procedures, 2012

EXPERIENCE SUMMARY

- Over 11 years of experience as an Environmental Scientist supporting federal/DoD environmental remediation projects through data management, sampling and analysis, site safety and quality control, and the development of work plans and reports
- Over 6 years of SSHO experience and specialized safety training in field and office workplace environments including USACE environmental remediation projects throughout California; ensure quality health and safety reporting, safety training; develop APPs and AHAs, perform safety inspections, conduct daily toolbox meetings and administer best safety practices; experience at sites where EPA Level C PPE was required
- Over 8 years of quality control (QC) experience including QC inspections and reporting of field and office work performance, equipment, and reports
- 2 years of experience implementing Stormwater Pollution Prevention Plan (SWPPP) Best Management Practices

PROJECT EXPERIENCE

Environmental Scientist and SSHO, Ahtna, 2009-Present

Maintain safety training records and schedule training. Assist with production of safety plans including Business Response Plans, Site Specific Health and Safety Plans (SSHPs), Activity Hazard Analyses (AHAs), Accident Prevention Plans (APPs), Emergency Action Plan (EAP), and Hazard Communication Program (HCP). Provide training to coworkers and subcontractors for safety related topics and conduct safety meetings. Maintain Safety Data Sheets (SDSs) for all onsite hazardous substances, inventories of materials, and update site plans and maps accordingly. Support the development of quarterly and annual monitoring reports, work plans, construction completion reports, and project-specific reports. Manage environmental data for various projects including tracking sample information, data validation, and data upload to project specific databases. Analyze environmental data by creating and updating site maps, plume and water elevation contours, tracking data trends, creating data tables, and assisting with project decisions based on data analyses. Completed all work to date with zero lost-time safety incidents.

Environmental Scientist/SSHO, Groundwater Treatment Plant O&M – Former Fort Ord, USACE Sacramento, Marina, CA, 2008-present, $10M

Prepare Quarterly and Annual Groundwater Treatment System and Groundwater Monitoring reports, and project APP and AHAs as well as Quality Assurance Project Plans (QAPPs). Provide technical support, handouts, and minutes for client and agency monthly and semi-annual meetings. Perform groundwater treatment plant sampling, data management, data analysis, and data validation in support of O&M of two GWTPs consisting of a network of 28 extraction and 6 injection wells and infiltration galleries. Provide field supervision and support, oversee QC, and health and safety during the quarterly sampling of over 200 groundwater monitoring wells, as well as water level measurements at over 300 wells. Support project optimization

Behavior Based Safety, 2012

Terrorism Awareness, 2013

Annual Medical Clearance and Respirator Fit Test

Globally Harmonized System, 2013

Munitions Response, 2012

Qualified SWPPP Practitioner (QSP) training, 2012 (not licensed)

WORK HISTORY

Ahtna Environmental Inc., Environmental Scientist/Site Safety & Health Officer, 2015-present

Ahtna Engineering Services, LLC, Environmental Scientist/Site Safety & Health Officer, 2009-2015

Volt Workforce Inc. (California American Water), Laboratory Technician, 2008-2009

Student Intern, California State University Monterey Bay, 2007-2010

MACTEC Engineering & Consulting, Environmental Scientist, 2005-2007

City of Menlo Park, Engineering Intern, 2004-2005

Yoh Scientific/ICF Consulting (USEPA Contractor), Laboratory Assistant, 2002-2004

PTRL West, Laboratory Assistant, 2001

and expansion strategies for remedial systems at three sites in six groundwater aquifers.

Environmental Scientist/SSHO, Operable Unit Carbon Tetrachloride Plume (OUCTP) Evaluation, Injection, and Bioremediation, Former Fort Ord, USACE Sacramento, Marina, CA, 2014-present, $2.5M

Write APP and AHAs and provide SSHO support for field work involving the evaluation and remediation of the OUCTP A-Aquifer CT groundwater plume, including installation and sampling of eight new groundwater monitoring wells, and installation and operation of an injection and bioremediation system (summer 2016).

Environmental Scientist/SSHO, Sites 2/12 Remedial Investigation/Feasibility Study (RI/FS) Addendum, Former Fort Ord, USACE Sacramento, Marina, CA, 2013-2015, $1.2M

Executed fieldwork as part of a four-person team to perform drilling and sampling work to investigate plume delineation of groundwater and soil gas, as well as potential for soil vapor intrusion in commercial buildings. Directed the installation and sampling of 167 soil gas probes and 17 monitoring wells, and provided support for 25 sub-slab soil gas samples and 25 indoor air samples. Provided technical input into the RI/FS Work Plan and Addendum report. Prepared Cinema Work Plan and SSHP. Provided technical support for client, agency, and land owner meetings. Performed data management and analyses. Performed onsite field QC inspections, safety meetings. Oversaw field activities including monitoring well and soil boring drilling, overnight drilling, soil gas probe and monitoring well installation, geologic logging, soil gas sampling, soil sampling, groundwater sampling, laboratory and subcontractor oversight. Completed the installation and operation of a Soil Vapor Extraction Pilot Study. Produced the RI/FS report and additional Indoor Investigation Technical Memorandum. Supported preparation to expand the groundwater remedy to include additional groundwater extraction and a full-scale soil vapor extraction treatment system at Sites 2/12.

Environmental Scientist/SSHO, Multiple Environmental Government Acquisition (MEGA) ID/IQ Environmental Services, USACE Sacramento, Hawthorne Army Depot, NV, 2014-2015, $97.7K

Prepared APP in support of groundwater assessment work at three solid waste management units. Provided safety support during field execution. Implemented corrective actions as needed to maximize safe execution of work.

Environmental Scientist/SSHO, Greely Hall, East Range Mine Shaft and South Range Landfill, Fort Huachuca, USACE Los Angeles, Fort Huachuca, AZ, 2013-2014, $1.3M

Prepared APP for all three sites that involve environmental services to achieve site closure including the installation of groundwater monitoring wells, groundwater monitoring, and development of a Response Complete Decision Document. Provided safety support during field execution. Implemented corrective actions as needed to maximize safe execution of work.

Environmental Scientist/SSHO, POM/OMC Stormwater Compliance,

USACE Sacramento, Former Fort Ord, CA, 2013-2014, $21K

Prepared the SWPPP Implementation Plan to guide the Presidio of Monterey/Ord Military Community in ensuring compliance with the new municipal storm water permit by researching new permit requirements, organizing requirements into an annual list of requirements, and researching available resources of nearby storm water organizations.

Environmental Scientist, Building 258 Source Area Remediation (SAR) Excavation, USACE Los Angeles, Fort Hunter Liggett, CA, 2012-2013, $5M

Prepared a SWPPP for the Building 258 Source Area Remediation (SAR) land farm. Implemented and provided staff training for the SWPPP including land farm BMP inspections, daily weather reports, Rain Event Action Plans, reporting on SMARTS including annual reports and the Notice of Termination (site closeout). Created gINT boring logs for the new monitoring wells installed.

Environmental Scientist/SSHO, O&M - Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2009-present, $1.2M

Perform QC document editing of monthly and quarterly progress reports, SDS records, training records, safety oversight of site personnel in support of the O&M of the GWTP.

Environmental Scientist/SSHO, Building 258 Monitoring Well Installation, UVOST, MIP, HPT profiling, USACE Sacramento, Fort Hunter Liggett, CA, 2011-2012, $5.8M

Supported the installation of new monitoring wells at Building 258. Drilled soil borings to perform Ultraviolet Optical Screening Tool (UVOST), Membrane Interface Probe (MIP), and Hydro Punch Tool (HPT) subsurface vertical profiling for site plume and remediation analysis. Performed HPT profiling, monitoring well installation. Prepared Work Plan and Construction Completion reports. Conducted data management and analyses. Created gINT boring logs for the new monitoring wells. Observed MIPS and UVOST field work. Presented HPT results to the Army. Provided safety oversight and QC inspections of field work.

Environmental Scientist/SSHO, FAA Anchorage, FAA Release Investigation, McGrath, AK, 2011, $760K

Provided field support during a UVOST subsurface investigation of 13 former Federal Aviation Administration (FAA) underground storage tank (UST) and aboveground storage tank (AST) and conveyance pipeline sites in remote McGrath, Alaska. Performed Geoprobe direct-push drilling oversight, UVOST data analysis, monitoring well installation oversight, soil sampling, geologic logging, monitoring well development with pump and bailer, groundwater sampling with micro-purge, shipping and receiving samples, created gINT boring logs, and survey monitoring wells. Performed QC and safety oversight of subcontractors.

Environmental Scientist/SSHO, Fort Hunter Liggett Building 194 Chemical Injections, USACE Sacramento, Fort Hunter Liggett, CA, 2011-2012, $360K

Provided oversight of fieldwork and technical support during in situ chemical injections at the Building 194 area using direct push technology as well as groundwater sampling and analysis to monitor the groundwater post-injection. Ensured all field work was executed in accordance with approved work plans and schedule. Conducted safety vapor monitoring of worker breathing zone. Coordinated sampling and laboratory work. Prepared Chemical Injection Completion Report. Performed safety oversight and QC inspections of field work.

Environmental Scientist/SSHO, Building 258 Groundwater Monitoring and Reporting, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2013, $750K

Provided technical expertise for groundwater monitoring and reporting of the monitoring well network at Building 258. Conducted groundwater sampling, safety oversight and QC inspections of field work. Prepared quarterly and annual progress reports, and data management and analysis.

Environmental Scientist/SSHO, OUCTP Monitoring Well Installation, USACE Sacramento, Former Fort Ord, CA, 2010-2011, $1.6M

Conducted safety meetings and safety oversight of field activities, and QC inspections during the installation of monitoring wells. Prepared Work Plan and Construction Completion report. Monitored well drilling and installation executed by a four-person crew, including geologic logging, well development, well surveying, groundwater sampling, Westbay multi-port well installation, and overnight drilling operations. Created gINT boring logs for the installed wells.

Environmental Scientist/SSHO, Landfill Post-Closure Monitoring, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2011, $750K

Provided technical guidance during the inspection and monitoring of the closed FHL Landfill. The FHL Landfill includes 32 landfill gas vents, 7 landfill gas probes, and 28 wells. Prepared semi-annual reports, and performed data management, safety and QC oversight of field activities, landfill inspections, and micro-purge groundwater sampling.

Environmental Scientist/SSHO, Building 258 Soil Vapor Extraction System (SVE) Operation and Maintenance, USACE Sacramento, Fort Hunter Liggett, CA, 2009-2011, $750K

Provided technical expertise during the construction and operation of an SVE treatment system including five SVE wells. Installed, maintained and sampled the SVE system. Performed micro-purge groundwater sampling and data management. Oversaw safety and QC for field activities. Prepared monthly and quarterly progress reports.

Environmental Scientist/SSHO, Building 194 Groundwater Monitoring and Reporting, USACE Sacramento, Fort Hunter Liggett, CA, 2009-2011, $207K

Supported groundwater monitoring and reporting of the monitoring well network at Building 194. Completed groundwater sampling with a bladder pump and micro-purge, and oversaw safety and QC inspections of field work. Prepared quarterly and annual monitoring reports, and performed data management and analyses.

Environmental Scientist/SSHO, Del Monte Shopping Center Groundwater Monitoring, USACE Sacramento, Monterey, CA, 2009-2010, $6.7K

Performed groundwater monitoring and reporting of the monitoring well network of approximately 15 wells at the Del Monte Shopping Center in Monterey, CA. Recorded groundwater elevation measurements. Completed groundwater sampling of monitoring wells, pump station, and creek surface water sampling. Communicated with shopping center personnel to coordinate sampling. Oversaw safety and QC inspections of field work.

Environmental Scientist/SSHO, Fort Hunter Liggett Building 194 Well Repair, USACE Sacramento, Fort Hunter Liggett, CA, 2009, $7.5K

Conducted safety tailgate meeting and safety oversight of field activities during the relocation of seven monitoring wells in the Building 194 area. Oversaw 2-person field crew.

Other Relevant Work Experience 2001-2009

Laboratory Technician, Volt Workforce Inc. (California American Water), CA, 2008-2009

Performed drinking water sampling at customer homes, businesses, reservoirs, treatment pump stations, and wells. Analyzed drinking water samples and Moss Landing pilot desalination plant samples in a bacteriological laboratory for coliform, total heterotrophic plate count, alkalinity, and general water quality parameters. Operated an autoclave for sterilization of bacteriological waste. Maintained laboratory and prepared biological media. Investigated customer drinking water complaints.

Student Intern, California State University Monterey Bay, CA, 2007-2010

Conducted field and laboratory tests and analyzed data with computer modeling simulation software to predict environmental data with various agricultural settings. Developed predictions of greenhouse gas emissions from application of fertilizer on agricultural fields. Performed stream and watershed analyses of steelhead fish population, diurnal invertebrate cataloging, urea contamination distribution, and impacts of wildfire and rain on stream erosion and meandering.

Environmental Scientist, MACTEC Engineering and Consulting, CA, 2005-2007

Prepared and implemented several phases of remedial investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater for design of an onsite remediation system at the site of a former flare manufacturing facility. Perchlorate was detected in onsite soil and onsite and offsite groundwater extending 10 miles from the site and to depths in excess of 600 feet below ground surface. Supported the identification and implementation of innovative monitoring well installation techniques, in situ aquifer testing procedures, groundwater sampling methods, as well as several monitoring and evaluation programs to save the client additional future costs. Collected drinking water samples for perchlorate analysis at customer homes, businesses, agricultural pumps, and municipal wells. Sampled groundwater from monitoring wells with micro-purge, barcade, bailer, airlift, bladder pump, snap sampler, and waterra hydrolift. Measured water elevation with water level meter and transducer. Inspected and sampled ion-exchange (IX) perchlorate groundwater treatment systems. Received HAZWOPER safety training and supervised QC and safety during field activities including monitoring well drilling, sampling, and surveying activities.

Engineering Intern, City of Menlo Park, CA, 2004-2005

Sampled drinking water at customer residences, water wells, pumps, and reservoirs. Analyzed drinking water for chemical disinfectant and byproducts with a colorimeter and performed data entry and analyses. Identified system maintenance and upgrades to increase water quality within the distribution system. Performed hazardous waste disposal per applicable regulations utilizing the Uniform Hazardous Waste Manifest. Prepared a Hazard Communication Program and an Emergency Preparedness Plan for the office.

Laboratory Assistant, Yoh Scientific/ICF Consulting (USEPA), 2002-2004

Performed laboratory analyses including Total Organic Carbon (TOC), percent moisture, and alkalinity. Performed safety and QC inspections of laboratory equipment, emergency equipment, personnel, and mobile laboratory vehicle. Cleaned laboratory equipment utilizing ovens and acid washers in accordance with SOPs. Maintained SDS records and disposed of and treated hazardous waste IAW laws and regulations. Produced laboratory spiral locked notebooks. Maintained laboratory scales, thermometers, pH meters, refrigerators, and freezers. Prepared an SOP report for calibrating thermometers.

Laboratory Assistant, PTRL West, 2001

Performed laboratory analyses, sample preparation, shipping and receiving including radioactive and biological materials, and hazardous waste operations.

Mark Fisler

Field Supervisor

EDUCATION

BS, Biology, George Mason University

CERTIFICATIONS, LICENSES, TRAINING

40-Hour HAZWOPER and annual 8-Hour refresher

CA. Dept. of Health Services Water Distribution 2 and Water Treatment 2 certifications

USACE Construction Quality Management for Contractors

OSHA Construction and Safety Health

OSHA 30-Hour Construction Safety

First Aid/CPR

WORK HISTORY

Ahtna Environmental, Inc., Field Supervisor, 2015-present

Ahtna Engineering Services, Field Supervisor, 2002-2006, and 2006-2015

Harding Lawson Associates, Plant Operator, 2001-2002

Advanced Biological Testing, VP and Field Manager, 1993-2001

EXPERIENCE SUMMARY

- Environmental: 15+ years of experience on Army/DoD environmental restoration projects with expertise in the O&M of groundwater treatment plants; 3+ years of experience in the O&M of soil vapor extraction systems
- Field Supervisor: 8 years of experience directing field teams during the execution of groundwater monitoring, upgrades and repairs to GWTS at three DoD/Army installations in CA

PROJECT EXPERIENCE

Senior Plant Operator/Field Supervisor, Groundwater Treatment System Operation and Maintenance, USACE Albuquerque and Sacramento, Former Fort Ord, Marina, CA, 2002-present, $16M

Manage daily O&M of OU2 and Sites 2/12 GWTPs consisting of 27 extraction wells, four injection wells, and five infiltration galleries. Perform weekly inspections of mechanical and electrical systems, repairs and preventive maintenance, routine housekeeping, GAC change-outs, GWTS monitoring, flow regulation, and process sampling. Direct the execution of system upgrades in support of optimization. Ensure the effective management of hazardous materials resulting from a 1,000-gal tank of sulphuric acid stored at Sites 2/12. Develop daily reports.

- To-date, maintained a total maximum flow rate of 1,200-gpm for both GWTS, for an average of 95% operability since 2002
- Consistently complete work on schedule and within budget in accordance with contract requirements

Field Supervisor, Groundwater Monitoring, USACE Albuquerque, Former Fort Ord, Marina, CA, 2010-present, $10M

Oversee quarterly groundwater sampling at over 200 wells across 5,000 acres using passive diffusion bag samplers, the Westbay sampling system, and HydraSleeves. Perform routine maintenance on monitoring wells, including replacing broken or worn locks on well covers, repainting and labeling well completions, checking and recording total depth.

Senior Plant Operator, Groundwater Treatment System Operation and Maintenance, sub to Geosyntec Consultants, Hollister, CA, 2013-present, $50K

Perform operations and maintenance of a groundwater extraction system with seven extraction wells at a former explosives facility utilizing a combination of bio-reaction, sand filtration, and granular activated carbon to remove perchlorate, chromium 6+, arsenic, and volatile organic carbons. Perform sampling of all plant constituents to comply with NPDES requirements for discharge. Provide daily reports to the client within 24 hours to confirm work completed in accordance with the task list provided by the prime contractor.

- Recommended and completed four upgrades and optimization strategies within the first three months to increase productivity and reduce long-term O&M costs

- Successfully resolved an unanticipated system shutdown within a few hours of discovery, avoiding significant impact to system functionality

Field Supervisor, Groundwater Treatment System Operation and Maintenance, Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2004-present, $8M

Oversee the operations and maintenance of the GWTP at the former Riverbank Army Ammunition Plant. Perform three phase inspection processes. Review daily field activity reports and monthly O&M reports. Manage hazardous waste streams, including treatment, handling and temporary storage, documentation, transport and disposal. Support the Project Manager in resolving any operation and maintenance issues.

- Successfully completed upgrades to an existing extraction well to increase the extraction capacity to three times the previous rate
- To-date, performed all work with zero safety incidents

Field Supervisor, Site 12 Remedial Investigation/Feasibility Study Addendum, Former Fort Ord, USACE Sacramento, Marina, CA, 2012-present, $1.2M

Manage field team performing soil gas sampling at Site 12 on the Former Fort Ord as part of the RI/FS addendum. Perform USACE three phase inspections. Work with chemistry labs to ensure the timely procurement of supplies. Support the field team in completing fieldwork in accordance with budget and schedule. Develop daily reports.

Senior Plant Operator/Field Supervisor, Soil Vapor Extraction System Operation and Maintenance, USACE Albuquerque and Sacramento, Former Fort Ord, Marina, CA, 2015-present

Manage daily O&M of Site 12 SVE System consisting of 10 vapor extraction wells. Perform daily and weekly inspections of mechanical and electrical systems, repairs and preventive maintenance, routine housekeeping, vapor extraction monitoring, flow regulation, and process sampling. Direct the execution of system upgrades in support of optimization. Develop daily reports.

- To-date, maintained a total maximum flow rate of approximately 800 cfm, for an average of 99% operability since 2015
- Consistently complete work on schedule and within budget in accordance with contract requirements
- Ensure cost efficiencies and productivity by evaluating the chemistry and identifying which of the 10 wells to run at any given time, and reducing sampling events from weekly to monthly to quarterly as appropriate
- Saved money by eliminating ambient air sampling after demonstrating through historical data collected from years working at the site, that the ambient air samples had been non-detect during the entire sampling period.

Field Supervisor, Monitoring Well Installation and Development, USACE Sacramento, Former Fort Ord, Marina, CA, 2010-2011, $1.6M

Executed fieldwork for the installation of 11 monitoring wells including lithologic logging and soil classification during drilling, and groundwater sampling and analysis. Managed IDW, including disposal of drill cuttings/soil core, in accordance with applicable laws and regulations.

- Successfully completed the work three months ahead of schedule and within budget, despite the challenges of working in and around an active airport and residential areas, and habitat reserve

Ahtna

Charles Holman

Vice President, Southwest Environmental Operations

EDUCATION

Graduate, Structural Design, Heald Institute of Engineering, 1978

CERTIFICATIONS, LICENSES, TRAINING

NQA-1 Certified Lead Auditor

40-Hour HAZWOPER and 8-Hour Refresher

USACE Construction Quality Management for Contractors

DOT Certification

WORK HISTORY

Ahtna Environmental, Inc., Environmental Program Manager, 2016-present

Ahtna Engineering Services, LLC, Environmental Program Manager, 2009-2015

Ahtna Government Services Corporation, Environmental Program Manager, 2006-2009

TN&A, Inc., Senior Technical Manager, 2003-2006

Shaw Environmental IT Corporation, Construction and QC Management, 1996-2003

Parsons Brinckerhoff, Nuclear Quality Services, 1986-1996

Kaiser Engineers, Construction Management, 1977-1986

EXPERIENCE SUMMARY

- 38 years of experience including 28 years working for the DoD and DOE on environmental engineering and construction projects located nationwide
- 15 years of program management experience on DoD/Army environmental contracts; managed multiple contracts valued at over $100M to-date; successfully procured $16M in DoD/Army sole source awards in 2013 as a result of outstanding performance and strong client relationships; maintained 100% repeat business with the AEC and USACE SPD, consistently performing quality work at individual sites for over 10 years
- 15 years of project management experience overseeing all technical execution of environmental restoration projects, QA/QC, project controls, and personnel management; managed projects/task orders exceeding $1B in total value
- Received multiple letters of recognition for outstanding work and client service for work performed at the Former Fort Ord and Riverbank Army Ammunition Plant: "…Without exception, Ahtna has provided the Fort Ord BRAC office with the highest degree of expertise and professionalism."
- More than doubled the growth of SWE operations from one office with five employees to three offices and 30 employees, with cumulative revenues of over $150 million

PROJECT EXPERIENCE

Vice President, Southwest Environmental Operations, Pleasant Hill, CA, 2015-present

Direct a team of 30 staff in the development and execution of USACE and USAEC programs across the southwest U.S. (CA, NV, NM, AZ) with an annual budget of $25M. Oversee the development of cost bids for negotiated and sole source contracts. Develop and maintain client relationships within the USACE SPD and USAEC, achieving 100% repeat business rate to-date. Manage staff resources in multiple locations to maintain an average of 89% utilization.

Program Manager, Two MESA IDIQs, USACE Los Angeles, AZ and CA, 9/2013-present, $20M

Direct the planning and execution of 12 environmental and engineering support services task orders (to-date) varying in size and complexity from a $30K geophysical survey to a $4.5M major auger excavation and a $5.8M soil removal at a high profile FUDS. Manage client relations. Review and approve work plans. Identify and allocate resources to meet project requirements. Ensure contractual, safety, and quality requirements and expectations are exceeded on all task orders.

Program Manager, Environmental Remediation Services IDIQ, USACE Sacramento, Multiple Locations, CA, 2006-present, $23M

Oversaw 40 TOs under four consecutive contracts to provide environmental services at multiple Army installations including O&M/optimization of GWTPs, groundwater sampling and analysis/monitoring, and the development of SWMPs. Direct the development of project estimates. Perform resource allocation and client communications. Oversee project teams for the timely and cost-effective completion of all work including project reports in accordance with plans. Develop and maintain relationships with regulators and ensure compliance with all requirements.

- Commended by Robert Smith, BRAC Environmental Coordinator: "I would like to congratulate and thank you for the exceptional professionalism and customer service I have received from Ahtna for the last three years…[I] look forward to working with [Ahtna] in the future."

Program Manager, Environmental Services IDIQ – Former Fort Ord, USACE Albuquerque, Marina, CA, 2010-present, $10M

Oversee the execution of FFP environmental quality and restoration projects at the Former Fort Ord, including development of hazardous materials management storage plans at the GWTP, O&M, remedial system construction, and document production. Manage government client and stakeholder relations with the USAEC, USACE, and US Army/FFO. Ensure the delivery of all work in accordance with quality, safety, and performance standards and expectations.

- Consistently complete work on schedule and within budget and in accordance with contract requirements
- Performed all work to-date with zero recordable or reportable injuries to-date

Ahtna Government Services Corporation/Ahtna Engineering Services, LLC (Ahtna), Environmental Program Manager

As the senior cost center manager for nationwide environmental operations, managed identification of opportunities, evaluated teaming options, developed proposals, and managed program start up through reporting and turnover. Achieved significant departmental growth, development of an employee mentoring plan, and consistent high evaluations from clients. Worked as an integral part of the company senior management team helping to keep this small disadvantaged business on the leading edge of technological and managerial excellence. Projects include the development and implementation of SWPPPs, groundwater treatment systems, construction, operations and maintenance (O&M), demolition, soil removal actions, and groundwater monitoring, reporting, and analysis. Specific Ahtna projects include the following:

Program/Project Manager, Pacific Gas and Electric Company Storm Water Pollution Prevention Services and Support, Various Locations, CA, 2009-2011, $2.6M

Directed multiple T&M, not-to-exceed projects to prepare, install, monitor and inspect a variety of SWPPPs. Managed 14-person team to perform full services from determination of BMPs, SWPPP development/approval, BMP implementation, and preparation and processing of NOTs. Interfaced daily with client. Monitored cost/schedule. Executed 29 projects at sites across California, with an average of 10 projects managed concurrently.

- Completed all work in compliance with 1 and 2 Risk/Type Levels for General Construction and Linear Underground/Aboveground Projects in accordance with permitting requirements

BMPs have included erosion control, sediment control, tracking control, wind erosion control, non-storm water management, and materials and waste management controls. The SWPPPs also featured appropriate BMP "cut-sheets" identifying installation, inspection, and maintenance requirements. Provided water pollution control drawings showing the recommended temporary BMPs. The SWPPPs included sampling and analysis plans for construction storm water monitoring for non-visible pollutants, sediment, siltation, and/or turbidity pollutants.

Program/Project Manager, Performance-Based Multiple Award Contract (PERMAC) for Environmental Remediation Services at Naval and Marine Corps Installations in California, Arizona, Nevada, New Mexico, and Utah, NAVFAC Southwest (Sub to AMEC), 2008-2009, $13M

- Camp Pendleton, Pesticides Soil Treatment/Removal, 400,000 cy, 370-acre soil removal. Mobilization and startup had to be accomplished in a very short time frame to support federal reconstruction funding requirements. Successfully mobilized including 14 pieces of heavy equipment and all operators and engineers and began operations within 2 weeks of NTP
- Moffett Naval Air Station, Hangar 1 Demolition Engineering Support, PCB contaminated Hangar Demolition
- Alameda Naval Air Station, Sites 1 and 2 Soil Remediation, landfill excavation, waste management and backfill immediately adjacent to the SF Bay

Nuclear Quality Services Director, Parsons Brinckerhoff, California

As Quality Services Director for the nuclear services division on DOE Projects, planned, budgeted, staffed, and assessed performance of QA/QC functions for all 4 high-level nuclear waste programs. Performed contract reviews, developed QA and PM procedures, completed audits and surveillance, and kept senior management advised of project performance. Developed and ensured implementation of all NQA-1 based quality programs, companywide.

- Successfully procured $500M project to perform QA/QC and engineering support for the exploratory tunnel construction at Yucca Mountain including repository design and exploratory studies facilities construction, construction of all radioactive waste conveyance systems and facilities, and ensuring that the disposal facilities met regulatory requirements
- Basalt waste isolation project, exploratory studies facilities (ESF), and repository design, including the assessment of radiological waste migration prevention measures and background surveys for naturally occurring radioactive constituents
- Salt project, ESF design, including designs for all radioactive waste isolation systems
- Waste isolation pilot project, sealing systems design, including performance monitoring of the test sealing and containment systems for radioactive leaks

Senior Technical Manager, TN and Associates Inc.,

Senior Technical Manager, Hunters Point Shipyard, Tetra Tech ECI, San Francisco, CA, $4M

Managed radiological remediation project including the production of high quality planning documents responsive to radiological and environmental regulatory standards, construction of SWPPP and BMPs for the excavation, regrading, and site restoration for $70M of cleanup activities.

- Successfully obtained approvals for HPS documents involving a complex set of regulations, working collaboratively and proactively with the EPA, DTSC, Water Board, Fish and Wildlife
- Completed all work on time and on budget

Shaw (IT) Environmental

Site Manager, Environmental Compliance, Alameda Naval Air Station, Alameda, CA

Manage environmental compliance and restoration work. Developed work plans, including SWPPP, QC, and Health & Safety Plans. Ensured NPDES SWPPP field compliance, and managed field construction, subcontractors, sampling, QC, Health and Safety, T&D of the soil and groundwater. Obtained Navy and regulatory (EPA, DTSC, and Water Board) approval of the plans governing construction and remediation operations for the groundwater analysis, design, and construction of dual-vapor extraction systems for removal of free hydrocarbon products.

- Successfully led the completion of more than $23M in remedial actions at Alameda and received commendations from the Navy

Construction Manager, Sulphur Bank Mercury Mine Superfund Site, USEPA, Clear Lake, CA

Managed the construction of a 36” diameter, mile-long storm water diversion pipeline at an abandoned mercury mine. The construction was completed in hazardous conditions on time and within budget.

Senior QC Manager, Fort Ord, Monterey, CA, $50M

Managed a support staff of more than 20 people during the execution of a $50M project. Oversaw SWPPP compliance inspection, chemistry, sampling, and document control. Worked extensively with client, regulators (EPA and DTSC), and responsible parties to facilitate cost-effective land transfer. Completed base-wide SWPPP compliance; installation, testing, and startup of a base-wide groundwater pump and treat system; consolidation of existing US Army landfills into a single facility; completion of a 28-acre landfill cap; removal, transportation, screening, and recycling of more than 285,000 cy of lead soils from the beach ranges.

- Successfully addressed all management and technical concerns of the client and was commended by the USACE Program Manager, Mr. Steve Lightner, for contributions to the successful turnaround of this major environmental undertaking

QC Manager, Presidio of San Francisco, San Francisco, CA

Managed the development and implementation of plans for both field and technical activities, ensuring balance between client needs and regulators (DHS, EPA and DTSC) in a highly charged political atmosphere. Managed the field technical staff, technicians, document control staff, and sampling groups. This project involved planning, field activities, and preparation of closure reports necessary to receive regulatory approval for turnover of multiple properties including the Crissy Field soil remediation, the fuel distribution systems pipeline removal and soil remediation, the Nike Missile Silos lead abatement and water treatment, and the Fill Site 7 soil and groundwater remediation.

- Successfully completed the remedial actions to allow the base to be turned over to the Presidio Trust

QC Manager, Hamilton Army Airfield, Novato, CA

Managed the review and approval of site closure documents including Work Plans, Sampling and Analysis Plans, Risk Assessment Reports, and Closure Reports.

Field Supervisor, Kaiser Engineers, CA

Supervised mechanical systems design, construction supervision, and QA/QC. Successfully performed the following:

- Basalt nuclear waste isolation project, ESF design/construction, including all natural and engineered high-level radioactive waste barriers
- ICBM basing research, construction
- VALCO aluminum smelter, construction and capital improvements
- Mechanical design, various industrial facilities

Ahtna

Sylvester Kosowski

Project Manager/Senior Environmental Scientist

EDUCATION

MS, Civil & Environmental Engineering, University of Wroclaw Poland

MS, Hydrogeology, University of Wroclaw Poland

BS, Geotechnical Engineering, University of Wroclaw Poland

CERTIFICATIONS, LICENSES, TRAINING

24-Hour Hazardous Waste Generator Training and 8-Hour Annual Refresher Training

40-Hour HAZWOPER & 8-Hour Refresher

OSHA 30-Hr Construction Safety Training

WORK HISTORY

Ahtna Environmental, Inc. Project Manager/Senior Environmental Scientist, 2016-present

T3W Business Solutions, Inc., Senior Project Manager, 2011-2016

Jacobs Technology, Inc./Jacobs Engineering, Inc. Senior Project Manager, 2008-2011

General Dynamics Information Technology (GDIT)

Remedial project Manager, 2006-2008

Tybrin Corporation, Senior Remediation Project Manager, 2000-2006

Laidlaw Environmental/Safety-Kleen, (California), Inc.

Project Manager, 1997-2000

Remedial Management Corporation,

Vice President Engineering

EXPERIENCE SUMMARY

- 30 years in environmental consulting including 16 years in program management with expertise in all phases of the environmental assessment and remediation in the United States within different EPA regions.
- Well-qualified Environmental Program and Project Management Leader with extensive experience in the development and execution of domestic and international remediation and compliance programs and projects that have significantly improved productivity and environmental quality while reducing operating costs for major domestic and international private companies and government agencies.
- Assists in negotiating cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated, risk based site remediation and closures.
- Oversees field teams including multiple subcontractors conducting soil/groundwater assessments, groundwater monitoring/sampling, SVE O&M, groundwater extraction system O&M, post-closure landfill O&M, in situ chemical injection, demolition, bioremediation, bio augmentation, land farming, and remedial landfill cap installations.
- Manages CERCLA remediation program and project-specific activities and oversees performance of the remediation project and program specific activities including technical document deliverables. Reviews remedy specific operations and monitoring to optimize remedies performances.

PROJECT EXPERIENCE

Project Manager/Senior Environmental Scientist, Sharp Army Depot Groundwater and Soil Remediation, USACE Sacramento, Lathrop, CA 5/2016-present, $ 10 M

Manages CERCLA remediation program and project-specific activities and oversees performance of the remediation project and program specific activities including technical document deliverables.

- Reviews remedy specific operations and monitoring to optimize remedies performances. Manages and supervises program and project specific staff and contractor personnel.

- Assists in negotiating cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated, 1993-1997

Canonie Environmental Corporation

Project Engineer/Project Manager 1989-1993

International Technology Corporation (IT)

Staff Engineer/Hydrogeologist 1986-1989

risk based site remediation and closures.

- Ensures remediation and remedy performance and monitoring activities are performed in accordance with applicable laws, guidelines and regulations. Recommends optimization approaches to remedial process and remedy operations and long term monitoring.
- Performs business development activities and assists in proposal preparations.
- Oversees personnel during field remediation and monitoring activities.

Senior Project Manager, RCRA Hazardous Waste Facility Management and IRP Program Support, NAF El Centro CA, NAVFAC SW San Diego, CA, 2011–2016,
$ 6.0 M

Directed program and project-specific activities and oversaw performance of the compliance and restoration program activities. Oversaw and participated in business development activities, including meetings, presentations and proposal preparation and oversight. Managed and supervised program and project staff and contractor personnel. Negotiated cleanup and remediation strategies and technical approaches with regulators to secure cost-effective remediation and accelerated, risk based site closures. Ensured compliance and remediation activities are performed in accordance with applicable laws, guidelines and regulations.

- Prepared and implemented Environmental Assessment, Remediation, Compliance, Solid and Hazardous Waste Management Plans, and Storm Water Pollution Prevention and Spill Prevention, Control and Countermeasure (SPPCC) Plans. Prepared water quality, surface water and treated groundwater discharge monitoring plans. Ensured compliance with all Federal (US EPA), State and Local environmental regulations pertaining to soil, storm water, air emissions and water quality.
- Provided support to project management, field remediation, compliance and construction personnel. Ensured storm water is managed and discharged in accordance with the General Permit to Discharge under the National Pollutant Discharge Elimination System (NPDES), State Pollutant Discharge Elimination System, and County

requirements.

- Ensured compliance and remediation systems at installations are managed with state and county specific air emissions permits and discharge requirements. Interacted with regulatory agencies to negotiate cleanup strategies based on risk based and cost-effective cleanup goals and objectives. Supported the client(s) at the meetings with regulatory agencies negotiations. Advised clients and supporting contractors on changes to compliance and restoration program approaches and strategies in order to optimize programs performance. Provided recommendations on how to implement new approaches, strategies, and technological advances to minimize waste generation activities at the installations.

Senior Project Manager, Site 25 OU8 and Multiple Sites in OU5, OU 10 and OU 8 RI/FS, PP, ROD, IRAs RD, RA, RAO and LTM, AFCEE/AFCEC San Antonio, TX, Edwards Air Force Base, Edwards, CA, 2008-2011,

$ 10 M

Maintained client relationships, directed and oversaw environmental remediation program and project work to maintain high technical and high quality control standards. Managed, mentored and supervised program and project specific personnel. Participated in business development activities, including meetings, presentations, proposal preparation, and oversight. Directed and oversaw preparation of budgets, and monthly status reports. Conducted due diligence activities, contaminated site investigation, remediation, regulatory compliance, permitting, and storm water management. Directed, performed and oversaw work in regulatory compliance for landfills and other solid waste projects.

- At Edwards Air Force Base (EAFB) in California, worked with Environmental Restoration operations, including program and project specific components. Performed the Environmental Restoration Program, Planning, Budgeting and Execution. Assisted in developing cleanup strategies and participated in cleanup strategies negotiations with regulatory agencies. Developed engineering cost estimates and scope of works (SOW).

- Provided program and project management, engineering support, and technical assistance for the Operable Units (OUs), on complex, Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Military Munitions Response Program (MMRP), Underground Storage Tank (UST) investigation, assessment, and remediation projects. Oversaw and performed technical reviews of Environmental Restoration documents.

- Reviewed new restoration and compliance mitigation technologies, and provided recommendations on how to implement restoration Research and Development (R&D) activities at Edwards AFB. Provided sub-consultants and subcontractors management and oversaw their performance via field surveillance activities. Served as a senior remedial project manager for OUs 5, 10 and OU8.

Remedial Project Manager, Multiple Sites in Multiple OUs RI/FS, PP, ROD, IRAs RD, RA, IRAs, RAO and LTM, NAVFAC SW and BRAC PMO West San Diego, CA, NWS Seal Beach Detachment Concord, CA, 2006-2008, $ 10 M

Served as client manager to direct and oversee environmental services program and project work to maintain high technical and high quality control standards. Participated in business development activities, including meetings, presentations, proposal preparation, and oversight. Managed and supervised program and project-specific staff personnel. Directed and oversaw preparation of budgets, and monthly status reports. Managed and mentored contract and task specific personnel and client(s). Interacted with regulators and clients to negotiate cleanup strategies and associated cleanup goals and objectives. Conducted due diligence assessments, contaminated site investigation, remediation, regulatory compliance, permitting, and storm water management. Directed, performed and oversaw work in regulatory compliance for landfills and other solid waste projects.

- Provided vision and direction as the Remedial Project Manager (RPM) at Naval Weapons Station Seal Beach Detachment Concord (NWSSB) Tidal and Inland Areas, in Concord, California.

- Assisted at Base Realignment and Closure Program Management Office (BRAC PMO West) in San Diego with the Installation Restoration Program/Environmental Restoration Program (IRP/ERP) Division operations by providing program and project management, engineering advisory support, and technical assistance on complex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Military Munitions Response Program (MMRP), and Underground Storage Tank (UST) investigation, assessment and remediation projects.

- Directed, oversaw, and performed technical reviews of IRP/ERP Remedial Investigation (RI), Feasibility Study (FS), Proposed Plan (PP), Record of Decision (ROD), Remedial Design (RD), Remedial Action (RA), Operations and Maintenance (O&M), Remedial Process Optimization (RPO), and Long Term Monitoring/Management (LTM) documents. Managed and provided oversight of the IRP/ERP contractors during the performance of field investigations, treatability and/or feasibility studies, remediation design and system optimization, remedial action, and long term management activities under CERCLA, RCRA, MMRP, and LUFT programs.

- Interacted with the regulatory Remedial Project Managers (RPMs), Restoration Advisory Board (RAB) members and other stakeholders during the program and project management planning and execution meetings and activities. Developed engineering cost estimates and scope of works (SOW).

Senior Remediation Project Manager, OU4 and OU 9 AFRL RI/FS, PP, ROD, IRAs RD, RA, RAO and LTM, AFCEE/AFCEC San, AFCCE San Antonio, TX, Edwards AFB, Edwards, CA, 2000-2006, $ 30 M

Worked with Environmental Restoration Division (ERD) operations by providing program and project management, engineering support, and technical assistance for the Operable Units (OUs 4 & 9), on complex Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), Munitions Response Program (MRP), and Underground Storage Tank (UST) investigation and remediation projects. Reviewed new restoration technologies, and provided recommendations on how to implement restoration Research and Development (R & D) at Edwards AFB. Developed engineering scope of works and cost estimates.

- Advised ERD on changes to technical documents to avoid receiving similar comments from the regulatory agencies and other reviewers. Provided surveillance of ERP contractors during the performance of field investigations, treatability and/or feasibility studies, remediation systems implementation, maintenance, operation, remedial systems optimization, and long term monitoring activities.

- Assisted ERD team in developing multiple risk based cleanup strategies leading to multi million dollars in remediation cost avoidance. Maintained and assimilated detailed technical information for tracking progress and efficiency of ERP projects. Performed remedial action (RACER) cost estimates. Prepared OU4 and 9 project funding narratives and associated cost estimates.

Project Manager, Multiple Private and Government Clients, Los Angeles, CA, 1997 – 2000, $ 12 M

Responsible for project management, client relations, and interaction with Federal, State, and local regulatory agencies to meet all requirements associated with hazardous waste removal, treatment, and remediation. Assisted with business development activities, proposal preparation, estimates, bids and maintained cost controls, community and client relations. Won multiple bids and contributed to a company gross revenue increase. Served as project manager and task (TO) and/or DO manager on a variety of private and government projects. Met with clients on a regular basis to provide updates regarding status of the projects and discuss scope of work of the projects.

- Directed, oversaw and performed technical review of documents that involved site investigations (RI/FS), remedial design and implementation (RD/RA), and Long Term Operation/Long Term Monitoring (LTO/LTM) associated with soil and groundwater remediation systems. Managed and oversaw development of work plans, remedial investigations, engineering design and remediation to comply with CERCLA, RCRA and LUFT laws, guidelines and regulations. Supervised, trained and mentored staff geologists, engineers and technicians.

Vice President Engineering, Multiple Private and Government Clients and Projects, Schaumburg IL, and Newport Beach, CA, 1993-1997, $ 10 M

Acted in charge of P&L and overall financial performance of the RMC

Schaumburg, Illinois office. Involved in development and implementation of strategic plans to establish and grow the business in Midwest and Europe. Directed and conducted marketing and business development activities to identify new domestic and international opportunities. Oversaw and participated in domestic and international contract, teaming and joint venture partnering activities and negotiations. Established an office for the environmental services consulting company in Midwest.

- Managed, mentored and supervised program and project specific RMC personnel in Schaumburg, Illinois office. Participated in business development activities. Acted as program account manager and client(s) representative/liaison during program and project execution activities, and negotiations with regulatory agencies.

- Managed and prepared business development proposals and cost estimates for the removal and treatment of contaminated soil and groundwater. Managed and oversaw the assessment of contaminant extent and design of soil and groundwater remediation systems. Directed and oversaw preparation of hydrogeological and engineering reports to ensure technical quality and thoroughness.

Project Engineer/Project Manager, Multiple Private and Government Clients and Projects San Mateo, CA, 1989 – 1993, $ 5.0 M

Served as project engineer and project manager and worked on private sector NPL, CERCLA and RCRA investigation and remediation projects such as industrial and landfill facilities. Prepared hydrogeological, design and remediation engineering reports. Reviewed and prepared applications for the NPDES permits. Planned and performed hazardous waste investigations, design and remediation under CERCLA, RCRA and LUFT regulations. Prepared landfill cap and liner design, closure and post closure reports. Participated and assisted in business development activities including meetings, presentations and proposal preparation. Evaluated NPL site investigation and remediation decision documents (RI/FS) to identify data gaps relating to selection, design and implementation of future potential remedies.

- Directed and prepared conceptual remedial and corrective action plans (RAPs and CAPs), engineering design, and construction plans and specifications. Investigated, selected and implemented RCRA corrective action programs associated with hazardous waste management facilities.

- Investigated and designed Class I surface impoundments and landfills meeting RCRA minimum standards. Developed surface impoundments and landfill cap and liner design and implemented closure and post closure plans.

Staff Engineer/Hydrogeologist, NPL Site Former Firestone Plant Salinas, CA, 1986-1989, $ 2.0 M

Worked as staff engineer and hydrogeologist on a National Priority List (NPL) site in Salinas, CA. The site was a former Firestone Site (Superfund Project). The project included additional site assessment, remedial design, remediation construction and site remediation, O&M, and LTO/LTM associated with a large full scale pump and treat system (800 gpm).

- Conducted pump tests for different types of aquifers, data analysis due to pumping tests and evaluation of hydrogeological characteristics for shallow and deep aquifers. Prepared technical hydrogeological and engineering reports.

- Performed data analysis of hydrological, hydrogeological and geotechnical parameters of the aquifers affecting groundwater and well hydraulics, their planning, design and construction. Evaluated groundwater flow directions, shallow and deep aquifers contour maps. Performed soil, treatment plant, surface and groundwater sampling.

Ahtna

Derek Lieberman, PE

Senior Project Manager/Regulatory Specialist

EDUCATION

MA, Science, Technology, and Public Policy, The George Washington University Elliott School of International Affairs, 2002

Master of Environmental Management, Yale University, School of Forestry and Environmental Studies, 2000

BS, Engineering (Geological Engineering), Purdue University, 1989

REGISTRATIONS

Professional Engineer, Civil Engineering, California #C57417

Qualified SWPPP Developer/Practitioner (QSD/QSP) CA#20527

CERTIFICATIONS, LICENSES, TRAINING

40-Hour HAZWOPER

8-Hour HAZWOPER Refresher

Supervisory Hazardous Substances/Waste Health and Safety, 1994

Health and Safety Training and Field Experience for Hazardous Materials Operations, 1994

U.S. Army CHPPM Advanced Health Risk Communication Training, 2004

Defensive Driving Techniques, 2010

Confined Spaces, 1992

OSHA 30-hour Construction Safety, 2013

DOT Hazmat Employee, 2013

USACE Construction Quality Management for Contractors, 2011

WORK HISTORY

Ahtna Environmental Inc., Senior Project Manager, 2015 – present

Ahtna Engineering Services, LLC, Senior Project Manager,

EXPERIENCE SUMMARY

- 23 years of engineering experience in environmental remediation services (ERS), including soil, soil gas and groundwater remediation, CERCLA (as amended by SARA)/RCRA/BRAC sites, and geotechnical investigation, design and construction oversight
- 13 years of experience managing the preparation of analytical and descriptive reports and property transfer documentation
- 12 years of experience in Community Relations, delivering presentations on behalf of the U.S. Army regarding the status of the groundwater remediation program at the former Fort Ord at the U.S. Army's Community Involvement Workshops, Technical Review Committee meetings, Open House events
- 10 years of experience managing operations and maintenance (O&M) of full scale groundwater treatment systems (GWTS) and soil vapor extraction and treatment systems (SVETS), including system optimization and QC oversight of construction, documentation and environmental sampling
- In-depth experience with the CERCLA process, including development of Decision Documents and use of EPA's Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents
- Commended by Gail Youngblood, BRAC Environmental Coordinator: "No listing of Ahtna's personnel would be complete without Derek Lieberman, whose breadth of knowledge about remediation systems, Fort Ord history, and the ins-and-outs of transferring property have helped Fort Ord reach the point of having transferred the vast majority of property available for redevelopment."

PROJECT EXPERIENCE

Director, Environmental Services, Former Fort Ord, Multiple Consecutive USACE Sacramento and Albuquerque Districts, Marina, CA, 2008-present, $10M

Manage seven environmental technical onsite staff performing FFP ERS, including development of hazardous materials business plans (HMBP), remedial system construction and O&M, reporting, preparation of CERCLA documents and UFP-QAPPs. Provide expertise on CERCLA/RCRA issues. Update the HMBP describing procedures for emergency response for hazardous materials (sulfuric acid and compressed helium) stored at the groundwater treatment plants (GWTP) in accordance with the requirements of the local California Certified Unified Program Agency. Maintain hazmat storage facilities in compliance with laws/regulations and received no notices of violation (NOVs). Participate in regular meetings with the U.S. Army Environmental Command (AEC), USACE, regulatory agencies and the public to provide technical and regulatory expertise on ERS in accordance with CERCLA/RCRA.

Project Manager, O&M of GWTS and SVETS, Former Fort Ord, Multiple Consecutive USACE Sacramento, Marina, CA, 2007-present, $20M (multiple consecutive awards)

2007 – 2015

J.M. Waller Associates, Inc., Senior Environmental Compliance Specialist, 2003 – 2007

U.S. Department of Agriculture, Economist, 2001 – 2003

The Tahoe-Baikal Institute, Environmental Exchange Participant, 2000

Harding Lawson Associates (now Amec Foster Wheeler), Project Engineer, 1991 – 1999

Herzog Associates (now defunct), Assistant Engineer, 1989 – 1991

Direct O&M of two GWTS, which include 32 extraction wells, 4 injection wells and 4 infiltration galleries, and one SVETS, which includes 10 extraction wells. All three systems use granular activated carbon (GAC) as the primary treatment technology for VOCs. Prepare and review programmatic documents, including project management plan, O&M manuals, project schedule, UFP-QAPPs, and site-specific Accident Prevention Plan (APP). Directed construction and commissioning of automated sampling and analytical platforms, including integration w/SCADA system to allow real-time automated decision-making for GWTS operations. Develop all work plans, QC/safety plans. Monitor productivity, cost/schedule and provide progress reports. Oversee implementation of USACE three-phase inspection process for ERS and remedial system construction. Perform data validation, database management, and reporting, which includes quarterly O&M status and monitoring summary reports, and an annual effectiveness evaluation report. Manage accumulation, manifesting and shipment of wastes in the form of spent GAC.

- Successfully operated both GWTS at over 99% cumulative operability since 2007
- As of December 2015, treated over 8.5 billion gallons of contaminated groundwater while maintaining plume capture; discharged treated water per CWA requirements with no NOVs
- Successfully operated the SVETS at over 99% cumulative operability since startup in September 2015
- Discharged treated air per CAA requirements with no NOVs

Project Manager, O&M of Landfills and Landfill Gas Extraction and Treatment System, Former Fort Ord, USACE Sacramento, Marina, CA, 2015-present

Direct O&M of five landfill areas and a landfill gas (LFG) extraction and treatment system, which includes 35 extraction wells, LFG collector pipes, and a thermal treatment unit (TTU) as the primary treatment technology for methane and VOCs. Prepare and review programmatic documents, including O&M manual, project schedule, UFP-QAPP, and site-specific APP. Develop all work plans, QC/safety plans. Monitor productivity, cost/schedule and provide progress reports. Oversee implementation of USACE three-phase inspection process for O&M activities. Perform data validation, database management, and reporting, which includes monthly O&M status and LFG monitoring reports, and an annual O&M and regulatory compliance monitoring report.

- Successfully operated the TTU at over 99% cumulative operability since September 2015
- Discharged treated LFG per CAA requirements with no NOVs
- Successfully managed LFG in compliance with California Code of Regulations Title 27

Senior Environmental Engineer, Optimization of GWTS and SVETS, Former Fort Ord, Multiple Consecutive USACE Sacramento Environmental Services Contracts, Marina, CA, 2007-present

Provide engineering and regulatory expertise to identify cost-saving measures to be implemented at the GWTS (e.g., waste minimization and waste management). Evaluate quarterly analytical and operational data and modify GWTS and SVETS operational parameters accordingly (e.g., extraction wells were operated based on specific decision rule criteria). Employ groundwater modeling to evaluate GWTS effectiveness and capture analysis to optimize the operation of extraction and injection wells. Evaluate new technologies for potential application to the GWTS and SVETS. Present optimization recommendations to the USACE for implementation with regulatory agency approval.

- Optimized GWTS operations through decision rules that maximize GAC lifecycle, confirm plume capture and remediation progress, and significantly reduce sampling frequency
- When an air stripper was installed as a polishing step after GAC treatment at the Sites 2 and 12 (2/12) GWTP, determined the air stripper effectively treated specific contaminants that were not efficiently treated by GAC. This allows for continuous operation until the GAC capacity is maximized for trichloroethene (TCE), the primary chemical of concern at Sites 2/12, reducing the need for GAC change-outs from once every 8-12 weeks to once every 19-23 months; decision rules were approved by regulatory agencies and subsequently modified and applied by other contractors at the former Fort Ord
- Performed a cost benefit analysis to determine the feasibility of relocating the Operable Unit 2 (OU2) GWTP to an area with the highest concentrations of contaminants in groundwater; determined that moving the GWTP in combination with installing new extraction wells and groundwater recharge structures would reduce the time to achieve remedial action objectives by 10 years, thereby reducing costs by almost 50% over the life of the project; based on these findings, the Army is proceeding with the project

Project Manager/Environmental Engineer, Installation of Monitoring Wells, Former Fort Ord, USACE Sacramento, Marina, CA, 2010-2011, $1.6M

Designed and executed the installation of 11 monitoring wells up to 450 feet deep in support of a monitored natural attenuation groundwater remedy in a deep aquifer. Developed a well installation work plan that included a SAP and an Environmental Protection Plan to address well installation in protected habitat areas that include several federally listed species and species of concern. Implemented a high level of quality control through all phases of well construction, including determining well locations, borehole logging, well design by a registered professional hydrogeologist, well casing and screen installation, well development, and installation of the Westbay sampling system. Coordinated all work with multiple stakeholders including: the Fort Ord BRAC Office Biologist to minimize impact to protected habitat; the Army to avoid impact to residential neighborhoods, and the municipality, airport staff, and the Federal Aviation Administration to avoid impact to airport operations.

- Completed the project three months ahead of schedule, and with no impact to residents, airport operations, or critical habitat

(of the 11 wells, two are located in the habitat area, four in residential areas, and one at an airport)

- Successfully worked with the Army, regulatory agencies and University of California (habitat reserve managers) to complete the work plans and obtain the necessary permits to allow work to start the first week of December, complying with the Army's request to start drilling no later than December to avoid impact to protected plant species (the growing season for sand gilia and Monterey spine flower is approximately December through May)

Project Manager, Groundwater Monitoring Program, Former Fort Ord, USACE Sacramento, Marina, CA, 2010-present, $900K

Manage quarterly groundwater sampling at over 150 wells on the former Fort Ord using passive diffusion bag samplers (PDS), the Westbay sampling system, and HydraSleeves. Analyze groundwater samples for organic and inorganic compounds in accordance with the approved Quality Assurance Project Plan (QAPP). Measure and record water level elevations with respect to established survey control points. Use data to optimize GWTS operations.

Project Manager, Soil Gas Investigation and Vapor Intrusion Analysis, Former Fort Ord, USACE Sacramento, Marina, CA, 2008-2009, $30K

Developed a work plan, SAP, and Activity Hazard Analysis to conduct a soil gas investigation within an area proposed for residential development at the former Fort Ord. Used the investigation data to perform a screening level assessment of the vapor intrusion pathway using DoD guidance documents (Tri-Services Handbook for the Assessment of the Vapor Intrusion Pathway) and the DTSC Human and Ecological Risk Division (HERD) version of the EPA Vapor Intrusion (Johnson and Ettinger [J&E]) Model (HERD Model), which contains the toxicity criteria acceptable to the DTSC. Based on the analytical and HERD Model results, the site passed a site-specific J&E evaluation; therefore, no further consideration for indoor air risk was necessary and the site continues to meet No Action conditions.

Community Relations Specialist, Former Fort Ord, USACE Sacramento, Marina, CA, 2004-present, $250K (multiple awards)

As a recognized subject matter expert with effective communication skills, provide community relations representation on behalf of the U.S. Army for environmental work at former Fort Ord. Deliver presentations regarding the status of the groundwater remediation program at the former Fort Ord to the public at the Army's Community Involvement Workshops (CIW), Technical Review Committee (TRC) meetings, and Open House events.

Environmental Compliance Manager, Property Transfer, Former Fort Ord, USACE Sacramento, Marina, CA, 2003-present, $450K (multiple awards)

Provide technical support to U.S. Army BRAC Fort Ord Office for property transfer documentation including producing reports and documents, and responding to regulatory agency and public comments concerning property transfer and real estate issues as they relate to the environmental remediation program. Draft deeds for transfer of former Fort Ord property in accordance with the Army's Model Deed and the Department of Defense Instruction Number 4165.72. Provide technical support for USACE legal review of the deeds including preparing or reviewing draft deed revisions and memorandums, coordinating receipt of legal descriptions and other deed exhibits, responding to comments and questions from USACE and property recipients regarding environmental and technical components of the deed, and tracking the progress of deed execution and recordation. With expertise in institutional controls for real estate transactions, prepare and coordinate Covenants to Restrict Use of Property (CRUPs) to be executed by the Army and the State of California for application and enforcement of land use controls on former Fort Ord property. Prepare documentation required to obtain RCRA Corrective Action Complete Determination (CACD) from DTSC for all transferred property where remedial action is complete.

- Completed Findings of Suitability to Transfer (FOST) in accordance with the Army's Model FOST for former Fort Ord property impacted by munitions and explosives of concern (MEC)
- Due to the policy complexities associated with MEC at CERCLA sites, participated in successful negotiations between the Army's Environmental Law Division and Office of General Counsel, EPA and DTSC to resolve issues pertaining to the environmental condition of the property and the appropriate section of CERCLA under which the transfer should occur
- Reviewed and commented on land use control implementation plans (LUCIPs) for munitions response areas (MRAs) at the former Fort Ord, which ensured conformity between the LUCIP and the requirements of the deed under CERCLA
- Established the procedure for issuing the CERCLA Warranty for early transfer property where CERCLA remedial actions are complete

Environmental Compliance Manager, CERCLA Decision Documents, Former Fort Ord, USACE Sacramento, Marina, CA, 2006-2010

Completed two Explanations of Significant Differences (ESDs) to the Operable Unit 1 (OU1) ROD and the OU2 ROD at the former Fort Ord. Successfully coordinated with the regulatory agencies and obtained signatures from all the parties on behalf of the Army. The OU2 ESD was particularly complex and addressed several areas of concern, including MEC, mitigation of landfill gas, Corrective Action Management Unit (CAMU) requirements for a landfill, and use of treated groundwater for construction purposes. Participated in the review process for several RODs and ROD Amendments.

Project Manager, Remedial Investigation/Feasibility Study (RI/FS) Addendum at Sites 2/12, Former Fort Ord, USACE Sacramento, Marina, CA, $1.2M, 2013-2014

Manage $1.2M project to determine the magnitude and extent of PCE and TCE contamination in soil, soil gas, groundwater, and indoor air. Developed and implemented detailed RI/FS work plan to meet the client's aggressive schedule, which included a significant community relations effort to address the concerns of the property owners and 11 retailers located within the project site (Target, Kohl's, Old Navy, Recreational Equipment, Inc., etc.), and to coordinate field work to ensure minimal impact to daily retail operations. Designed and implemented remedial investigation; designed and constructed a soil vapor extraction (SVE) and air sparge (AS) pilot treatability study, and developed a RI/FS Addendum report.

- Eliminated offsite disposal of waste – solid IDW transferred to onsite OU2 Landfills for reuse as landfill cover, liquid IDW treated at the onsite GWTS
- Scheduled the SVE/AS pilot study as "proveout" study ahead of the RI/FS report, based on 10+ years of experience at the former Fort Ord including previous use of SVE at other former Fort Ord locations, thereby completing the project four months ahead of schedule
- Completed extensive indoor air and sub-slab sampling program without disruption to retail operations; received no complaints from property owners, retail managers or customers
- Based on RI results, determined there was no unacceptable risk to human health due to vapor intrusion, but additional remedial action was appropriate to protect groundwater from contaminants found in soil gas

Project Manager, Groundwater Remedy Addendum at Sites 2/12, Former Fort Ord, USACE Sacramento, Marina, CA, 2015, $1.2M

Based on the results of the RI/FS Addendum, prepared an ESD to the Remedial Investigation Sites ROD to include soil vapor extraction and treatment as part of the Sites 2/12 groundwater remedy to prevent partitioning of contaminants between soil gas and groundwater. Managed $1.2M project to construct and operate the SVETS and one additional groundwater extraction well. Developed and implemented detailed remedial action work plan to meet the client's aggressive schedule, which included a significant community relations effort to address the concerns of the property owners and 11 retailers located within the project site (Target, Kohl's, Old Navy, Recreational Equipment, Inc., etc.), and to coordinate field work to ensure minimal impact to daily retail operations. Developed an O&M manual based on construction and start-up/shakedown activities.

Qualified SWPPP Developer (QSD), Multiple federal and commercial clients, Marina, CA

In compliance with CWA requirements, develop storm water pollution prevention plans (SWPPPs) for federal facilities and private utility sites throughout California. QSD of record for over a dozen projects. Select and design Best Management Practices (BMPs). Developed an implementation plan and related cost estimate for the execution of the new storm water management program at the Presidio of Monterey (POM) and Ord Military Community (OMC) in accordance with the Phase II Small Municipal Separate Storm Sewer Systems (MS4) General Permit (California State Water Resources Control Board [SWRCB] Order No. 2013-0001 DWQ) and applicable SWRCB guidance.

Quality Control Engineer, Fort Hunter Liggett Building 194 Groundwater Monitoring and Reporting, USACE Sacramento, Fort

Hunter Liggett, CA, $285K (multiple task orders)

Provide senior level quality control review for quarterly groundwater sampling and analysis, data validation, waste management, well maintenance, quarterly groundwater monitoring reports, and annual groundwater monitoring report. Ensure regulatory compliance and technical accuracy.

Quality Control Engineer, Fort Hunter Liggett Building 258 Soil Vapor Extraction System Operations and Maintenance, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2011, $478K

Provide senior level quality control review, ensuring regulatory compliance and technical accuracy of all documents for a project involving vadose zone hydro-carbon remediation at the Building 258 Area using SVE technology. Reviewed Remedial Action Work Plan detailing the SVE system requirements for installation, start-up, and shakedown, and semi-annual treatment system monitoring reports.

Quality Control Engineer, Operations and Maintenance of Fort Hunter Liggett Landfill, USACE Sacramento, Fort Hunter Liggett, CA, 2010-2012, $109K

Provide senior level quality control review, ensuring regulatory compliance and technical accuracy of all documents for a project involving the O&M of Landfill #1, including semiannual groundwater monitoring, landfill gas monitoring, laboratory analysis, data validation, waste management, reporting, well maintenance, and landfill cover inspections.

Quality Control Engineer, O&M of Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2007-2012, $4M

Support the O&M for the RBAAP GWTP and quarterly groundwater monitoring. Provide QC and technical and regulatory compliance oversight for O&M of groundwater treatment facilities, a closed landfill, and associated reporting and documentation.

Quality Control Engineer and Regulatory Specialist, RCRA Hazardous Waste Facility Permit Closure, Riverbank Army Ammunition Plant, USACE Sacramento, Riverbank, CA, 2011-2013, $4M

Provide QC and technical and regulatory compliance oversight during preparation of closure plans, QAPP, and closure certification reports, and decommissioning activities for 13 hazardous waste management units.

Senior Environmental Compliance Specialist, Fort Ord Office, U.S. Army Base Realignment and Closure, J.M. Waller Associates, Inc., College Park, GA, 2003-2006

Worked with the BRAC Environmental Coordinator (BEC), USACE, contractors, and regulatory agencies to ensure requirements were met for environmental cleanup actions for contaminated soil and groundwater at the former Fort Ord. Monitored and modified project schedules and ensured specifications of the Federal Facility Agreement, CERCLA, RCRA, and applicable or relevant and appropriate requirements (ARARs) were met. Ensured actions were cost-effective and efficient, as well as protective of human health and the environment. Met with and presented information to community groups, local government officials, and others as requested by the BEC.

- Successfully completed and obtained regulatory approval of four FOSTs, two Findings of Suitability for Early Transfer (FOSETs), two Findings of Suitability to Lease (FOSLs), and 24 CRUPs leading to the transfer of more than 8,000 acres of property
- Coordinated with USACE to support production of deeds for transfer of property; reviewed and commented on draft deeds and provided technical support
- Initiated request and compiled all documentation for DTSC RCRA corrective action complete determinations
- Provided technical support for completion of a Covenant Deferral Request (CDR) for early transfer of property
- Initiated development of a land use control (LUC) database for LUCs for use in drafting LUC Implementation Plans
- Coordinated with property recipients to resolve post-transfer issues related to the environmental condition of the property
- Achieved regulatory closure of RCRA hazardous waste facility

Economist, U.S. Department of Agriculture, Foreign Agricultural Service, Commodity and Marketing Programs, Forest and Fishery Products Division, Washington, DC , 2001 - 2003

Assisted industry associations to develop and maintain export markets for U.S. forest and fishery products via a Unified Export Strategy. Analyzed markets for U.S. forest products in North America, Europe, and Oceania. Assessed impact of trade agreements and environmental reviews on U.S. forest products exports. Assessed causes and consequences of illegal logging and timber trade. Analyzed market trends for exports of U.S. forest and fishery products for development of a Global Marketing Strategy. Wrote briefing papers for each of the top 15 states in seafood industry production for use in presentations and speeches by USDA personnel.

Environmental Exchange Participant, Lake Baikal, Russia and Lake Tahoe, United States, Tahoe-Baikal Institute, South Lake Tahoe, CA, 2000

Studied natural and cultural histories and current environmental problems and policies related to the respective limnological systems through contact with government agencies, non-government organizations, and citizens. Performed volunteer work for multiple water quality improvement projects at both lakes:

- Site Restoration in the village of Khuzhir on Olkhon Island in Lake Baikal: Worked on the U.S. Agency for International Development (USAID)-funded restoration of Shaman’s Cape, a Buryat sacred site. Work focused on an area once encompassed by a Soviet-era petroleum fueling and storage facility. Provided manual labor and made recommendations to project leaders for site restoration. Utilized engineering experience to plan and implement interim erosion control measures to mitigate shoreline degradation and migration of contaminated silt and storm runoff to the lake.
- Land-use Planning -- Environmental Assessments on Olkhon

Island: Worked with researcher from the Institute of Geography of Irkutsk, Siberian Branch of the Russian Academy of Sciences to assess anthropogenic impact on wildlife areas. Proposed policies for future land use, management of wildlife protection, recreational activities, and waste disposal to be incorporated into national park zoning plan.

- Stream Restoration: Worked with California Tahoe Conservancy on stream restoration project for Cold Creek, a tributary to Lake Tahoe. Native vegetation was transplanted into areas degraded by livestock activity along a one-mile section of stream.
- Environmental Policy and Natural Resource Management: Evaluated impact of wild horses and domestic livestock grazing in the South Lake Tahoe watershed and Great Basin by observing wild horses and range areas, interviewing experts, including Bureau of Land Management (BLM) officials and ranchers, and performing research regarding wild horses. Completed a report, including policy recommendations, for the Animal Legal Defense Fund, BLM, U.S. Forest Service, and members of U.S. Congress.

Project Engineer, Harding Lawson Associates (now AMEC), Petaluma, CA, 1991 - 1999

Managed field offices, coordinated and supervised trainees, engineering technicians, staff engineers, and scientists in environmental sampling and investigation work. Developed and implemented health & safety and work plans. Conducted QA/QC programs for hazardous materials/waste investigations. Performed feasibility studies and remedial actions on civilian, military and Superfund projects, including: lead abatement in former military small arms ranges in coastal sand dunes; hexavalent chromium abatement in former military pickling and plating facility; decommissioning of sewage treatment plants and tank farms; sampling and analysis of discharge from shoreline storm drain outfalls; monitoring and remediation of contaminated groundwater; sampling and remediation of contaminated dredge material. Performed O&M of remedial systems, including soil vapor extraction, bioremediation, and groundwater treatment facilities utilizing granular activated carbon and ultraviolet light oxidation/reduction. Supervised trainees, engineering technicians, staff engineers, and scientists in the same. Successfully operated systems with minimal down time. Devised and proposed expansion of groundwater treatment system. Supervised general laborers and heavy equipment operators in construction of remedial systems. Consistently completed projects on time and within budget. As site project manager, acted as liaison to clients, regulatory agencies, the public, and the media; interpreted data and wrote project status reports and proposals; and gave presentations to prospective clients. Conducted Phase I and Phase II site assessments; supervised drilling crews for installation of exploratory borings and monitoring and extraction wells; logged and sampled borings; conducted soil gas surveys; developed and sampled wells; and performed construction and remedial action oversight.

Assistant Engineer, Herzog Associates, Petaluma, CA, 1989 - 1991

Observed and tested geotechnical related construction, including earthwork, grading, paving, and foundation installations for commercial and residential projects to confirm conformance to plans and specifications. Wrote proposals, reports, and plan reviews; drafted site plans and detailed specifications; and designed street and parking lot pavements and building foundations. As Radiation Safety Officer, devised and implemented state compliant program for and oversaw use of nuclear testing equipment.

Christopher Ohland

Senior Program Chemist

EDUCATION

BS, Water Chemistry, University of Wisconsin, 1985

CERTIFICATIONS, LICENSES, TRAINING

40-hour HAZWOPER, 1988

8-Hour HAZWOPER Refresher, 2015

Blood-borne Pathogens, 1998

Confined Spaces, 1996

DOT Hazmat Employee, 2013

RCRA Statistics, 1992

Supervisory Hazardous Substances/Waste Health and Safety, 1988

USACE Construction Quality Management for Contractors, 2015

WORK HISTORY

Ahtna Environmental, Inc.
Senior Program Chemist, 2015 – Present

E-Data, Inc.

Technical Director, 2009 – 2015

Sullivan International, Inc.
Project Manager / Program Chemist, 2007 – 2009

OTIE, Inc.
Project Manager / Program Chemist, 1998 – 2007

Katalyst Analytical Technologies, Inc.
Operations Director, 1996 – 1998

CH2M Hill, Inc.
Senior Project Scientist, 1988 – 1996

Hazleton Laboratory America
Senior Project Scientist, 1985 – 1988

EXPERIENCE SUMMARY

- Over 27 years of experience in environmental investigation and remediation programs for government/DoD, state, and commercial clients
- 19 years of experience as Project Manager directing site assessments; remedial investigations; feasibility studies; risk assessments; long-term operations and management; remedial actions; regulatory agency interaction and negotiations; community involvement programs
- Technical expertise in environmental chemistry, data management, meteorological and perimeter air quality, natural attenuation, soil vapor and indoor air monitoring, multi-media sampling methods, quality assurance, and quality control

WORK EXPERIENCE

Ahtna Environmental Inc. – Pleasant Hill, CA Senior Program Chemist

Oversight of corporate laboratory programs, third-party quality assurance/quality control (QA/QC) reviews, and analytical chemistry consulting services to industrial clients and environmental science and engineering firms.

E-Data Inc. – San Francisco, CA Technical Director

Oversight of corporate laboratory programs, third-party quality assurance/quality control (QA/QC) reviews, and analytical chemistry consulting services to industrial clients and environmental science and engineering firms.

Typical tasks include: develop chemistry programs, perform laboratory data validation, define data quality objectives, complete QA/QC project plans, write SOPs, train employees in proper field sampling protocol and documentation, and perform ongoing QC audits of sample collection and handling activities and contracted laboratory vendors. Used MS Access to import various electronic data (SEDDs, ERPIMS, EQuIS, others), evaluate, report, and export large datasets.

Sullivan – San Francisco, CA Project Manager / Program Chemist
Served as USACE and Navy Program Chemist with firm-wide oversight of task-level associates that wrote sampling and analysis plans, quality assurance plans (UFP-QAPP), performed sampling and chemical testing, managed laboratory vendors, reviewed chemical data, and validated data with ADR.net.

Managed 16 ongoing environmental projects valued at $2.4M that were completed on time and profitable. Projects included: fuel spills investigations, hotspots assessments, sediment/soil/groundwater investigations, skeet debris removal, and soil gas and vapor intrusion studies.

Proposal and deputy program manager for USEPA Region 9 and USACE Sacramento District direct awards. Successful as proposal manager and interim program manager for awards with USEPA

Region 9 ($1M direct award and $3.5M small biz award), USACE-Omaha ($1M MATOC task order); and USEPA Region 2 ($10M Small Business RAC IDIQ). Developed project scope through carefully written specification statements to limit contract liability and establish a fair price. Developed cost and schedule estimates, managed risk registers, wrote technical specifications, and assigned staff resources for projects.

OTIE, Inc. – Project Manager / Program Chemist

Technical lead for environmental chemistry programs and data management using in-house database management tools. Responsible for growing the environmental chemistry practice, maintaining high quality standards and efficient work processes, training and mentoring the team, providing senior technical support, working to create external visibility, while building the client portfolio.

Extensive experience in preparation and peer review of field sampling plans and data quality objectives to ensure effective and appropriate data collection along with other quality-related tasks, including field and laboratory auditing and training, writing technical specifications and standard operating procedures (SOPs), providing QA/QC and health and safety orientation, document preparation, data quality assessments, data validation of analytical laboratory data, data management, technical support, and senior document review. Identified innovative solutions to streamline work flow processes resulting in reduced levels of labor effort, budget and schedule improvements, and increased access to innovative technology.

Project management of more than 30 projects valued between $25K and $1M. In this role, collaborated with project stakeholders, developed scope of work, wrote work plans, established budgets and schedule, staffing plans, QA/QC plans, and risk management plans; monitoring progress of project and providing technical direction and resources to project team, and managing project scope.

Brief list of extraordinary personal accomplishments:

- Knowledge of USEPA terminology and requirements for environmental chemistry programs was a key advantage to winning the firm’s first USEPA Region 9 contract
- Expert testimony led to two successful subcontractor litigations
- Grew the environmental chemistry team from a single office to a nationwide team of highly qualified chemists and data managers
- Collected, chemically tested, and managed data for 900 multimedia samples for off-site chemical analysis and 3,000 soil samples for onsite analysis during a 3 month remedial action
- Developed a perimeter air monitoring program with real-time data acquisition and reporting that allowed sediment remediation work to proceed without a single fence line non-compliance

- Designed a soil bio-pile treatability study resulting in remediation of fuel contaminated soil and onsite reuse at base landfill; successfully eliminating all offsite transportation and disposal costs
- Performed a PA/SA for 91 listed areas at Dare County Bombing Range and successfully negotiated 86 no action determinations and reducing remediation cost by 85%

Katalyst Analytical Laboratory, Inc. - Laboratory Operations Director

Manage the overall financial and technical aspects of the laboratory operations while maintaining corporate profit goals. Responsibilities include all data reported by the laboratory, personnel management, environmental consulting, public relations and financial support and management. Review the operations of each reporting function on a regular basis and support the development and implementation of the quality control program to maintain an excellent reputation in the environmental field.

CH2M Hill, Inc. - Sr. Project Scientist.

Skilled in the sampling of multimedia environmental samples (air, water, soil, waste, unknown material), chain-of-custody documentation, packing and shipping hazardous materials, data interpretation and reporting, and regulatory agency notification. Authored various documents and work plans including activities memorandums, field sampling and analysis plans, quality assurance project plans, health and safety plans, spill containment plans, and sections of investigation reports. Setup and operated mobile laboratories for general chemistry, GC, HPLC, and XRF instrumentation.

Hazleton Laboratory America, Inc. – *Project Scientist*

As a project scientist in the Environmental Fate, Metabolism, and Transport department responsible for laboratory procedures used to quantify pesticide degradation using various pathways such as soil metabolism, soil and aqueous photolysis, hydrolysis, column leaching, and volatility. Trained in the safe use of radiological isotopes.

Eric Schmidt

Chemist

EDUCATION

M.S., Environmental Science and Engineering, Contaminant Hydrology Focus, Oregon Graduate Institute, 1993

B.S., Biochemistry, University of California, Davis, 1986

TRAINING

40-Hour HAZWOPER

ERPIMS Training course, 2013

QSP/QSD Training course, 2012

Microsoft elearning SQL Server 2005 coursework, 2010

Geographic Information Systems, San Francisco State University, 2002

Stream Habitat Restoration Course, CDFG, 1995

Database: MS Access, SSMS, Oracle

Programming: VBA, C, FORTRAN, Javascript, HTML

WORK HISTORY

Ahtna Environmental, Marina, CA, Senior Environmental Project Manager, 2015-Present

Chicago, Bridge, and Iron Federal Services, IMS Analyst III, 2013 – 2015

Shaw Environmental, Scientist III, 2003 – 2013

International Technologies Corporation, Project Chemist, 1997 – 2003

Woodward Clyde Consultants, Project Chemist, 1995 – 1997

Law Crandall Associates, Project Chemist, 1994-1995

Kuparuk Industrial Center Laboratory, Chemist, 1990 – 1992

Chemical and Geological Laboratories of Alaska,

EXPERIENCE SUMMARY

- 21 years of experience as a Project Chemist for multiple environmental investigation and remediation DoD/Army CERCLA sites
- 20 years of experience performing environmental data management, and programming
- 27 years of field sampling of multiple media including soil, ambient air, indoor air, landfill gas, soil vapor, surface water, vernal pools, groundwater, and landfill leachate.
- Document Development: Primary or co-author in documents that include Quality Control Summary Reports, Work Plans, Technical Memorandums and Reports, Quarterly and Annual Reports, Closure Reports, Uniform Federal Policy Quality Assurance Project Plans (UFP-QAPP), Sampling and Analysis Plans, Chemical Data Quality Management Plans, and Environmental Protection Plans

PROJECT EXPERIENCE

Project Chemist/Senior Scientist, Former Fort Ord, Presidio of Monterey, CA, 9/97 - present

Management of subcontracted laboratories and third party data validation using Automated Data Review (ADR) software; Development of project specific ADR libraries; Gas/Soil/Groundwater/Surface water sampling; Familiar with standard test methods, SW846, and other analytical methods in sample analysis; Incorporation of the latest DoD QSM requirements and EPA data quality objectives process in the development of UFP-QAPPs; Implementation of data validation per EPA guidance; Production of Quality Control Summary Reports, Contractor Quality Assurance Reports, and Data Quality Assessments.

Optimization, monitoring of landfill gas (LFG) thermal treatment unit; field measurement of LFG for compliance, LFG Annual reporting, assistance in annual source testing to determine compliance with regulations; groundwater velocity calculations and plume determinations, creation of Environmental Protection Plan which involved detailed review of Fort Ord Wetlands Restoration Plan, and USFWS Biological Opinions.

Programmer, Treasure Island, San Francisco, CA, 2013 – 2014

Performed needs assessment and worked with radiological technicians and program manager in the development of a customized Excel VBA application for radiological field work.

GIS/Database Manager, Former Fort Ord, Presidio of Monterey, CA, 8/2006 – 8/2009

Managed www.fortordcleanup.com and www.fodis.net, and associated databases (MS Access and SQL Server); designed web-based chemistry data loading tool, managed subcontractors performing work for Sacramento Total Environmental Restoration Contract (TERC) I and II project site; and provided cost estimates, schedule updates, accruals, and budget information on a monthly basis.

Supervisor/Chemist, 1988 – 1990

Sebastiani Vineyards, Laboratory Technician, 1987 - 1988

Data Management/Programming, 8/2006 – 8/2009

Creation of customized MS Access databases for data management of chemistry and landfill data; Development of custom MS Excel VBA macros for data conversion, loading, and presentation; Optimization and improvement of existing programming, utilization of data in a multitude of formats (delimited, fixed length); Querying, and updating of SQL and oracle databases; Tortoise SVN SOP development; Development of Migration Plan and QC Test Plan for migration and merger of multiple databases; Google API map development: http://199.255.250.170/parcelmap/; and troubleshooting and QC of applications, and training.

Task Manager, Former Fort Ord, Presidio of Monterey, CA, 2006 – 2007

Task management for offsite drilling operations, and fence construction; Liaison with local land owners to address their concerns and provide information; installed passive diffusion bags, and profiled aquifer for TCE contamination; provided technical evaluations of data to the client and to the agencies, wrote statements of work and procured subcontractors; and tracked costs/invoices and performed monthly accruals.

MEC Removal Database Manager, Former Fort Ord, Presidio of Monterey, CA, 8/2005 – 9/2008

Data management for MEC removal action; imported data into an offsite SQL server database that was collected using handheld PDAs, resolved data issues with field staff, queried SQL server database (using MS Access as a front end) for daily reporting, presented updates at weekly meetings with USACE, made grid assignments working with task management and UXO supervisors, worked with UXO QC, lead Geophysicist;

Senior Staff Scientist, Hamilton Army Airbase, Novato, CA, 8/1995 – 9/1997

Applied statistical analysis on analytical data to characterize remediation stockpiled soils; created SAPs, QAPPs, work plans, and Data Quality Assessment reports for the USACE; developed database for analytical data; generated data quality assessment for inclusion in Remedial Investigation report; and directed preparatory phase inspections.

Supervisor/Chemist, AK, 10/1988 – 8/1992

Worked at two laboratories, one of which was on remote camp in the Arctic; Developed and produced Standard Operating Procedures to ensure uniformity in sample analysis; implemented QA/QC procedures for inorganic sample analysis and field work done at Kuparuk Field, Alaska; gathered soil samples at petroleum spill site; Supervised Inorganic Chemical Analysis section; and developed extraction procedure for soil petroleum hydrocarbons analyses.
Field work: Kenai, Alaska, screened for petroleum hydrocarbons at oil company cleanup site; Kodiak, Alaska, screened for petroleum hydrocarbons on bore samples, to determine location of leaking

underground fuel tank; and Soldotna, Alaska, samples monitoring wells at Kenai and Soldotna landfills.

Zachary T. Carroll - *Staff Database Analyst II*
13 total years of experience

EDUCATION
Bachelor of Art, History (Social Science Program), 1999, California State University, Sonoma

BIOSKETCH
Mr. Carroll is a Data Management Specialist and Data Validation Technician who has been maintaining data integrity and production of scheduled reports in a timely manner since 2000. He has reviewed all aspects of program databases for accuracy, advised on future database design needs, performed data validation, wrote and presented reports, and answered questions regarding analysis.

PROJECT EXPERIENCE

Data Validation Technician: Casmalia Resources Superfund Site Maintenance, Remedial Investigation/Feasibility Study (RI/FS), Groundwater Monitoring, Casmalia, California. Responsible for providing quality assurance (QA) and quality control (QC) review relative to analytical laboratory data. Performed Level III and Level IV data review in accordance with the project work plan, the project field sampling plan, and the principals presented in the *USEPA National Functional Guidelines for Superfund Organics Data Review* and the *USEPA National Functional Guidelines for Laboratory Data Review, Inorganics*. Scope: Work performed in support of site maintenance and management, RI/FS, regulatory compliance and support of investigation at a 252-acre, former Class I Superfund, Hazardous Waste Management Facility comprising five separate landfills and which included approximately 40,000 tons of industrial waste on site (with acids, caustics, solvents, pesticides, and metals). Implemented 24-hour operating leachate collection and contaminated groundwater treatment system, and over 300 monitoring wells.

Data Validation Technician: Universal Paragon Corporation / BP PLT-1, LLC Former Schlage Lock and Southern Pacific Brisbane Rail Yard Operable Units (OUs) Brownfield Soil and Groundwater Remediation Services, San Francisco, California. Responsible for providing data review summary reports describing analytical performance expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). Scope: Engineering efforts in development of a strategic roadmap to help close the real estate deal and transfer of environmental liability to BP/MACTEC Team for redevelopment. Brownfield site is scheduled to be redeveloped into a $450 million mixed-use development, including 1,200 residential homes and public open space. Conducted remedial investigation (RI) and feasibility studies (FSs) to identify final remedies for volatile organic compound- (VOC) impacted soil and groundwater and metal-impacted soils. The selected remedial action will entail in-situ bioremediation of VOC-impacted groundwater using enhanced reductive de-chlorination by injecting soybean oil into the subsurface to enhance natural microbial activities.

Database Specialist/Data Validation Technician: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Groundwater Sampling, Analysis and Reporting, Fort Ord Site (Seaside), California. Responsible for providing data review in accordance with the *Uniform Federal Policy for Quality Assurance Project Plans*; generating quarterly output and maintaining the project libraries for the project's Automated Data Review (ADR) software; writing of the Quality Control Summary Report for inclusion in the Quarterly Report; and conducting ongoing data loading in SQL and Access databases. Scope: Continuation of ongoing groundwater sampling, analysis, and reporting program at Fort Ord site. Quarterly sampling and analysis conducted at more than 300 stations along with evaluation of treatment systems operation.

Database Technician/Data Validation Technician: Former Chemical Manufacturing Facility Perchlorate Investigation, Remediation, Morgan Hill, California. Responsible for providing Level III and Level IV data review in accordance with the *USEPA National Functional Guidelines for Laboratory Data Review, Inorganics*; troubleshooting data validation issues with laboratory personnel; MAROS Mann-Kendall Analysis for determining trends in analyte concentration levels; performing quarterly reporting of QA/QC findings; regulatory uploading of data packages and written reports to Geo-Tracker online website; and data loading and QC tracking in SQL and Access databases. Work is being done in support of a Remedial Investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater at the site of a former flare manufacturing facility. Perchlorate has been detected in onsite soil and onsite and offsite groundwater.

Database Specialist/Data Validation Technician: Confidential Client, Former Manufacturing Facility, Groundwater Investigation and Remediation, Northern California. Responsible for ongoing uploading of chemistry data to SQL database and providing database support in implementation of SQL database relating both historical and incoming chemistry data in support of regulatory review and environmental support services for a former industrial building products manufacturer; Level II and Level III data validation performed in accordance with the project's Quality Assurance Project Plan and the *USEPA National Functional Guidelines for Superfund Organics Data Review* and writing of quarterly data review summary. Services provided include groundwater testing and sampling pertaining to nearby groundwater plume impacted by solvents (PCE and TCE).

Database Specialist/Data Validation Technician: Groundwater Monitoring Program, Los Angeles, California. Responsible for reviewing data for compliance with laboratory control limits and method compliance in accordance with USEPA Level II review; quarterly reporting of validation summary for groundwater data to assist client with making project decisions; MAROS Mann-Kendall analysis to determine trends in chemicals of concern on a quarterly basis. Work is being done in support of O&M of Soil Vapor Extraction (SVE) system and vapor enhanced recovery (VER) system and semi-annual groundwater monitoring program. Site occupies several acres on property converted from manufacturing operation (including buildings) to present day asphalt-covered commercial parking lot.

Database Specialist/Data Validation Technician: Site A Environmental Site Assessment and Remediation, Torrance, California. Responsible for quarterly reporting of validation summary for groundwater data to assist client with making project decisions; review of data for compliance with laboratory control limits and method compliance, in accordance with USEPA Level II review. Work being done in support of soil and groundwater contamination remediation at a 3.2 million square feet industrial complex site comprised of numerous manufacturing buildings. Services included indoor air monitoring for VOCs.

Database Technician: IBM Corporation Phase I Environmental Site Assessments, Groundwater Treatment System O&M and Monitoring, San Jose, California. Provided database support, including data loading, QC, reporting, and archiving. Created and delivered to the client a data extract from SQL database in EQuIS data format. Scope: Phase I Environmental Site Assessments and other environmental services for leased properties at end of lease, prior to being returned to owner. Sites have included offices and manufacturing facilities. Activities included well installation and abandonment; O&M of groundwater extraction system; management of Self-Monitoring Program; and various on-call services to support client's environmental program. MACTEC services saved IBM an average of $40,000-$50,000 a year over a four-year period in monitoring and O&M costs by negotiating closure of over 150 monitoring wells.

Jeffery J. Fenton - ***Senior Geologist***
27 total years of experience

EDUCATION
Bachelor of Science, Geology, 1981, Oregon State University, Corvallis

CERTIFICATIONS
HAZWOPER 40 Hour
HAZWOPER 8 Hour Refresher
HAZWOPER 8 Hour Supervisor
OSHA Confined Space Entry

BIOSKETCH
Mr. Fenton is a Senior Geologist and Project Manager with over 27 years of experience. He is responsible for designing and managing programs, developing work plans, performing record searches and evaluation of storage and handling of hazardous wastes, supervising field work and data reduction, and participating in agency and public meetings. He has managed numerous large and small HTRW projects, including the evaluation and characterization of sites with hydrocarbon, solvent, metals, pesticide, PCB, explosive compound, and low-level radioactive wastes. His responsibilities have included preparing RI/FS and site characterization reports, confirmation reports, IA Approval Memos, Environmental Baseline Surveys, FOSTs, FOSLs, FOSETs, environmental compliance reports, BRAC Cleanup Plans, site safety plans, and confirmation reports in compliance with BRAC, DoD, CERCLA, RCRA, USACE, EPA and State and local guidance. He has managed tasks involving industrial facilities, landfills, munitions response sites, service stations, food processing plants, and agricultural facilities for federal DoD agencies (e.g., USACE, Army, and Navy) and private sector clients.

PROJECT EXPERIENCE
Project Manager: Ahtna Engineering Services, Fort Ord Groundwater Monitoring Program, Sites 2 and 12, OU2 and OUCTP. Responsible for the monitoring and characterization of three groundwater plumes at the former Fort Ord, CERCLA site. Manage the collection of groundwater elevations and the chemical sampling of a network of over 300 monitoring wells on a quarterly basis. Samples are analyzed for a variety of inorganic and organic compounds. Groundwater elevation and chemistry data are compiled for inclusion into quarterly and annual monitoring reports that include groundwater elevation contour maps and iso-concentration plots of the data collected for each plume and for each aquifer affected. Responsible for overall project quality control, validation of analytical data and submittal of the quarterly and annual reports to the client, regulatory agencies and the public.

Project Manager: Ageiss, Inc., Data Validation Support, Semi-Annual Groundwater Sampling, Dodge Hill Landfill, Fort Sill Oklahoma. Provide validation and statistical analysis of all groundwater data collected during semi-annual groundwater sampling at the Dodge Hill Landfill, fort Sill Oklahoma. Validation includes Level III review on 100% of the data and Level IV review on 10% of the data with qualifiers applied to the electronic deliverable file (EDD). Data review is presented in a Data Validation Summary Report. Perform statistical analysis on all groundwater analytical data for each sampling event. The statistical analysis is presented in a report which is appended to the client's semi-annual groundwater report for submittal to the US Army Corps of Engineers (Ageiss client) and the Oklahoma Department of Environmental Quality.

Project Manager: Hydrogeologic Inc. (HGL), Treatment Plant Decommissioning, Fort Ord, California.
Provided technical review of the Work Plan and Completion Report prepared by HGL and provided field oversight of well destruction activities to ensure well destruction was completed as per the permit requirements and HGLs Work Plan. Work performed for HL under Huntsville Small Business Worldwide Environmental Services (WERS) contract.

Project Manager: Innovative Technical Solutions, Inc. (ITSI), A Gilbane Company, Groundwater Modeling and Technical Memorandum Revision, Fort Ord, California. Provided updates to the fort Ord groundwater model to support the design element of the relocation of the Operable Unit 2 (OU2) groundwater treatment plant. Completed a groundwater model run with existing and proposed extraction and injection wells, including a cost benefit analysis used to support the design basis for the new location of the OU2 groundwater treatment plant. Included revision/finalization of the draft groundwater technical memorandum. The technical memorandum included the proposed locations of new extraction wells to supplement and optimize the existing groundwater extraction well network.

Task Manager: Lennar / BVHP, LLC Hunters Point Naval Shipyard Parcel A Environmental Consulting Services, San Francisco California. Environmental consulting services to support client's legal counsel, address special requests for information from project stakeholders, and present information at planning and technical meetings as part of ongoing effort to redevelop Parcel A of area formerly occupied by U.S. Naval shipyard. Provided review of and recommendations on existing documents. ***Lennar achieved compliance with regulatory requirements with MACTEC's assistance.*** Responsible for preparing a Finding of Suitability to Lease document for 8 buildings and 2 open spaces.

Geologist: The Presidio Trust Site Closure Environmental Services, San Francisco California. Environmental services associated with site closure, including site investigation, risk assessment, feasibility study (FS), engineering design, data management, ecological risk assessment, remediation, and reporting at historic 1,416-acre former military base at the south end of the Golden Gate Bridge. Responsible for preparing a Supplemental Health and Safety Plan for Munitions and Explosives of Concern.

Task Manager: U.S. Army Corps of Engineers - Huntsville District, Fort Ord Operable Unit (OU) Habitat Remedial Investigation / Feasibility Study (RI/FS), Monterey California. Since 2004, MACTEC has been conducting full remediation investigation / feasibility study (RI/FS) to address munitions and explosives of concern (MEC) at the Impact Area Munitions Response Area (MRA) for 6,500 acres of a 8,000-acre former U.S. Army training range complex (small arms to artillery fire). Activities included planning, site characterization, archival (historic) search, risk assessment (human health), feasibility study, and community relations support. Responsible for conducting site characterization efforts.

Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento Districts, Fort Ord Site RI/FS Reports Track 0&1 Approval Memorandum, Parker Flats ROD and Public Meeting, Monterey California. Under an additional delivery order, completed the development and submittal of additional Track 0 and 1 approval memoranda and ROD for multiple reuse parcels throughout site of former Fort Ord. Activities support remedial investigation efforts as part of Military Munitions Response Program. ***Analysis performed by MACTEC resulted in No Further Action determination for 21 of 24 Track 1 sites.*** Responsible for participating as one of the authors of the Remedial Investigation / Feasibility Studies document.

Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento District, Environmental Baseline Survey for Transfer (EBST) Documentation Services, Monterey California. Preparation of documents and associated evaluations relating to broad range of environmental issues (e.g., asbestos and lead-based paint) at Fort Ord as part of work for Environmental Baseline Survey for Transfer (EBST). In support of property transfer MACTEC prepared Findings of Suitability to Transfer (FOST), Findings of Suitability to Lease (FOSL), and Findings of Suitability for Early Transfer (FOSET). ***Early transfer was approved saving $1 million in infrastructure and maintenance cost.*** Responsible for writing the FOST documents for 30 parcels and the FOSET documents for 64 parcels.

Task Manager: U.S. Army Corps of Engineers - Huntsville and Sacramento Districts, Fort Ord Site Investigation and Documentation for FOST, Monterey California. Investigative and documentation activities performed as part of development of environmental basewide survey for transfer (EBST) and findings of suitability for transfer (FOST) at former Fort Ord site. In support of property transfer MACTEC prepared Findings of

Suitability to Transfer (FOST), Findings of Suitability to Lease (FOSL), and Findings of Suitability for Early Transfer (FOSET). ***Early transfer was approved saving $1 million in infrastructure and maintenance cost.*** Responsible for writing the FOST document for one parcel.

Project Manager: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Groundwater Sampling, Analysis and Reporting 2008-2009, Fort Ord Site (Seaside) California. Continuation of ongoing groundwater sampling, analysis and reporting program at Fort Ord site for 2008-2009 (Option Year 3). Quarterly sampling and analysis conducted at more than 300 stations along with evaluation of treatment systems operation. Responsible for data management, data evaluation, and reporting.

Task Leader: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Site Electronic Data Integration and Management, Monterey California. Electronic data integration and management of various environmental databases, administrative records, facilities management information and GIS applications developed for site characterization, OE investigation, and remediation activities at former Fort Ord site. Work is continuation of services under ongoing BRAC and IRP programs. The database contains over one million records. Contract Compliance Screening (CCS), Automated Data Review (ADR), and Environmental Management System software programs were developed and resulted in ***cost savings of up to 50% in labor reduction ($250K) and improvements in the data management process for numerous task orders.*** Responsible for contributing information regarding property transfer-related documents that needed to be integrated into the overall Fort Ord database.

Environmental Task Manager: U.S. Army Corps of Engineers, Sacramento District, Fort Ord Complex Site BRAC Related Environmental Services, Monterey California. Environmental and engineering services under BRAC Program since 1985 for Fort Ord Complex (28,000-acre former Fort Ord, the Presidio of Monterey, and Fort Hunter Liggett, Fritzsche Army Airfield), a National Priorities List (NPL) site. Completed several hundred multidisciplinary, multitask delivery orders, with dozens more in progress. Services have included site investigations, risk assessments, feasibility studies, including ordnance/explosives remedial investigation, remedial designs, remedial actions, environmental compliance, utilities/roads, parcel descriptions, endangered species and habitat assessments, underground storage tank investigations, asbestos assessments, groundwater remediation, planning for base reuse, and community relations. Services have been conducted under CERCLA; RCRA; NEPA/CEQA; California landfill regulations; Monterey County underground storage tank (UST) regulations; air toxics regulations; and other federal, state, and local environmental laws and regulations. ***Successful completion of RI/FS documentation as part of 40+ site RI/FS allowed the Army to meet the congressionally mandated 36 month RI/FS schedule.*** To track the status of the property transfer and to provide the most up-to-date information to community stakeholders on the environmental cleanup, MACTEC developed a public website (www.fortordcleanup.com). This allowed interested parties to view information online. ***This reduced the time needed for onsite staff to manage the paper administrative record by approximately 50%.*** Responsible for serving as the BRAC task manager, preparing appropriate documentation, including Environmental Baseline Surveys (EBSs), Findings of Suitability to Transfer (FOSTs), Findings of Suitability for Early Transfer (FOSETs), Findings of Suitability to Lease (FOSLs), and Notices of Intent (NOIs), under the Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA) guidance, which accelerated real-property transfers in accordance with the Defense BRAC Act (BRAC Program). Worked closely with the U.S. Department of the Army, U.S. Army Corps of Engineers (USACE), EPA, and State of California to develop approaches that met the requirements of CERCLA 120(h) and satisfied regulatory concern for documenting the environmental condition of the property at the time of transfer. Also responsible for RCRA closure activities.

Technical Consultant: U.S. Army Corps of Engineers - Sacramento District, Fort Ord Wetlands Habitat Monitoring 2003, Monterey California. Continuation of habitat monitoring work as part of the BRAC and IRP activities at site of former Fort Ord. Monitoring activities at wetland sites on property include vegetation sampling, wildlife surveys, and collecting and analyzing physical and hydrological data. ***Results of the habitat monitoring showed that the habitat had recovered in four years and thus eliminated the fifth year of monitoring saving $85,000.*** Responsible for review of property transfer documents related to habitat monitoring activities.

Task Manager: U.S. Army Corps of Engineers - Sacramento District, Fort Ord and Fort Hunter Liggett Groundwater Monitoring Program, Forts Ord, Hunter Liggett California. Groundwater investigations and provided quarterly monitoring; prepared property transfer documents; performed habitat monitoring and groundwater remediation system evaluation; and conducted Small Arms Range remediation pilot study evaluation at site of two former U.S. Army installations under BRAC program. ***The project has been completed and consisted of twelve sites requiring remediation that have been closed with regulatory approval resulting in a reduction in long-term O&M for the client.*** Responsible for data evaluation and management, preparation of reports and cost proposals, and review of invoices.

Task Manager: USACE, Sacramento District, Military Munitions Response Program (MMRP), FortOrd, Monterey County, California. Currently serving as Task Manager responsible for the completion of a RI/FS, Proposed Plan, and Record of Decision at former munitions response sites. Conducted and evaluation of the possible use of military munitions at 24 former military munitions sites. The evaluation included researching the history of each site (PA/SI) and completing a review of the available data to develop conceptual site model(s) for each potential site. Data gaps were identified and the potential risk remaining at each site was also evaluated. Worked directly with federal and state regulatory agencies and community stakeholders throughout the review and approval process. The RI/FS is being conducted following EPA, DoD, and CERLA guidance. Other documentation prepared in support of the Fort Ord MMRP include IA Approval Memorandums, and Notices of Intent (NOI) for Removal Actions and Land disposal Site Plans prepared in support of the Army's Time-Critical Removal Action (TCRA) program. The NOI complies with 40 CFR, Part 300, Section 415 and notifies the regulatory agencies and the public of upcoming removal actions, intended to mitigate or eliminate the threat to public safety presented by the presence of munitions and explosives of concern (MEC).

Task Manager: USACE, Sacramento District, Closure of RCRA Solid Waste Management Units, Former Fort Ord, Monterey County, California. Implementing the closure of two solid waste management units under the Fort Ord RCRA program. Closure involves the site investigation and characterization of a former PCB storage facility and a former Open Burning/Open Detonation (OB/OD) munitions disposal unit. Investigation involved conducting a field investigation including the sampling and analysis for chemicals of concern, and completion of a closure certification report following RCRA guidance.

Task Manager: USACE, Sacramento District, Investigation of Solid Waste Management Units, Former Fort Ord, Monterey County, California. Task manager for the evaluation of former hazardous waste storage units. Evaluation involves physical inspection of the units including a review of the cleanliness and integrity, waste handling and storage practices, determining whether a release has occurred and making sampling recommendations if necessary. Information including any recommendations made to state and federal regulatory agencies through a status report. Wastes stored and evaluated include waste oil, fuel, solvents and paint, PCBs, pesticides, asbestos, used ethylene glycol, adhesives and polymers. Created a detailed historic account of the solid waste management units which has been instrumental in the regulatory approval of the transfer of property containing the units.

Project Geologist: Confidential Client, Regulatory Compliance Audits, Processing and Distribution Facilities, Western U.S. Served on audit teams performing regulatory compliance audits for a major food production, processing and distribution company. The project entailed the completion of audits in a 5-month period at 37 facilities in California, and several other facilities in four states. The audit protocol prepared by HLA addressed facility compliance with regulations for hazardous waste, hazardous materials, air quality, water quality, drinking water and transportation. The protocol further provided for the completion of a preliminary screening evaluation that involves the local facility management in targeting relevant operations and matters of concern for the audit, prior to proceeding with the on-site phase of the program.

Task Manager: USACE, Site Investigations, Fort Ord, Monterey, California. Served as task manager for the investigation of several UST sites. Was responsible for determination of MACTEC and subcontractors scope of work, calculation of excavation volumes, oversight of subcontractors, collection of samples, review of analytical data, preparation of clearance and characterization reports, and budget tracking.

Task Manager: USACE, Remedial Investigation/Feasibility Study, Fort Ord, Monterey, California. Served as task manager for the remedial investigation/feasibility study (RI/FS) of two IRP sites at Fort Ord. Was responsible for the interpretation of chemical and hydrogeologic data, oversight of chemical and geologic database, coordination with risk assessment and engineering personnel, determination of contaminant fate and transport, coordination and production of final RI/FS report, and budget tracking.

Task Manager: Alameda County Department of Public Works, Landfill Investigation, Winton Avenue Landfill, Hayward, California. Served as task manager for landfill investigation under the state Solid Waste Assessment Test (SWAT) program. Was responsible for the preparation of work plan, installation and quarterly sampling of groundwater and leachate monitoring wells, aquifer testing, data evaluation, assessment of impact of leachate on waters of the state, and preparation of SWAT report.

Task Manager: U.S. Navy/PRC, Utilities Investigation, Hunters Point Naval Shipyard, San Francisco, California. Was task manager for a cross-base underground utilities investigation. Study involved the review of as-built drawings of sanitary sewer, storm drain, steam pipelines, and fuel lines, and the collection of soil and water samples adjacent to and within utility systems. Was responsible for the review and interpretation of analytical data, recommendations on remediation and mitigation measures, and the presentation of the results at a series of client and agency meetings.

Task Manager: U.S. Navy/PRC, Remedial Investigation, Hunters Point Naval Shipyard, San Francisco, California. Served as task manager for RI of five sites for contaminants including petroleum hydrocarbons, PNAs, pesticides, and metals. Completed interim-action evaluation in accordance with the EPA Superfund Accelerated Cleanup Model. Was responsible for budget and schedule tracking, chemical and hydrogeologic data interpretation, report preparation, and client representation at regulatory agency meetings.

Field Manager: U.S. Navy/PRC, Field Coordination, Hunters Point Naval Shipyard, San Francisco, California. Managed all aspects of field work, including the development, implementation and tracking of field schedules; coordination with client, subcontractors, and regulatory agencies; scheduling field personnel and reviewing all field documentation; and calculating and ordering all field supplies.

Task Manager: U.S. Navy/PRC, Aquifer Testing, San Francisco, California. Developed and implemented site-wide aquifer characterization program. Work included the development of the scope of work assessment of well construction and suitability, performing step-tests, and constant rate discharge tests.

Project Manager: Confidential Client, Product Removal Investigation, Hunters Point Naval Shipyard, San Francisco, California. As project manager, supervised the field investigation involving the removal of free-phase floating hydrocarbons from monitoring wells. Calculated and tracked the volume of product removed to determine the feasibility of installing a pumping system.

Task Manager: Confidential Client, Monitoring Well Network Installation, Longview, Washington. Installed, developed, and sampled network of groundwater monitoring wells in bedrock to investigate the impacts of a long-term release of mercury.

Task Manager: Montecito Heights Landfill, Monitoring Well Installation, Napa County, California. Installed monitoring well in deep aquifer using air rotary drilling method.

Task Manager: Former Fuel Storage and Dispensing Facility, Contra Costa County, California. Supervised and directed excavation of hydrocarbon-contaminated soil at former oil tank farm.

Task Manager: Site Assessment and Remediation, Richmond, California. Installed and developed monitoring wells and collected soil and groundwater samples. Supervised and directed contractor's removal of lead-, hydrocarbon-, and lime-contaminated soils at former shipyard site.

Field Manager: Well Installation, Morgan Hill, California. Installed double-cased well in deep aquifer using mud rotary drilling methods.

Field Manager: Well Installation, Vorhees, New Jersey. Installed monitoring well nests in shallow and deep aquifers using mud rotary and hollow stem auger methods.

Well Site Geologist: Exploration Logging Geothermal Division, Geothermal Exploration, California, Nevada, and Japan. Experienced in mud rotary, air rotary, and aerated mud drilling systems. Performed geologic logging of deep exploration geothermal boreholes. Responsibilities included descriptive lithologic sample analysis, monitoring of borehole temperature, borehole pressure and borehole gas levels; collection of borehole gas samples for chemical analysis; geothermal well production testing and reservoir analysis. Health and safety monitoring of carbon dioxide, methane and hydrogen sulfide gas levels around the drill site. Field experience in the Geysers California, Steamboat Nevada, Takigami and Fushime Fields, Kyushu Japan.

Kevin E. Garrett Ph.D., P.E., PMP – *Senior Principal*
21 Years Experience

EDUCATION
Doctor of Philosophy, The Pennsylvania State University Chemistry, 1990
Bachelor of Science, Colorado State University Chemistry, 1986

REGISTRATIONS
Colorado Licensed Professional Engineer (License number 43243)
Project Management Institute Project Management Professional (PMP)

BIOSKETCH
Dr. Garrett has a Ph.D. in Chemistry and is a Colorado licensed professional engineer with extensive experience in groundwater and soil remediation, site investigation, and the application of environmental chemistry. Dr. Garrett has managed RCRA facility investigation projects (RFIs) and remediation projects that have included developing innovative regulatory approaches resulting in significant cost savings for associated site remediation. Dr. Garrett has managed projects and applied innovative approaches to remediate groundwater, including monitored natural attenuation (MNA), enhanced reductive dechlorination (ERD), in situ biological remediation, in situ chemical oxidation (ISCO), soil vapor extraction (SVE), and neutralization remediation strategies.

Dr. Garrett has designed a full-scale in situ treatment system to remove chlorinated solvents such as methylene chloride, trichloroethene (TCE), tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), petroleum products, and inorganic constituents such as nitrate and perchlorate from groundwater. The remediation designs utilizes innovative strategies that that has minimized system complexity with reduced set up, operating and maintenance costs and achieve client and regulatory agency remediation goals in the shortest time possible.

Dr. Garrett has managed projects under a variety of regulatory programs including Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and State Voluntary Cleanup Programs. During these projected, Dr. Garrett has aided clients in negotiating site closure, points of compliance, and remediation criteria with regulatory agencies. . These negotiations have aided AMEC clients to close and/or redevelop sites for other uses while meeting the environmental and human health protection goals of the regulatory agency.

In addition, Dr. Garrett has assisted clients with implementation of client's environmental compliance programs including monitoring. Activities include requirements hazardous waste, waste water and storm water compliance, spill prevention plans, and emergency response planning. Dr. Garrett has extensive experience with Phase I and II environmental site assessments (Phase I and Phase II ESA).

As Project Manager and Senior Principal, Dr. Garrett manages technically difficult projects. Dr Garrett is responsible for all aspects of a project, including compliance with company policies, definition of scope of work, establishment of budgets and schedules, control of project costs, compliance with schedule, timely payment for the work, and assurance of overall client satisfaction. In addition, as project manager, Dr. Garrett ensures project quality control activities are in place and adhered to. Selects and supervises project team members; ensures that team members are assigned appropriate roles. Provides leadership to project team; maintains a positive environment and high morale. As Senior Principal, Dr. Garrett provides senior-level technical expertise for project teams. Acts as primary interface with clients for assigned projects; communicates with clients on an ongoing basis; responds effectively to meets clients' needs.

Dr. Garrett is the Chief Engineer of AMEC's Golden, Colorado office. As Chief Engineer, Dr. Garrett provides leadership role for marketing to major clients, service areas, and technically unusual projects; responsible for selected key clients. Serves as primary quality assurance officer for assigned office(s); verifies implementation of quality programs and initiatives.

In the area of quality assurance, Dr. Garrett has extensive experience in development of project-specific QA / QC programs and writing of quality assurance project plans (QAPPs). He has developed appropriate analytical and QA/QC criteria, selected appropriate methods, and developed appropriate reporting limits and method detection limits (MDLs). Dr. Garrett has extensively validated and evaluated analytical data.

PROJECT EXPERIENCE

Project Manager: Molycorp RCRA Facility Investigation (RFI) and Site Closure Remediation Services, Louviers, Colorado. Dr. Garrett managed design and construction of a full-scale in situ biodenitrification system (under RCRA) to treat the groundwater nitrate plume at the facility's 34-acre pond area and 32acre operations area. He developed an innovative in situ remediation system to remove nitrate from groundwater that minimized system complexity and minimized treatment costs to the client. Negotiated and developed the technical approach and justification to close 6 process water holding ponds two years ahead of the original schedule. Included in the technical approach were negotiations with the state regulatory agency on site-specific soil standards for nitrate that met the state goal of being protective of groundwater. Provided technical oversight of the pond closure contractor to ensure that the closure plan requirements were met. Closure of the ponds allowed for expansion of the groundwater treatment system. The expanded in situ treatment system reduced the time required to meet the compliance schedule with respect to nitrate in groundwater. Developed monitoring and characterization plan for perchlorate and demonstrated that the nitrate treatment was effective in meeting the negotiated site specific remediation goals with CDPHE. Performed radiological dose assessment for groundwater and soil in support of the facilities request to terminate their radioactive materials license. This effort included modeling potential radiation dose to hypothetical future residents from exposure to the sites soil and groundwater.

Project Manager: GSA - Denver Federal Center (DFC), Site-Wide Long-Term Monitoring, Lakewood, Colorado. As project manager, Dr. Garrett is leading the site-wide long-term monitoring activities at the Denver Federal Center. These activities include quarterly sampling of up to 250 monitoring wells and surface water locations on and off of the DFC. Quarterly activities include water level measurements, sampling, data validation, data management, and reporting. Additional activities include a 5-Year Review of the performance of the groundwater corrective measures. These corrective measures include, funnel and gate barrier system, source area pump and treat system, and off site plume. At project manager, Dr. Garrett is responsible for ensuring that the activities area completed on time and within budget.

Project Manager: GSA - Denver Federal Center (DFC), Investigative Area (IA) 13 and 16 Corrective Measures, Lakewood, Colorado. As project manager, Dr. Garrett lead the IA 13 source area characterization activities. These activities included characterization of 2 geophysical anomalies by trenching and soil sampling. In addition, the extent of the source area groundwater plume was evaluated using a Membrane Interface Probe (MIP). Based on the MIP results 20 additional monitoring wells were installed. After characterization activities, AMEC implemented the corrective measure which included injection of potassium permanganate into the alluvium and upper weathered bedrock (UWB) and injection of sodium permanganate into the lower weathered bedrock (LWB). Of particular interest was injection of permanganate at the LWB/consolidated bedrock interface. Injections were conducted in approximately 157 alluvium/UWB locations and 60 LWB locations. Post injection monitoring is currently being performed to evaluate the remediation effort to date.

Project Manager: GSA - Denver Federal Center (DFC), Investigative Area (IA) 04D RCRA Facility Investigation (RFI), Lakewood, Colorado. Dr. Garrett conducted two RCRA Facility Investigations (RFIs) and a survey of asbestos in soil for two parcels for the General Services Administration (GSA) at the DFC. The Interior RFI was completed at Building 41 and 42 and consisted of 68 borings and monitoring wells installed inside the buildings. The drilling was completed in conjunction with the facilities ongoing operations. The work included extensive coordination with the GSA and building tenants to ensure that the RFI activities did not impact their normal business activities. The Exterior RFI for the investigation area 04D included installing 80 borings and monitoring wells, excavating 11 trenches to characterize soil and potential impacts from historic operations at the DFC. The investigation included jetting/cleaning and video survey of sanitary and storm water sewer lines in IA04D. Responsibilities included general supervision of the work and activities such as development of subcontractor scopes of work, soliciting competitive subcontractor bids, insuring compliance with standard operating procedures, and health and safety plan development/implementation. Dr. Garrett was responsible for maintaining project schedules, monitoring the budget and costs, and preparing invoices for submittal to GSA. Dr. Garrett also provided regular project status updates to the GSA Project Manager.

Principal-in-Charge: Colorado Department of Transportation (CDOT) Region 6 Headquarters RCRA Facility Investigation (RFI) and Remediation Project, Denver, Colorado. Dr. Garrett served as a Remediation Specialist and Principal Chemist responsible for evaluating and interpreting groundwater monitoring and treatment data as well as conducting statistical evaluation of the treatment data. He oversees engineering and environmental services implemented to remediate soil and groundwater contaminated with methylene chloride, TCE, PCE, and 1,1-DCE. Dr. Garrett's responsibilities include ensuring that the project meets the technical and quality requirements for the engineering and environmental services implemented to remediate groundwater and soil. He has assisted in (1) site investigations; (2) design and construction of the bioremediation system; and (3) ongoing O&M activities for the groundwater treatment system.

Remediation Specialist and Principal Chemist: Lowry Assumption Company - Former Lowry Air Force Base Redevelopment Design / Build, Denver, Colorado. Remediation Specialist responsible as for assisting in development of groundwater and soil analytical programs for Operable Unit 2 (OU2) work, and assisting in development of OU2 Work Plan and final report for OU2 landfill closure. Scope: Design and construction of a 67-acre landfill cap, remediation of major groundwater plume, and privatized contaminant characterization and cleanup including groundwater monitoring at 1,866-acre former air force base in large urban area. Services included engineering design and construction quality assurance. Approach is predicted to save several years of cleanup time and has allowed for more efficient and quicker redevelopment activities into a mixed-use community that has been recognized with the Governor's Award for Smart Growth.

Project Manager, Petroleum Distribution Center, Denver, Colorado. Through a comprehensive liability assessment of the site, AMEC identified an alternative approach to obtaining site closure and significantly reducing the cleanup costs and the amount of time needed to obtain closure from the regulators. This approach required the transfer of the site from the EPA Region VIII's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Emergency Response Administrative Order to the Colorado Department of Public Health and Environment's (CDPHE's) Voluntary Cleanup program (VCUP). This strategic transfer from EPA CERCLA oversight to the CDPHE VCUP oversight resulted in an overall project remediation cost savings and has expedited the time necessary to obtain closure from the regulators thereby reducing the time required for remediation activities at the site. Negotiated with CDPHE and developed a strategy to break the site into 5 parcels. Wrote VCUP applications for 4 of the 5 parcels and received no action determinations for 3 of the parcels. Dr. Garrett was responsible for the site-wide operation and maintenance reporting and groundwater monitoring compliance program. The monitored natural attenuation (MNA) approach for groundwater remediation has been implemented. VOC contamination was reduced in soil source areas by applying soil vapor extraction (SVE) remediation strategy. Contracted and provided oversight for the demolition of 3 buildings on the client's property.

Project Manager: Rocky Mountain Steel Mills South Mills Solid Waste Management Units (SWMUs), RCRA Facility Investigation (RFI), Pueblo, Colorado. Dr. Garrett was responsible for managing the project that included a RCRA Facility Investigation (RFI) for the South Mills SWMUs that includes the South Mills waste water treatment lagoons. RFI work included sampling of soil borings, waste oil skimmer remediation, including surface soil sampling, soil removal and disposal. Sixteen soil borings were logged and sampled and soil around 4 oil water separator were removed and backfilled with clean material. In addition, sediment from three lagoons was samples. An RFI report was prepared and submitted to the CDPHE for approval.

Project Manager: Rocky Mountain Steel Mills Solid Waste Management Unit (SWMU) No. 78 Desulfurizer Baghouse, RCRA Facility Investigation (RFI), Pueblo, Colorado. Dr. Garrett was responsible for managing the project, writing the RFI report, and performing historic research on the design and historic operation of the desulfurizer baghouse facility. He conducted the RCRA Facility Investigation (RFI) for Solid Waste Management Unit (SWMU) No. 78, a former desulfurizer baghouse that was part of former blast furnace operations at the steel mill facility. Research of historic records conducted to demonstrate to State Regulator that the baghouse facility was not connected to the historic coke oven facility (as historic permits incorrectly indicated). This research enabled the client to limit the SWMU investigation and facilitate closure, thereby saving both time and money. Thirty samples also collected from five boring locations as part of investigation.

Project Manager: Confidential Client Site Characterization and Remediation Services, Olathe, Kansas. Responsible for overseeing on-site groundwater monitoring activities, developing budgets, developing site closure and remediation strategy; and providing oversight of remediation activities. The scope includes site characterization and development of final groundwater and soil remediation strategy and plan for final closure of 9,000-SF building site occupying corner of property near source area. Plume extends 1,000 feet to near property boundary.

Remediation Specialist and Principal Chemist: Hamilton Sundstrand, RCRA Facility Investigation (RFI) Project, Denver, Colorado. Dr. Garrett has evaluated the analytical data for this project since 1992. He also assisted in design and implementation of soil, groundwater, NAPL and seepage water investigations (RFIs); feasibility and treatability studies; remedial design pilot-scale testing, engineering and construction; regulatory permitting, treatment systems O&M; treatment systems monitoring and reporting; risk assessments; RCRA and CAP designs and implementation. He redesigned the groundwater quality monitoring program incorporating elements of the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA, 1996). He assisted in preparation of an accelerated RCRA Corrective Action Strategy for site. As Principal Chemist, he was responsible for data evaluation, validation, and interpretation as well as site conceptual model development.

Chemist: University of Nebraska Agricultural Research & Development Center (ARDC) Remedial Investigation / Feasibility Study, Remedial Assessment and Removal Action, Ithaca, Nebraska. Responsible as principal chemist for writing and reviewing project Quality Assurance Project Plan (QAPP), oversight of the analytical program, and project quality assurance program. The scope includes Remedial Investigation / Feasibility Study (RI/FS) and removal actions involving four different sites from one-half to five acres each, distributed over the 9,600-acre R&D facility and including eight disposal trenches, a former landfill and a pesticide rinsate area. Work included excavation, characterization, packaging, disposal and transportation of 30,000 CY of radioactive and chemical wastes produced as part of University medical research program and buried at site many years earlier, quality control planning and data management.

Project Manager, Landfill Monitoring Program, Denver, Colorado Managed groundwater monitoring and reporting for EPA CERCLA groundwater and surface-water monitoring program. Tasks include coordinating the analytical laboratory and field activities for the Landfill Operation and Maintenance (O&M) monitoring program for the semiannual groundwater and surface-water sampling. Prepare laboratory scope of work, oversight of data management activities, and coordination with field and laboratory personnel. Oversaw data validation for the project and reported the analytical and QA/QC results to the client and regulatory agencies. Dr. Garrett prepared a statistical approach to find potentially flawed or inconsistent data. Reported results of site O&M and groundwater monitoring program to the EPA on a semiannual basis.

CHEMICAL RESEARCH

Research Associate, University of Delaware. Research Associate in organometallic, inorganic, and catalytic chemistry. Studied the interaction of metal clusters on metal oxide supports. Developed new methodology for the synthesis of mixed metal transition metal clusters on metal oxide supports. Studied these supported metal clusters by a variety of instrumental and analytical techniques.

Graduate Student Researcher, Pennsylvania State University. Researcher in organometallic and inorganic chemistry. Studied the interaction of a variety of organic compounds with highly reactive transition metal complexes. Demonstrated the use of tungsten complexes as substrates in the synthesis of organic compounds such as naphthols. Studied the mechanisms by which the organic products are formed. Studied organic, organometallic, and inorganic compounds by a variety of instrumental and analytical techniques.

CERTIFICATIONS AND TRAINING

OSHA 8-Hour Hazardous Materials/Waste Health and Safety Training Refresher Course
OSHA 40-Hour Hazardous Materials/Waste Health and Safety Training Course
OSHA 8-Hour Supervisory Hazardous Materials/Waste Health and Safety Training Course
Project Management Training the AMEC Way, 2012
Project Controls Level I and Level II Training, 2010
Capturing and Winning AMEC Business, Shipley 2006
Optimizing Injection Strategies for Full-Scale In Situ Reactive Zone Remediation, 2005
Contract Review Seminar, 2005
Applications of Ground Water Geochemistry, 2004
Economic Analysis for Ground Water Remediation a Tool for Decision Making, 2003
The Remediation Course, Princeton Groundwater, Inc., 2003
Environmental Geochemistry of Metals, 2003
Principles and Practices of Project Management, 2002
Groundwater Pollution and Hydrology Course, Princeton Groundwater, Inc., 2001
Environmental Law Short Course, Environmental Education Enterprises, Inc., 1996

PUBLICATIONS AND PRESENTATIONS

2007. Selecting the Optimal Remediation Strategy. *Presentation at the March 2007 Society of American Military Engineers Frontier Post Meeting, March 22, 2007, Cheyenne Wyoming.*

2005. In situ Biodenitrification Groundwater Remediation System. *Proceedings of the Eighth International In Situ and On-Site Bioremediation Symposium, Baltimore, Maryland, June 6-9, 2005*, B.C. Alleman and M.E. Kelley: Battelle Press: Columbus, OH, 2005; Paper O-02 (with Amy L. Hudson).

2005. In situ Biodenitrification Groundwater Treatment System. *Presentation to the New Mexico Environment Department, May 9, 2005, Santa Fe, New Mexico.*

2005. Large-Scale Application of In Situ Remediation to Remove Nitrate from Groundwater. *Federal Facilities Environmental Journal*, Wiley Periodicals, Inc., Spring 2005; p 97 (with Amy L. Hudson)

2004. Impacts of Near Mountain Geology on an In Situ Biodenitrification System. *Presentation at the 2004 Geological Society of America (GSA) Annual Meeting, November 2004, Denver, Colorado* ; (with Amy Hudson).

2004. Large Scale Application of In Situ Biodenitrification. *Presentation at the 9th Annual Joint Services Environmental Management Conference , August 2004, San Antonio, Texas,* (with Amy Hudson).

2003. In Situ Biodenitrification – A Case Study. *Proceedings of NGWA Conference on Remediation: site Closure and the Total Cost of Clean-Up, November 13-14, 2003, New Orleans, Louisiana*: National Ground Water Association; p 378 (with Amy Hudson).

2001. Accelerating the Reductive Dechlorination Process in Groundwater. *Anaerobic Degradation of Chlorinated Solvents*, Magar V.S., et. al.: Battelle Press: Columbus, 2001; p. 205 (with D. South, J. Seracuse, D. Li).

1996. Removal of N-nitrosodimethylamine from Rocky Mountain Arsenal waters using innovative adsorption technologies. Technical report EL-96-11, U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS (with E. C. Fleming, J. C. Pennington, N. R. Francingues, D. R. Felt, B. G. Wachob, R. A. Howe, and M. R. Colsman).

1990. Further studies of the synthesis of 1-naphthols and 4-hydroxy-5,6-dimethylbenzothiophene by protonation of $Cp(CO)_2WCTol$ and $Cp(CO)_2WC(2\text{-}C_4H_3S)$ in the presence of alkynes and CO. *J. Organomet. Chem.,* 394, 251 (with W. C. Feng, H. Matsuzaka, G. L. Geoffroy, and A. L. Rheingold).

1990. The synthesis and characterization of size selective Pt-Ir clusters on metal oxide surfaces. Annual Research Review, Center for Catalytic Science and Technology, University of Delaware, October (with B. C. Gates, and A. L. Rheingold).

1989. Transient generation of the reactive carbene complex $[Cp(CO)_2W{=}CH(Tol)]^+$ and its reactions with alkynes to form vinylcarbene, allyl, naphthol, diene, and metallafuran complexes. *J. Am. Chem. Soc.*, 111, 8383 (with J. B. Sheridan, D. B. Pourreau, W. C. Feng, G. L. Geoffroy, D. L. Staley, and A. L. Rheingold).

1989. In situ generation of the benzylidene complex $[Cp(CO)_2W{=}CH(Tol)]^+$ and its reaction with alkynes. *Advances in Metal Carbene Chemistry,* Schubert U. Ed.: Kluwer Academic Publishers: Dordrecht, 1989; p. 189 (with G. L. Geoffroy, J. B. Sheridan, and D. B. Pourreau).

1989. Cycloaddition of imines and $Bu^tN{=}O$ with the carbyne complexes $[Cp(CO)_2MCTol]^+$ (M=Mn, Re). *Organometallics*, 9, 1562 (with B. M. Handwerker, K. L. Nagle, G. L. Geoffroy, and A. L. Rheingold).

1989. New types of metallacycles formed by cycloaddition of imines and $Bu^tN{=}O$ with Mn and Re carbyne complexes. *J. Am. Chem. Soc.,* 111, 369 (with B. M. Handwerker, G. L. Geoffroy, and A. L. Rheingold).

1989. Transient generation of the reactive carbene complex $[Cp(CO)_2W{=}CH(Tol)]^+$ and its reactions with alkynes to form vinylcarbene, allyl, naphthol, and metallafuran complexes. Presented at 23rd Middle Atlantic Regional Meeting of the American Chemical Society, May (with J. B. Sheridan, D. B. Pourreau, G. L. Geoffroy, and A. L. Rheingold).

1988. Preparation and structural characterization of $[\{Cp(CO)_2W\}_2(\eta$□$TolCC(OH)CTol)][BF_4]$ CH_2Cl_3. *Inorg. Chem.,* 27, 3248 (with J. B. Sheridan, G. L. Geoffroy, and A. L. Rheingold).

1988. Reaction of $[Cp(CO_2MCTol]^+$ (M=Mn, Re) with imines and hydrazones. *Third Chemical Congress of North America*, June (with B. M. Handwerker, G. L. Geoffroy, and A. L. Rheingold).

Scott Graham

Project Geologist

Professional summary

Mr. Graham, a Geologist and Environmental Scientist, has been working in the environmental consulting field since 1995. He has demonstrated ability to effectively manage projects, personnel, and budgets. He has extensive knowledge of environmental compliance, including site assessments, remedial feasibility testing, remediation system design and construction, reporting, risk assessment, project and lifecycle budget forecasting, case planning, client and regulatory liaison, and staff training and management. The majority of his project experience is in the governmental, real estate, and petroleum industries.

Years with Wood: 13

Years' Experience: 23

Education

Bachelor of Science, Geology, California State University, Sonoma, 1995

Associate of Science, Science, Santa Rosa Junior College, 1991

Location

West US - Petaluma

Languages

English

Employment history

Wood Environment & Infrastructure, Petaluma, CA, Technical Professional 3, 2017-Present

Amec Foster Wheeler Environment & Infrastructure, Inc., Petaluma, CA Project Geologist, 2014 to 2017

AMEC Environment & Infrastructure, Inc., Petaluma, CA, Project Geologist, 2011–2014

MACTEC Engineering and Consulting, Inc., Petaluma, CA, Project Geologist, 2005–2011

SCS Engineers, Santa Rosa, CA, Geologist, 6/2005–12/2005

Delta Environmental Consultants, Incorporated, Sacramento, Project Manager, 10/2004–5/2005

SECOR International, Incorporated, Sacramento, CA, Associate Geologist, 7/2003–10/2004

Environmental Resolutions, Incorporated, Novato, CA, Project Manager, 1/2001–6/2003

Environmental Resolutions, Incorporated, Novato, CA, Senior Staff Geologist, 4/2000–1/2001

Environmental Resolutions, Incorporated, Novato, CA, Staff Geologist, 7/1998–4/2000
Environmental Resolutions, Incorporated, Novato, CA, Environmental Technician, 5/1995–7/1998

Non-professional certifications and training

CPR/AED

Defensive Driving

First Aid

HAZWOPER 40 Hour

HAZWOPER 8 Hour Refresher

HAZWOPER 8 Hour Supervisor

OSHA 10 Hour Construction Safety and Health

OSHA 30 Hour Construction Safety and Health

U.S. Army Corps of Engineers Construction Quality Management for Contractors

Doyle Scholarship, Santa Rosa Junior College, 1988

Representative projects

Beale Air Force Base, 2017, Yuba City, CA, Field Geologist. As Field Geologist, oversaw installation of soil borings and monitoring wells. Scope: Perform remedial investigation tasks as associated with the Air Force's PFAS Investigation activities. Tasks include planning, driller oversight, and soil and groundwater sampling.

March Air Force Base, 2017, Riverside County, CA, Field Geologist. As Field Geologist, oversaw installation of soil borings and monitoring wells. Scope: Perform remedial investigation tasks as associated with the Air Force's PFAS Investigation activities. Tasks include planning, driller oversight, and soil and groundwater sampling.

Alameda Naval Air Force Base, 2016 and 2017, Alameda, CA, Field Geologist. As Field Geologist oversaw the installation and development of groundwater monitoring wells. Tasks include permitting, driller oversight, soil and groundwater sampling.

Borehole Field Verification Activities, 2016 to 2018, California Department of Transportation (Caltrans), Various Cities and Counties, CA. As Field Geologist, Perform Field verification of the presence and location of geotechnical borings and wells throughout the state. Tasks include planning, research of online databases, QA/QC of historical documents, and field verification activities associated with locating geotechnical borings and wells installed at various construction sites throughout the state.

ABB Chico 2012, Chico, CA 107652, 880,000, 2010. Field Geologist. As Field Geologist, oversaw installation of monitoring wells. Scope: Perform remedial investigation/feasibility study tasks specified by the DTSC's Partial Consent Agreement issued to ABB Inc. to investigate and remediate impacted groundwater at the site. Tasks include litigation support and project management, monthly status reports, RI implementation, annual wellhead treatment system sampling, and quarterly groundwater monitoring. Chlorinated solvents and TCE were found along the Skyway plume.

Roadside Vegetated Treatment System (RVTS) Study Oversight 2007-2008, California Department of Transportation (Caltrans) - Environmental Program Office, Various Cities, CA, United States. 074859 RVTS, 250,080, 2010. Project Geologist. Responsible for conducting stormwater monitoring and maintenance activities at two sites (Napa and San Mateo) in Northern California. Collected water samples and tabulated data related to major storms at both sites. Scope: Monitoring oversight, data management, and reporting for 2007-2008 Roadside Vegetated Treatment Study (RVTS). Study designed to assess treatment performance of vegetated slopes with varied configurations of vegetative cover, dependent on slope and soil, for effectiveness of erosion control. Services also included post-storm monitoring of stormwater runoff; technical memorandum reviews; and updating of both Sampling & Analysis Plan and Health & Safety Plan.

Casmalia Resources Superfund Site Maintenance, Remedial Investigation / Feasibility Study (RI/FS), Groundwater Monitoring, Bingham McCutchen, LLP (formerly McCutchen, Doyle, Brown & Enerson), Casmalia, CA, United States. 990061, 21,900,000, 2009. Geologist. Responsible for assisting with non-aqueous phase liquid monitoring and well development via air lifting and WaTerra Pump under work conditions involving development and monitoring in Class C PPE. Scope: Site maintenance and management, RI/FS, regulatory compliance and support of investigation at a 252-acre, former Class I Superfund, Hazardous Waste Management Facility comprising five separate landfills and which included approximately 40,000 tons of industrial waste on site (with acids, caustics, solvents, pesticides and metals). Implemented 24-hour operating leachate collection and contaminated groundwater treatment system, and over 300 monitoring wells.

Chico Facility Regulatory Review Environmental Support Services, Major Chemical Manufacturing Company, CONFIDENTIAL CLIENT ABB, Inc.- Combustion Engineering (CE), Chico, CA, United States. 072198, 3,400,000, 2016. Geologist. Responsible for providing drilling/well construction oversight for installation of sonic wells. Finished long-term, out of town project on schedule with a minimum downtime. Assisted with preparation of RI/FS Work Plan, with drilling price quote and drilling set-up, and provided oversight of drilling and sampling.**DO NOT USE THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS WITHOUT FIRST CONTACTING THE AMEC PROJECT MANAGER. DUE TO LITIGIOUS OF THIS PROJECT, WHICH IS THE REASON IT IS BEING PERFORMED IN THE FIRST PLACE, THIS CLIENT DOES NOT WANT US TO USE THEIR PROJECTS IN ANY PUBLIC COMMUNICATIONS OR MARKETING EFFORTS WITHOUT FIRST OBTAINING THEIR PERMISSION.** Scope: Regulatory review and litigation-related environmental support services for former industrial building products manufacturer. Services include subsurface characterization, groundwater quality testing and sampling pertaining to characterizing the extent of a groundwater plume impacted by the historic disposal of solvents (PCE and TCE).

Signal Oil Semiannual Groundwater Sampling, Major Industrial Client, CONFIDENTIAL CLIENT Honeywell International, Inc., Edgewood, WA, United States. 031612, 38,000, 2007. Geologist. Responsible for site schedule, performing pre-drill protocols, writing HASP, coordinating equipment shipment for out of state locations, overseeing drilling of five hollow stem auger borings to collect soil and water data, performing quarterly monitoring, and sampling field work for the 4th quarter 2005; assisted in determining the extent of hydrocarbon contamination and future placement of oxygen releasing product injection.**DO NOT USE THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS WITHOUT FIRST CONTACTING THE AMEC PROJECT MANAGER. Although this project was not performed under the Alliance agreement, it should be considered CONFIDENTIAL in view of the client's recent mandate.** Scope: Semiannual groundwater monitoring and sampling of three onsite wells at site of former service station (approximately 110 ft. X 120 ft. site) and installation of soil borings. One well exhibits concentrations of fuel hydrocarbons.

Former Chemical Manufacturing Facility Perchlorate Investigation, Remediation, Confidential Chemical Manufacturer, CONFIDENTIAL CLIENT, Morgan Hill, CA, United States. 020905, 6,000,000, 2010. Geologist. Responsible for assisting in door-to-door sampling of privately-owned domestic wells, and well development of offsite monitoring wells using airlifting, and groundwater sampling using airlifting and a WaTerra pump. PLEASE CONTACT THE AMEC PROJECT MANAGER BEFORE USING THIS PROJECT IN ANY PROPOSAL OR MARKETING MATERIALS. Scope: Prepared and implemented several phases of remedial investigation to delineate lateral and vertical extent of perchlorate in soil and groundwater for design of an on-site remediation system at the site of a former flare manufacturing facility. Perchlorate has been detected in on-site soil, and on-site and off-site groundwater extending from the site and to depths in excess of 600 feet below ground surface. AMEC identified and implemented innovative monitoring well installation techniques, in situ aquifer testing procedures, and groundwater sampling methods. AMEC devised several monitoring and evaluation programs to save the client additional future remediation and monitoring well installation costs.

Hunters Point Naval Shipyard Parcel A Environmental Consulting Services, Lennar / BVHP, LLC, San Francisco, CA, United States. 053085, 850,000, 2012. Project Geologist. Provided review of and recommendations on existing documents. Lennar achieved compliance with regulatory requirements with Amec Foster Wheeler's assistance. Performed air/dust monitoring at Hunters Point. Scope: Environmental consulting services to support client's legal counsel, address special requests for information from project stakeholders, and present information at planning and technical meetings as part of ongoing effort to redevelop Parcel A of area formerly occupied by U.S. Naval shipyard. Provided review of and recommendations on existing documents. ***Lennar achieved compliance with regulatory requirements with AMEC's assistance.***

Leviathan Mine Field Support (IWO), Atlantic Richfield Company, Markleeville, CA 115724, 75,600, 2011. Field Geologist. Performed drilling and exploration services at Leviathan Mine. Scope: Drilling and exploration services at Leviathan Mine. This site is an abandoned open-pit sulfur mine located in Alpine County, California. The mine is located at on the eastern slope of the Sierra Nevada at about 7,000-foot (2,100 m) elevation, 6 miles (9.7 km) east of Markleeville and 24 miles (39 km) southeast of Lake Tahoe. The mine site comprises approximately 250 acres.

Brownfields Land Recycling Program, Nevada Division of Environmental Protection (NDEP), Henderson, NV, United States. 010476, 850,000, 2007. Geologist. Responsible for writing the Work Plan and Sampling and Analysis Plan for future excavation work to remove lead contamination at a former firing range. Scope: Master Services Agreement for 4 years to provide brownfields assessment and cleanup services in a statewide program to recycle / redevelop brownfields sites. ***Project included successful completion of cleanup of almost a century's worth of waste materials at the Northern Nevada Railway Museum (Ely, NV), which allowed continuation of preservation efforts, and should improve attendance and increase local revenue because more historical buildings on the site will soon be open to the public.***

Queen of the Valley Medical Center Geotechnical Engineering Services, St. Joseph Health System, Napa, CA 107815, 127,000, 2011. Field Geologist. Served as Field Geologist with responsibility for overseeing the exterior site grading and pavement construction. Scope: Geotechnical engineering services during the construction of the new, three-story acute care building in Napa. Building footprint dimensions are 105 x 225 feet.

Site Closure Environmental Services, The Presidio Trust, San Francisco, CA, United States. 008379, 6,655,330, 2011. Geologist. Oversaw the installation of Test pits to determine the extent of fill materials and contaminants, install soil borings and test pits to determine extent of asphalt roofing materials, log soils and debris across site, collect soil samples, and assist in results report. As a Field Geology Professional, conducted field operations for a subsurface investigation, assisted in writing a technical memorandum and Corrective Action Plan, wrote a Corrective Action Implementation Work Plan, and attended site meetings with clients and regulators. Also assisted with developing a master reference cost spreadsheet and providing quality assurance/control of several cost spreadsheets used to price remedial options for Corrective Action Plans. Produced investigation reports for multiple sites within the Presidio. Performed field investigations (i.e., surface sediments and shallow soil borings) at Building 1450/1451, Nike Facility, and Building 1369 sites to specify excavation areas, amounts to be excavated, procedures, and remedial methods to be used in site cleanup.

- For Fill Site 1 and Landfill 2, provided drilling oversight for the installation of hollow stem auger soil borings to delineate the boundaries of the debris, fill, and native materials.
- For Building 1065, developed construction completion report. Also authored Corrective Action Implementation Work Plan; oversaw field work, including excavation, collection of soil and water samples, land use control cap inspection; served as regulatory liaison between Presidio and regulators to complete work in a manner acceptable to all parties.
- Assisted with the production of pre-remedial investigation Work Plans, Corrective Action Plans, a technical memorandum, and investigation reports for multiple sites within the Presidio; performed field investigations (surface sediments and shallow soil borings) at Building 1450/1451, Nike Facility, and Building 1369 sites to specify excavation areas, amounts to be excavated, procedures, and remedial methods to be used in site cleanup.
- Oversaw the installation of Test pits to determine the extent of fill materials and contaminants, install soil borings and test pits to determine extent of asphalt roofing materials, log soils and debris across site, collect soil samples, and assist in results report.

Environmental services associated with site closure, including site investigation, risk assessment, feasibility study (FS), engineering design, data management, ecological risk assessment, remediation, and reporting at historic 1,416-acre former military base at the south end of the Golden Gate Bridge.

Environmental Services at 8 Army Reserve Centers, Kemron - North Division, Seven U.S. Department of the Army - Northern Region Contracting Center, US, United States. 040979, 3,387,120, 2010. Project Geologist. Responsible for remediation implementation for Camp Parks Site and organized remediation field efforts and reporting. Scope: Full range of environmental and technical services at eight U.S. Army installations in five states (Massachusetts, Connecticut, Rhode Island, Maine, and California) addressing soil and groundwater contamination at landfills, underground storage tank sites and other waste storage and disposal sites. Work included remedial investigations / feasibility studies (RI/FS) and environmental remediation design services.

Fort Ord Operable Unit (OU) Habitat Remedial Investigation / Feasibility Study (RI/FS), U.S. Army Corps of Engineers (USACE) – Huntsville District, Monterey, CA, United States. 027629 FTORD, 20,000,000, 2009. Project Geologist. 1) Responsible for gathering, reviewing, and summarizing historical data for a Basewide RI/FS. Assisted with the development of tables and site maps and addressed agency comments regarding the RI/FS. Assisted in developing and writing a Technical Memo for part of the Base detailing the site history and proposed scope of future work. 2) Assisted in data gathering and writing of a technical memorandum and assessment approach for multiple sites across Fort Ord. Assisted in design of the RI pathways and methods. Scope: Since 2004, AMEC has been conducting full remediation investigation / feasibility study (RI/FS) to address munitions and explosives of concern (MEC) at the Impact Area Munitions Response Area (MRA) for 6,500 acres of a 8,000-acre former U.S. Army training range complex (small arms to artillery fire). Activities included planning, site characterization, archival (historic) search, risk assessment (human health), feasibility study, and community relations support.

Unlinked Amec Foster Wheeler projects

Industrial Hygiene Services, 50 California Street, Shorenstein Realty Services, San Francisco, CA, United States. 8415180450. Ongoing. Industrial Hygiene Technician. Performed annual Heating, Ventilation, and Air Conditioning (HVAC) and Transmission Electron Microscopy (TEM) surveys and reporting to monitor the air quality and performance of the HVAC system to ensure compliance with applicable health and safety standards.

Environmental Services, MDC Engineered Process Solutions, Hayward and San Jose, CA, United States. 8615180420. Geology Professional. Performed site inspection (phase I environmental screening analysis) and comprehensive compliance audit of environmental program.

Environmental Services, California Paperboard Company, Santa Clara, CA, United States. OD13165230. December 2015. Geologic Professional. Performed permitting, job preparation and setup, and field oversight for the installation of two monitoring wells, direct push soil borings, and soil vapor wells. Performed site oversight for the removal and over excavation of three undocumented underground storage tanks (USTs) and performed set up and sampling of groundwater, over excavation soil samples, and soil vapor.

Environmental Services, Hertz Northfield QTA Facility, Oakland, CA, United States. Ongoing. Geologic Professional. Performed field oversight and reporting for the installation and sampling of 25 direct push soil borings, three test trenches, and six groundwater monitoring wells to evaluate the site conditions, transport mechanisms, and extent of the hydrocarbon plume. Performed oversight and soil sampling for over excavation and removal of impacted soils in source area.

Environmental Services, Alameda Naval Yard – Site 6, Alameda CA, United States. 5023136030. Geology Professional. Performed operations and oversight of 2 subcontractors during the extraction and injection activities of 30+ wells and 20,000 gallons of injection materials. Scheduling, set-up, and operation of post-injection groundwater monitoring activities.

Environmental services, Former Honeywell Site, Newark CA, United States. OD14171100. Geology Professional. Performed oversight and soil logging for the installation of 29 injection wells and four groundwater monitoring wells.

Environmental Investigation Chevron Estero Facility, Chevron, Morro Bay, CA, United States. OD11161540. Estimate completion: April through October 2012. Geologic Professional. Performed job preparation and field oversight for the installation of four well pairs using hollow stem auger and attempted water supply wells using air-rotary drilling techniques. Oversaw well development and pump testing of one water supply well. Helped to develop an asbestos monitoring/abatement plan and performed the asbestos monitoring and oversight during drilling through rock containing naturally occurring asbestos (NOA).

Environmental Services, Fort Hunter Liggett, U.S. Army, Jolon, CA, United States. 4084106586.02.3. June 2011. Geologic Professional. Performed field oversight for the installation of direct push borings using a membrane interface probe and a ultra-violet optical screening tool to detect free product and PAHs to get an estimate of the vertical and horizontal extent of the hydrocarbon plume and determine any data gaps in the monitoring well setup.

Santa Rosa Service Center, CONFIDENTIAL CLIENT, Pacific Gas and Electric, Santa Rosa, CA, United States. 013045005H.2. Geologic Professional. Performed field oversight for the installation of sub-slab and subsurface soil vapor sampling probes and direct push soil borings onsite and offsite. Soil vapor sampling probes and onsite soil borings were installed inside buildings using limited access rigs.

Mojave National Preserve, National Park Service, Mojave, CA, United States. Geology Professional. Performed planning, field oversight, sampling, and reporting in conjunction with excavation work at three sites within the preserve. Site work performed for auditing purposes and to allow for site closures.

Continued...

Site Conceptual Model and Corrective Action Plan, Mariposa Ranger Unit Headquarters, Mariposa, CA, United States. Geology Professional. Developed and wrote a Site Conceptual Model and Corrective Action Plan recommending hydrogen peroxide injection to treat residual hydrocarbon concentrations in groundwater at the subject site. Wrote the fourth quarter 2005 quarterly monitoring and sampling report.

Camp Parks, Corrective Action Plan, Dublin, CA, United States. Geology Professional. Wrote corrective action plan and helped to compile data from site conceptual model, assessment report, and CAP into one coherent report. Allowed for future excavation of contaminated soils and providing remedy in place to allow for property transfer. Provided oversight of excavation and injection activities to finish cleanup activities at site and help to develop results and closure report which allowed final site closure.

Circuit City, Puyallup, WA, United States. Geology Professional. Setup drilling, performed pre-drill protocols, wrote HASP, coordinated equipment shipment (for out of state job), and oversaw drilling of 2 hollow stem auger borings to geotechnical data for new loading dock.

Phase I Environmental Site Assessments, Pacific Oroville Power, Inc., Oroville, CA, United States. 3031122016. Geologic Professional. Performed a Phase 1 Environmental Site Assessment at the former power plant for use as due diligence as part of a potential property transaction. Wrote the report detailing the findings of the site visit.

Caitlin Elizabeth Brice, M.Sc.

315 Bellerose Dr. Apt. 2
San Jose, CA 95128
Tel. 954-651-3395
caity63@yahoo.com
LinkedIn Profile

EDUCATION

Nova Southeastern University, Master of Science in Marine Biology **May 2014**
Thesis title: "The Detection of Amazonian Manatees (*Trichechus inunguis*) Using Side-Scan Sonar and the Effect of Oil Activities on Their Habitats in Eastern Ecuador" GPA: 3.79
http://nsuworks.nova.edu/occ_stuetd/8/
GRE: Verbal – 530, Quantitative – 750, Writing – 4.5

St. Andrews University, Introduction to Distance® Sampling **August 2012**

Drury University, Bachelor of Arts in Biology and Chemistry (with Honors) **May 2009**
Minor in Global Studies GPA 3.95
Summa Cum Laude
ACT: 31

PROFESSIONAL EXPERIENCE

Accutest Northern California, Quality Assurance Officer **Jan. 2015 – Present**

- Manage, enforce, and audit the quality systems, procedures, data, reports, and analyst competency at a certified environmental laboratory for conformance to NELAC, DOD, DOE, ISO, and EPA requirements, state specific requirements (CA, AK, AZ, OR, WA, NV), client specific objectives, and improvement of laboratory performance.

Florida Spectrum Environmental Services, Inc., Quality Assurance Director **Dec. 2012-Jan. 2015**

- Direct, enforce, and audit the quality systems, procedures, data, reports, and analyst competency at five certified laboratories for conformance to NELAC, FDOH, FDEP, and EPA requirements, client specific objectives, and improvement of laboratory performance.

Florida Spectrum Environmental Services, Inc., **Feb. 2010 – Dec. 2012**
Analytical Chemist and Microbiologist

- Performed EPA methods in inorganics, organics, extractions, and microbiology in solid, water, and chemical matrices.
- Analyzed samples using HPLC, IC, GC/MS, Flow Analyzers, Discrete Analyzers, Block Digesters, Distillation Units, and Incubators.

RESEARCH EXPERIENCE

Nova Southeastern University, Graduate Research Assistant **August 2010 – May 2014**

- Collected water samples, conducted interviews, and performed side-scan sonar surveys to detect Amazonian Manatees and investigate their population ecology in the rivers and lagoons of the Amazon River basin in Eastern Ecuador. Field time: 6 weeks.

Newfound Harbor Marine Institute Seacamp, Research Intern **May 2006**

- Surveyed marine life in Big Pine Key, FL.

TEACHING EXPERIENCE

Nova Southeastern University, Laboratory Assistant **Aug. 2009-May 2011**

- Assisted with the set-up and teaching of Biology 101 laboratory classes.

PUBLICATIONS

Brice, Caitlin E. 2014. "The Detection of Amazonian Manatees (Trichechus inunguis) Using Side-Scan Sonar and the Effect of Oil Activities on Their Habitats in Eastern Ecuador." http://nsuworks.nova.edu/occ_stuetd/8.

Brice, Caitlin. October 2011. "The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador". Sirenews. Number 56. www.sirenian.org/sirenews/56OCT2011.pdf

PRESENTATIONS

Florida Marine Mammal Health Conference, Poster Presenter **April 2012**
"Oil Effects on the Amazonian Manatee (*Trichechus inunguis)* in Eastern Ecuador: Evaluating the Risks"
Southeast and Mid Atlantic Marine Mammal Symposium, Oral Presenter **March 2012**
"Oil Effects on the Amazonian Manatee (*Trichechus inunguis*) in Eastern Ecuador: Evaluating the Risks"
19th Biennial Conference on the Biology of Marine Mammals, Oral Presenter **Nov. 2011**
"The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador"
Fifth Annual International Sirenian Symposium, Oral Presenter **Nov. 2011**
"The Status of Amazonian Manatees (*Trichechus inunguis*) and Their Habitats in Eastern Ecuador"

SKILLS

Superior Organization and Communication
Management of Multiple Teams Effectively Toward a Common Goal
Rapid Learning and Adaptability
Trained Protected Species Observer (PSO)
Certified PADI Open Water Diver
Proficient with Laboratory Internal Management Systems (LIMS), JMP®, Humviewer®, ArcGIS®, Agilent ChemStation®, Distance® software, and Microsoft® Office
Intermediate Spanish Reading, Writing, and Conversational Skills
Violinist

HONORS AND AWARDS

First Place - Southeast and Mid Atlantic Marine Mammal Symposium (2012)
Walter H. Hoffman Chemistry Award for outstanding academic performance (2009)
Beta Beta Beta, Chi Chapter Inductee – Biology Honor Society (2008)
Omicron Delta Kappa – Leadership Honor Society Inductee (2008)
National Honor Society (Inducted 2003)
Concert Master – Drury Chamber Orchestra and Drury String Quartet (2007-2009)
Girl Scout Gold Award Recipient (2008)
Community Leadership Scholarship (2005)
Elk's Lodge Scholarship (2005)
Presidential Academic Scholarship (2005)
Presidential Musical Scholarship for Violin (2005)
Women in Science Award (May 2005)

ORGANIZATIONS AND AFFILIATIONS

Marine Animal Rescue Society (MARS) – Trained Volunteer
The Society of Marine Mammalogy
Florida Society of Environmental Analysts (FSEA)
The NELAC Institute (TNI)
American Chemical Society

REFERENCES

Dr. Caryn Self-Sullivan, Ph.D.
Areas of Expertise: Marine Mammal Surveys and Surveys in Remote Areas
Major Thesis Advisor - Nova Southeastern University Oceanographic Center
Co-founder - Sirenian International, Inc.
540-287-8207
cs1733@nova.edu

Dr. Donald McCorquodale, Ph.D.
Areas of Expertise: Environmental Assessments, Project Management, and Microbiology
Thesis Committee Member - Nova Southeastern University Oceanographic Center
Founder, Former Quality Assurance Director, Microbiologist, and Mentor - Florida Spectrum Environmental Services, Inc.
954-258-4630
mccorq@nova.edu

Richard Vicchiarelli, M.S.
Areas of Expertise: Analytical Chemistry
Chemist – Florida Spectrum Environmental Services, Inc.
954-547-4296
vicchi@bellsouth.net

Dr. Daniel Gonzalez-Socoloske, Ph.D.
Areas of Expertise: Marine Mammal Surveys and Side-Scan Sonar Surveys
Thesis Committee Member – Andrews University
Associate Editor – Latin American Journal of Aquatic Mammals
gonzalezd@andrews.edu

Dr. Roger Reep, Ph.D.
Areas of Expertise: Florida Manatees and Marine Mammal Surveys
Thesis Committee Member – University of Florida
reepr@ufl.edu

SGS ACCUTEST

Professional Summary

Name: **Norman Farmer**
Title: **Corporate Technical Director,**
SGS Accutest Inc.

Education: BS Chemical Oceanography
Florida Institute of Technology

Post Baccalaureate Study
Florida Institute of Technology

Employment History:

2014 – present	Accutest Laboratories Southeast, SGS-Accutest Technical Director, Corporate Technical Director
2001 – 2014	Accutest Laboratories Southeast Technical Director
1996 – 2001	Accutest Laboratories Southeast Organics Manager
1994 – 1996	Orlando Laboratories, Inc. Organics Supervisor (Semivolatiles)
1991 – 1994	Orlando Laboratories, Inc. Senior GC/MS Analyst
1990 – 1992	Orlando Laboratories, Inc. Extraction Supervisor

Experience/Qualifications:

Mr. Farmer currently oversees the technical operation for SGS-Accutest. This includes co-ordinating projects between the facilities, project review, Research and Development oversight, instrumentation acquisition and method validation. In addition, Mr. Farmer is responsible for creating and maintaining project specific requirements in the LIMS and EDD development.

Mr. Farmer is also active on various regulatory committees and advisory groups.

Prior Mr. Farmer managed the Organics Department of Accutest Laboratories' Southeast Lab. The laboratory utilizes GC, GC/MS, and HPLC instrumentation to analyze samples by EPA 600 and 8000 Series Methods.

Mr. Farmer is familiar with the various QC and reporting criteria for Navy, U. S. Army Corps of Engineers, and AFCEE. Mr. Farmer reviews Quality Assurance Project Plans to ensure that all data quality objectives and reporting requirements are met by laboratory.

SGS ACCUTEST

Professional Summary

Name: **Elvin Kumar**

Title: **Project Manager**
SGS Accutest Inc. – Orlando

Education: Auckland University of Technology, New Zealand. **2004**
Fiji Institute of Technology
Bachelor of Applied Science (Environmental Studies)

Fiji Institute of Technology
Diploma in Environmental Science

Additional Professional courses/Certificates

40 Hour HAZWOPER – 29CFR 1910.120(e)
DOT 49 CFR 172.704 - Hazardous Material Transportation
IATA-Shipping Dangerous Goods by Air
Compliance Solution Occupational Trainers, Inc.

Employment History:

2016-Present SGS Accutest – Orlando
Project Manager

2013-2016 SGS Accutest – San Jose
Project Manager

2008-2013 Accutest Laboratories, Northern California
Sample Control Manager/Safety Officer

2007-2008 Entech Analytical Labs, Santa Clara
Laboratory Technician

2005-2006 Emperor Gold Mining Co., Fiji Islands
Environmental Technician/EHS/Field Sampler

Experience/Qualifications:

Mr. Kumar is currently a Project Manager for the SGS Accutest – Orlando, assisting both commercial clients and clients serving the Department of Defense. His background includes client services, sample management and routine interface with various departments to ensure timeliness of sample analyses. His responsibilities include management of client projects, addressing client inquiries and issues, and preparing sample bottle orders. Additionally, Mr. Kumar acts as a liaison between the clients and various laboratory departments to ensure timeliness of data and addressing project-specific requirements.

SGS ACCUTEST

Professional Summary

Name: **Svetlana Izosimova**
Title: **Quality Assurance Officer**
Southeast Regional Laboratory

Education: B.S./M.S. – Chemical Engineering
Waste Recovery Technology – 1987, Leningrad Institute of Pulp and Paper Industry, Russia.

Ph.D. – Colloid Chemistry, “Physical-Chemical Basis of Pulp Deresination Using Surfactants” – 1991, Leningrad Institute of Pulp and Paper Industry, Russia.

Employment History:

2001 – Present Accutest Laboratories Southeast, SGS Accutest - Orlando
Quality Assurance Officer

2000 – 2001 STL Tampa East, Tampa, FL
MS/Semivolatiles Section Leader

1999 – 2000 PBS&J Analytical Services, Orlando, FL
Quality Assurance Officer

1991 – 1998 PBS&J Analytical Services, Orlando, FL
GC/MS Analyst

1987 – 1991 Leningrad Institute of Pulp and Paper Industry, Russia
Researcher, Junior Grade

Experience/Qualifications:

Ms. Izosimova is currently the Quality Assurance Officer for Accutest Laboratories Southeast. She is responsible for implementing the Corporate Quality Assurance Program in the Southeast Laboratory. Ms. Izosimova has 25 years of experience in environmental analytical chemistry, organic and inorganic testing instrumentation, and industrial hygiene. Ms. Izosimova has served as a QA Officer for projects performed under U.S. Department of Defence.

ATTACHMENT C

Field Documentation Forms

1. Example Field Daily Logbook
2. Water Level Field Data Worksheet
3. Passive Diffusion Sampler (PDS) Groundwater Sampling Form
4. Groundwater Sampling and Pressure Levels Form for Westbay Wells
5. Water Level Indicator Calibration by Steel Tape
6. Ahtna Daily Site Safety Tailgate / Inspection Log
7. Task Specific Health and Safety Worksheet
8. Fort Ord Munitions and Explosives of Concern (MEC) Incident Reporting Form
9. Wood Chain of Custody Form
10. Ahtna Chain of Custody (Water / Soil)
11. Example Sample Labels
12. Post-Treatment Parameter Monitoring Form

Pm Jeff Fenton
Ft. Ord. GW monitoring Q406
12/14

Team 2
SB/JK
Sounder 36392
Cor. -.06

0746 @ MW-02-04-180 WL - 94.57
SN2 @ 103' Cor - -.06

0757 sampled # 065ØLØØ2Ø24F
Dropped 1@2

0808 @ MW-12-05-180 WL - 74.61
SN3 @ 88' Cor - -.06

0820 (18) sampled # 0650L012025F & 026D
Dropped 1@3

0835 @ MW-10-04-180 WL - 259.75
SN2 @ 271' Cor. -.06

0845 sampled # 0650L010027F
Dropped 1@2

0902 @ MW-OU2-25-A WL - 129.38
SN4 @ 146' Cor. -.06

0910 sampled # Ø65ØLOU2Ø28F
Dropped 1@4

0919 @ MW-OU2-53-180 WL - 204.09
SN5 @ 259' Cor. -.06

0927 sampled # 665ØOU2Ø29F
Dropped 1@5

0934 @ MW-OU2-39-180 WL - 203.99
SN4 @ 244' Cor. -.06

0943 sampled # Ø65ØLOU2Ø3ØF
Dropped 1@4

Team 2
SB/JK
12/14/06

0950 @ MW-OU2-24-180 WL - 187.97
SN3 @ 214 Cor. -.06

1002 sampled # Ø65ØLOU2Ø31F
Dropped 1@3

1009 @ MW-OU2-09-180R
SN2 @ 199' WL - 156.08
Cor. -.06

1022
1024 sampled # Ø65ØLOU2Ø32F & Ø33D
Dropped 1@2

1029 @ MW-OU2-06-A WL - 106.26
SN6 @ 128' Cor. -.06

1039 Sampled # Ø65ØLOU2Ø34F
Dropped 1@6

1046 @ MW-OU2-06-180R WL - 157.87
SN4 @ 214' Cor. -.06

1053 sampled # Ø65ØLOU2Ø35F (MS/MSD)
Dropped 1@4

1110 @ MW-OU2-07-180R WL - 182.36
SN3 @ 233' Cor. -.06

1117 sampled # 065ØLOU2036F
Dropped 1@3

1123 @ MW-OU2-05-180 WL - 155.49
SN4 @ 215' Cor. -.06

1130 sampled # Ø65ØLOU2Ø37F
Dropped 1@1

Field Activity Daily Logbook

Water Level Field Data Worksheet

Sampling DB; Version 7EX

For Event: WL2011Q2, 2011 2nd Quarter water levels

Team: 3 Sounder Serial #:________ Calibration Diff :_________ Initials::_________ Scheduled Sampling Date: 06/20/ 2011

Station Name	Plate #	Notes	Avg. DTW (ft)	Date	Time	Measured DTW:1	Measured DTW: 2	Calibration Difference from Steel Tape	Calc. DTW	Total Depth (ft)	Measured Total Depth	Comments
MP-BW-34-492		westbay	140									
MP-BW-34-537		westbay	141									
MP-BW-35-242		westbay	146									
MP-BW-35-312		westbay	152									
MP-BW-35-366		westbay	152									
MP-BW-35-467		westbay	151									
MP-BW-35-527		westbay	151									
MP-BW-35-562		westbay	153									
MP-BW-35-402		westbay	152									
MP-BW-37-178	4	westbay	143							477.		
MP-BW-37-193	4	westbay	143							477.		
MP-BW-37-303	4	westbay	146							477.		
MP-BW-37-328	4	westbay	146							477.		
MP-BW-37-368	4	westbay	146							477.		
MP-BW-37-398	4	westbay	145							477.		
MP-BW-38-327	5	westbay	139							457.		
MP-BW-38-341	5	westbay	132							457.		
MP-BW-38-353	5	westbay	135							457.		
MP-BW-38-368	5	westbay	139							457.		
MP-BW-38-418	5	westbay	139							457.		
MP-BW-39-310	4	westbay	152							467.		
MP-BW-39-330	4	westbay	152							467.		
MP-BW-39-350	4	westbay	152							467.		
MP-BW-39-395	4	westbay	151							467.		
MP-BW-40-333	5	westbay	142							496.		

Reviewed by _______________________ Date ___________

Passive Diffusion Sampler (PDS) Groundwater Sampling Form
Former Fort Ord Groundwater Sampling Program

wood.

Project_Task Number: ____________ Sampled By: ____________
Task Manager: ____________
Team Number: ____________ Site Report: ____________
Recorded by: ____________
Reviewed by: ____________ Water Level Indicator Serial #: ____________

Well	# Stations	Sample Number	Dup	Bag Sampled	# of bottles	Analysis	Pres.	Lab	Sample Date	Sample Time	Bag Drop	DTW	Cooler Temp.

Quality Control Samples

Type		Sample No.

General Comments: ____________

wood.

Groundwater Sampling and Pressure Levels Form for Westbay Wells

Project Number: ____________________ **Well Name:** ____________________ **Client:** USACE

Task Manager ____________________ **Sample Date:** ____________________ **Location:** Former Fort Ord

Technicians: ____________________ **Barometric Pressure:** ____________________ **Probe Type:** West Bay

Recorded By: ____________________ / ______ **Sample Time:** **Start:** ____________ **Probe Serial No.:** ____________
(Signature) (Initials) **Finish:** ____________

Reviewed By: ____________________ / ______
(Signature) (Initials) **Sample # First Port:** ____________________

Port Identification			**Surface Functioning Tests (Probe in Flushing Collar)**						**Position Sampler**	**Pressure Test and Sample Collection Check at Port (Pressure Test) (Sample Collection)**								
Port No.	Port Name	Port Depth (Cable)	Arm Out Land Probe Shoe Out	Close Valve	Check Vacuum	Open Valve	Evacuate Container	Close Valve Shoe In	1. Locate Port 2. Arm Out 3. Land Probe	Pressure in MP (Internal)	Shoe Out	Zone Pressure (External)	Open Valve	Zone Pressure (External)	Close Valve	Shoe In	Pressure in MP (Internal)	Last 4 Digits of Sample #
1	**282**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
2	**317**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
3	**342**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
4	**397**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
5	**467**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
6	**537**		☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
			☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		
			☐	☐	☐	☐	☐	☐	☐		☐		☐		☐	☐		

General Comments: **Cooler Temp:** ^{o}C

QC Sample # Associated Sample:

Second Quarter, 2008
4084086506 02.1.1

Fort Ord Quarterly Groundwater Monitoring Program

Water Level Indicator Calibration by Steel Tape

Well #:	
Steel Tape DTW:	
Date:	

Serial No.	Measured DTW	Calibration Differential

Reviewed by:	
Date:	

AHTNA DAILY SITE SAFETY TAILGATE / INSPECTION LOG

GENERAL DATA	**Date:**
Site:	Site Location:
AHTNA Site Manager:	AHTNA SSHO:

DOCUMENTATION OF WORKDAY SAFETY MEETING (List Topics of Discussion)**:**

Other items to address as appropriate (**check those discussed**):

☐ Scope of day's work	☐ OSHA's Focus Four	☐ Recent near miss / injuries / lessons
☐ Site SH&E Plan / Revisions	☐ Fall Hazards	☐ Lifting Safety / Materials Handling
☐ AHA's / PTSP's completed/reviewed?	☐ Electrical Hazards	☐ BBS Hazard Triggers[1]
☐ Emergency SOPs (i.e. rally pt., tele #s)	☐ Struck-by Hazards	☐ BBS Trigger Controls[2]
☐ Communications Check	☐ Caught in / between Hazards	☐ Other (heat, noise, trench, confine sp)
☐ PPE Requirements	☐ Other Primary Hazards	

MEETING ATTENDEES: (place * next to subcontractor safety representatives**)**

NAME / COMPANY		NAME / COMPANY

SUBCONTRACTOR SAFETY REPs COMMENTS**?**

DAILY INSPECTIONS: (SSHO shall initial each completed applicable inspection item)

Y	N	NA	Inspection Item	Y	N	NA	Inspection Item	Y	N	NA	INSPECTION ITEM OTHER (List)
☐	☐	☐	Postings/Plans (APP) readily avail.	☐	☐	☐	Signs (No Smoking, Site Control)	☐	☐	☐	
☐	☐	☐	Designated Parking / Traffic Control	☐	☐	☐	PPE(head/eye/foot/hand/ear/body)	☐	☐	☐	
☐	☐	☐	Subcontractor Safety Rep Involved	☐	☐	☐	Hi-Vis, PFD's, Ring Buoys, Etc.	☐	☐	☐	
☐	☐	☐	Subcontractor / Task AHA's	☐	☐	☐	Excav./Trench/Spoils Protection	☐	☐	☐	
☐	☐	☐	Subcontractor Equip. Inspections	☐	☐	☐	Confined Spaces Management	☐	☐	☐	
☐	☐	☐	Emergency Equip. (PFE's, FA Kits)	☐	☐	☐	Physical Barriers / Covers	☐	☐	☐	
☐	☐	☐	Eye Wash / Shower	☐	☐	☐	Fall Hazards (Protected)	☐	☐	☐	
☐	☐	☐	Communications Check	☐	☐	☐	Ladders	**ISSUES TO FOLLOW-UP**			
☐	☐	☐	Sanitation (Toilets, Hand Wash)	☐	☐	☐	Power & Portable Hand Tools	(Immediately Correct Deficiencies if able)			
☐	☐	☐	Water & Shade, Non-Pot Identified	☐	☐	☐	Company Field Equipment				
☐	☐	☐	Utilities Identified / Controlled	☐	☐	☐	Alarms / Seatbelts				
☐	☐	☐	Material Storage Proper	☐	☐	☐	GFCI's, Whip-Checks, Slings				
☐	☐	☐	Lay Down Areas Orderly	☐	☐	☐	Exposed Rebar Protected				
☐	☐	☐	Waste Containers	☐	☐	☐	Safety / Health Behaviors:				
☐	☐	☐	Spill Control (Pads, Snakes, Drums)	☐	☐	☐	Competent / Qualified Persons				

Immediately Correct any deficiencies. Note any uncorrected deficiencies on the APP Safety and Occupational Health Deficiency Tracking Log.

Comments/Field Notes:

I acknowledge that above elements performed (SSHO/Inspector signature): **Date:**

[1] **BBS Triggers**: (e.g. Distractions, rushing, short-cuts, frustration, exhaustion, complacency, anger, multi-tasking, mind elsewhere)

[2] **BBS Trigger Controls**: (e.g. communicating, accountability, patience, relaxation techniques, healthy lifestyle, and adequate sleep).

AHTNA DAILY SITE SAFETY TAILGATE / INSPECTION LOG

Additional MEETING ATTENDEES: (place * next to subcontractor safety representatives**)**

NAME / COMPANY		NAME / COMPANY

NOTES / COMMENTS / SKETCHES

wood.

TASK SPECIFIC HEALTH AND SAFETY WORKSHEET
SUPPLEMENT TO THE PROGRAM HEALTH AND SAFETY PLAN

This worksheet shall be used in conjunction with the AHTNA Accident Prevention Plan, March 2015, and the U.S. Army Corps of Engineers Safety and Health Manual, EM 385-1-1, November 2014.

GENERAL PROJECT INFORMATION

Project Number:______________________________ Date:__________________________________
Site or Activity Description:____________________ Prepared by:____________________________
____
Location Description:__________________________ Reviewed by:___________________________

TASK DESCRIPTION (Check all that apply)

______Sample Location Marking
______Geophysics borehole clearance
______Biological borehole clearance
______Monitoring well installation
______Soil Borings
______Trenching
______Hand augering
______Soil gas survey
______Geophysics
______Groundwater sampling
______Soil sampling
______Other (specify)_________________________________
_____Water level surveys
_____Sediment sampling
_____Biological inventory
_____Hazardous waste handing /mgmt
_____Hydropunch

SITE HAZARDS (check all that apply)

______Contaminated water
_____VOC _____Pesticides
_____SOC _____Petroleum
_____Metals _____Chlorinated hydrocarbons
_____PCB _____Other (specify_______________

______Contaminated Soil
_____VOC _____Pesticides
_____SOC _____Petroleum
_____Metals _____Chlorinated hydrocarbons
_____PCB _____Other (specify)____________

______Contaminated Air
_____VOC _____Pesticides
_____SOC _____Petroleum
_____Metals _____Chlorinated hydrocarbons
_____PCB _____Other (specify)___________________

______Ionizing radiation (specify)_______
____
______Non-ionizing radiation (specify)
____
______Noise
______Biological hazards (specify) mountain lions, dogs, spiders, snakes, ticks, poison oak__
______Temperature extremes Heat______Cold_________
______Overhead/underground utilities
______Vehicle traffic
______Air traffic/noise
______Unexploded ordnance (UXO)
______Equipment/mechanical
______Other (specify)________________
____

LEVEL OF PROTECTION REQUIRED (A, B, C, or D) _____minimum______maximum
PPE REQUIRED (Check all that apply)

Head: _____hardhat
Eye: _____safety glasses
_____chemical goggles
_____face shield
Ear: _____earplug
_____earmuff
Foot: _____steel-toed boots (specify)____________________
_____disposable overbooties (specify)______________
Hand: _____gloves (check type)
_____Neoprene
_____Viton
_____Nitrile
_____PVC
_____Underglove (type)____________________
_____Other (specify)_______________________

Body: _____ fully encapsulated suit
_____two-piece rain suit
_____apron
_____Tyvek suit
_____Saranex suit
_____hooded Tyvek suit
_____hooded Saranex suit
_____hooded polyethylene suit
_____cloth overalls
_____high visibility vest
_____Other (specify)____________
Respiratory: _____SCBA (pressure demand)
_____airline respiratory (pressure demand)
_____full face respirator, cartridge=____
_____half mask respirator cartridge=___
_____escape mask/bottle (specify)_____

OTHER SAFETY EQUIPMENT REQUIRED (Check all that apply)

______ventilation blower/fan
______traffic cones
______barrier tape
______blast alarm
______ground fault circuit interrupter
______lifeline with harness
______radiation dosimeter
______first aid kit
______fire extinguisher
______emergency eye wash
______cellular telephone
______Other (specify)___________

REQUIRED CLEARANCES

______Utilities Date Completed:__________
______Biological Date Completed:__________
______Airfield Date Completed:__________
______UXO/EOD Date Completed:__________
______Military Operations Date Completed:_______________________
______ Vehicle traffic area: Date Completed:_______________________
______Archaeological: Date Completed:_______________________
______Other (specify):______Date Completed:_______________________

LIST OF PERSONNEL ASSIGNED TO SITE AND RECORDS VERIFICATION

(Note: SSHO must initial verification that each personnel record is present in field binder.)

NAME	HAZWOPER CERTIFICATION	MEDICAL CLEARANCE	RESPIRATOR FIT TEST	FIRST AID/CPR	CELL PHONE NUMBER

I have read and become familiar with all aspects of the Site Safety and Health Plan. I also understand that the Site Safety and Health Plan may be supplemented with other site-specific health and safety documents for which I will be held equally responsible.

NAME	**DATE**	**COMPANY**	**SIGNATURE**

USACE PROJECT SITE SAFETY LOG

GENERAL DATA

Job # ____

Activity ____

Location Description ____

____

DOCUMENTATION OF DAILY MORNING SAFETY MEETING:
TOPICS OF DISCUSSION (check all that apply)

______scope of work/SAP
______potential hazards
______health and safety plan highlights/revisions
______emergency procedures
______PPE requirements
______equipment calibration
______special topics (specify)_________
____

MEETING ATTENDEES:

NAME	DATE	COMPANY	SIGNATURE

DAILY INSPECTIONS: (Site crew chief shall initial each completed inspection)

______PPE
______field equipment
______vehicles
______safety equipment
______field health and safety binder in vehicle
______first aid kit
_______required eyewash station filled, and charged
_______fire extinguisher
_______communication check
method____________________________
time______________________________

Note any deficiencies:

____

____

I acknowledge that the above health and safety program self audit and inspections have been performed prior to the initiation of scheduled work.

Signature of Site Safety and Health Officer (SSHO)____________________________________

LIST OF AUTHORIZED VISITORS NOT NORMALLY ASSIGNED TO THIS SITE

(Note: SSHO must initial verification that each personnel record is present in the field binder.)

NAME	HAZWOPER CERTIFICATION	MEDICAL CLEARANCE	RESPIRATOR FIT TEST	FIRST AID/CPR

FORT ORD MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)
INCIDENT REPORTING FORM

If you recognize any object that resembles munitions or explosives on current or former Fort Ord property, retreat to a safe location, and report the finding to the **appropriate agencies immediately** (see below)

A. PROVIDE THE FOLLOWING INFORMATION:

Name of Person Reporting:	Telephone:
Agency:	Fax:
Date & Time of Incident/Discovery:	
Description of Item Found (refer to the "Safety Alert" pamphlet if possible):	
Location (direction from nearest road/building, attach map if possible):	
GPS Coordinate Location: (Type of Instrument, NAD83 California State Plan Coordinates Zone IV, feet)	
Describe how the item was found:	

CONTACT THE APPROPRIATE AGENCIES IMMEDIATELY:

Initial when completed	**Mon– Thu (6 a.m. – 5 p.m.) Contact and FAX Form to:**	**Contact Number**	**Date & Time Called**
	USACE Ordnance Safety Specialist or MMRP Site Safety Manager	Ph: (831) 884-9925 ext.226 Cell: (831) 760-2571 Fax:(831) 884-9030 Ph: (831) 242-7919 Fax:(831) 242-7019 Cell: (831) 760-2575	
	Fri – Sun (24 Hours) 60th Civ Engr Sqdn EOD	Phone: (707) 424-5517	
	Note: If 60th Civ Engr Sqdn EOD is contacted, notify the MMRP Site Safety Manager: (831) 242-7919, Cell (831) 760-2575.		

B. To be completed by USACE Ordnance Safety Specialist when applicable (Mon – Thu)

Form Received By:		Date & Time:
Identification of Item Found:		
Extent of Area Surveyed:		Name of digital file for picture (date):
Disposition of Item:		
Fax completed form to MMRP Site Safety Mgr Bldg 4463 Gigling Rd, POM (Fort Ord) when response complete	Fax: (831) 242-7091 Phone: (831) 242-7919	Date & Time:

C. To be completed by MMRP Site Safety Manager:

Acknowledge Completed Form Received:	Date & Time:
Regulatory Agencies Notified (Date):	

Seq. No. 1389

Lab:

1465 North McDowell Blvd.
Suite 200
Petaluma, CA 94954
(707) 793-3800

CHAIN OF CUSTODY FORM

wood.

Samplers:

Job Number:

Name/Location:

Project Manager:

Recorder: (Signature Required)

MATRIX				# CONTAINERS						SAMPLE NUMBER	DATE				STATION DESCRIPTION		ANALYSIS REQUESTED		
Water	Soil	Air		Unpres.	H2SO4	HNO3	HCL				YR	MO	DAY	TIME		DEPTH	8260	8270	TITLE 22 METALS

ADDITIONAL INFORMATION

REPORT TO:

PO#:

TAT:

Comments: Field Filtered Y/N

CHAIN OF CUSTODY RECORD

Relinquished By *(Signature)* *(Print Name)* *(Company)* *(Date/Time)*

Received By (Signature): *(Print Name)* *(Company)* *(Date/Time)*

Relinquished By *(Signature)* *(Print Name)* *(Company)* *(Date/Time)*

Received By (Signature): *(Print Name)* *(Company)* *(Date/Time)*

Relinquished By *(Signature)* *(Print Name)* *(Company)* *(Date/Time)*

Received By (Signature): *(Print Name)* *(Company)* *(Date/Time)*

Method of Shipment:

White - Laboratory Copy Yellow - Project Office Copy Pink - Field or Office Copy

F1008-E

Ahtna
296 12th St
Marina, CA 93933
(831) 384-3735

CHAIN OF CUSTODY

WATER / SOIL

Chain of Custody #: ____________________
Carbon Copies: White - Laboratory Yellow - Ahtna

Project Information:

Project Location: ______________________ Sampler/s: ______________________

Project Name: ______________________ Report To: ______________________

Project Number: ______________________ E-Mail: ______________________

Sampling Event: ______________________ Laboratory: ______________________

Analysis Requested

Lab Sample Receipt

Laboratory Sample Delivery

Group #: ______________

Custody Seal: ______________

Temp (°C): ______________

Lab Number	Sample Number/Description	Sample Collection		Matrix			Total # of Bottles	Number of Preserved Bottles								Analysis Requested								Notes
		Date	Time	Water	Soil	Other		HCl	HNO_3	H_2SO_4	NaOH	MeOH	$NaHSO^4$	None	Other									

Turnaround Time: _____: Standard _____: 3-5 Day Rush _____: 48 Hour Rush _____: 24 Hour Rush

Shipment: **Method:** ______________ **Tracking ID:** ______________________

Comments:

Chain of Custody Tracking:

Relinquished By Sampler:	Date/Time:	Received By:	Date/Time:
Relinquished By:	**Date/Time:**	**Received By:**	**Date/Time:**
Relinquished By:	**Date/Time:**	**Received By Laboratory:**	**Date/Time:**

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Wood/Ahtna
Ft Ord GW Monitoring-
Samplers:
Date: Time: ________
Sample #:

Ahtna

POST-TREATMENT PARAMETER MONITORING FORM

Project Information:

Project and Task No.: ______________________________

Project Name: ______________________________

Date: ______________________________

Field Personnel Name/s: ______________________________

Well Information:

Well ID: ______________________________

Total Depth: __________ **Well Diameter:** ____________

Three Casing Volumes: ______________________________

Parameter Collection Information:

Method of Monitoring: ☐ **Purging** ☐ **Downhole Meter**

Downhole Meter Type and ID: ______________________

Pump Type and ID: ______________________________

Multi-Meter Type and ID: __________________________

Meter Calibration Completed (except Temperature)[1]: ☐

Water Level Information:

Initial Depth to Water: ______________________________

Depth to Water after Monitoring: ______________________

Time	Pump Intake Depth	Rate (mL/min)	Cum. Vol. (L)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Dissolved Oxygen (mg/L)	Oxidation-Reduction Potential (mV)	Turbidity (NTU)	Remarks (color, odor, suspended materials, etc.)

NOTES:

[1] If the Horiba U-50 Series multi-meter is used, calibration should occur daily. If the YSI 6-Series Multi-Parameter Water Quality Sonde with downhole probe is used, calibration is performed by the vendor and field calibration is not required for field events lasting less than 1 month, unless field conditions present erroneous data or the Sonde experiences mechanical issues.

ATTACHMENT D

Three Phase Quality Control Process and Documentation

INVESTIGATION, MONITORING, O&M PROJECTS
PREPARATORY PHASE INSPECTION COVER SHEET

Contract No.: ____________________ Date: _______________
Task No.: ____________________
Location/Project: ____________________

A. Key Personnel Present:

	Name	Position	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

B. Submittals:

1. Review submittals and/or submittal register. Have all applicable submittals been approved? Yes___ No___

If No, what items have not been submitted?

a. ______________________________
b. ______________________________
c. ______________________________

______________________ ______________________
USACE Representative Signature Quality Control Manager Signature

INVESTIGATION, MONITORING, O&M PROJECTS: PREPARATORY PHASE INSPECTION CHECKLIST				
Assessment Activity	**Assessment Mechanism**	**Person(s) Responsible**	**Response Action**	**Completed by/Date**
Have planning documents been prepared in accordance with the statement of work, regulatory requirements, and contract requirements?	Quality control review of document by Project Manager and QC reviewer.	Project Manager, QC Reviewer	Modify document as directed by reviewers	
Prior to project activities: Have planning documents been read by appropriate project personnel (including subcontractors) before work is conducted.	Documentation (e.g., sign-off form, note to file, email acknowledgement) that document has been read and requirements are understood.	Subcontractors as required. Project Manager, Task Manager, and Project Chemist to check signoff and forms.	Direct project personnel to read relevant documents.	
Prior to project activities: Has required preliminary work (e.g., clearance activities, permits, site access) been completed in accordance with project plan.	Comparison of information obtained from preliminary work completion assessment as specified in the project planning document(s).	Project Manager, Safety and Health Officer, QC Manger/Reviewer, Task Manager, Project Chemist, Field Staff	Delay startup if necessary preliminary work has not been completed. Implement corrective actions by directing appropriate personnel or subcontractors to complete necessary preliminary work.	
Prior to project activities: Are staff and subcontractors prepared to implement project activities according to planning documents?	Review and discussion of planned activities prior to implementation.	Project Manager, Safety and Health Officer, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Delay startup if staff and subcontractors are not prepared to implement activities *in* accordance with specification.	
Prior to project activities: Is necessary field equipment available and in acceptable working order?	Compare field equipment list with planned activities. Compare field equipment calibration documentation with project goals specified in the SAP.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Delay startup if equipment is unavailable or not in proper working order. Implement corrective actions to include use of alternate equipment, or recalibration of available equipment.	

INVESTIGATION, MONITORING, O&M PROJECTS
INITIAL PHASE INSPECTION COVER SHEET

Contract No.: ____________________ Date: _______________
Task No.: ____________________
Location/Project: ____________________

Description and Location of Work Inspected: ____
____

A. Key Personnel Present:

	Name	Position	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

____
Quality Control Manager Signature

INVESTIGATION, MONITORING, O&M PROJECTS: INITIAL PHASE INSPECTION CHECKLIST				
Assessment Activity	**Assessment Mechanism**	**Person(s) Responsible**	**Response Action**	**Completed by/Date**
Beginning of project activity: Is work being performed according to project plans?	Conduct field and laboratory audits.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Stop work if audits indicate significant deviation from project plan. Implement immediate or long- term corrective actions. Communicate deficiencies to USACE Project Manager.	
Early phase of project: Have necessary audits been performed?	Review project phase and check to see if required audits have *been s*atisfactorily completed.	Project Manager, Project Manager, Quality Control System Manager	Stop work if reviewer decides that absence of audit jeopardizes successful implementation of project plans. Immediately schedule necessary audits.	
Ongoing throughout project: Are daily quality control reports being prepared according to contract requirements?	Review Content and delivery schedules of daily quality control reports.	Project Manager, Task Manager, Project Chemist, Project Staff	Correct deficiencies in reports or reporting delays.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goal?	Compare data gathered to assess conformance to the project plan and conceptual site model.	Project Manager, Safety and Health Officer, Quality Control System Manager, Task Manager, Project Chemist, Field staff.	Stop work if assessor decides that project plan deficiencies are significant. Implement corrective action to include modification of project plans. Notify USACE Project Manager.	
Ongoing throughout project: Do project plans adequately address any changes in project activities or goals?	Compare data gathered to assess conformance to the conceptual site model, data quality objectives, and project plan.	Project Manager, Quality Control System Manager, Task Manager, Project Chemist, data users and evaluators.	Propose additional data collection activities to fill data gaps. Notify USACE Project Manager. Revise or update planning documents as appropriate.	

INVESTIGATION, MONITORING, O&M PROJECTS
FOLLOW-UP PHASE INSPECTION COVER SHEET

Contract No.: ______________________ Date: ________________

Task No.: ______________________

Location/Project: ______________________

Project/Area of Inspection: ____

____

____

A. Key Personnel Present:

	Name	Position	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

B. Definable Features of Work: Status of Inspection:

____

____

____

____

____

____

____

____

____

____

____

____

____

____

Quality Control Manager

Investigation Project Follow-Up Phase Inspection Checklist				
Assessment Activity	**Assessment Mechanism**	**Person(s) Responsible**	**Response Action**	**Completed by/Date**
Reporting phase of project: Have data reports been prepared in accordance with project plans?	Compare data reports to specifications detailed in planning documents.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.	
After draft report submittal or project completion: Are reports adequate to meet client and regulatory agency requirements?	Review client and agency comments. Prepare responses to comments.	Project Manager, Quality Control Manager, Task Manager, Project Chemist, data users and evaluators.	Revise documents and reports as appropriate.	
Have other definable features of work been completed in accordance to project requirements	Compare definable features of work with project requirements.	Project Manager, Quality Control Manager	Complete definable feature of work as required.	

ATTACHMENT E

ADR Library and Qualifier Tables

Project Accuracy and Precision Report

eQapp Name: FtOrd_UFP_QAPP_Rev7
Description: Quality Assurance Project Plan Former Fort Ord, California

Analyte Name	Analyte Label (CAS)	Lower Rejection (%)	Lower Recovery (%)	Upper Recovery (%)	Upper Rejection (%)	RPD (%)
Method: EPA6010C	**Matrix: AQ**					
QC Type: LCS						
ANTIMONY	7440-36-0		80.00	120.00		20.00
COPPER	7440-50-8		80.00	120.00		20.00
LEAD	7439-92-1		80.00	120.00		20.00
QC Type: MS						
ANTIMONY	7440-36-0		80.00	120.00		20.00
COPPER	7440-50-8		80.00	120.00		20.00
LEAD	7439-92-1		80.00	120.00		20.00
Method: EPA8260-SIM	**Matrix: AQ**					
QC Type: LCS						
1,1-DICHLOROETHANE	75-34-3		81.00	122.00		15.00
1,1-DICHLOROETHYLENE	75-35-4		78.00	137.00		18.00
1,2-DICHLOROETHANE	107-06-2		75.00	125.00		14.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0		76.00	127.00		17.00
1,2-DICHLOROPROPANE	78-87-5		76.00	124.00		14.00
1,3-Dichloropropene (total)	542-75-6		75.00	120.00		23.00
BENZENE	71-43-2		81.00	122.00		14.00
CARBON TETRACHLORIDE	56-23-5		76.00	136.00		23.00
CHLOROFORM	67-66-3		80.00	124.00		15.00
CIS-1,2-DICHLOROETHYLENE	156-59-2		78.00	120.00		15.00
METHYLENE CHLORIDE	75-09-2		69.00	135.00		16.00
TETRACHLOROETHYLENE	127-18-4		76.00	135.00		16.00
TRICHLOROETHYLENE	79-01-6		81.00	126.00		15.00
VINYL CHLORIDE	75-01-4		69.00	159.00		18.00

Analyte Name	Analyte Label (CAS)	Lower Rejection (%)	Lower Recovery (%)	Upper Recovery (%)	Upper Rejection (%)	RPD (%)
Method: EPA8260-SIM	**Matrix: AQ**					
QC Type: MS						
1,1-DICHLOROETHANE	75-34-3		81.00	122.00		15.00
1,1-DICHLOROETHYLENE	75-35-4		78.00	137.00		18.00
1,2-DICHLOROETHANE	107-06-2		75.00	125.00		14.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0		76.00	127.00		17.00
1,2-DICHLOROPROPANE	78-87-5		76.00	124.00		14.00
1,3-Dichloropropene (total)	542-75-6		75.00	120.00		23.00
BENZENE	71-43-2		81.00	122.00		14.00
CARBON TETRACHLORIDE	56-23-5		76.00	136.00		23.00
CHLOROFORM	67-66-3		80.00	124.00		15.00
CIS-1,2-DICHLOROETHYLENE	156-59-2		78.00	120.00		15.00
METHYLENE CHLORIDE	75-09-2		69.00	135.00		16.00
TETRACHLOROETHYLENE	127-18-4		76.00	135.00		16.00
TRICHLOROETHYLENE	79-01-6		71.00	126.00		15.00
VINYL CHLORIDE	75-01-4		69.00	159.00		18.00
QC Type: SURR						
1,2-DICHLOROETHANE-D4	17060-07-0	30.00	74.00	125.00		
TOLUENE-D8	2037-26-5	30.00	88.00	111.00		
Method: EPA9056A	**Matrix: AQ**					
QC Type: LCS						
Chloride	1003		90.00	110.00		
QC Type: MS						
Chloride	1003		90.00	110.00		20.00

Project Holding Time Report

eQapp Name: FtOrd_UFP_QAPP_Rev7
Description: Quality Assurance Project Plan Former Fort Ord, California

Analyte Group	Sampling to Analysis	Sampling to Extraction	Sampling to Leaching	Leaching to Extraction	Leaching to Analysis	Extraction to Analysis	Units	Rejection Factor
Method: EPA6010C Matrix: AQ								
Primary	180.00						Days	2.00
Method: EPA8260-SIM Matrix: AQ								
Primary	14.00						Days	2.00
Method: EPA9056A Matrix: AQ								
Primary	28.00						Days	2.00

Project Target Analyte Reporting Limit, Blank Contamination, and Lab & Field Duplicate RPD Criteria

eQapp Name: FtOrd_UFP_QAPP_Rev7
Description: Quality Assurance Project Plan Former Fort Ord, California

Target Analyte Name	Analyte Label (CAS)	Quantitation Limit	Detection Limit	Units	Blank Contamination Rule	LabDup RPD	FieldDup RPD
Method: EPA6010C Matrix: AQ							
ANTIMONY	7440-36-0	6.0	5.0	ug/L	5.00	20.00	30.00
COPPER	7440-50-8	10	5.0	ug/L	5.00	20.00	30.00
LEAD	7439-92-1	10	3.0	ug/L	5.00	20.00	30.00
Method: EPA8260-SIM Matrix: AQ							
1,1-DICHLOROETHANE	75-34-3	0.50	0.25	ug/L	5.00	20.00	30.00
1,1-DICHLOROETHYLENE	75-35-4	0.50	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROETHANE	107-06-2	0.50	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROETHENE (TOTAL)	540-59-0	1.0	0.25	ug/L	5.00	20.00	30.00
1,2-DICHLOROPROPANE	78-87-5	0.50	0.25	ug/L	5.00	20.00	30.00
1,3-Dichloropropene (total)	542-75-6	0.50	0.25	ug/L	5.00	20.00	30.00
BENZENE	71-43-2	0.50	0.25	ug/L	5.00	20.00	30.00
CARBON TETRACHLORIDE	56-23-5	0.50	0.25	ug/L	5.00	20.00	30.00
CHLOROFORM	67-66-3	0.50	0.25	ug/L	5.00	20.00	30.00
CIS-1,2-DICHLOROETHYLENE	156-59-2	0.50	0.25	ug/L	5.00	20.00	30.00
METHYLENE CHLORIDE	75-09-2	2.0	1.0	ug/L	10.00	20.00	30.00
TETRACHLOROETHYLENE	127-18-4	0.50	0.25	ug/L	5.00	20.00	30.00
TRICHLOROETHYLENE	79-01-6	0.50	0.25	ug/L	5.00	20.00	30.00
VINYL CHLORIDE	75-01-4	0.10	0.050	ug/L	5.00	20.00	30.00
Method: EPA9056A Matrix: AQ							
Chloride	1003	250	0.50	mg/L	5.00	20.00	30.00

ADR **Data Qualification Table**

Description	VOA	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Difference Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Difference Lower Rejection	J-	R
Continuing Calibration Verification Percent Difference Upper Estimation	J+	
Continuing Calibration Verification Percent Difference Upper Rejection	J+	UJ
Continuing Calibration Verification Relative Response Factor	J	UJ
Continuing Tune	J	R
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial calibration Correlation Coefficient	J	UJ
Initial Calibration Percent Relative Standard Deviation	J	UJ
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Difference Lower Estimation	J-	UJ
Initial Calibration Verification Percent Difference Lower Rejection	J-	R
Initial Calibration Verification Percent Difference Upper Estimation	J+	
Initial Calibration Verification Percent Difference Upper Rejection	J+	UJ
Initial Calibration Verification Relative Response Factor	J	UJ
Initial Tune	J	R
Internal Standard Estimation	J	UJ
Internal Standard Rejection	J	R
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Preservation	J-	UJ
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Surrogate Recovery Lower Estimation	J-	UJ
Surrogate Recovery Lower Rejection	J-	R
Surrogate Recovery Upper Estimation	J+	
Surrogate Recovery Upper Rejection	J+	R
Temperature Estimation	J-	UJ
Temperature Rejection	J-	R
Trip Blank Contamination	U	

ADR **Data Qualification Table**

Description	Metals	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	R	R
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	R	
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	R	R
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	R	
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Trip Blank Contamination	U	

ADR **Data Qualification Table**

Description	GenChem	
	Detect Qualifier	Non-detect Qualifier
Calibration Blank Contamination	U	
Continuing Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Continuing Calibration Verification Percent Recovery Lower Rejection	R	R
Continuing Calibration Verification Percent Recovery Upper Estimation	J+	
Continuing Calibration Verification Percent Recovery Upper Rejection	R	
Equipment Blank Contamination	U	
Extraction to Analysis Estimation	J-	UJ
Extraction to Analysis Rejection	J-	R
Field Blank Contamination	U	
Initial Calibration Relative Response Factor	J	UJ
Initial Calibration Verification Percent Recovery Lower Estimation	J-	UJ
Initial Calibration Verification Percent Recovery Lower Rejection	R	R
Initial Calibration Verification Percent Recovery Upper Estimation	J+	
Initial Calibration Verification Percent Recovery Upper Rejection	R	
Laboratory Control Precision	J	UJ
Laboratory Control Spike Lower Estimation	J-	UJ
Laboratory Control Spike Lower Rejection	J-	R
Laboratory Control Spike Upper Estimation	J+	
Laboratory Control Spike Upper Rejection	J+	R
Laboratory Duplicate Precision	J	UJ
Matrix Spike Lower Estimation	J-	UJ
Matrix Spike Lower Rejection	J-	R
Matrix Spike Precision	J	UJ
Matrix Spike Upper Estimation	J+	
Matrix Spike Upper Rejection	J+	R
Method Blank Contamination	U	
Sampling to Analysis Estimation	J-	UJ
Sampling to Analysis Rejection	J-	R
Sampling to Extraction Estimation	J-	UJ
Sampling to Extraction Rejection	J-	R
Sampling to Leaching Estimation	J-	UJ
Sampling to Leaching Rejection	J-	R
Trip Blank Contamination	U	

ATTACHMENT F

Analytical Laboratory Certifications

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board

500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

and DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.1.1)

while demonstrating technical competence in the fields of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of calibrations and/or tests to which this accreditation applies.

L2229
Certificate Number

ANAB Approval

Certificate Valid: 12/05/2018-12/15/2021
Version No. 003 Issued: 12/05/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

ANSI-ASQ National Accreditation Board

ANAB

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD QUALITY SYSTEMS MAUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.1.1)

SGS North America Inc. - Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph. D., QA Officer
407-425-6700

TESTING

Valid to: **December 15, 2021** Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624.1; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Chlorotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 624.1; EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)

ANSI-ASQ National Accreditation Board

ANAB

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260B/C	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Vinyl chloride

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 625.1; EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625.1; EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1; EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 625.1; EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D	Acetophenone
GC/MS	EPA 625.1; EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 625.1; EPA 8270D	Atrazine
GC/MS	EPA 625.1; EPA 8270D	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D	Benzidine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 625.1; EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Carbazole
GC/MS	EPA 625.1; EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 625.1; EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1; EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 625.1; EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D	Phenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 625.1; EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 610	1-Methylnaphthalene
HPLC	EPA 610	2-Methylnaphthalene
HPLC	EPA 610	Acenaphthene
HPLC	EPA 610	Acenaphthylene
HPLC	EPA 610	Anthracene
HPLC	EPA 610	Benzo(a)anthracene
HPLC	EPA 610	Benzo(a)pyrene
HPLC	EPA 610	Benzo(b)fluoranthene
HPLC	EPA 610	Benzo(g h i)perylene
HPLC	EPA 610	Benzo(k)fluoranthene
HPLC	EPA 610	Chrysene
HPLC	EPA 610	Dibenz(a,h)anthracene
HPLC	EPA 610	Fluoranthene
HPLC	EPA 610	Fluorene
HPLC	EPA 610	Indeno(1,2,3-cd)pyrene
HPLC	EPA 610	Naphthalene
HPLC	EPA 610	Phenanthrene
HPLC	EPA 610	Pyrene
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2',6,6'-Tetranitro-4,4'-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanoic Acid

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 MOD[2]	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD[2]	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD[2]	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD[2]	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD[2]	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD[2]	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)

Non-Potable Water		
Technology	**Method**	**Analyte**
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 610; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE
GC/ECD	EPA 8081B	4,4`-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	AK-101	Gasoline range organics (GRO)
GC/FID	AK-102	Diesel range organics (DRO)
GC/FID	AK-103	Residual range organics (RRO)
GC/FID	OK-GRO	Gasoline range organics (GRO)
GC/FID	OK-DRO	Diesel range organics (DRO)
GC/FID	TX-1005	Total Petroleum Hydrocarbons (TPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethylene
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,2-Dichloroethane
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein (Propenal)
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl Chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	sec-Butylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Cyclohexanone
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C; EPA 8260B/C SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C	Ethyl acetate
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethylene Oxide
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Isopropylbenzene
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene (total)
GC/MS	EPA 8260B/C	m,p-Xylene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	1-Bromopropane
GC/MS	EPA 8260B/C	Isopropyl Alcohol
GC/MS	EPA 8260B/C	n-Butyl Alcohol
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D	1,2-Diphenylhydrazine
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D	1,4-Dithiane
GC/MS	EPA 8270D	1,4-Oxathiane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1,4-Naphthoquinone
GC/MS	EPA 8270D	1,4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D; EPA 8270D SIM	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D; EPA 8270D SIM	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Nitroaniline

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4,4'-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D; EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D; EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D; EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D; EPA 8270D SIM	Dibenz(a,h)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Dibenz(a,j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D; EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D; EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D; EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D; EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D; EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D; EPA 8270D SIM	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Simazine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	2,2’,6,6’-Tetranitro-4,4’-azoxytoluene
HPLC	EPA 8330A/B	2-amino-6-Nitrotoluene
HPLC	EPA 8330A/B	4-amino-2-Nitrotoluene
HPLC	EPA 8330A/B	2-amino-4-Nitrotoluene
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
HPLC	EPA 8330A	Nitroguanidine
HPLC	EPA 8330A	Guanidine Nitrate
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorononanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluorodecanesulfonic Acid
LC/MS/MS	EPA 537 MOD[2]	Perfluoropentanesulfonic Acid

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 MOD²	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 537 MOD²	Perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	EPA 537 MOD²	Perfluoro-1-octanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 MOD²	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	4:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	N-Ethyl perfluorooctane sulfonamidoethanol
LC/MS/MS	EPA 537 MOD²	6:2 Fluorotelomer Sulfonate
LC/MS/MS	EPA 537 MOD²	8:2 Fluorotelomer Sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-1515	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorobutanesulfonic Acid (PFBS)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1010A MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup

ANSI-ASQ National Accreditation Board

ANAB

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229
2. Not compliant with QSM V5.1.1 Table B-15

Vice President

ATTACHMENT G

Response to Comments on the Draft QAPP

Responses to Comments submitted by the Central Coast Regional Water Quality Control Board (CCRWQCB)[1]

SPECIFIC COMMENT 1: Section 3.1.3 Known Contaminants and Section 3.6.1 – Worksheet #15a: VOCs by EPA Method 8260-SIM: Section 3.1.3 indicates that known contaminants, or contaminants of concern (COCs), were identified during Remedial Investigations at the sites and documented in the decision documents for each site. The COCs for each site are listed in Section 3.6.1, Worksheet #15a. Based on a review of groundwater analytical data for the site, it appears that select wells were historically sampled and analyzed for 1,2,3-trichloropropane (1,2,3-TCP). This constituent was ruled out as a potential COC however, the detection limits were above the California Maximum Contaminant Level (MCL) of 0.005 micrograms per liter (µg/L) that was adopted in 2017. Therefore, the Water Board recommends selecting one key groundwater monitoring well (i.e.: the well with the highest concentrations of a known COC) at each of the OU2, Sites 2/12, and OUCTP Areas to sample and analyze for 1,2,3-TCP to confirm non-detectable results using a detection limit below the MCL. In 2018, the municipal water supply wells in the former Fort Ord Area (FO-29 through FO-31) were sampled and analyzed for 1,2,3-TCP using a detection limit below 0.005 µg/L. 1,2,3-TCP was not detected in the samples collected from the municipal water supply wells.

RESPONSE TO SPECIFIC COMMENT 1: *It is acknowledged the analytical detection limits for groundwater samples historically collected at the former Fort Ord are higher than the current California MCL, but additional sampling and analysis for 1,2,3-TCP is not warranted based on the following lines of evidence:*

- *Common uses of 1,2,3-TCP included use as a paint and varnish remover, and a cleaning and degreasing agent.[2] These uses would be consistent with historical uses of other solvents, including carbon tetrachloride (CT), tetrachloroethene (PCE), and trichloroethene (TCE), at the former Fort Ord when it was an active military installation. However, while CT, PCE, and TCE have historically been detected in groundwater, soil, and soil gas at the former Fort Ord at concentrations exceeding MCLs or screening levels by several orders of magnitude, there have been no corresponding detections of 1,2,3-TCP, indicating there was no significant usage of this compound.*
- *The vapor pressure of 1,2,3-TCP (3.1 mmHg at 25°C) and the calculated Henry's law constant (3.17×10^{-4} atm-m^3/mol at 25°C) suggest volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.[3] Therefore, if there was any release of 1,2,3-TCP to the ground surface, it is likely most or all of it would have volatilized to the atmosphere before it could leach to groundwater.*
- *Other media, including soil and soil gas, have been sampled and analyzed for 1,2,3-TCP at various sites across the former Fort Ord, including OU1, OU2, OUCTP, and Sites 2/12, and 1,2,3-TCP has never been detected, further indicating no significant usage of this compound at the former Fort Ord.*

---

[1] In a letter dated March 22, 2019 (see Administrative Record No. BW-2785G.4).
[2] Agency for Toxic Substances and Disease Registry: Toxicological Profile for 1,2,3-Trichloropropane, May 2019: https://www.atsdr.cdc.gov/toxprofiles/tp57.pdf
[3] Ibid.

- *CT and TCE have historically been detected in municipal water supply wells FO-29, FO-30, and FO-31, and these compounds are associated with identified upgradient operable units; however, as noted in the comment, 1,2,3-TCP has not been detected in these wells. Because 1,2,3-TCP is a chlorinated solvent with high mobility, it would be expected to be present concurrently with CT and TCE; however, its absence indicates there is no upgradient source.*

SPECIFIC COMMENT 2: Section 3.1.4 – Fate and Transport Considerations, OU2 and OUCTP: The subsections for OU2 and OUCTP indicate the aquifers that are impacted by COCs. In the subsection for Sites 2/12 please add the aquifer(s) impacted by COCs.

RESPONSE TO SPECIFIC COMMENT 2: *The text was revised per the comment.*

SPECIFIC COMMENT 3: Section 3.1.4 – Fate and Transport Considerations, OU2 and OUCTP: In the subsection for OUCTP consider adding the following discussion related to TCE in the Lower 180-Foot Aquifer: *Due to the lateral discontinuity in the Intermediate 180-Foot Aquitard between the Upper and Lower 180-Foot Aquifers, existing TCE data for the A-Aquifer in the OU2 Area and for the Upper and Lower 180-Foot Aquifers in the OUCTP and OU2 Areas will be reviewed and evaluated to determine the source of TCE concentrations above the California MCL of 5 µg/L in the Lower 180-Foot Aquifer.* Please cite reference documents that include information on the discontinuity of the Intermediate 180-Foot Aquitard, as appropriate.

RESPONSE TO SPECIFIC COMMENT 3: *Text was added to Section 3.1.4 to provide more detail about the migration of CT in the affected aquifers at OUCTP, and to note the presence of TCE in the Lower 180-Foot Aquifer and its possible association with OU2. However, the Quality Assurance Project Plan (QAPP) is a guidance document for groundwater sampling and analysis activities at the former Fort Ord; therefore, the suggested discussion would be more appropriately included in the "Suggested Monitoring Modifications" section of the OUCTP Fourth Quarter 2018 through Third Quarter 2019 Groundwater Monitoring Report.*

SPECIFIC COMMENT 4: Section 3.1.8 – Geology and Hydrogeology: This section indicated that the aquifers consist predominantly of fine to coarse-grained sands which are separated by silty clay or clayey fine-grained sand aquitards. Please consider including additional information on the aquitards such as that the Fort Ord Salinas Valley Aquitard pinches out to the west towards the Pacific Ocean and that the Intermediate 180-Foot Aquitard that separates the Upper 180-Foot Aquifer and Lower 180-Foot Aquifer appears to be laterally discontinuous in the eastern portion of the former Fort Ord near the OU2 and OUCTP Areas. Additionally, please cite reference documents that include information on the aquitards, as appropriate.

RESPONSE TO SPECIFIC COMMENT 4: *The text was revised per the comment.*

SPECIFIC COMMENT 5: Section 3.2.1 – Step 1: State the Problem, OUCTP Lower 180-Foot Aquifer: Consider adding the following discussion related to TCE detections in the Lower 180-Foot Aquifer: *Due to the lateral discontinuity in the Intermediate 180-Foot Aquitard between the Upper and Lower 180-Foot Aquifers, existing TCE data for the A-Aquifer in the OU2 Area and for the Upper and Lower 180-Foot Aquifers in the OUCTP and OU2 Areas will be reviewed and evaluated to determine the source of recent detections of TCE above the California MCL of 5 µg/L in the Lower 180-Foot Aquifer. Please cite reference* *documents that include information on the discontinuity of the Intermediate 180-Foot Aquitard, as appropriate.*

RESPONSE TO SPECIFIC COMMENT 5: *Consistent with the response to Specific Comment 3, text was added to the OUCTP Lower 180-Foot Aquifer subsection of Section 3.2.1 to note the presence of TCE in the Lower 180-Foot Aquifer and its possible association with OU2. Accordingly, Section 3.2.2 was revised to identify additional study goals to address the revised problem statement.*

SPECIFIC COMMENT 6: Section 3.2.6 – Step 6: Specify Performance or Acceptance Criteria, OU2, Sites 2/12, and OUCTP GWMP: This section includes the following information: VOCs in groundwater at the former Fort Ord range in concentration from ND to 27.4 micrograms per liter (µg/L) PCE (at Sites 2/12), 19.6 µg/L TCE (at site OU2), and 6.5 µg/L CT (at OUCTP), the primary COCs at these sites (as measured in the Third Quarter 2016 GWMP). Please update the ranges in concentrations of VOCs in groundwater with the concentrations measured in the Third Quarter 2017 GWMP.

RESPONSE TO SPECIFIC COMMENT 6: *The data was updated with Third Quarter 2018 GWMP information in the OU2, Sites 2/12, and OUCTP GWMP subsection of Section 3.2.6.*

SPECIFIC COMMENT 7: Section 3.5.16 – Project Schedule: In the table for the general project schedule under the activity column OU2 GWMP is listed twice. It appears that Sites 2/12 GWMP is missing from the list. Please modify the activity list as appropriate.

RESPONSE TO SPECIFIC COMMENT 7: *The table was revised per the comment.*

SPECIFIC COMMENT 8: Section 4.1.5 – Worksheet #17c1: Sites 2/12 GWMP and Figure 2: Following submittal of the Draft QAPP for review, Ahtna requested a modification to the Sites 2/12 GWMP in an email on February 25, 2019 and the Water Board approved the modifications by email on February 28, 2019. Provided that the United States Environmental Protection Agency (USEPA) and Department of Toxic Substances Control (DTSC) concur, please update the sampling frequency for well MW-12-26-180U from quarterly to annual on Worksheet #17c1 and Figure 2.

RESPONSE TO SPECIFIC COMMENT 8: *Worksheet #17c1 and Figure 2 were edited to move MW-12-26-180U from quarterly to annual monitoring frequency.*

SPECIFIC COMMENT 9: Section 4.1.7 – Worksheet #17c3: OUCTP A-Aquifer GWMP and Figure 8A: Following submittal of the draft QAPP for review, Ahtna requested modifications to the OUCTP A-Aquifer GWMP in an email on February 25, 2019 and the Water Board approved the modifications by email on February 28, 2019. Provided that the EPA and DTSC concur, please update the following on Worksheet #17c3 and Figure 8A:

- Modify the sampling frequency for wells EW-BW-132-A, EW-BW-163-A, EW-BW-167-A, EW-BW-168-A, and EW-BW-169-A from quarterly to annual.
- Remove wells EW-BW-161-A, EW-BW-162-A, EW-BW-164-A, EW-BW-165-A, MW-BW-16-A, and MW-BW-57-A from the sampling program.
- Include quarterly DO/ORP monitoring at wells MW-BW-87-A and MW-BW-91-A.

RESPONSE TO SPECIFIC COMMENT 9: *Worksheet #17c3 and Figure 8A were edited to change the frequency of monitored wells as described above, with the following exceptions:*

- *EW-BW-163-A is removed from the program.*
- *EW-BW-165-A sampling frequency is reduced from quarterly to annual.*
- *MW-BW-87-A and MW-BW-91-A casing diameters are too small for the DO/ORP meter; therefore, they were substituted with EW-BW-161-A and EW-BW-164-A for DO/ORP monitoring.*
- *MW-BW-30-A sampling frequency was increased to annual.*

Responses to Comments submitted by the Fort Ord Community Advisory Group (FOCAG)[1]

COMMENT 1: To begin, please reference and review previous responses found on the Administrative Record
BW-2327E.1
OU2-630F
And this from the CCRWQCB dated December 19, 1986 http://docs.fortordcleanup.com/ar_pdfs/AR-OU2-019//ou2-019.pdf. To quote a portion: "The plan does not fully address the extent of contamination in the deeper aquifers. For example, Marina's Well No. 10 is perforated solely in the 900 foot aquifer. The well has shown Trichloroethane contamination. The source of the contamination is most likely from the shallower aquifers. This should be addressed in your sampling plan."

The current document, Version 7, does not address VOC contamination in the Marina Coast Water District supply wells that draw water from the 900-foot aquifer. How often are these wells tested for VOCs? Have the sources of the contamination been determined? Is the water being pumped from these three 900-foot deep wells still being blended to meet State water quality standards?

RESPONSE TO COMMENT 1: *The U.S. Department of the Army (Army) conducted a basewide hydrogeologic evaluation and determined volatile organic compound (VOC) contamination in groundwater at the former Fort Ord does not impact the 400-Foot Aquifer and 900-Foot Aquifer.[2] Drinking water supplied by the Marina Coast Water District (MCWD) meets all Federal, State, and local regulatory standards. MCWD regularly tests drinking water quality and reports the results in an annual Consumer Confidence Report (CCR) found at www.mcwd.org. Water quality data and operational information are available at MCWD. Contact information for MCWD is available at https://mcwd.org/customer_service_contact.html.*

COMMENT 2: Large Army burns on the former Army Training Range lands called Site 39 was a common occurrence. The Army would extinguish these brush and ordnance fires. We ask, where are the test results for Perfluorooctanoic Acid and Perflorooctane Sulfanate in the groundwater beneath Site 39? Because a good portion of Site 39 sits directly atop the Seaside Groundwater Basin.

RESPONSE TO COMMENT 2: *The Army is currently conducting a basewide review of historical activities at the former Fort Ord that may have resulted in releases of PFOA/PFOS to soil and groundwater, and the results will be included in a report scheduled to be issued in summer 2019. Based on the preliminary results of this review, there is no suspected release of perfluorooctanoic acid (PFOA) or perfluorooctane sulfonate (PFOS) at Site 39. During prescribed burning at the former Fort Ord, fire foam or retardant may be used for pretreatment of the containment line around the burn unit, or to extinguish fires that have gone outside the containment line; however, these are Class A foams or retardants designed for use on combustible materials, such as wood, and not Class B foams designed for use on petroleum-based fires that may contain PFOA or PFOS. Additionally, the Fort Ord fire department historically used water tenders and not foam for fighting fires at Site 39.*

---

[1] In a letter dated March 8, 2019 (see Administrative Record No. BW-2785G.2). The comments are reproduced here as provided to the Army and there have been no changes to spelling, grammar, or punctuation.
[2] See Administrative Record No. BW-1283A.

As required by the federal third Unregulated Contaminant Monitoring Rule, water systems in the vicinity of the former Fort Ord, including the MCWD and California American Water, collected and analyzed drinking water samples for PFOA and PFOS from 2013 to 2015 and there were no detections. Analytical results are available in a downloadable Microsoft Excel file at the State Water Resources Control Board (SWRCB) website under the heading "Findings in California Drinking Water:"

https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/PFOA_PFOS.html

The SWRCB has also issued orders to public water systems in the vicinity of the former Fort Ord requiring testing for PFOA and PFOS. The SWRCB will also prepare a map of the sampling completed to date by the end of summer 2019. The map, along with a spreadsheet of all available data, will be made available to the public.

COMMENT 3: Please have the document tell of the decision to create an unlined landfill and transfer contamination and waste from one cell to another new one across the road at OU2.

RESPONSE TO COMMENT 3: *When the Fort Ord Landfills were receiving waste from 1956 to 1987, the waste was placed in shallow unlined trenches; however, the remedial action for the Fort Ord Landfills does not include creating an unlined landfill, and no new landfill cells were created as part of the remedy for OU2. In accordance with the Record of Decision, Operable Unit 2, Fort Ord Landfills (OU2 ROD)[3] and OU2 Area A Explanation of Significant Differences (ESD),[4] waste was consolidated in the existing landfill areas south of Imjin Parkway and an engineered cover system, including a linear low-density polyethylene liner, was constructed over the top of the waste. With implementation of the remedy, the overall area of the Fort Ord Landfills decreased by approximately 20 percent.[5]*

Regardless, the information requested to be included in the Quality Assurance Project Plan (QAPP) is not relevant because the QAPP is a guidance document for groundwater sampling and analysis activities at the former Fort Ord; however, the OU2 Landfills QAPP is referenced in Section 3.1.3, and this document contains detailed information about the Fort Ord Landfills and the OU2 remedy.

COMMENT 4: Page 18, Section 3.1.8 Geology and Hydrology: The two paragraphs are insufficient. During the 1990's the Army BRAC held Community Involvement Workshops (C.I.W.). The community was informed that there was an impermeable clay aquitard that prevented contamination from flowing into the Lower 180-ft aquifer. Some community members expressed skepticism at the time. Later we learned that, Oops, guess there was a hole in the aquitard.

RESPONSE TO COMMENT 4: *Additional information regarding the system of aquifers and aquitards at the former Fort Ord was added to Section 3.1.8.*

COMMENT 5: Page 19, Section 3.2.1 Step 1: State the Problem: We suggest that since water and VOC contaminants run downhill, that the 900-ft aquifer be studied, and reported on too.

RESPONSE TO COMMENT 5: *See response to Comment 1.*

[3] See Administrative Record No. OU2-480.
[4] See Administrative Record No. OU2-458.
[5] See Administrative Record No. OU2-630B.

COMMENT 6: Was the source of the Meningitis outbreak among the troops training at Fort Ord in the 1962-1964 time frame ever determined?

RESPONSE TO COMMENT 6: *There was no determination of the source as noted in the following article: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1515912/.*

COMMENT 7: Page 19-20, Sites 2/12, second paragraph, regarding contamination of the groundwater by COC's and seawater intrusion. The FOCAG asks about a timeline here because initially wells had to be closed and moved inland and the reason given, at the time, was because of chloride concentrations (sea water).

RESPONSE TO COMMENT 7: *In 1940 and 1941 there were nine water supply wells constructed in the Main Garrison area (some in the vicinity of Sites 2/12). Two of these were never used and most of the others pumped sand and produced water with high chloride concentrations. Seven of the water supply wells were decommissioned in 1951 or 1952, and the last two were decommissioned in 1989. From 1942 until 1984, additional water supply wells were constructed further inland. Most of these have been decommissioned, with only FO-29, FO-30, and FO-31 remaining.[6] Wells constructed in the Sites 2/12 area since 1989 have been for groundwater monitoring and groundwater extraction and treatment, not for water supply. Because seawater intrusion can damage groundwater remediation equipment, the Army measures chloride concentrations annually at Sites 2/12 in select groundwater wells, as noted in QAPP Worksheet #17c1, to ensure groundwater extraction and treatment activities do not make seawater intrusion worse in this area.*

COMMENT 8: Page 20, OU2; Please make it clear that moving a portion of the landfill to an unlined landfill contributed to the migration of contaminants downward into the aquifers. Secondly, the three wells referenced; FO-29, FO-30, and FO-31, located near the OU2 area are the Marina Coast Water District's source wells. The MCWD currently serves residential and commercial service connections on former Fort Ord and the City of Marina.

RESPONSE TO COMMENT 8: *Excavating waste from Landfills Area A on the north side of Imjin Parkway and consolidating it with waste in Landfills Areas B through F on the south side of Imjin Parkway did not contribute to migration of COCs to groundwater. The remedy for the Fort Ord Landfills is functioning as designed and is protective of human health and the environment.[7] The engineered landfill cover system, constructed in accordance with the remedy identified in the OU2 ROD, is specifically designed to prevent migration of contaminants to the groundwater. Migration of contaminants from the Fort Ord Landfills to groundwater that occurred prior to construction of the engineered cover system has been mitigated through extraction and treatment of landfill gas and groundwater per the requirements of the OU2 ROD (see also the response to Comment 3).*

The text was revised to state that MCWD owns and operates FO-29, FO-30, and FO-31 as part of the water supply system for the former Fort Ord and the City of Marina.

COMMENT 9: Page 21, 3.2.2, Step 2: Identify the Goals of the Study: We call your attention to the second "bullet" below OU2 and Sites 2/12 GWTS. GWTS stands for Ground Water Treatment Systems. It

[6] See Administrative Record No. BW-2002A.
[7] See Administrative Record No. OU2-480.

states here that, "Assess whether GWTS effluent meets discharge requirements before it is used for groundwater recharge or onsite for non-potable construction purposes (dust control, soil compaction, etc.)" We ask that you please expand this to include analysis of the goal of the Monterey Peninsula Water Management District's plan to inject treated sewer water, and water used for washing pesticides from produce, and other waste water, directly into the ground above a portion of the Seaside Groundwater Basin. This is a groundwater recharge effort, and we ask for clarification as to how much Fort Ord GWTS effluent might, or will, be mixed with this either intentionally or unintentionally?

RESPONSE TO COMMENT 9: *It is assumed the comment is referring to the Pure Water Monterey project, which includes replenishment of the Seaside Groundwater Basin with purified recycled water.*[8] *This type of analysis is not within the scope of the QAPP, which is a guidance document for groundwater sampling and analysis activities at the former Fort Ord. However, according to the* Final Engineering Report, Monterey One Water Pure Water Monterey Groundwater Replenishment Project*, replenishment is to occur via four injection wells that will recharge the Santa Margarita Aquifer and the Paso Robles Aquifer.*[9] *No mixing of purified recycled water and the Army's groundwater treatment systems (GWTS) treated effluent can occur because:*

- *The Santa Margarita Aquifer and the Paso Robles Aquifer are significantly deeper than, and not hydrologically connected to, the Upper 180-Foot Aquifer being recharged by the Army's GWTS.*
- *The northern boundary of the Seaside Groundwater Basin is at least 1.6 miles south of the Army's closest groundwater recharge structures.*
- *The general groundwater flow direction in the Seaside Groundwater Basin is to the west (i.e., parallel to flow in the Upper 180-Foot Aquifer).*

COMMENT 10: Bottom of page 22, Footnote 7 states, "Antimony, copper, and lead are the primary metals found in spent ammunition deposited in the Fort Ord landfills. MCL's are used to evaluate concentrations of these dissolved metals in groundwater near the Fort Ord Landfills; however, the groundwater being monitored is not intended for use as drinking water." The FOCAG asks for clarification of this footnote. Also, Army training involved dozens of chemicals. We understand the intent wasn't to drink it. But it is in the groundwater now, or headed there. Please reference the Administrative record for FOCAG document OTH-253 dated 01/02/2010.

RESPONSE TO COMMENT 10: *Footnote 7 was revised to clarify that:*

- *Detected concentrations of antimony, copper, and lead are compared to Federal and California Maximum Contaminant Levels (MCLs) because there are no Aquifer Cleanup Levels (ACLs) for these metals identified in the OU2 ROD.*
- *The groundwater being monitored is not intended for use as drinking water because it is within the Prohibition Zone of the Special Groundwater Protection Zone.*

---

[8] At its public meeting on March 9, 2017, the Central Coast Regional Water Quality Control Board adopted waste discharge and water recycling requirements for the Pure Water Monterey Advanced Water Purification Facility and Groundwater Replenishment Project; a copy of the order is available at https://www.waterboards.ca.gov/centralcoast/board_decisions/adopted_orders/

[9] The Engineering Report is available at http://purewatermonterey.org/wp/wp-content/uploads/M1W-Final-Title-22-Engineering-Report-April-2019.pdf

Section 3.2.1 of the QAPP was also revised to clarify the rationale for monitoring for antimony, copper, and lead in groundwater near the Fort Ord Landfills. Results of the sampling for metals analysis described in QAPP Worksheet #17c2 are in the OU2 reports for Third Quarter groundwater monitoring events, which are included in the Administrative Record. Concentrations of these metals in groundwater samples are all below MCLs.

Based on the reference to Administrative Record No. OTH-253, it is assumed the comment is concerned with chemical warfare material (CWM) contaminating groundwater at the former Fort Ord. There is no evidence of CWM having been used at the former Fort Ord. A comprehensive search was conducted at Fort Ord and did not uncover any evidence in records, interviews, or other information sources to indicate that chemical weapons were ever stored, used, or buried at Fort Ord. Evidence indicates the only CWM used at the former Fort Ord were Chemical Agent Identification Sets, which were used to train soldiers to recognize and protect themselves from chemical agents. In addition, more than 13 million anomalies have been investigated and more than 300,000 cubic yards of contaminated soil have been excavated during investigations and removals at Fort Ord without any evidence of CWM.[10]

[10] Technical Memorandum, CWM-Related Responses and Reports, Administrative Record No. OE-0726.

ATTACHMENT H

Response to Comments on the Draft Final QAPP

Responses to Comments submitted by the Central Coast Regional Water Quality Control Board (Water Board)[1]

In the Draft Final QAPP, Ahtna provides Attachment G: Responses to Comments Submitted by the Central Coast Regional Water Quality Control Board on the Draft QAPP. The Water Board has the following comments on the responses provided in Attachment G:

COMMENT 1: In Specific Comment 1, the Water Board recommended selecting one key groundwater monitoring well (i.e.: the well with the highest concentration of a known COC) at each of the OU2, Sites 2/12, and OUCTP Areas to sample and analyze for 1,2,3-Trichloropropane (1,2,3 -TCP) to confirm non-detectable results using a detection limit below the California Maximum Contaminant Limit (MCL) of 0.005 micrograms per liter (µg/L).

In response to Specific Comment 1, Ahtna acknowledged the analytical detection limits for groundwater samples historically collected at the former Fort Ord are higher than the current California MCL, but additional sampling and analysis for 1,2,3-TCP is not warranted based on the following lines of evidence:

- Common uses of 1,2,3-TCP included use as a paint and varnish remover, and a cleaning and degreasing agent. These uses would be consistent with historical uses of other solvents, including carbon tetrachloride (CT), tetrachloroethene (PCE), and trichloroethene (TCE), at the former Fort Ord when it was an active military installation. However, while CT, PCE, and TCE have historically been detected in groundwater, soil, and soil gas at the former Fort Ord at concentrations exceeding MCLs or screening levels by several orders of magnitude, there have been no corresponding detections of 1,2,3-TCP, indicating there was no significant usage of this compound.
- The vapor pressure of 1,2,3-TCP (3.1 mmHg at 25°C) and the calculated Henry's law constant ($3.17x10^{-4}$ atm-m^3/mol at 25°C) suggest volatilization from either dry or moist soil to the atmosphere will be a significant environmental process.[2] Therefore, if there was any release of 1,2,3-TCP to the ground surface, it is likely most or all of it would have volatilized to the atmosphere before it could leach to groundwater.
- Other media, including soil and soil gas, have been sampled and analyzed for 1,2,3-TCP at various sites across the former Fort Ord, including OU1, OU2, OUCTP, and Sites 2/12, and 1,2,3-TCP has never been detected, further indicating no significant usage of this compound at the former Fort Ord.

The Water Board appreciates the information provided in response to Specific Comment 1. Based on this information at a minimum the Central Coast Water Board recommends that the OU2 Groundwater Treatment System influent be sampled and analyzed for 1,2,3-TCP using a detection limit below the MCL of 0.005 µg/L. This data would confirm that 1,2,3-TCP is not present in the influent groundwater extracted as part of the groundwater remediation activities. If 1,2,3-TCP is present in influent groundwater extracted for treatment and recharge back into the aquifer, an effluent sample should also

[1] In a letter dated July 17, 2019 (see Administrative Record No. BW-2785G.4).
[2] Ibid.

be collected confirm that 1,2,3-TCP is removed to levels below the MCL prior to recharge back into the aquifer.

RESPONSE TO COMMENT 1: *The U.S. Department of the Army (Army) agrees to collecting a sample at the influent to the Operable Unit 2 (OU2) groundwater treatment plant (GWTP) to analyze for 1,2,3-TCP using a detection limit below the MCL of 0.005 µg/L. The sample will be collected during a regularly scheduled quarterly groundwater monitoring event or concurrently with GWTP process monitoring. Depending on the analytical results, the Army will evaluate the need for additional sampling in consultation with the Water Board.*

COMMENT 2: In response to Specific Comment 9, Worksheet #17c3 and Figure 8A were updated to remove well EW-BW-162-A from the OUCTP A-Aquifer sampling program. Well EW-BW-162-A appears on Figure 8A as a well that will be monitored for water levels however this well is not included on Worksheet #17c3.

Please update Worksheet #17c3 to show that well EW-BW-162-A will continue to be monitored for water levels.

RESPONSE TO COMMENT 2: *Figure 8A was revised to remove well EW-BW-162-A, and this well was not added to Worksheet #17c3. Per QAPP decision criteria, this well will not be monitored for chemicals of concern or for water levels.*

Appendix 7-D

Monterey County Quality Assurance Project Plan

Quality Assurance Project Plan (QAPP)
For
Water Quality Monitoring
Associated with the Salinas Valley Integrated Water Management Plan (SVIWMP)

EPA R9#03-238
X-97994701-0

Monterey County Water Resources Agency
P.O. Box 930
Salinas, CA 93902
Telephone: (831) 755-4860
Fax: (831) 424-7935
Website: http://www.mcwra.co.monterey.ca.us

1.0 PROJECT MANAGEMENT

1.1 TITLE AND APPROVAL PAGE

Quality Assurance Project Plan
For
Water Quality Monitoring Associated with
The Salinas Valley Integrated Water Management Plan (SVIWMP)
EPA R9#03-238
X-97994701-0

Prepared by:
Monterey County Water Resources Agency (MCWRA)
P.O. Box 930
Salinas, CA 93902

Prepared for:
US EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105-3901

Approval Signatures

[signature] Elizabeth Krafft Agency Project Manager:	8/12/07 Date:
[signature] Kathleen Thomasberg Agency Project QA/Task Manager:	8/17/07 Date:
[signature] Eugenia McNaughton, Ph.D. USEPA Region 9 QA Program Manager:	10/22/07 Date:
[signature] Carolyn Yale USEPA Region 9 Project Officer:	12/3/07 Date:
Mark Kutnink Mark Kutnink USEPA Region 9 Chemist:	22 OCT 2007 Date:

1.2 TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.3 DISTRIBUTION LIST

The following is a list of organizations and persons who will receive copies of the approved QA Project Plan and any subsequent revisions:

Monterey County Water Resources Agency (Agency)
P.O. Box 930
Salinas, CA 93902

Elizabeth Krafft
Project Manager
(831) 755-4860
krafftea@co.monterey.ca.us

Kathleen Thomasberg
Project QA/Task Manager
(831) 755-4860
thomasbergk@co.monterey.ca.us

Manuel Saavedra
Hydrologist/ Team Lead
(831) 755-4860
saavedram@co.monterey.ca.us

Carla James
Water Resources Technician/ Field Sampler
(831) 755-4860
JamesCR@co.monterey.ca.us

Tamara Voss
Water Resources Technician/ Field Sampler
(831) 755-4860
vosstl@co.monterey.ca.us

U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street
San Francisco, CA 94105-3901

Eugenia McNaughton, Ph.D.
QA Program Manager
(415) 972-1111

Carolyn Yale
Project Officer
(415) 972-3482

Mark Kutnink
Chemist
(415) 972-3801

Monterey County Consolidated Chemistry Laboratory (CCL)
1270 Natividad Road, Room A15
Salinas, CA 93906

Germain Guibert
Laboratory Director
(831) 755-4516

1.4 PROJECT/TASK ORGANIZATION

The organization responsible for overseeing this ground water monitoring program is the Monterey County Water Resources Agency (Agency). This project is funded through a grant from the Environmental Protection Agency (EPA), under the authority of Section §104 (b)(3) of the Clean Water Act. This project falls under the Monitoring and Assessment funding category. The Monterey County Health Department's Consolidated Chemistry Laboratory is a California state certified laboratory that will perform the chemical analyses for this ground water monitoring program. The laboratory will use standard analytical methods.

The roles and responsibilities of those involved in the implementation of the ground water monitoring program are described below. An organizational chart for the program is shown below.

Project Manager is the responsible official who will oversee the preparation of grants and the fiscal management of the project.

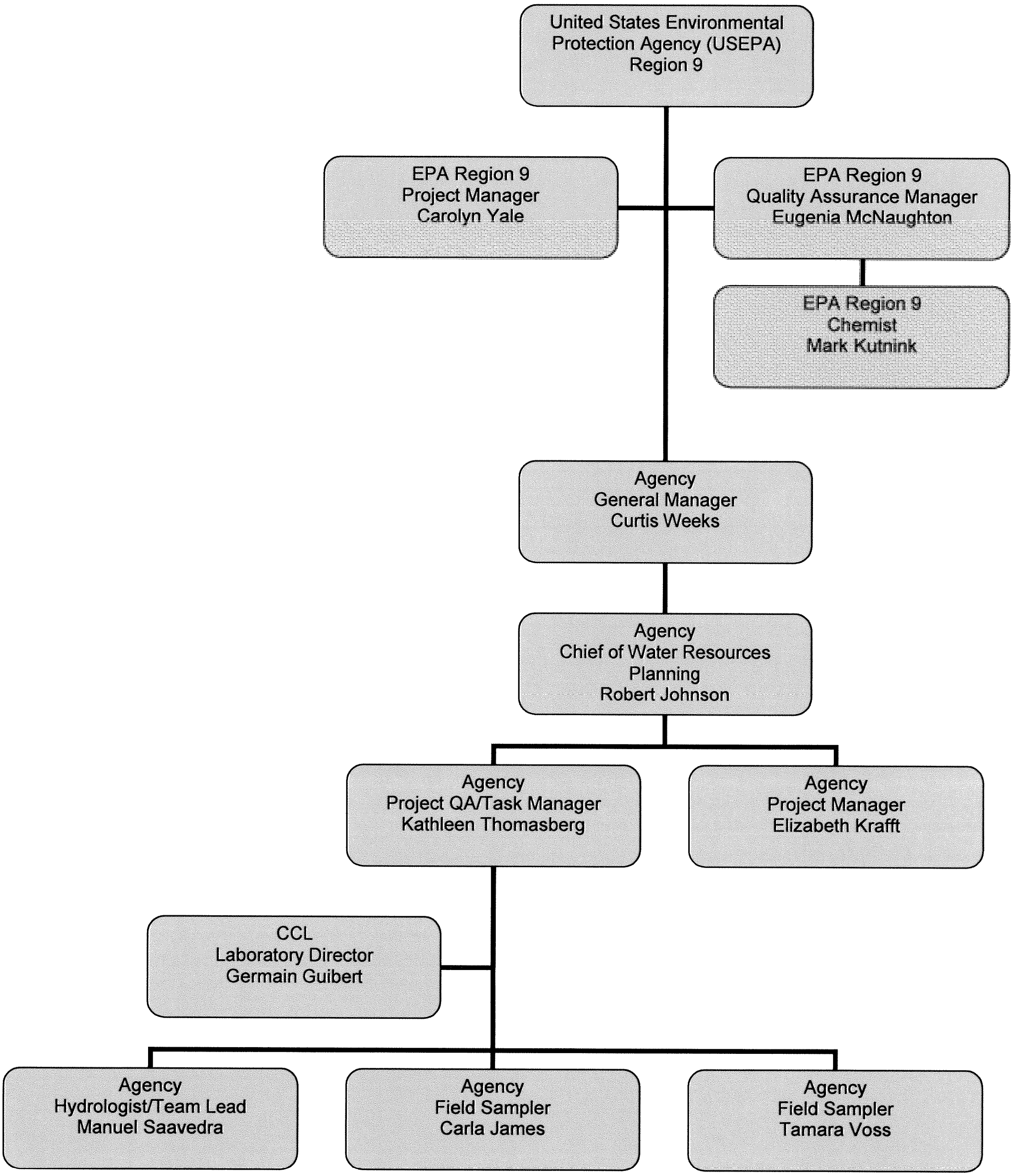
Project QA Manager is in charge of establishing the QA/QC protocols found in the QAPP as part of the sampling and analysis procedures. The QA Manager will also review and assess all analytical data from the contract laboratory and will be the liaison regarding data quality issues and concerns. She may stop all actions, including those conducted by the contract laboratory and will be responsible for ensuring that any amended versions of the QAPP are distributed to the organizations and individuals listed in Section 1.3.

Project Task Manager will oversee the ground water monitoring program. She will ensure that all QAPP protocols are followed and will oversee the writing and revisions of the QAPP. Since the Agency's Water Quality Department is not large, the Project Task Manager will function in the dual role of Task Manager and QA Manager.

Hydrologist/Team Lead will be responsible for coordinating with the Water Resources Technicians/ Field Samplers to review field and analytical requirements, documentation, and sampling schedules.

Water Resources Technicians/Field Samplers will be responsible for sample collection and communication with the contract laboratory regarding the sampling shipment schedule. They are also responsible for writing the QAPP.

ORGANIZATIONAL CHART



1.5 PROBLEM DEFINITION/BACKGROUND

1.5.1 Background

The Monterey County Water Resources Agency's (Agency) mission is to manage, protect, and enhance the quantity and quality of water for present and future generations of Monterey County (County). Monterey County, located along the California Central Coast, covers 3,322 square miles (8604 km^2) and has a resident population of 424,842 (Fact Finder, 2007). The County supports a \$3.4 billion agricultural industry (Ag Commission, 2006) and a \$1.75 billion tourism industry (EPA Grant R9#03-238). The primary land use within the Salinas Valley is agricultural. Since the 1940's, irrigated acreage within the valley has increased substantially. Coastal regions of California are subject to rapid urbanization, and the milder coastal climate supports year-round intensive cultivation of many high-value crops (Hunt et al, 2003). As agricultural and urban areas have expanded, so have the water needs of the County (EPA Grant R9#03-238).

The Agency uses a network of wells to monitor ground water conditions in the Salinas Valley Ground Water Basin (Basin) (Geomatrix, 2001). The Basin is situated entirely within the County (EPA Grant R9#03-238). The Salinas Valley is surrounded by the Gabilan and Diablo Ranges on the east, by the Sierra de Salinas and Santa Lucia Range on the west, and is drained by the Salinas River, which empties into Monterey Bay in the north (DWR 1946a) (Fig 1). Four subareas based on differences in local hydrogeology and recharge have been identified (White Paper, 1995; DWR, 2003). These are known as the Pressure, East Side, Forebay, and Upper Valley subareas (Fig 2). These subareas are hydrologically and hydraulically connected (EPA Grant R9#03-238); all information collected to date indicates there are no barriers to the horizontal flow (of ground water) between these subareas (White Paper, 1995). The "boundaries" between these subareas have been identified as zones of transition between different depositional environments in past millennia (White Paper, 1995).

The primary surface water features overlying and influencing the Basin's hydrology are the Salinas River and its tributaries, the Nacimiento and San Antonio reservoirs, and the Monterey Bay (EPA Grant R9#03-238). The Salinas River extends approximately 120 miles from the river's headwaters in San Luis Obispo County, near Santa Margarita, and flows north/northwest and discharges into the Monterey Bay National Marine Sanctuary near Moss Landing in Monterey County (EPA Grant R9#03-238). The Nacimiento and San Antonio reservoirs, located in the upper watershed, serve as storage and flood control for the Basin.

Ground water recharge in Salinas Valley is principally from infiltration from the Salinas River, Arroyo Seco Cone, and to a much lesser extent, from deep percolation of rainfall (White Paper, 1995). Deep percolation of applied irrigation water is the second largest component of the ground water budget, but because it represents recirculation of existing ground water rather than an inflow of "new" water, it is not considered a source of recharge (White Paper, 1995). Nitrate contamination of ground water poses a significant threat to the beneficial use of ground water for drinking water and for some agricultural water uses (White Paper, 1995). Nitrate concentrations exceed drinking water standards in some parts of the Basin (MCWRA, 1997). The principal source of nitrates to ground water is almost certainly excess fertilizer that is leached by rainfall and applied irrigation water (White Paper, 1995).

Seawater intrusion is another source of inflow to the Basin, but because it is not usable freshwater it is also excluded as a source of recharge (White Paper, 1995). Historically, ground water flowed from subareas to the south and east through the (Pressure) and seaward to discharge zones in the walls of the submarine canyon in Monterey Bay (Durbin et al 1978; Greene 1970). Within the Pressure subarea, due to the impermeable nature of the clay aquitard above the 180-Foot Aquifer, recharge from precipitation, agricultural return flows, or river flow is nil (DWR, 2003). Instead, recharge is from underflow originating in Upper Valley areas such as the Arroyo Seco Cone and Salinas River bed or the East Side subarea, and more recently, from seawater intrusion (DWR, 2003). Heavy pumping of the Pressure-180 Foot and Pressure-400 Foot aquifers has caused significant seawater intrusion into both of these aquifers, which was first documented in the1930's (DWR 1946a). Ground water flow in the northernmost area of the Pressure subarea has been directed from the Monterey Bay inland since this time (DWR, 2003). With increased pumping in the East Side subarea since the 1970's, ground water flow is dominantly northeast in the Pressure's central and southern locations (DWR, 2003).

Declining ground water levels in the Pressure and East Side subareas, Basin overdraft, ground water contamination, including nitrate and seawater intrusion are serious concerns for the Agency. (EPA Grant R9#03-238)

1.5.2 Program Objectives

The Agency is charged with management of the Basin's ground water resources. Much of the Agency's investigative work pertaining to the occurrence and use of ground water is to identify the quality, quantity, and temporal trends of ground water resources within the County. A network of monitoring wells provides the information needed to manage and protect ground water resources and sustain beneficial uses. In order for the Agency to develop projects to mitigate problems, such as seawater intrusion, local ground water overdraft, and high nitrate concentrations, the Agency must first implement an effective and accurate monitoring program to identify the extent of the potential problem.

The Ground Water Quality Monitoring Objectives are:
-continued monitoring of the ambient ground water quality, including general minerals
-continued monitoring of coastal aquifers (including Pressure Deep Aquifer) for detection of advancing seawater intrusion
-continued monitoring to determine distribution of conductivity in ground water
-continued monitoring to determine distribution of nitrate in ground water and identification of problem areas

Ambient ground water quality will be used to establish a cohesive and succinct Water Quality Management Plan in accordance to the work begun under EPA-I and continued under EPA-II. For the purposes of this QAPP, the EPA-I grant has funded the Agency to develop this QAPP. The EPA-II grant is funding the Agency to implement the sampling described in the QAPP.

1.5.3 Program Goals

The ground water monitoring objectives in the Salinas Valley will be met by the goal of sampling all 344 wells located throughout the four subareas within the Salinas Valley Ground Water Basin, during the 2007 summer field season.

The ground water monitoring objectives along the coast, specifically located within the Pressure subarea will be met by the goal of sampling all 85 monitoring wells, during the 2007 summer field season.

The Agency's overarching goal for this program is the continued monitoring of the Basin's ambient ground water for use in the management of this important resource, and *not* for the purpose of regulatory control.

1.6 PROJECT/TASK DESCRIPTION

1.6.1 Work Statement and Produced Products

The Salinas Valley Ground Water monitoring will sample 344 wells located throughout the Salinas Valley Ground Water Basin for ten constituents (Table 1). Each well will be sampled once. Samples will be collected during the 2007 summer agricultural growing season and analyzed for a complete mineral panel. The Coastal Ground Water monitoring will sample 85 wells located within the area of historic seawater intrusion. Each well in the Coastal Program will be sampled once a month during the agricultural growing season. The first month's sample will be analyzed for complete mineral panel and the two remaining sampling events will by analyzed for partial mineral panel (three constituents) (Table 1). All water monitoring samples will be delivered the same day as collected to the contract laboratory for analysis.

All ground water sampling locations are accessible using a 4-wheel drive vehicle. All samples will be collected as a grab sample. All sampling locations will be recorded using global positioning system (GPS) equipment, and digital pictures will be taken at each site.

After laboratory analysis and data validation is completed, a technical memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment) will be written and submitted to US EPA. The technical memorandum, EPA II, XP-96995301 Task 2 Water Quality Assessment, will include result tables for chloride, nitrate, and specific conductivity, and maps of chloride, nitrate, and specific conductivity gradient contours.

1.6.2 Constituents to be monitored and measurement techniques

Samples will be sent to an off-site laboratory for analysis. Ground water samples will be analyzed for either complete or partial mineral panels. A complete mineral panel includes calcium, cation-anion balance, chloride, conductivity, magnesium, nitrate, pH, potassium, sodium, sulfate, and total alkalinity. A partial mineral panel consists of chloride, conductivity, and nitrate.

Sample analysis will be preformed at the Monterey County Consolidated Chemistry Laboratory (CCL), which is part of the Environmental Health Department. Listed below is the laboratory's contact information and ELAP Certification number.

Laboratory Name	***Contact Information***	***Abbreviation***
Monterey County Consolidated Chemistry Laboratory ELAP Certification No 1395	1270 Natividad Road Salinas, CA 93906 Phone: 831-755-4516 Fax: 831-755-4652 http://www.co.monterey.ca.us/health	CCL

1.6.3 Project Schedule

The proposed project schedule is summarized below.

Prior to Sample Collection	
January 2006 - January 2007	: Develop project strategy
15 January, 2007	: Submit Draft QA Project Plan
22 March, 2007	: Receive review comments on QA Project Plan from US EPA
6 July, 2007	: Submit Draft Final QA Project Plan
13 July, 2007	: Obtain QA Project Plan approval (to begin fieldwork)
20 July, 2007	: Submit Final QA Project Plan (signatory copy) EPA R9#03-238; X-97994701-0
Sample Collection	
August 2007 - September 2007	: Coastal Ground Water (each well 3x, once per month)
August 2007 - September 2007	: Salinas Valley Ground Water (each well 1x)
Post Sample Collection	
November 2007	: Compile all remaining laboratory analyses reports
1 - 15 December, 2007	: Evaluate laboratory data for QA/QC requirements
15 December, 2007	: Copy of analytical results sent to well owner/operators
16 - 31 December, 2007	: Summarize and tabulate data
January 2008	: Write Technical Memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment)
March 2008	: Submit Technical Memorandum (EPA II, XP-96995301 Task 2 Water Quality Assessment) to US EPA

1.6.4 Geographical Setting

The Salinas Ground Water Basin encompasses approximately 537.5 square miles (1,392 km^2). The regional ground water flow is to the northwest. Seawater intrusion is a result of coastal pumping (Figure 3). Ground water pumping can dramatically impact localized coastal ground water flow.

1.6.5 Constraints

Ground water samples must be taken from the well while the pump is operating to ensure that the sample is representative of the aquifer and not standing water within the well casing. The Agency wants to measure the water quality when the aquifers are stressed due to pumping. For this reason the 2007 field sampling season will coincide with the agricultural irrigation season.

1.7 DATA QUALITY OBJECTIVES FOR MEASUREMENT DATA

This section describes the data objectives of the project and defines the measurement performance criteria deemed necessary to meet those objectives.

1.7.1 Objectives and Project Decisions

In Monterey County the Salinas Valley and Coastal Ground Water ambient monitoring programs are designed to characterize the ground water quality conditions of the Basin. All data generated from the sampling program in this project are tabulated as they have been over the many years of the program. Data generated from these monitoring activities allows the Agency to track changes in ground water quality over time and to assess potential impacts to ground water in the Basin. Water resource management and policy decisions may follow based on maps and tabulated data generated as a part of this project (program).

For the coastal ground water sampling program, the general mineral data are evaluated to determine if seawater intrusion is progressing landward as indicated by increasing well chloride values. The chloride values for all wells are evaluated, and then the 500mg/L chloride isochlor contours are mapped for the two coastal aquifers. When the maps are published, the information generated by MCWRA staff and approved by the MCWRA Board of Directors, is posted and passed on to Monterey County departments, regional government regulatory agencies, and public / private entities via the MCWRA web page, presentations, public meetings, and networking.

Monterey County departments such as the Planning Department and Health Department utilize the advancement of seawater as it relates to potable water and public health, while the agricultural community becomes aware of the proximity of their wells to the intrusion advancement, and the possible need for funds to drill new, deeper, wells and destroy the older high nitrate wells. Actions by regulators, depending on the entity, are related to prioritization of Regional Watershed and Water Quality Action Plans, and the associated success of MCWRA capital projects to halt seawater intrusion as governed by the State Water Resources Control Board adjudication process.

Actions by the MCWRA after the landward advancement of seawater have been ongoing for many years. Actions include consideration of more stringent Monterey County well drilling ordinances for assuring the continued prevention of cross-aquifer contamination in the coastal Salinas Valley, *"Zone 6 Drilling Standards", April 19, 1988;* the development and implementation of the Monterey County Recycling Projects, a tertiary treatment plant and treated water distribution system, to help further reduce agricultural pumping in the coastal Salinas Valley for halting seawater intrusion; and future use of these data will be utilized by the newly established Seaside Watermaster for comparison to and the development of the Monterey Peninsula seawater intrusion front.

For the Salinas Valley general mineral ground water sampling program, nitrate data tabulation and map representation has been the focus of the MCWRA for many years. All results over the laboratory's practical quantitative limit generated from this program are tabulated to evaluate the minimum, maximum, median, and mean value of nitrate as NO_3 in mg/L for each of the Salinas Valley Hydrogeologic Subareas.

For the Salinas Valley monitoring program, the Agency sends the general mineral testing results, including nitrate, to the well owners/growers who operate the wells sampled. Also, in this transmittal, the well operators are also provided with a conversion sheet of the nitrate concentration *from mg/L nitrate as NO_3 to pounds of nitrate per acre inch of water*, agricultural terms. If a nitrate value in ground source water is elevated, then that growers can incorporate this available nitrate into their fertilizer crop scheduling. This is a method for growers to reduce applied nitrate to crops, while maintaining maximum crop productivity.

And, as with the Coastal monitoring program, the tabulated and mapped Salinas Valley nitrate data are posted and passed on to Monterey County departments, regional government regulatory agencies, and public / private entities via the MCWRA web page.

The MCWRA uses the well nitrate data during the technical well application review process. Monterey County Health Department (Heatlh Department) issues well permits after the Agency provides a technical review of well applications for new, abandoned, or repaired wells. The well application proposal is evaluated with other well construction and water quality within a one miles radius of the new well and represented on a map. Agency staff makes qualitative recommendations to the Health Department on the new well's sanitary seal based on other well seals, the perforated intervals, and the nitrate values of wells in the area. The final decision for the well construction is made by the Health Department after the well drilling progresses.

Actions taken by the MCWRA are conditional. If extreme nitrate values are observed in agricultural production wells, then re-sampling of the wells may take place to confirm the elevated concentrations and may lead to increased sampling points for wells in the same vicinity and with the same well design. Continued increases in Salinas Valley ground water nitrate values could lead to special nitrate investigations on movement of nitrate in ground water and also outreach to the public on the reduction of nitrate to the environment.

1.7.2 Action Limits/Levels

Since the overarching goal for this project is the continued monitoring of ambient ground water, the Agency has set no specific water quality standards. As a result, the laboratory's practical quantitation limits (PQL) will serve as the Project Action Levels (PALs). Table 1 provides a listing of the parameter to be sampled and a summary of the laboratory's method detection limit, those minimum concentrations that can be detected above the instrumental background/baseline signal noise. Table 1 also provides the PQL, lowest calibration standard and PALs required by the Agency for the QAPP. The quality limits listed are deemed acceptable by the Agency to meet the project objectives.

1.7.3 Measurement Performance Criteria

The objective of data collection for this Monitoring Project is to produce data that represent the *in situ* conditions of the ground water. This objective will be achieved by using accepted standard methods for water collection and analysis and defining data quality indicators (DQIs) for each analytical parameter. The DQIs include accuracy, precision, comparability, sensitivity, completeness, and representativeness and are defined below and presented in Table 2. Some DQIs will be assessed quantitatively, while others will be qualitatively assessed. Example calculations have been provided for quantitative assessments and appropriate quality control (QC) samples have been identified. Laboratory Data Quality Objectives are given in Table 3.

Accuracy, or bias, is a measure of how close a result is to the expected value of the target analyte in a sample. Accuracy will be determined by the analysis of certified reference materials and matrix spikes, where the results can be compared with an expected value and expressed as %recovery. This is an assessment of laboratory analytical methods. For Laboratory Control Samples (LCS), it will be expressed as %recovery by the following equation:

$$\%Recovery = \frac{X}{T} \times 100$$

where,

X = Measured concentration
T = True spiked concentration

or, for Matrix Spike (MS) samples, by the following equation:

$$\%Recovery = \frac{(B - A)}{T} \times 100$$

where,

B = Measured concentration of spiked sample
A = Measured concentration of unspiked sample
T = True spiked concentration

The frequency of the LCS and MS samples associated with the analytical parameters will be 5%. MS and MSD samples will be spiked at 3-10 times the native sample concentration.

Accuracy/bias as related to contamination involves both field and laboratory components. Field blanks will be collected at a frequency of 5%. Laboratory blanks will be prepared and analyzed at a one per batch or 5% frequency.

Precision is concerned with the ability to quantitatively repeat results. To demonstrate the precision of a method or instrument, field duplicates will be collected, analyzed, and their results compared. Precision is expressed as relative percent difference (RPD) by the following equation:

$$RPD (\%) = \frac{|X_1 - X_2|}{(X_1 + X_2)/2} \times 100$$

where,

X_1 = Original sample concentration
X_2 = Duplicate sample concentration
$|X_1 - X_2|$ = Absolute value of $X_1 - X_2$

Field duplicates will be collected at a frequency of 10% for the first two sampling events. If the criterion of <25% RPD is met, then the remaining field duplicates will be collected at a 5% frequency. Laboratory duplicates will be prepared and analyzed at a one per batch or 5% frequency.

Comparability of the data can be defined as the similarity of data generated by different monitoring programs. Comparability helps to measure the scientific coherence and validity of a project. This objective is addressed primarily by using standard sampling and analytical procedures. Additionally, comparability of analytical data is addressed by result comparison of certified reference materials.

Sensitivity of the analytical instrument or method is the ability to detect and quantify an analytical parameter at the concentration level of interest. Sensitivity can be evaluated by method or instrument detection limit studies (MDL and IDL) or calculated practical quantitative limits (PQL) and method report limits (MRL).

Completeness is a measure of the amount of successfully collected and validated data relative to the amount of data planned to be collected for the project. Project completeness is typically based on the percentage of the data needed for the program or study to reach statistically valid conclusions. Because the SVIWMP is a monitoring program, data that are not successfully collected for a specific sample event or site can typically be recollected at a later sampling event. For this reason, most of the data planned for collection can not be considered statistically critical, and it is difficult to set a meaningful objective for data completeness. However, some reasonable objectives for the data are desirable, if only to measure the effectiveness of the Monitoring Program. %Completeness will be expressed by the following equation:

$$\%\text{Completeness} = \frac{N}{T} \times 100$$

where,

N = Number of usable results
T = Total number of samples planned to be collected

A completeness goal of 90% has been set for the ground water monitoring program.

Representativeness can be defined as the degree to which the environmental data generated by the monitoring program accurately and precisely represent actual environmental conditions. This objective is addressed by the overall design of the monitoring program. Specifically, assuring the representativeness of the data is addressed primarily by selecting appropriate locations, methods, times, and frequencies of sampling for each environmental parameter, and by maintaining the integrity of the sample after collection. Representativeness judges how well a single sample can describe the conditions of an entire sample population. Accurate, artifact-free sampling procedures and appropriate sample homogenization achieve representativeness.

1.8 TRAINING REQUIREMENTS/CERTIFICATION

1.8.1 Training of Field Personnel

A specialized training requirement for this project is for the use of Global Positioning Systems (GPS) Technology. Training in the use of handheld GPS units and software will be performed on an individual basis between the trainer and the trainee. Training will be provided by staff experienced in the use of GPS and Geographic Information Systems (GIS).

Field personnel will also be given initial instructions prior to the beginning of sample collection activities. These initial instructions will help familiarize the field personnel with sample collection containers, sample handling techniques, chain-of-custody forms, and sample transport. New field personnel will be accompanied by a trainer in the field as part of the initial instructions. All field samplers have completed a four-hour training session in the field. Training included confirmation of the well ID electrical meter tag number and MCWRA tag number, recognizing the appropriate sampling port, sample collection technique, proper handling of the sample during transportation to the lab, and accurate completion of the chain-of-custody forms. The completion of field training session has been documented in the Agency's personnel files.

All field personnel will follow sample collection procedures from accepted methods for the collection of ground water. Sample collection will follow protocols in accordance with recommended guidelines established by the U.S. Geological Survey (USGS) for ground water collection as described in the

National Field Manual for the Collection of Water-Quality Data, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9. Field personnel will be familiar with the above-mentioned document.

Field personnel will also read and be familiar with this Quality Assurance Project Plan (QAPP) prior to beginning any sample collection activities.

1.8.2 Training of Laboratory Personnel

No specialized training of laboratory personnel is required for this project. The ground water constituents to be analyzed by the laboratory are routine and do not require additional expertise. In addition, the laboratory's QA plan notes that analysts 'must conduct sufficient preliminary tests using the methodology and typical samples to demonstrate competence in the use of the measurement procedure'.

1.8.3 GPS Training Documentation

Documentation of field personnel training for GPS includes: the name of the staff member being trained, the training date, the name of the trainer (instructor), and a checklist of satisfactory completion of each step. These training records are stored inside a monitoring binder and filed in the Agency's Water Quality Section. A sample GPS training record is attached in Appendix A.

Training documentation of laboratory personnel for routine methods is kept on file at the Consolidated Chemistry Laboratory (CCL). The CCL has written a policy regarding laboratory personnel training in their lab QA plan.

1.9 DOCUMENTATION AND RECORDS

1.9.1 QA Project Plan Distribution

The MCWRA Hydrologist/ Team Lead will safeguard the original QAPP and any subsequent revisions (both hard and electronic), plus keep a record of the distribution list in order to send out amendments to the QAPP and retrieve any obsolete versions (from the individuals listed earlier in section 1.3).

1.9.2 Field Documentation and Records

All field documentation generated by the sampling program will be kept on file in the Water Quality Section of the Agency. Field documentation includes field sheets, chain of custody (COC) forms, photographs, and labels (see Appendix B for examples of each).

1.9.2.1 Field Sheets

Field sheets are used to aid in the identification of each ground water source (well). The field sheets list the name of each well (as assigned by the well owner) and the State Well Number. The field sheets also contain a section that describes who the sampler should contact in order to have a well turned on, where to find the sample port, etc. The sampler is responsible for recording the sample date and time on the field sheet. Site observations should be written in the comments section of the field sheet, and initialed by the sampler. Site observations may include information such as detailed directions to the well location, changes to the electrical meter tag number, and the owner contact name and phone number. Field sheets also contain PG&E electrical meter numbers, which can be either verified or updated while the sampler is in the field.

Field sheets are double-checked by the sampler for completeness and accuracy while still in the field. The sampler should look for: incomplete and/or missing data/omissions, incorrect or invalid information, and clarity problems. Any discrepancies should be cleared up before the sampler leaves the field. Data that has been entered by one field sampler will be reviewed by a different field sampler to verify that no transcription errors have occurred. These data entry reviews will take place at least weekly.

Original field sheets are categorized (according to Coastal wells or Salinas Valley wells) inside binders which are kept in the Water Quality Section at the Agency for a period of 10 years. After such time, the copies are transferred to the Monterey County Record Retention Center and archived for a period of 5 years.

Data collected on field sheets will also be recorded electronically and stored in an Access database inside a shared network drive that is backed-up on a daily basis. These electronic records will be retained permanently.

1.9.2.2 Chain Of Custody (COC) Forms

Chain-of-custody (COC) forms will be provided by the Consolidated Chemistry Laboratory and filled out while the sampler is in the field. The COC will accompany the samples at all times in order to insure the custodial integrity of the samples. A sample is considered to be in custody if it is: in someone's physical possession, in someone's view, locked up, or secured in an area that is restricted to authorized personnel.

Care should be taken to protect the COC from physical damage (i.e., water, wind, etc). The COC will have the following information:

- Client Code
- Client Name
- Client Address
- Client Phone Number
- Client Fax Number
- Report Attention
- Sampler Name
- Collection Date
- Collection Time
- Sample Site (identified by state well identification number) or QC sample (if appropriate)
- Sample Type (all of the samples in this project will be **grab** samples)
- Matrix (all of the samples in this project will be **ground water** samples)
- Analyses Requested

Upon relinquishing the sample(s) to the Consolidated Chemistry Laboratory, the sampler will sign and date the COC form. Lab personnel will then receive the sample(s), mark the date and time received, assign unique lab identification numbers (lab IDs) to each sample, and sign the COC form. The signed COC form is then photocopied; the lab keeps the original, and a copy is given to the sampler.

Hard copies of COC forms are categorized (Coastal wells or Salinas Valley wells) inside binders which are kept in the Water Quality Section at the Agency for a period of 10 years. After such time, the copies are transferred to the Monterey County Record Retention Center and archived for a period of 5 years.

Electronic COC information is also stored in an Access database inside a shared network drive that is backed-up on a daily basis. These electronic records will be retained permanently.

1.9.2.3 Photographs

The Agency maintains a photo catalog which contains photographs of the Coastal well site locations. The photo catalog is carried into the field to assist with the identification of each well. If there are significant changes to the appearance of the well site, then staff will take a new digital photo. The old photo in the catalog will then be replaced with a copy of the new photo. Photographs will be taken of the Salinas Valley wells after confirming the correct well location of each.

Two photographs of each well location will be taken using a high resolution digital camera. One photograph will be from a distance of 100 ft. or more to aid in the identification of the correct site location. The second photograph will be a close up of the well and pump head, which will be used to verify location of the correct sampling port. Printed hard copies of these two photographs for each well will be kept in the photo log book and labeled with the state well identification number as listed on the field sheets.

Photographs will serve to help verify information entered into the field sheets. Photographs are stored in an electronic database and labeled according to site number and date last photographed. Previous photos will be archived electronically for retrieval purposes if the need arises.

1.9.2.4 Labels

Labels for each sample site are pre-printed on Avery (size 5163) sheets (10 labels per sheet). Indelible ink will be used on the labels and clear packing tape will be applied over the label to prevent it from coming off if it gets wet. Each label will have the following information:

- Sample Site (pre-printed)
- Collection Date (to be filled out in the field)
- Collection Time (to be filled out in the field)
- Analyses Requested (complete or partial mineral panel)
- Sampler Name (to be filled out in the field)
- Comments (if any)

The sample site name (state well identification number) will serve as the unique identifier for each sample (e.g. 14S/02E-08M02). When the samplers arrive at the CCL a unique in-house lab number is assigned to each sample.

1.9.2.5 Field Quality Control Sample Records

Quality Control samples from the field will be identified using the state well identification number plus either -1 or -2 (e.g. 14S/02E-08M02-1, for a field blank).

- -1 = Field Blank
- -2 = Field Duplicate

1.9.3 Laboratory Documentation and Records

The Consolidated Chemistry Laboratory will keep a sample receiving log containing the completed COC forms submitted with the samples collected for this project. The CCL will keep records of all analyses performed as well as associated QC information, including: laboratory blanks, laboratory duplicates, matrix spikes, matrix spike duplicates and laboratory control samples. Hard copy data of analytical results will be maintained for three years by the CCL. The CCL maintains a Laboratory Information Management System (LIMS) which will be used to store electronic data.

The data generated by the CCL for each sampling event will be compiled into individual data reports. The individual data reports will include the following information:

- Sample results and associated Quantitative Limits (QLs)
- Cation-Anion Balance Sheet
- QC check sample records and acceptance criteria for the following:
    - Laboratory Control Sample(s)
    - Matrix Spike(s)
    - Matrix Spike Duplicate(s)
    - Analytical Duplicate(s)
    - Method Blank(s)
- Project narrative including a discussion of problems or unusual events (including, but not limited to, topics such as: receipt of samples in incorrect, broken, or leaky containers, with improperly or incompletely filled out COC forms; receipt and/or analysis of samples after the holding times have expired; summary of QC results exceeding acceptance criteria; etc.)

The above information is logged into the LIMS database at CCL.

The Public Health Chemist of the Consolidated Chemistry Laboratory will be responsible for reviewing, validating, and/or qualifying results on the data reports. Any deviations from sample preparation, analysis, and/or QA/QC procedures will be documented. Departure from QC acceptance limits will be highlighted. Once the data reports are finalized, the hard copy will be sent to the Project QA Manager at the Agency.

At the end of the sampling season, all data for both programs (Coastal and Salinas Valley) will be electronically transferred to the Agency. After data verification, the Agency Hydrologist/ Team Lead will upload the data to the Agency's Water Resources Agency Information Management System (WRAIMS) relational database.

1.9.4 Technical Reviews and Evaluations

Technical reviews and evaluations are limited to Field Activities and Laboratory Data Review Checklists.

1.9.4.1 Field Activities Review Checklist

Field personnel will be required to fill out a Field Activities Review Checklist as part of the double-check process upon returning from the field after each sampling event (see Appendix C).

1.9.4.2 Laboratory Data Review Checklist

Laboratory data reports from the CCL will be routed to the Project QA Manager at the Agency, who will do a preliminary assessment of the data. The data reports will then be given to the Agency

Hydrologist/ Team Lead who will be responsible for completing a Laboratory Data Review Checklist (see Appendix C).

1.9.5 Technical Memorandum

The Agency Project QA Manager is responsible for the preparation of the technical memorandum. The technical memorandum will be written in the "post sample collection" phase (see section 1.6.3). The technical memorandum will be submitted to USEPA for review by the EPA Region 9 Project Manager.

The technical memorandum will contain the following elements:

- Table of results for Chloride
- Table of results for Nitrate
- Table of results for Specific Conductance
- Map of Chloride contours for 500 mg/L values
- Map of Nitrates showing those sites which have values above and below the Drinking Water Standard Limit of 45 mg/L (nitrate as NO3)
- Map of Conductivity contours

2.0 DATA GENERATION AND ACQUISITION

2.1 SAMPLING DESIGN

In the Salinas Valley, there are four hydrogeologic subareas: Pressure, East Side, Forebay, and Upper Valley. All four subareas were selected using a directed sampling design approach. These subareas were selected deliberately based on knowledge from previous monitoring work to contain analytes of interest, specifically nitrate and conductivity in the Salinas Valley Program, and chloride and conductivity in the Coastal Program. Actual sampling sites/wells within the Salinas Valley Basin Monitoring Program were chosen using a non-deliberate sampling approach. The wells included are acquired opportunistically. Site accessibility is a key issue for sampling. Permission of property owners must be secured before accessing private wells.

There are just over 1700 active wells in the Salinas Valley. Of this total number of wells, 344 wells make up the Salinas Valley Ground Water program and 85 wells make up the Coastal Ground Water program. The wells that make up these two programs have all been sampled in the past; some have data sets as far back as the 1950's, when this was a State of CA Department of Public Works (now the Department of Water Resources) program. The Agency wants to keep as complete and continuous a data set for each of these wells as possible.

Due to the time constraints the Agency is facing during this shortened 2007 field season, June - September, staff will prioritize which wells within the Salinas Valley portion of this project will be sampled. Wells to be sampled first will be located within approximately one mile radius of municipalities and industries (such as vegetable packing plants). We refer to these areas as high beneficial use areas. Ground water wells will be identified by State Well Numbers (Township, Range, Section, and Subsection).

All wells are high production agricultural wells. All wells are sampled in the same way, if the pump is in operation then a sample will be collected. If the pump if not operating then the field sampler will note it on the field sheets and come back to the well at a later date when the well is in operation. The pump must be operating for a sample to be collected. The age of well does not alter sampling protocols. If a well is found to have been abandoned since the Agency last sampled the well, a notation will be made on the field sheets and the well will be removed from future sampling efforts.

2.1.1 Salinas Valley Ground Water

While it is known that high levels of nitrates exist in some aquifers of the Salinas Valley Ground Water Basin, a significant sampling effort to determine the extent in the ground water has not been conducted by the Agency for several years. There are a total of 344 sample locations within the Salinas Valley monitoring program. Sample locations are operational ground water wells, the majority of which are used for agricultural irrigation. The Pressure subarea has 158 wells, the East Side subarea has 66 wells, the Forebay has 84 wells, and the Upper Valley has 35 wells (Figures 4-7). Each of these wells will be sampled once during the 2007 summer field season (July-September). The primary criterion currently used to determine if a well will be included in the Salinas Valley monitoring program has been its status as previously sampled. This program is an ongoing ambient ground water monitoring program and continuity in sampling the same wells each field year is of prime importance, especially for water quality trend analysis. Other factors that are important in deciding if a well should be included in the monitoring program are; copy of the well completion report (commonly referred to as the driller's log), location of the perforation interval along the well casing to determine which aquifer is sampled, age of the well, and construction method used to drill the well. Additionally it is useful to know the proximity of the well to other water use (industrial, municipal, or domestic) areas. A list of Salinas Valley well names and locations are given in Table 4. All wells on this program are planned to be part of the monitoring design for subsequent years. Until these monitoring wells are abandoned or destroyed, they will remain part of this program.

2.1.2 Coastal Ground Water

The Agency currently conducts a seawater intrusion monitoring and mapping program (EPA II). This program will continue to evaluate the extent and status of seawater intrusion in the coastal areas of the Salinas Valley Basin (EPA II). The Coastal portion of the ground water program contains 85 wells, most of which are located in the Pressure subarea (Figure 8). Each well will be sampled three times, once each month of the summer 2007 field season (July-September). The first sample collection at each well will be analyzed for a complete mineral panel (Table 1), and following two collections will be analyzed for a partial mineral panel (Table 1). There are 21 wells located in the Pressure 180-Foot Aquifer, 52 wells within the Pressure 400-Foot Aquifer, two wells with perforations within both the Pressure180-Foot and 400-Foot Aquifers, four wells are located within the Pressure Deep Zone Aquifer, three in the East Side Deep Aquifer, one in the East Side Shallow Aquifer, and one in the Prunedale Aquifer. The principal criterion for inclusion in the Coastal monitoring program is historical sampling and well availability. Additional criteria for selecting a well for inclusion into the Coastal monitoring program are: a well completion report, location of the perforation interval along the well casing to determine which aquifer is sampled (180, 400, or deep zone AQ), well age, and well construction type. A list of Coastal sites and their representative aquifers are listed in Table 5.

It can not be stressed enough how important the continued monitoring of these ground water wells are for the Agency to meet its mission of monitoring the quality of the County's ground water resources. Some of these well have been sampled since the 1950's and the loss of such a long term water quality record within the County of Monterey would irreplaceable.

2.2 SAMPLING METHODS

The objectives of the sampling procedure are to minimize changes in ground water chemistry during sample collection and transport to the laboratory, and to maximize the probability of obtaining a representative, reproducible ground water sample. This well-volume purging procedure provides a reproducible sampling technique with the goal that the samples obtained will represent water quality over the entire screen interval of the well.

Standing water in the well casing can be of a different chemical composition than that contained in the aquifer to be sampled. Solutes may be adsorbed on to, or desorbed from the well casing material, oxidation may occur, and biological activity is possible. Therefore, the stagnant water within the well must be purged so that the sample is representative of the aquifer. As a result, a well may be sampled only after the pump has been in operation for at least 15-20 minutes.

All the wells included in this project, from both the Salinas Valley area and the Coastal monitoring area are high production agricultural wells that contain deep turbine pumps operating at 500-1200 gallons per minute (gpm). Over the years of managing the ambient monitoring program, the Agency has determined that operating a deep turbine pump for 15-20 minutes before taking a sample is sufficient time to clear the entire well casing of three well volumes for ensuring a representative well sample. For referencing well casing volume, the Agency uses the well casing size provided in the well completion reports (driller's log) for each of the wells included in this monitoring program (National Field Manual for the Collection of Water-Quality Data, Chapter A2).

Sample bottles and caps are rinsed three times with ambient ground water prior to collection. The sample container is then filled, tightly capped, and labeled. No field sample filtration is required. Samples are put into a cooler with ice immediately and maintained at 4°C and delivered to the laboratory daily. See Table 6 for sample collection requirements. Extra sample containers, caps and field supplies will be carried in the truck as back-up should any problem arise in the field. Additionally, the Field Sampler will carry and maintain an updated hardcopy of the QAPP in the field to be used as a reference.

The following precautions will be followed in order to limit sampling error at the wellhead:

- Operate the pump long enough to produce water that is representative of the aquifer and not stagnant water from the casing.
- Take samples at the wellhead or near the wellhead and away from fertilizer injection ports.

Sample collection will follow protocols in accordance with recommended guidelines established by the U. S. Geological Survey (USGS) for ground water collection as described in the National Field Manual for the Collection of Water-Quality Data.

The National Field Manual for the Collection of Water-Quality Data, U.S. Geological Survey, Techniques of Water-Resources Investigations, Book 9, Chapters A1-A9 is maintained as a web-based document and is located at http://pubs.water.usgs.gov/twri9A. Updates and revisions for the National Field Manual can be found using this web-based approach.

2.3 SAMPLE HANDLING AND CUSTODY

This section describes how all samples will be treated after collection, during transport, and upon arrival at the CCL. It also includes information on proper sample disposal after laboratory analysis.

2.3.1 Sample Containers and Preservatives

Sample containers to be used in this project are high density polyethylene (HDPE), one pint (~0.5 L) and 0.5 gallon (~2 liter) sizes, for partial mineral or complete mineral analyses, respectively. The Agency has used these same sample container types during previous years of this ongoing ambient monitoring program and has never had any problems with container contamination issues. Field blanks will be closely monitored and, should a problem arise, corrective actions will be taken. Only one container (pint *or* half gallon) is needed per sampling site to provide the necessary volume to run the required lab analyses (see Table 6). Sample containers and caps are purchased in bulk from a plastic container manufacturer (Consolidated Container Company). The caps for the containers are packaged separately. The containers and caps are clean upon receipt, as long as they arrive with the outer cardboard packaging intact. The containers will be kept in a closed, dry environment away from the outside elements. Sterility is not of importance because this sampling project does not include microbiological testing. As previously mentioned, all containers and caps will be rinsed three times with ambient sample water prior to sample collection.

Sample containers are labeled with pre-printed labels, which lists which panel of analytes is requested, either complete mineral or partial mineral. The collection date, collection time, and sampler name are recorded in the field with an indelible marker. After being filled out, labels will be covered with clear plastic tape (packaging type) to protect the labels from destruction during transport.

No chemical *field preservation* of the samples is required. All samples will be kept at 4±2°C.

Preservation of samples, if required prior to analysis, will be the responsibility of the contract lab (CCL). Part of the CC lab sample receiving protocols includes lab personnel verifying, at the time of sample receipt, if any samples require lab preservation. Refer to Table 6 for listings of preservatives for specific analytes.

2.3.2 Sample Packaging and Transport

All samples will be handled, prepared, transported and stored in a manner so as to minimize contamination and spills. After collection, sample caps will be checked for tightness, and the samples will be put in ice chests immediately. During travel between sites, ice chest lids will be kept tightly closed in order to keep the samples at the correct temperature and protect them from sunlight. Ice used for maintaining sample temperature will be double-bagged inside durable plastic bags (Ziploc type) and be of sufficient quantity so that all samples will stored at 4±2°C. Maximum holding times for specific analytes are listed in Table 6.

2.3.3 Sample Custody

Chain of custody (COC) procedures require that possession of samples be traceable from the time the samples are collected until completion and submittal of the analytical results. A completed chain of custody form is to accompany the samples to the contract laboratory (CCL). Requirements for COC paperwork can be found in Section 1.9.2.2 of this document.

All samples collected for this project will be transported from the field to the CCL via an Agency vehicle. The field sampler will deliver the samples directly to the CCL daily; there will be no intermediary transfers. Samples need to arrive at the CCL no later than 15:00, to ensure log-in and laboratory preservation. Personnel at the CCL will examine the samples for correct documentation and holding times. The CCL will follow sample custody procedures as outlined in their QA plan (see Appendix D).

2.3.4 Sample Disposal

All samples remaining after successful completion of analyses will be disposed of properly. It is the responsibility of the personnel at the CCL to ensure that all applicable regulations are followed in the disposal of samples or related chemicals. Sample disposal procedures used by the CCL are discussed in their QA plan (see Appendix D).

2.4 ANALYTICAL METHODS

All samples will be analyzed at the County Consolidated Chemistry Laboratory (CCL). Analyses will be performed following either EPA approved methods or methods from *Standard Method for the Examination of Water and Wastewater, 18th Edition,* see Table 1 (CCL's QA Manual cites *18th Edition,* see Appendix D). Standard operating procedures (SOPs) from CCL have been included in Appendix D for each of the analyses. Should there be any deviation from these SOPs the Laboratory Director must contact the Project QA Manager.

The CCL will submit a data report and associated QC results after analyses are complete to the Project QA Manager. This data report is described in Section 1.9.3. After a preliminary assessment the Project QA Manager will pass the data on to the Team Lead, who will review the data report and QC results and evaluate its quality and usability in addressing the Project objectives.

2.5 QUALITY CONTROL

2.5.1 Field Sampling Quality Control

The assessment of field measurements will be determined from the collection and analysis of field blanks and field duplicates. For this monitoring program the field blanks will be collected at one every 20 samples or a frequency of 5%. Field duplicates will be collected at a frequency of 10% for the first two sampling events. If the criterion of <25% RPD is met, then the remaining field duplicates will be collected at a 5% frequency. Analytical acceptance criteria and corrective actions for field QC are listed in Table 2.

Deionized (DI) water will be acquired from the CCL and kept at 4±2°C, while transported into the field. Field blank samples will be obtained by pouring DI water into a pint (~500 mL) HDPE sample container that has been triple-rinsed with DI water at the sampling location. The container will be tightly capped, placed in the cooler and delivered to the contract laboratory. Field blanks are labeled with the sampling location (State Well Number) followed by "-1".

Field blanks will be used to evaluate the collection process (from field sampling through sample analysis) for contamination from exposure to ambient conditions, from sample containers or from improper sampling and handling technique. If target analytes are found in field blanks, sampling and handling procedures will be reevaluated and corrective actions taken. Corrective actions may consist of, but are not limited to, re-training of field personnel, discussions with the contract laboratory, invalidation or qualifying of results.

Field duplicates will be collected for every analytical parameter. The duplicate sample will be collected immediately after collection of the native, following the same sampling protocols. Field duplicates are labeled with the sampling location (State Well Number) followed by "-2".

Field duplicates will be used to evaluate the precision of the sample collection through analysis. The combined variability from sampling and analysis technique, in addition to sample heterogeneity, will be assessed using field duplicates. If acceptance criteria are exceeded, field sampling and handling protocols will be reviewed and problems corrected. These may consist of, but are not limited to, additional training, revised sampling techniques and reevaluation of sampling location.

2.5.2 Laboratory Analyses Quality Control (Contract Laboratory)

The Monterey County Consolidated Chemistry Laboratory's (CCL) personnel are responsible for analytical Quality Control. Standard laboratory quality control elements include method blanks, laboratory control samples, analytical duplicates, matrix spikes and calibration procedures. Laboratory data quality objectives include QC acceptance criteria, frequency of analysis, and corrective actions. These data quality objectives and quality control elements for CCL are described in its QA Manual (Appendix D) and SOPs (Appendix D) and are listed in Table 3. After examination of these documents, the Agency believes that the laboratory will be able to meet the project data quality needs. Any deviation from these written procedures must be documented by the laboratory and reported to the Project QA Manager.

2.6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Testing, inspection, and maintenance of laboratory equipment are the responsibility of the Monterey County Consolidated Chemistry Laboratory and are detailed in its QA manual in Appendix D.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

Instrument calibrations are the responsibility of the Monterey County Consolidated Chemistry Laboratory and acceptance criteria for calibrations are detailed in its QA manual in Appendix D.

2.8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES

2.8.1 Initial Inspection of Supplies

As mentioned previously in Section 2.3.1, sample containers are purchased in bulk from an outside vendor who specializes in supplying plastics to the beverage industry. An initial inspection will be conducted upon receipt of each shipment. Each shipment will be considered acceptable for use if *all* of the following are true:

- The shipment arrives with the outer cardboard packaging intact.
- The containers are the correct type (HDPE) and size (0.5 gal/~2L *or* 1 pint/~0.5L).
- The insides of the containers are dry.
- The insides of the containers are free of dirt or any particulate matter.

2.8.2 Field Inspection of Supplies

Immediately prior to sample collection, field samplers will visually inspect each sample container for the following:

- Dirt or any particulate matter
- Cracks of any size
- Improper fit of the cap on the container

If the field sampler observes any of the above, then the container will be discarded and an acceptable container will be used instead.

2.8.3 Laboratory Inspection of Supplies

CCL will be responsible for establishing inspection and acceptance criteria for supplies that adhere to their internal QA/QC policies.

2.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

Non-direct measurement data will not be used during this monitoring program. Should at some time in the future the Agency decide to use data from an external source, QA/QC requirements will be established. Should this occur, an addendum to this QAPP will be submitted to USEPA.

2.10 DATA MANAGEMENT

Data, as related to documentation and records, will be managed as outlined earlier in Section 1.9 of this QAPP.

In addition, the CCL will group QA/QC data under a separate client code so that QA/QC data can be filtered from regular sample data before being uploaded into the Agency's Data Management System (WRAIMS). This allows the Agency a greater flexibility both in quickly and easily accessing the data that included QA/QC samples for initial review, and increased flexibility in uploading and moving large data sets.

3.0 ASSESSMENT AND RESPONSE ACTIONS

This section lists review procedures that will be taken to ensure all the protocols outlined in the QAPP are consistently followed.

3.1 REVIEWS

3.1.1 Readiness Reviews

Water Resources Technicians/ Field Samplers will be trained by the Hydrologist/Team Lead before any field sampling begins. Training will cover proper sample collection and handling and the completion of all paperwork (COCs, field logbooks, etc). The Team Lead will ensure that Field Samplers have properly prepared all collection containers, paperwork and other supplies needed to complete a successful sampling event. Any problems discovered during the readiness review will be corrected before the Samplers begin work.

3.1.2 Field Reviews

The Team Lead will be responsible for overseeing that all field activities are incompliance with Agency protocols. The Team Lead will be available via phone should any questions arise while the Samplers are in the field. The Team Lead will also review all field paperwork such as COCs and field logbooks for completion. Additionally the field QC samples (field blanks and duplicates) will be used to evaluate the individual Sampler's technique. If problems are exposed they will be corrected straight away so that all further samples are valid. A stop-work order may be issued by the Project QA Manager at any time if a discrepancy or error is found that could negatively affect the data being collected.

3.1.3 Post Sampling Reviews

Post sampling reviews will be conducted following each sampling event in order to ensure all information is complete. Reviews will be conducted by the Field Sampler due to the small size of the staff. They will include evaluation of sampling activities and field documentation and will take place in the office, not in the field. Findings will be passed on to the Team Lead and the Project QA Manager to be incorporated into the next field event.

3.1.4 Laboratory Data Reviews

The Team Lead will be responsible for reviewing the laboratory's data for completeness and accuracy. The data will also be checked to determine that all specified methods were used and all related QC data was provided with the sample analytical results. These reviews will take place immediately upon receipt of data reports from the laboratory. This will ensure that any method deviations are corrected or explained, and any missing or incomplete data are provided. The Project QA Manager has the authority to request re-testing of laboratory data if it is invalid or would otherwise compromise the quality of the resulting project conclusions.

3.2 REPORTS

The Project QA Manager will be responsible for the technical memorandum (EPA R9# 03-238 Task 3.3) which will be provided in March 2008 to US EPA. The technical memorandum (EPA R9# 03-238 Task 3.3) will include result tables for chloride, nitrate, and specific conductivity, and maps of chloride, nitrate, and specific conductivity gradients. The technical memorandum will include a summary of any significant QA/QC issues and how they were resolved. It is currently understood that this project is of short enough duration that only a final technical memorandum to the EPA is necessary.

4.0 DATA VALIDATION AND USABILITY

4.1 DATA VERIFICATION AND VALIDATION

Data review is the in-house examination to ensure that the data have been recorded, transmitted, and processed correctly. The Team Lead is responsible for the data review. This examination will check for data entry errors, calculation errors, and data omission errors. If possible these errors will be corrected.

4.1.1 Field Data

Field data include logbooks, photographs, and COCs. The Field Sampler is responsible for reviewing the field data at the end of the sampling event. This includes determining that all information is complete and any deviations from the sampling methodologies are documented using the Field Activities Review Checklist (Appendix C).

4.1.2 Laboratory Data

Initial evaluation of the laboratory data are carried out by the CCL in agreement with protocols listed in their SOPs and QA manual. The Team Lead will also conduct an independent review of the data and QC parameters as described in sections 3.1.4 and using the Laboratory Data Review Checklist as detailed in section 1.9.4.4 and Appendix C.

4.2 RECONCILIATION WITH USER REQUIREMENTS

The purpose of the continued ambient monitoring of the Salinas Valley Basin Ground Water is to assess the water quality to manage and protect ground water resources. For data to be useful in developing the overreaching Salinas Valley Integrated Water Management Plan, it must first meet the requirement of this QA project Plan. The Project QA Manager will be responsible for making the final evaluation of the data's usability in meeting the Project objectives. All data passing this final evaluation will then be used to establish a cohesive and succinct Water Quality Management Plan in accordance to the work begun under EPA-I and continued under EPA-II. Additionally, the Agency will integrate these ground water quality data with previously collected data for use in trend analysis.

5.0 REFERENCES

Department of Public Works, Division of Water Resources (DWR). 1946. *Bulletin 52: Salinas Basin Investigation.*

Durbin, TJ, GW Kapple, JR Freckleton. 1978. *Two-Dimensional and Three-Dimensional Digital Flow Models of the Salinas Valley Ground-Water Basin, California.* US Geological Survey. Water Resources Investigations Report 78-113. Prepared in cooperation with the US Army Corps of Engineers.

Geomatrix Consultants. 2001. *Evaluation of the Salinas Valley Groundwater Monitoring Network and Proposed Redesign.* Prepared for The Monterey County Water Resources Agency.

Greene, HG. 1970. *Geology of Southern Monterey Bay and its Relationship to the Ground-Water Basin and Seawater Intrusion.* US Geological Survey Open File Report.

Hunt, JW, BS Anderson, BM Phillips, PA Nicely, RS Tjeerdema, HM Puckett, M Stephenson, K Worcester, V deVlaming. 2003. *Ambient toxicity due to chlorpyrifos and diazinon in a Central California Watershed.* Environ. Monit. Assess. 82: 83-112.

Monterey County Agricultural Commissioner's Office (Ag Commission). 2006. *Monterey County Crop Report.*

Monterey County. 2007. *Fact Finder.* Prepared by Monterey County Administrative Office.

Monterey County Water Resources Agency (MCWRA). 1997. *Water Resources Data Report, Water Year 1994-1995.*

Quality Assurance Project Plan for Monitoring of Surface Water Eagle Valley Reservation. 2005. Prepared by Eagle Valley Environmental Program Eagle Valley Band of Indians Eagle Valley Reservation. Prepared for US EPA Region 9.

Salinas Valley Ground Water Basin Hydrology Conference (White Paper). 1995. *Hydrogeology and Water Supply of Salinas Valley.* Prepared for The Monterey County Water Resources Agency.

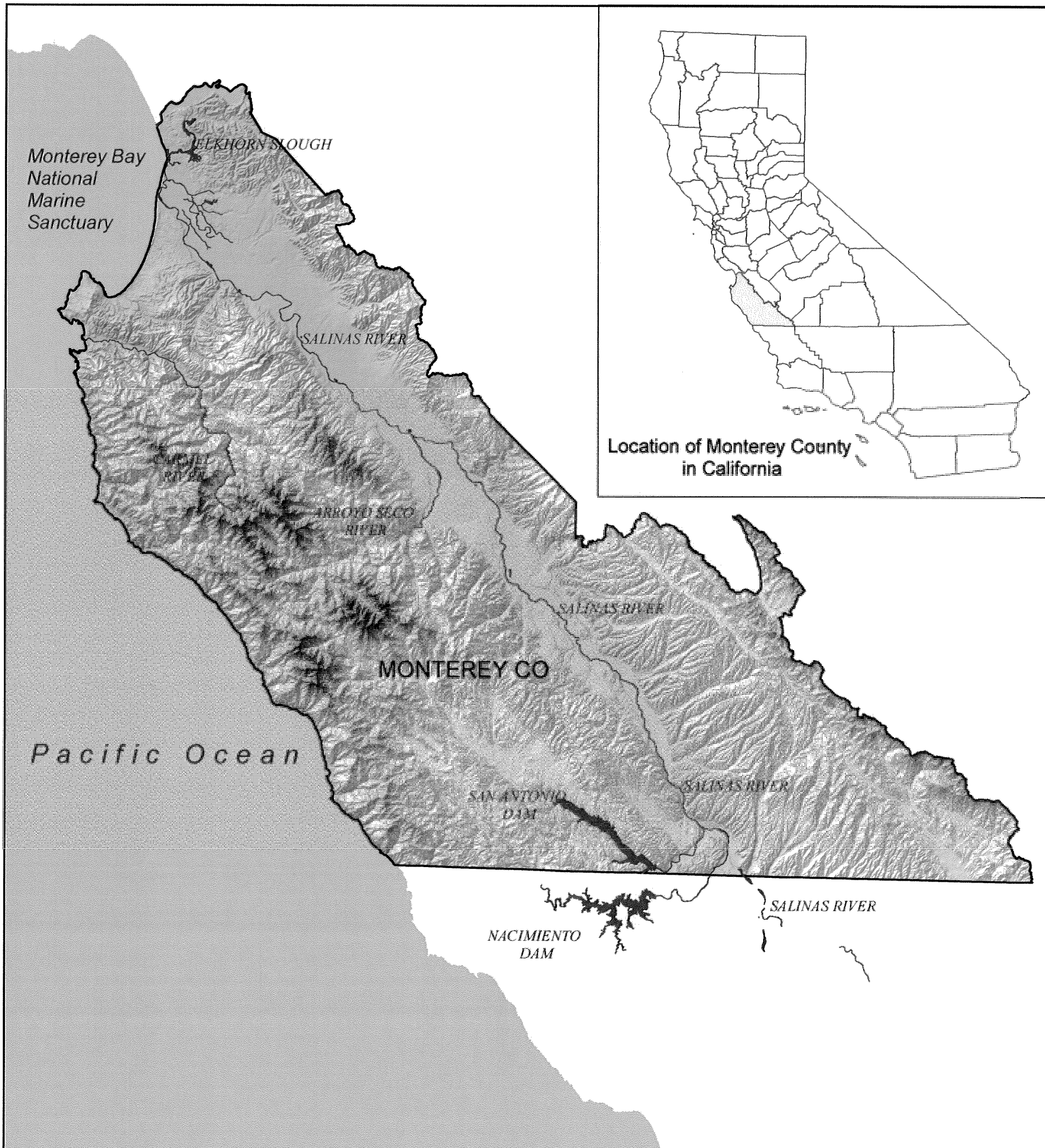
State of California, Department of Water Resources (DWR). 2003. *Bulletin 118 Update: California's Groundwater.*

Sycamore Creek Quality Assurance Management Plan. 2006. Prepared by Instant Reference Sources, Inc. Prepared for California State Water Resources Control Board.

US EPA. 2002. *Guidance for Quality Assurance Project Plans.*

US EPA Grant R9# 03-238. 2003. *Salinas Valley Integrated Water Management Plan.* Prepared by The Monterey County Water Resources Agency. Prepared for US EPA Region 9. Grants Management Office.

FIGURES



Legend
Water Bodies/ Channels

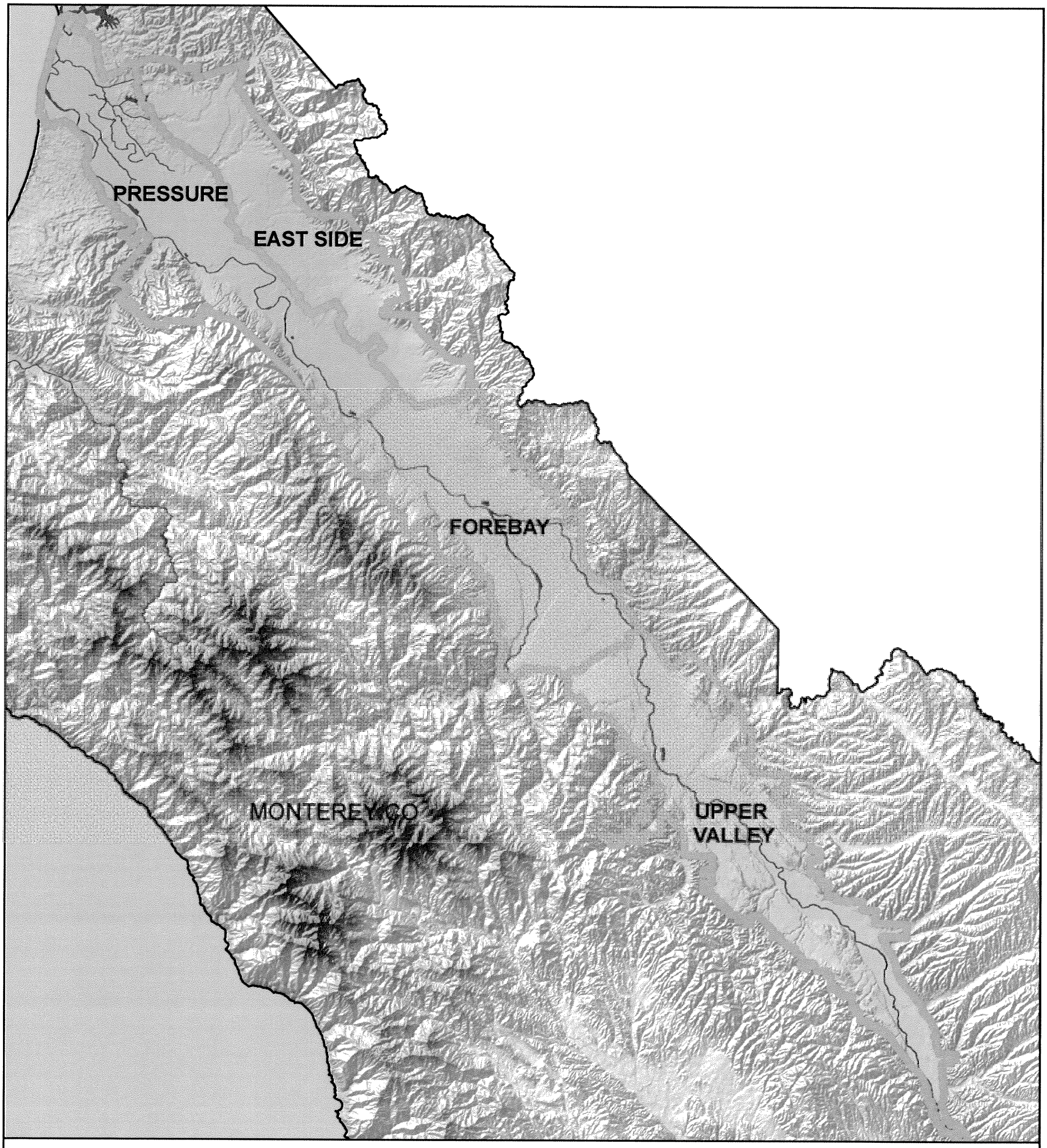
Monterey County, California

Figure 1

0 4 8 12 16 Miles

Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Legend
Water Bodies/ Channels

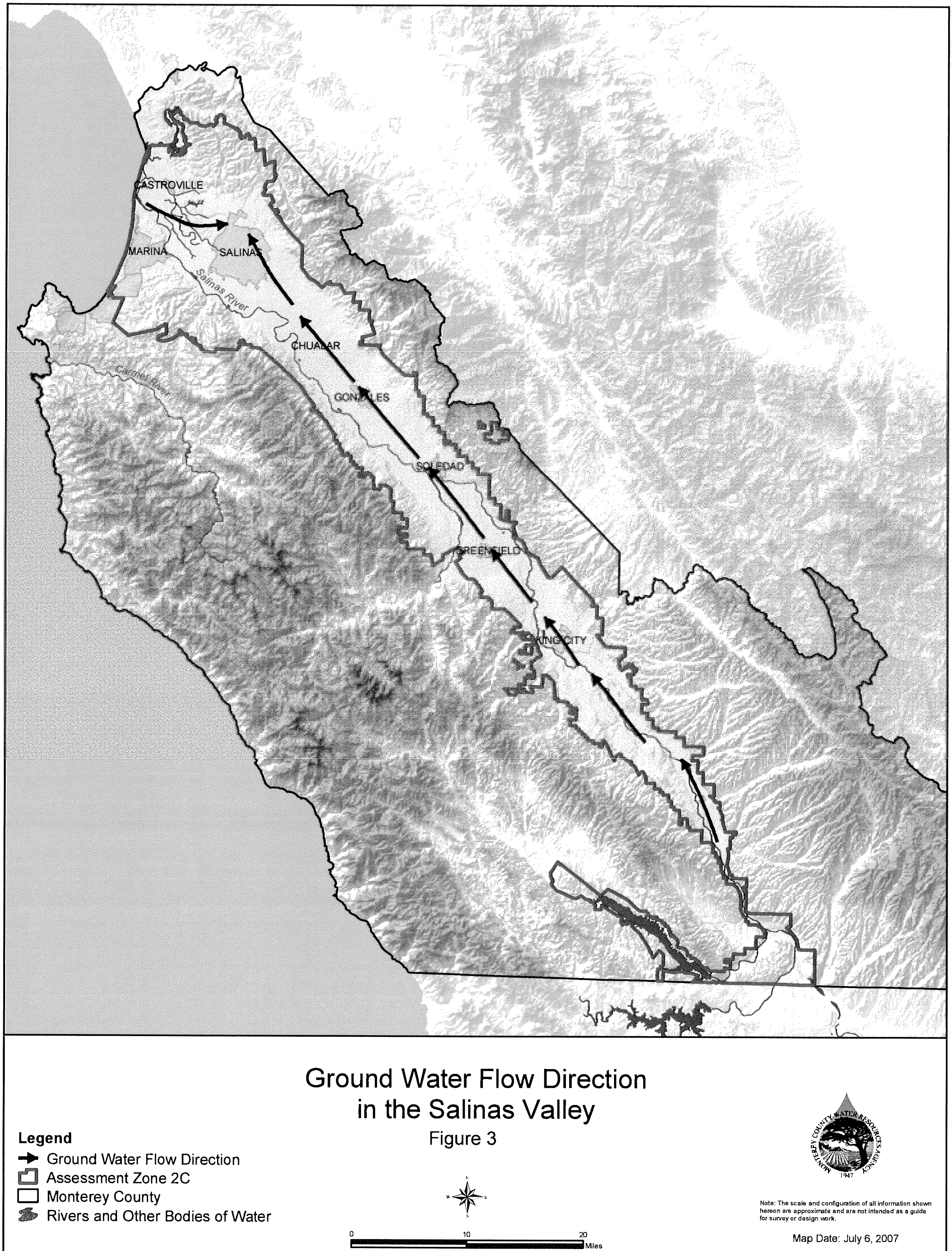
Salinas Valley Aquifers

Figure 2

0 2 4 6 8 Miles

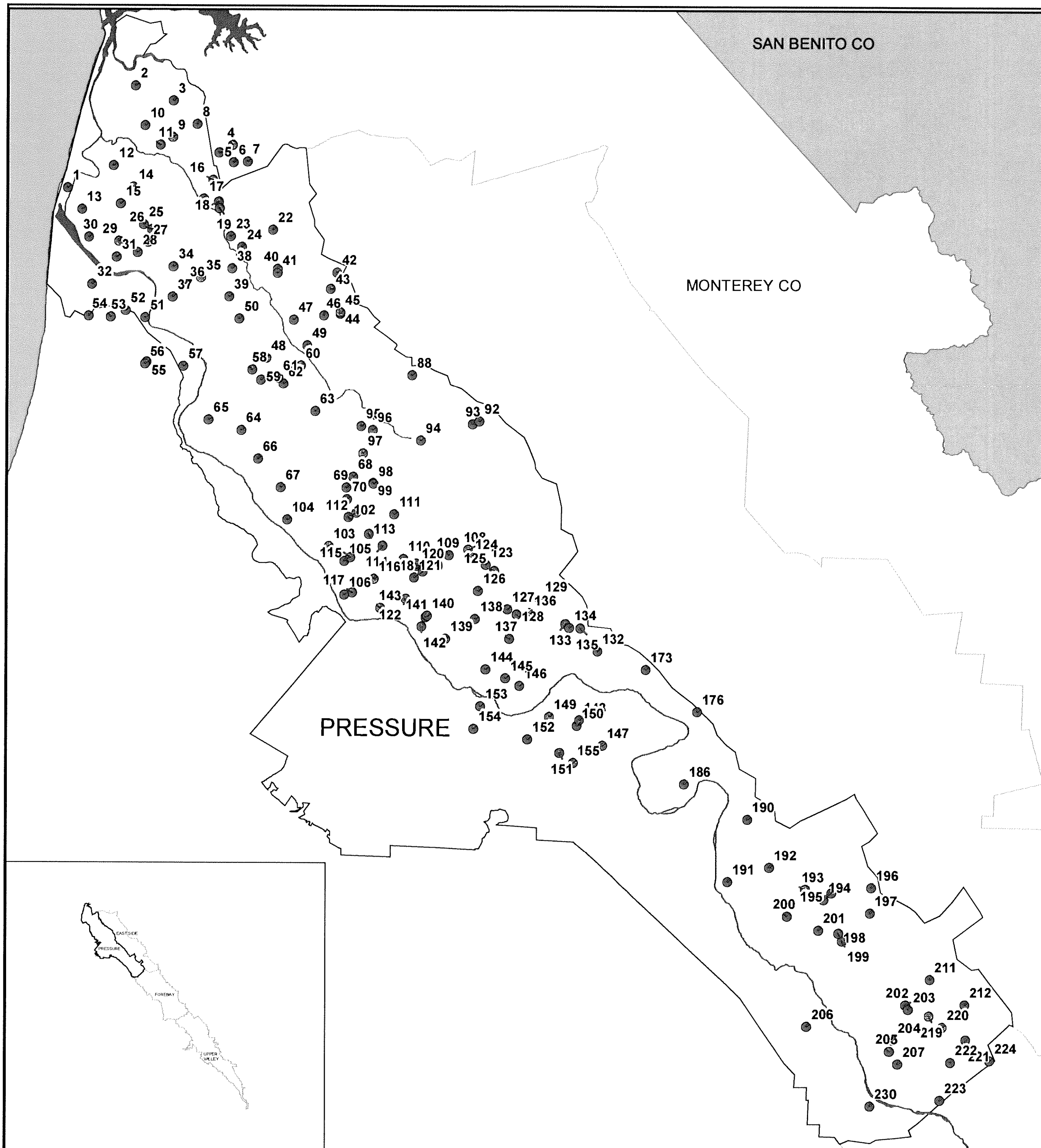
Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Ground Water Flow Direction in the Salinas Valley

Figure 3



Salinas Valley Wells in the Pressure Subarea

Figure 4

Legend:

- Study Well
- Rivers

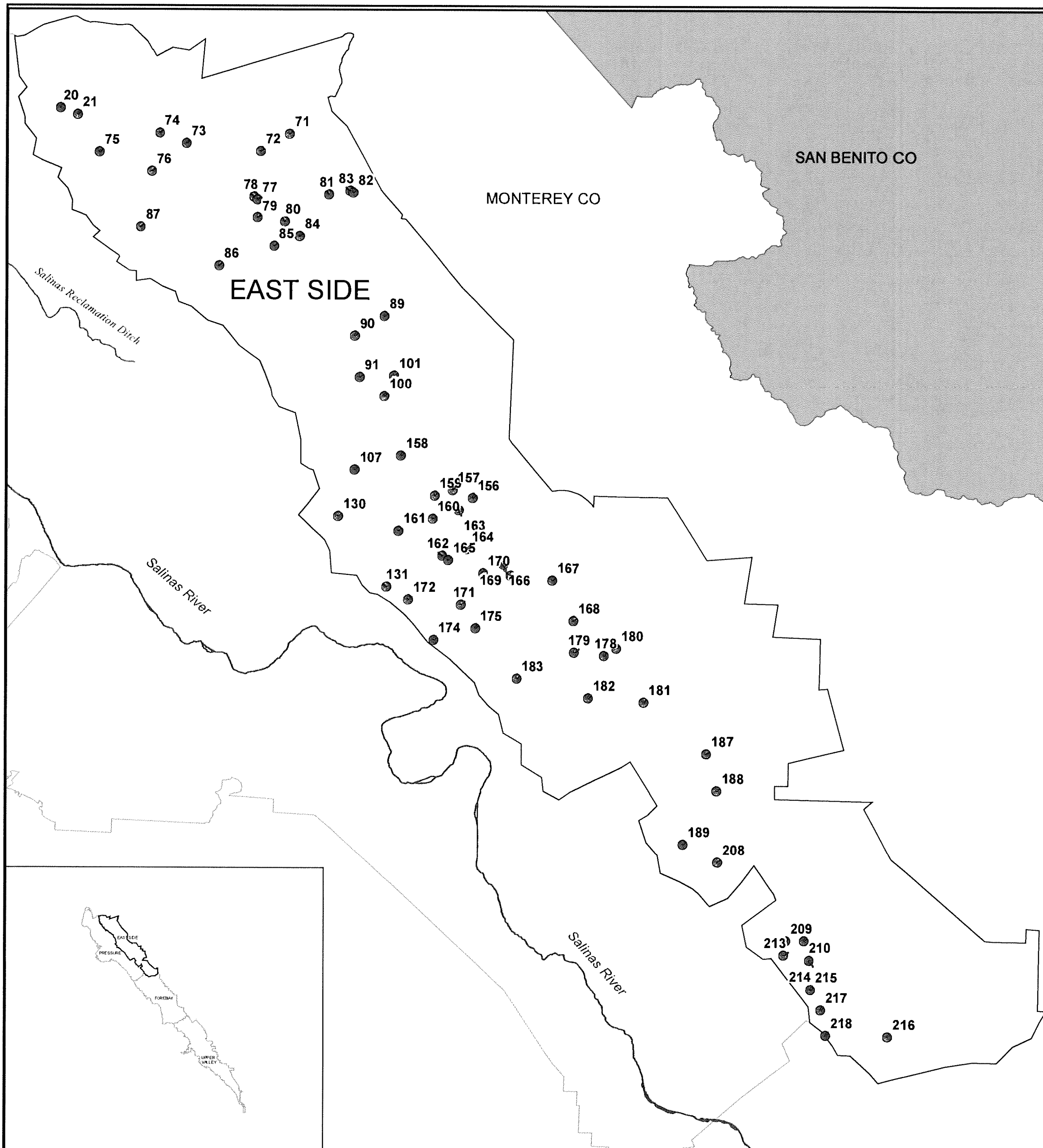
SUBAREA

- SUBAREA
- PRESSURE

0 0.75 1.5 2.25 3 Miles

Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Salinas Valley Wells in the East Side Subarea

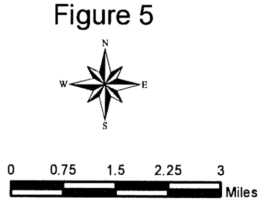
Figure 5

Legend:

- Study Well
- Rivers

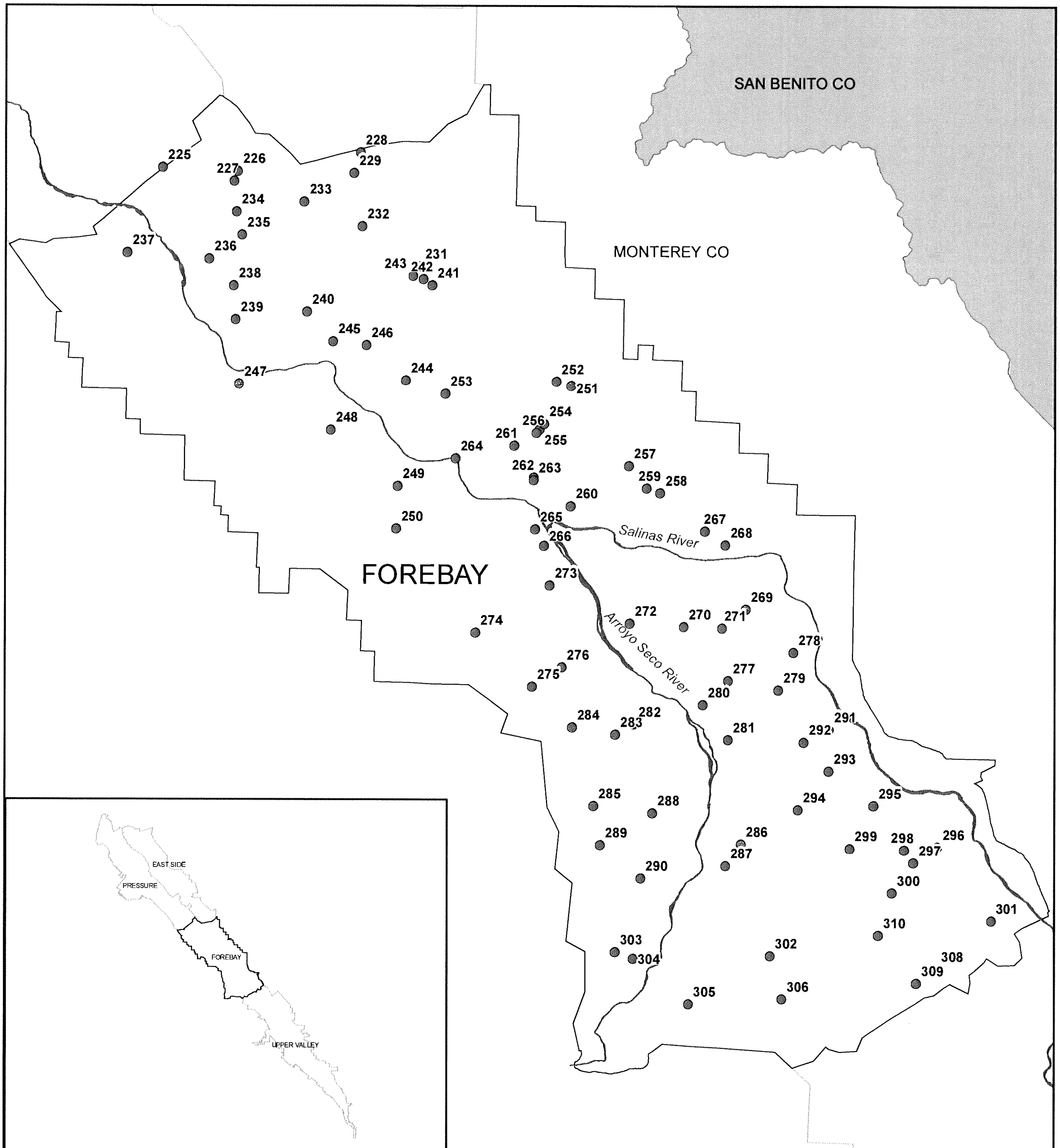
SUBAREA

- SUBAREA
- EAST SIDE



Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Salinas Valley Wells in the Forebay Subarea

Figure 6

Legend:

- Study Well
- Rivers

SUBAREA

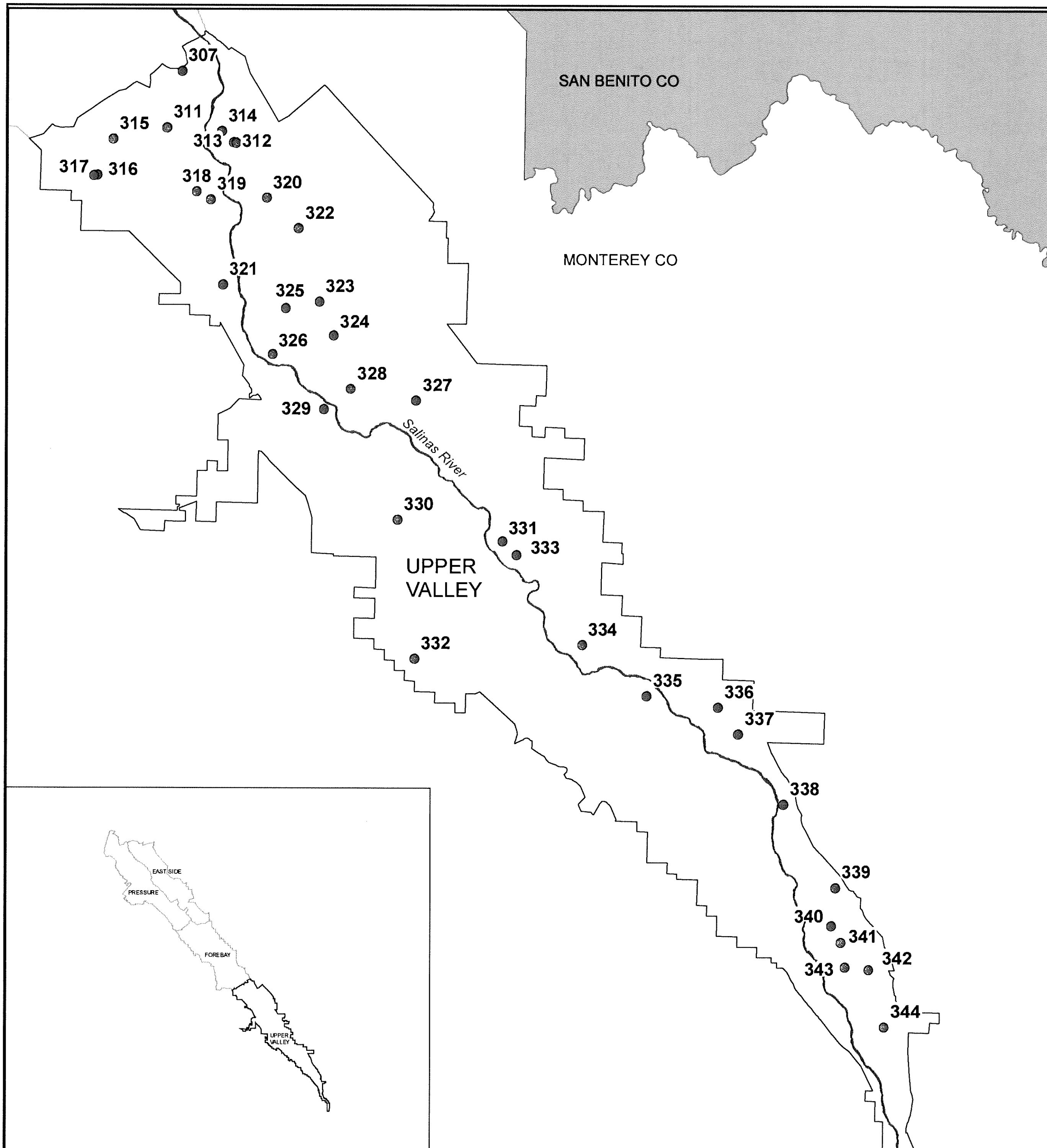
- SUBAREA
- FOREBAY

N W E S

0 0.75 1.5 2.25 3 Miles

Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Salinas Valley Wells in the Upper Valley Subarea

Figure 7

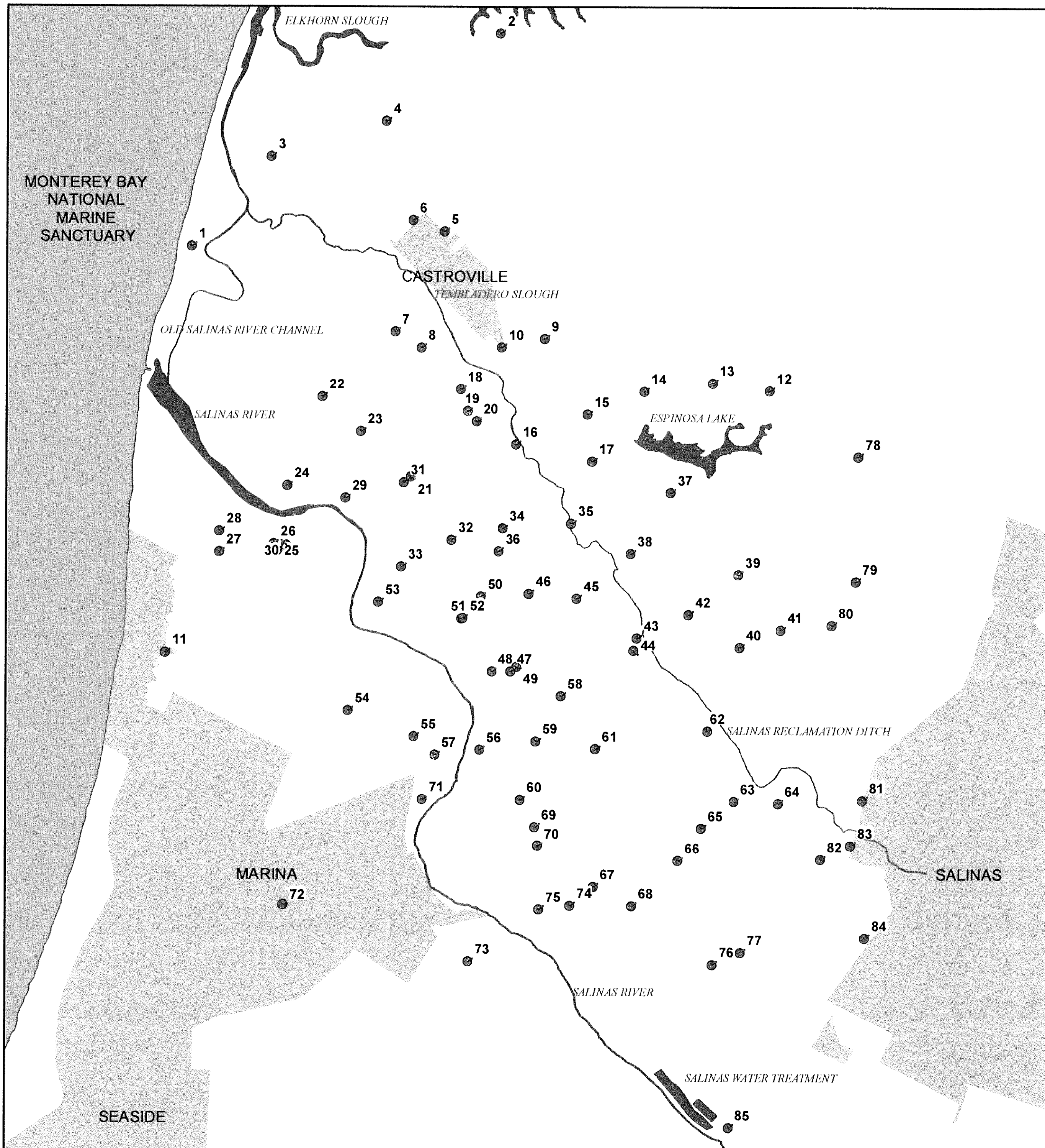
Legend:
- Study Well
- Rivers

SUBAREA
- SUBAREA
- UPPER VALLEY

0 0.75 1.5 2.25 3 Miles

Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 5, 2007



Coastal Ground Water Monitoring Program Wells

Figure 8

Legend:
- Study Well
- Cities
- Water Bodies/ Channels

0 0.5 1 1.5 2 Miles

MONTEREY COUNTY WATER RESOURCES AGENCY 1947

Note: The scale and configuration of all information shown hereon are approximate and are not intended as a guide for survey or design work.

Map Date: July 02, 2007

TABLES

Table 1 COMPLETE MINERAL PANEL ANALYTES

ANALYTE	METHOD	LABORATORY MDL**	LABORATORY PQL	LOWEST CALIB. STD.	PAL
Calcium (Ca)	SM 3111 B[1]	0.02 mg/L	1.0 mg/L	1.0 mg/L	1.0 mg/L
CATION ANION BALANCE	Calculated	--	--	--	--
*Chloride (Cl)	EPA 300.0[2]	0.01 mg/L	1.0 mg/L	0.1 mg/L	1.0 mg/L
*Conductivity (SEC)	SM 2510 B	1 umho/cm @ 25 C	1 umho/cm @ 25 C	N/A	1 umho/cm @ 25 C
Magnesium (Mg)	SM 3111 B	0.005 mg/L[1]	1.0 mg/L	0.1 mg/L	1.0 mg/L
*Nitrate (NO3)	EPA 300.0	0.002 mg/L[2]	1.0 mg/L	0.1 mg/L	1.0 mg/L
pH (Laboratory)	SM 4500-H B	pH Units (2 sig figs)	pH Units (2 sig figs)	N/A	pH Units (2 sig figs)
Potassium (K)	SM 3111 B	0.025 mg/L[1]	0.1 mg/L	0.1 mg/L	0.1 mg/L
Sodium (Na)	SM 3111 B	0.03 mg/L[1]	1.0 mg/L	0.1 mg/L	1.0 mg/L
Sulfate (SO4)	EPA 300.0	0.03 mg/L[2]	1.0 mg/L	0.1 mg/L	1.0 mg/L
Total Alkalinity (as CaCO3)	SM 2320 B	1.0 mg/L	1.0 mg/L	N/A	1.0 mg/L

[1] = MDL study completed February 2007
[2] = MDL study completed May 2007
* = Partial Mineral Panel analytes
** = These are the laboratory's latest MDLs and supersede the MDLs listed in Appendix D-1.
MDL = method detection limit; PQL = practical quantitative limit; PAL = project action level
All laboratory results are bracketed by calibration standards. No "estimated" results (below the lowest calib std and above the MDL) are given to the Agency.

Table 2 QUALITY CONTROL REQUIREMENTS FOR LABORATORY ANALYSES

QA PROCEDURE	QA PARAMETER	FREQUENCY	CRITERION	CORRECTIVE ACTION
Field Blank	Field Contamination	1/20 field samples; 5% frequency	<MDL	Recollect sampling event or flag data if unable recollect
Field Duplicate	Field Precision	1/10 field samples for first two events; if criterion is met, then 1/20 field samples	RPD < 25%	Recollect sampling event or flag data if unable recollect
Method Blank	Analytical Contamination	3 per analytical batch	< RL	Reanalyze analytical batch
LCS (CRM)	Accuracy	1 per analytical batch	80-120% REC	Reanalyze analytical batch
Analytical Duplicate	Analytical Precision	1 per analytical batch	RPD < 25%	Reanalyze analytical batch
Matrix Spike	Matrix Interference and Accuracy	1 per analytical batch; at 3-10x the native conc.	75-125% REC	Reanalyze analytical batch
Matrix Spike Duplicate	Precision and Accuracy	1 per analytical batch; at 3-10x the native conc.	RPD <25%	Reanalyze analytical batch
Continuing Calibration	Analytical Control	1 per 10 sample runs	80-120% of initial slope	Reanalyze analytical batch
Assess percent of data successfully collected	Data Completeness	N/A	90%	N/A

MDL=Method Detection Limit; RPD=Relative Percent Difference; RL=Report Limit;

REC=Recovery; LCS=Laboratory Control Sample; CRM=Certified Reference Material

An analytical batch is defined as 20 or fewer samples.

Table 3 LABORATORY DATA QUAILITY OBJECTIVES (DQOs)

ANALYTE	***METHOD BLANK***	***LCS (CRM)***	***ANALYTICAL DUPLICATE***	***MATRIX SPIKE***	***MATRIX SPIKE DUPLICATE***	***CONTINUING CALIBRATION***
Calcium (Ca)	yes	yes	yes	yes	yes	yes
Chloride (Cl)	yes	yes	yes	yes	yes	yes
Conductivity (SEC)	yes	yes	yes	no	no	yes
Magnesium (Mg)	yes	yes	yes	yes	yes	yes
Nitrate (NO3)	yes	yes	yes	yes	yes	yes
pH (Laboratory)	no	yes	yes	no	no	yes
Potassium (K)	yes	yes	yes	yes	yes	yes
Sodium (Na)	yes	yes	yes	yes	yes	yes
Sulfate (SO4)	yes	yes	yes	yes	yes	yes
Total Alkalinity (as CaCO3)	yes	yes	yes	no	no	yes

Table 4 SALINAS VALLEY WELLS AND LOCATIONS

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
13S/01E-36J01	PRESSURE 900	1	5741483.0	2170847.00002
13S/02E-20M02	PRESSURE 400	2	5748878.5	2182094.25003
13S/02E-21N01	PRESSURE 400	3	5753018.5	2180456.75002
13S/02E-27L01	PRESSURE 180	4	5759500.0	2175572.50002
13S/02E-27M01	PRESSURE 400	5	5758010.0	2174784.50002
13S/02E-27P01	PRESSURE 400	6	5759593.5	2173660.50002
13S/02E-27Q02	PRESSURE 400	7	5761129.5	2173768.75002
13S/02E-28B01	PRESSURE 400	8	5755624.0	2177900.75002
13S/02E-28E01	PRESSURE 400	9	5752984.0	2176434.75002
13S/02E-29F02	PRESSURE 400	10	5749961.0	2177732.25002
13S/02E-29J01	PRESSURE 400	11	5751657.5	2175604.25002
13S/02E-31A02	PRESSURE 900	12	5746516.5	2173308.00002
13S/02E-31N02	PRESSURE 400	13	5743060.5	2168496.25002
13S/02E-32M02	PRESSURE 900	14	5748673.0	2170965.00002
13S/02E-32N01	PRESSURE 400	15	5747285.0	2169132.75003
13S/02E-33H03	PRESSURE 180	16	5757325.5	2171726.00002
13S/02E-33R01	PRESSURE 180	17	5756359.5	2169699.75003
13S/02E-34M02	PRESSURE 180	18	5757952.0	2169365.25003
13S/02E-34N01	PRESSURE 180	19	5758043.5	2168657.25003
13S/02E-36J01	EAST SIDE BOTH	20	5772057.0	2168257.00002
14S/02E-01A01	EAST SIDE	21	5773736.0	2167596.00002
14S/02E-02E02	PRESSURE 400	22	5763989.0	2166284.00003
14S/02E-03F02	PRESSURE 180	23	5759284.0	2165549.00003
14S/02E-03K02	PRESSURE 400	24	5760546.0	2164390.00002
14S/02E-05F04	PRESSURE 400	25	5749784.5	2166850.50002
14S/02E-05G03	PRESSURE 400	26	5750701.5	2166258.50002
14S/02E-05K01	PRESSURE 400	27	5750303.5	2164892.00002
14S/02E-05P02	PRESSURE 400	28	5749120.0	2163754.25002
14S/02E-06J03	PRESSURE 400	29	5747119.5	2164986.75002
14S/02E-06L01	PRESSURE 900	30	5743826.5	2165438.75002
14S/02E-06R02	PRESSURE 400	31	5746852.5	2163229.50003
14S/02E-07K01	PRESSURE 400	32	5744199.0	2160286.75002
14S/02E-08A01	PRESSURE 400	33	5751818.0	2162226.75002
14S/02E-09D03	PRESSURE 400	34	5753098.5	2162246.50002
14S/02E-09H03	PRESSURE 400	35	5756070.0	2161048.75002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
14S/02E-09L02	PRESSURE 400	36	5754291.5	2160250.25002
14S/02E-09N01	PRESSURE 400	37	5752950.5	2158867.00003
14S/02E-10C01	PRESSURE 400	38	5759437.0	2162015.75002
14S/02E-10P02	PRESSURE 400	39	5759125.0	2158942.75002
14S/02E-11C01	PRESSURE 180	40	5764471.5	2161959.50002
14S/02E-11D01	PRESSURE 180	41	5764508.5	2161568.25002
14S/02E-12B01	PRESSURE 400	42	5771184.5	2161614.00002
14S/02E-12L02	PRESSURE 400	43	5770434.5	2159815.50002
14S/02E-12Q01	PRESSURE 400	44	5771537.0	2157088.75002
14S/02E-13B02	PRESSURE 180	45	5771526.0	2157219.75003
14S/02E-13D01	PRESSURE 180	46	5769699.5	2156883.75002
14S/02E-14B01	PRESSURE 180	47	5766275.0	2156434.00002
14S/02E-14N03	PRESSURE 400	48	5763230.0	2152205.50003
14S/02E-14R01	PRESSURE 180	49	5767842.5	2153580.50002
14S/02E-15B01	PRESSURE 400	50	5760275.5	2156533.25002
14S/02E-17B02	PRESSURE 400	51	5749990.5	2156598.25002
14S/02E-17C01	PRESSURE 180	52	5747844.0	2157381.75003
14S/02E-18A01	PRESSURE 400	53	5746233.0	2156686.25002
14S/02E-18C01	PRESSURE 400	54	5743827.5	2156787.25002
14S/02E-20B01	PRESSURE 180	55	5750165.5	2151711.75003
14S/02E-20B02	PRESSURE 180	56	5750001.0	2151554.75003
14S/02E-21F02	PRESSURE 180	57	5754169.5	2151251.50002
14S/02E-22H01	PRESSURE 400	58	5761690.5	2150902.75002
14S/02E-22H02	PRESSURE 180	59	5762674.0	2149777.00002
14S/02E-23A01	PRESSURE 180	60	5767130.0	2151399.50002
14S/02E-23F01	PRESSURE 180	61	5764570.5	2149971.00002
14S/02E-23L03	PRESSURE 400	62	5765164.5	2149382.00002
14S/02E-25D03	PRESSURE 400	63	5768753.5	2146325.50002
14S/02E-27K01	PRESSURE 180	64	5760536.0	2144212.25002
14S/02E-28H02	PRESSURE 180	65	5756940.5	2145354.75002
14S/02E-34A03	PRESSURE 400	66	5762394.5	2141097.75002
14S/02E-35L02	PRESSURE 400	67	5764879.0	2137944.25002
14S/02E-36H01	PRESSURE 180	68	5773015.5	2139158.50003
14S/02E-36J02	PRESSURE 400	69	5772268.5	2137939.00002
14S/02E-36R02	PRESSURE 400	70	5772326.5	2136698.50002
14S/03E-02E03	EAST SIDE BOTH	71	5794727.5	2165742.50002
14S/03E-03K01	EAST SIDE BOTH	72	5791884.0	2164011.25002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
14S/03E-04E01	EAST SIDE BOTH	73	5784479.5	2164809.75002
14S/03E-05B02	EAST SIDE BOTH	74	5781839.5	2165837.25002
14S/03E-06L01	EAST SIDE SHALLOW	75	5775895.0	2163924.50003
14S/03E-08C01	EAST SIDE BOTH	76	5781050.5	2162072.25002
14S/03E-10F02	EAST SIDE	77	5791569.0	2159330.50002
14S/03E-10F03	EAST SIDE BOTH	78	5791236.5	2159578.00002
14S/03E-10P01	EAST SIDE	79	5791544.0	2157558.25002
14S/03E-10R02	EAST SIDE BOTH	80	5794251.5	2157151.00002
14S/03E-11H01	EAST SIDE SHALLOW	81	5798504.0	2159823.00002
14S/03E-12E01	EAST SIDE SHALLOW	82	5800865.5	2160009.25003
14S/03E-12E02	EAST SIDE	83	5800608.5	2160173.25003
14S/03E-14D01	EAST SIDE SHALLOW	84	5795697.5	2155748.25003
14S/03E-15H03	EAST SIDE BOTH	85	5793222.5	2154777.00002
14S/03E-16K03	EAST SIDE	86	5787748.0	2152845.50003
14S/03E-17D01	EAST SIDE	87	5779979.0	2156594.00002
14S/03E-20D01	PRESSURE 400	88	5779540.0	2150357.75002
14S/03E-24H01	EAST SIDE SHALLOW	89	5803951.0	2147934.50002
14S/03E-24N01	EAST SIDE	90	5801060.0	2146002.50002
14S/03E-25L02	EAST SIDE BOTH	91	5801508.5	2141975.75002
14S/03E-28B02	PRESSURE 400	92	5786919.0	2145249.50002
14S/03E-28F02	PRESSURE 400	93	5786200.6	2144963.98574
14S/03E-29L04	PRESSURE 180	94	5780547.4	2143125.21920
14S/03E-30E01	PRESSURE 180	95	5773899.5	2144670.25003
14S/03E-30F02	PRESSURE 180	96	5775180.5	2144268.50002
14S/03E-30N01	PRESSURE 180	97	5774083.5	2141696.50002
14S/03E-31F01	PRESSURE 180	98	5775271.5	2138346.50003
14S/03E-31F02	PRESSURE 400	99	5775228.5	2138492.00002
14S/03E-36A01	EAST SIDE SHALLOW	100	5803921.0	2140085.50002
14S/04E-30N01	EAST SIDE BOTH	101	5804847.5	2142132.00001
15S/02E-01A03	PRESSURE 400	102	5772482.0	2134724.00002
15S/02E-01K01	PRESSURE 180	103	5770291.5	2131514.75002
15S/02E-02G01	PRESSURE 400	104	5765615.0	2134401.50002
15S/02E-12A01	PRESSURE 400	105	5772051.5	2129878.50002
15S/02E-12R01	PRESSURE 400	106	5772057.5	2126203.25003
15S/03E-01L01	EAST SIDE	107	5801038.5	2132896.75002
15S/03E-04K03	PRESSURE 400	108	5785732.5	2131172.00002
15S/03E-04N03	PRESSURE 400	109	5783621.0	2130577.75002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
15S/03E-05N01	PRESSURE 180	110	5778619.0	2130164.00003
15S/03E-06A03	PRESSURE 180	111	5777613.0	2135010.00002
15S/03E-06D02	PRESSURE 400	112	5773392.0	2135175.75002
15S/03E-06F02	PRESSURE 400	113	5774781.5	2132857.75002
15S/03E-06K01	PRESSURE 400	114	5776302.5	2131605.50002
15S/03E-07D02	PRESSURE 400	115	5772729.0	2130304.25002
15S/03E-07G01	PRESSURE 400	116	5775356.0	2127909.75002
15S/03E-07N01	PRESSURE 180	117	5772911.5	2126430.50002
15S/03E-08B04	PRESSURE 400	118	5780790.5	2128738.25002
15S/03E-08C06	PRESSURE 180	119	5780025.5	2129640.75003
15S/03E-08C07	PRESSURE 400	120	5780124.5	2129385.50002
15S/03E-08F07	PRESSURE 400	121	5779786.0	2128096.50002
15S/03E-08N03	PRESSURE 400	122	5778859.5	2125760.50002
15S/03E-09B01	PRESSURE 180	123	5787613.5	2129526.50003
15S/03E-09C01	PRESSURE 180	124	5785912.0	2130387.75002
15S/03E-09H02	PRESSURE 180	125	5788543.5	2128841.50003
15S/03E-09K04	PRESSURE 400	126	5786815.0	2126625.50003
15S/03E-10P01	PRESSURE 180	127	5789973.0	2124641.25002
15S/03E-10P03	PRESSURE 180	128	5790992.5	2124075.25002
15S/03E-10R02	PRESSURE 180	129	5793537.5	2125764.25002
15S/03E-12E02	EAST SIDE BOTH	130	5799472.0	2128349.25000
15S/03E-13J02	EAST SIDE	131	5804170.5	2121482.50002
15S/03E-13N01	PRESSURE 180	132	5799834.5	2120075.00003
15S/03E-14C01	PRESSURE 180	133	5796323.5	2123063.75002
15S/03E-14G01	PRESSURE 180	134	5796738.0	2122656.50003
15S/03E-14H01	PRESSURE 180	135	5797941.0	2122606.00002
15S/03E-15B01	PRESSURE 400	136	5792336.0	2124219.00002
15S/03E-15L02	PRESSURE 180	137	5790177.0	2121393.00002
15S/03E-16B03	PRESSURE 400	138	5786481.0	2123545.50002
15S/03E-16M01	PRESSURE 180	139	5783233.5	2121388.25002
15S/03E-17B01	PRESSURE 180	140	5781259.5	2123911.75003
15S/03E-17B02	PRESSURE 180	141	5781099.5	2123757.50002
15S/03E-17G01	PRESSURE 180	142	5780630.0	2122750.25002
15S/03E-18B01	PRESSURE 180	143	5776074.5	2124737.50002
15S/03E-21A01	PRESSURE 180	144	5787617.0	2118056.00002
15S/03E-22F02	PRESSURE 180	145	5789756.5	2117099.00002
15S/03E-22G01	PRESSURE 180	146	5791343.0	2116241.25002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
15S/03E-25L01	PRESSURE 180	147	5800408.5	2109728.50003
15S/03E-26A01	PRESSURE 400	148	5797857.5	2112518.00002
15S/03E-26D01	PRESSURE 180	149	5794548.5	2112893.75003
15S/03E-26H02	PRESSURE 180	150	5797573.5	2111904.75002
15S/03E-26P01	PRESSURE 400	151	5795686.5	2108925.25002
15S/03E-27J01	PRESSURE 400	152	5792207.5	2110413.00002
15S/03E-28B02	PRESSURE 400	153	5787075.5	2113993.25002
15S/03E-28G01	PRESSURE 180	154	5786358.0	2111546.50003
15S/03E-35B05	PRESSURE 180	155	5797153.0	2107813.50003
15S/04E-05K01	EAST SIDE	156	5812585.0	2130171.00001
15S/04E-05M01	EAST SIDE BOTH	157	5810608.5	2130920.50001
15S/04E-06D04	EAST SIDE BOTH	158	5805535.0	2134296.75001
15S/04E-06R01	EAST SIDE BOTH	159	5808832.0	2130397.50001
15S/04E-07A01	EAST SIDE BOTH	160	5808667.0	2128112.25001
15S/04E-07E02	EAST SIDE	161	5805290.0	2126918.25001
15S/04E-07R01	EAST SIDE SHALLOW	162	5809617.5	2124497.75001
15S/04E-08C01	EAST SIDE SHALLOW	163	5811226.0	2128961.75001
15S/04E-08L01	EAST SIDE BOTH	164	5812038.0	2125163.50001
15S/04E-08N01	EAST SIDE BOTH	165	5810237.5	2124086.00001
15S/04E-09N01	EAST SIDE	166	5815679.0	2123673.25001
15S/04E-15D02	EAST SIDE SHALLOW	167	5820525.5	2122131.50001
15S/04E-15P02	EAST SIDE BOTH	168	5822591.0	2118164.75001
15S/04E-16D01	EAST SIDE BOTH	169	5816370.5	2122604.00001
15S/04E-17B01	EAST SIDE	170	5813674.5	2122802.00001
15S/04E-17P02	EAST SIDE SHALLOW	171	5811444.0	2119748.75001
15S/04E-18L01	EAST SIDE	172	5806258.0	2120249.25001
15S/04E-19D02	PRESSURE 400	173	5805231.0	2118084.25001
15S/04E-19H03	EAST SIDE	174	5808765.0	2116311.75003
15S/04E-20B02	EAST SIDE SHALLOW	175	5812893.0	2117437.00001
15S/04E-20N01	PRESSURE 400	176	5810999.0	2113437.25001
15S/04E-20Q01	EAST SIDE	177	5813019.5	2113916.75003
15S/04E-22J01	EAST SIDE	178	5825620.5	2114797.50001
15S/04E-22L02	EAST SIDE BOTH	179	5822626.0	2115130.25001
15S/04E-23M01	EAST SIDE	180	5826800.0	2115510.00001
15S/04E-26G01	EAST SIDE	181	5829452.0	2110273.75001
15S/04E-27G01	EAST SIDE BOTH	182	5824082.0	2110658.00001
15S/04E-28C01	EAST SIDE	183	5817013.0	2112539.50001

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
15S/04E-28C01	EAST SIDE	184*	*	*
15S/04E-29K03	EAST SIDE	185*	*	*
15S/04E-32E01	PRESSURE 180	186	5809573.0	2105524.75003
15S/04E-36H01	EAST SIDE BOTH	187	5835591.5	2105235.00001
15S/04E-36R02	EAST SIDE BOTH	188	5836592.5	2101652.75001
16S/04E-01L02	EAST SIDE	189	5833261.5	2096387.25003
16S/04E-04C01	PRESSURE 400	190	5816563.5	2101653.00001
16S/04E-08J01	PRESSURE 180	191	5814399.5	2094772.87501
16S/04E-09A01	PRESSURE 180	192	5818962.5	2096385.75001
16S/04E-10K01	PRESSURE 400	193	5822871.5	2093933.87501
16S/04E-10R02	PRESSURE 400	194	5824891.5	2092808.00001
16S/04E-11E02	PRESSURE 400	195	5825734.0	2093587.12501
16S/04E-12M01	PRESSURE 400	196	5830110.0	2094179.62501
16S/04E-13D01	PRESSURE 400	197	5829977.5	2091400.75001
16S/04E-14M01	PRESSURE 400	198	5826507.0	2089158.00001
16S/04E-14M02	PRESSURE 400	199	5826934.0	2088314.12501
16S/04E-15D01	PRESSURE 180	200	5820915.5	2091029.00003
16S/04E-15H02	PRESSURE 400	201	5824314.0	2089470.00001
16S/04E-24R01	PRESSURE 400	202	5833826.5	2081330.00003
16S/04E-25A01	PRESSURE 400	203	5834115.0	2080854.00001
16S/04E-25K01	PRESSURE 180	204	5832503.0	2077482.12501
16S/04E-25Q01	PRESSURE 400	205	5832125.5	2076199.75001
16S/04E-27G01	PRESSURE 180	206	5823057.0	2078926.75001
16S/04E-36B01	PRESSURE 180	207	5833029.5	2074811.87501
16S/05E-07G01	EAST SIDE BOTH	208	5836648.0	2094674.00003
16S/05E-17P01	EAST SIDE BOTH	209	5843361.0	2086999.12503
16S/05E-17R01	EAST SIDE SHALLOW	210	5845212.0	2087024.25003
16S/05E-19F01	PRESSURE 180	211	5836477.0	2084158.37503
16S/05E-19R01	PRESSURE 180	212	5840423.0	2081360.37503
16S/05E-20C01	EAST SIDE	213	5843125.0	2085585.12503
16S/05E-20H01	EAST SIDE	214	5845691.0	2085074.25003
16S/05E-20R01	EAST SIDE BOTH	215	5845834.0	2082220.00003
16S/05E-27G01	EAST SIDE	216	5853466.8	2077678.05320
16S/05E-28D01	EAST SIDE BOTH	217	5846865.0	2080272.25003
16S/05E-28P01	EAST SIDE BOTH	218	5847355.5	2077784.37503
16S/05E-30C01	PRESSURE 180	219	5836401.5	2080129.50003
16S/05E-30G01	PRESSURE 180	220	5837912.0	2078876.87503

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
16S/05E-30J02	PRESSURE 400	221	5840526.5	2077512.50003
16S/05E-31A01	PRESSURE 180	222	5838804.0	2075067.12503
16S/05E-31Q01	PRESSURE 180	223	5837656.0	2070857.75003
16S/05E-32C01	PRESSURE 180	224	5843159.0	2075228.62503
16S/05E-32M01	FOREBAY	225	5840439.0	2072879.00003
16S/05E-33F01	FOREBAY	226	5847064.0	2072544.75003
16S/05E-33Q01	FOREBAY	227	5846731.0	2071679.00003
16S/05E-35C01	FOREBAY	228	5857923.0	2074215.75003
16S/05E-35L01	FOREBAY	229	5857341.0	2072381.25003
17S/04E-01D01	PRESSURE 180	230	5829970.4	2070190.88233
17S/05E-01R01	FOREBAY	231	5863270.5	2064114.75003
17S/05E-02G01	FOREBAY	232	5858061.5	2067655.75001
17S/05E-03B01	FOREBAY	233	5852910.5	2069821.37503
17S/05E-04C01	FOREBAY	234	5846947.5	2068985.25003
17S/05E-04K01	FOREBAY	235	5847433.5	2066928.37503
17S/05E-04N01	FOREBAY	236	5844523.0	2064819.50003
17S/05E-06Q01	FOREBAY	237	5837274.0	2065350.12503
17S/05E-09G01	FOREBAY	238	5846689.0	2062431.75003
17S/05E-09Q01	FOREBAY	239	5846868.5	2059437.25003
17S/05E-10Q01	FOREBAY	240	5853142.5	2060133.00003
17S/05E-12B01	FOREBAY	241	5864362.0	2062470.37503
17S/05E-12B02	FOREBAY	242	5863570.5	2063023.50003
17S/05E-12B03	FOREBAY	243	5862636.0	2063300.00003
17S/05E-13L02	FOREBAY	244	5861995.0	2054065.12503
17S/05E-14D01	FOREBAY	245	5855476.7	2057512.98904
17S/05E-14G01	FOREBAY	246	5858431.5	2057156.87503
17S/05E-21A01	FOREBAY	247	5847203.9	2053734.78530
17S/05E-23L01	FOREBAY	248	5855276.5	2049667.00003
17S/05E-25L01	FOREBAY	249	5861282.5	2044709.87503
17S/05E-36F02	FOREBAY	250	5861156.5	2040988.13679
17S/06E-16N01	FOREBAY	251	5876658.0	2053579.37503
17S/06E-17R01	FOREBAY	252	5875370.0	2053960.00003
17S/06E-19D01	FOREBAY	253	5865512.0	2052870.75003
17S/06E-20K01	FOREBAY	254	5874270.5	2050202.50003
17S/06E-20Q02	FOREBAY	255	5873861.0	2049734.12503
17S/06E-20Q03	FOREBAY	256	5873624.0	2049413.37503
17S/06E-27E03	FOREBAY	257	5881725.5	2046512.12503

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
17S/06E-27K01	FOREBAY	258	5884526.5	2044144.50003
17S/06E-27L01	FOREBAY	259	5883319.0	2044534.62503
17S/06E-28N01	FOREBAY	260	5876603.5	2042971.37503
17S/06E-29C01	FOREBAY	261	5871659.0	2048323.00003
17S/06E-29K01	FOREBAY	262	5873377.5	2045490.50003
17S/06E-29Q01	FOREBAY	263	5873361.0	2045274.25003
17S/06E-30F01	FOREBAY	264	5866434.0	2047190.00003
17S/06E-32G01	FOREBAY	265	5873481.5	2040947.12503
17S/06E-32J02	FOREBAY	266	5874264.0	2039466.50003
17S/06E-35F01	FOREBAY	267	5888535.0	2040776.00003
17S/06E-35J01	FOREBAY	268	5890370.5	2039573.75003
18S/06E-01E01	FOREBAY	269	5892201.0	2033873.12503
18S/06E-02N01	FOREBAY	270	5886656.0	2032336.12503
18S/06E-02R01	FOREBAY	271	5890070.0	2032210.75003
18S/06E-03P01	FOREBAY	272	5881836.0	2032629.37503
18S/06E-05H01	FOREBAY	273	5874765.0	2035980.12503
18S/06E-07A01	FOREBAY	274	5868250.5	2031805.25003
18S/06E-08R01	FOREBAY	275	5873246.0	2027074.87503
18S/06E-09M02	FOREBAY	276	5875856.5	2028751.00003
18S/06E-11J01	FOREBAY	277	5890622.5	2027590.87503
18S/06E-12A01	FOREBAY	278	5896424.0	2030093.87503
18S/06E-12R02	FOREBAY	279	5895096.5	2026768.25003
18S/06E-14B01	FOREBAY	280	5888379.5	2025469.87503
18S/06E-14R01	FOREBAY	281	5890625.0	2022391.37503
18S/06E-15F01	FOREBAY	282	5882187.0	2023781.12503
18S/06E-15M01	FOREBAY	283	5880584.0	2022838.50003
18S/06E-16L01	FOREBAY	284	5876773.5	2023478.50003
18S/06E-21Q01	FOREBAY	285	5878665.0	2016542.37503
18S/06E-25F01	FOREBAY	286	5891762.0	2013188.12503
18S/06E-26R01	FOREBAY	287	5890408.5	2011271.25003
18S/06E-27A01	FOREBAY	288	5883864.0	2015914.75003
18S/06E-28J01	FOREBAY	289	5879251.0	2013091.87503
18S/06E-34B01	FOREBAY	290	5882838.0	2010128.37503
18S/07E-18K01	FOREBAY	291	5899619.5	2023322.62503
18S/07E-18P01	FOREBAY	292	5897367.5	2022162.75003
18S/07E-19G02	FOREBAY	293	5899561.5	2019657.12503
18S/07E-19N01	FOREBAY	294	5896875.0	2016213.75002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
18S/07E-20K01	FOREBAY	295	5903526.5	2016596.50003
18S/07E-28K01	FOREBAY	296	5909064.5	2012996.12503
18S/07E-28N02	FOREBAY	297	5906995.5	2011573.25003
18S/07E-29J01	FOREBAY	298	5906172.5	2012704.50003
18S/07E-29M01	FOREBAY	299	5901432.0	2012790.87503
18S/07E-32G02	FOREBAY	300	5905129.0	2008896.37503
18S/07E-34P02	FOREBAY	301	5913853.5	2006429.50003
19S/06E-01H01	FOREBAY	302	5894418.0	2003322.50003
19S/06E-03E02	FOREBAY	303	5880577.0	2003637.62503
19S/06E-03K01	FOREBAY	304	5882172.5	2003068.00003
19S/06E-11C01	FOREBAY	305	5887118.5	1999053.25003
19S/06E-12A01	FOREBAY	306	5895441.5	1999532.50003
19S/07E-03H02	UPPER VALLEY	307	5916058.0	2002263.25003
19S/07E-04G01	FOREBAY	308	5908976.0	2002192.50003
19S/07E-04Q01	FOREBAY	309	5907241.5	2000938.12503
19S/07E-05B02	FOREBAY	310	5903922.5	2005128.00003
19S/07E-10P02	UPPER VALLEY	311	5914112.0	1994937.37503
19S/07E-13D01	UPPER VALLEY	312	5923060.5	1993005.87503
19S/07E-13D02	UPPER VALLEY	313	5922703.0	1993016.87503
19S/07E-13D03	UPPER VALLEY	314	5921177.5	1994464.25003
19S/07E-16D01	UPPER VALLEY	315	5907215.0	1993447.25003
19S/07E-20A01	UPPER VALLEY	316	5904728.0	1988737.75003
19S/07E-20A02	UPPER VALLEY	317	5905140.0	1988780.50003
19S/07E-23F01	UPPER VALLEY	318	5917918.5	1986682.87503
19S/07E-23G01	UPPER VALLEY	319	5919819.5	1985678.50003
19S/07E-24H02	UPPER VALLEY	320	5927076.5	1985899.12503
19S/07E-36N01	UPPER VALLEY	321	5921376.0	1974705.75003
19S/08E-30A01	UPPER VALLEY	322	5931268.5	1981945.62503
20S/08E-05C02	UPPER VALLEY	323	5933968.0	1972500.37503
20S/08E-05R03	UPPER VALLEY	324	5935855.5	1968133.00003
20S/08E-06B01	UPPER VALLEY	325	5929631.0	1971657.50003
20S/08E-07E01	UPPER VALLEY	326	5927847.5	1965744.25003
20S/08E-15H03	UPPER VALLEY	327	5946414.0	1959720.37503
20S/08E-16C01	UPPER VALLEY	328	5938055.0	1961243.37501
20S/08E-17K03	UPPER VALLEY	329	5934573.0	1958618.62503
20S/08E-34G01	UPPER VALLEY	330	5944061.5	1944379.50003
20S/08E-36R01	UPPER VALLEY	331	5957517.0	1941628.62503

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
21S/08E-15J01	UPPER VALLEY	332	5946267.0	1926489.62503
21S/09E-06C01	UPPER VALLEY	333	5959365.5	1939884.62503
21S/09E-16E02	UPPER VALLEY	334	5967913.5	1928310.37503
21S/09E-22J01	UPPER VALLEY	335	5976378.5	1921774.75003
21S/09E-24Q01	UPPER VALLEY	336	5985537.5	1920320.00003
21S/10E-30E02	UPPER VALLEY	337	5988110.5	1916891.25003
21S/10E-32N01	UPPER VALLEY	338	5993930.5	1907839.00003
22S/10E-09P01	UPPER VALLEY	339	6000619.0	1897117.87503
22S/10E-16P01	UPPER VALLEY	340	6000072.0	1892154.87503
22S/10E-21C01	UPPER VALLEY	341	6001268.5	1890089.75003
22S/10E-22N01	UPPER VALLEY	342	6004921.0	1886561.87503
22S/10E-28B01	UPPER VALLEY	343	6001816.0	1886849.25003
22S/10E-34G01	UPPER VALLEY	344	6007012.0	1879185.87503

[1] State Plane Coordinate System, California Zone IV, Feet, North American Datum 1983

*Coordinates to be collected

Table 5 COASTAL WELLS AND LOCATIONS

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
13S/01E-25R01	PRESSURE 900	1	5742345.5	2174687.00002
13S/02E-15M01	PRUNEDALE	2	5757881.5	2185405.50002
13S/02E-19Q03	PRESSURE 900	3	5746313.5	2179184.50002
13S/02E-20J01	PRESSURE 400	4	5752096.0	2180981.25002
13S/02E-28L02	PRESSURE BOTH	5	5755055.5	2175441.75002
13S/02E-28M02	PRESSURE 400	6	5753447.0	2175997.50002
13S/02E-32J03	PRESSURE 400	7	5752560.0	2170401.75002
13S/02E-33N04	PRESSURE 400	8	5753898.0	2169605.00002
13S/02E-34G01	PRESSURE 400	9	5760129.5	2170052.25002
13S/02E-34M01	PRESSURE 400	10	5757997.5	2169621.75002
14S/01E-13J02	PRESSURE 400	11	5741048.0	2154289.50002
14S/02E-01C01	EASTSIDE DEEP	12	5771477.5	2167454.25002
14S/02E-02A02	EASTSIDE DEEP	13	5768561.0	2167823.50002
14S/02E-02C03	PRESSURE 400	14	5765109.0	2167416.00002
14S/02E-03H01	PRESSURE 400	15	5762283.0	2166255.50002
14S/02E-03M02	PRESSURE 400	16	5758710.5	2164740.50002
14S/02E-03R02	PRESSURE 400	17	5762517.0	2163892.75002
14S/02E-04B01	PRESSURE 400	18	5755909.0	2167499.00002
14S/02E-04G02	PRESSURE 400	19	5756262.0	2166403.75002
14S/02E-04H01	PRESSURE 400	20	5756715.0	2165886.25002
14S/02E-04N03	PRESSURE 400	21	5753365.0	2163112.75002
14S/02E-05C03	PRESSURE 400	22	5748893.5	2167132.50002
14S/02E-05K02	PRESSURE 400	23	5750829.0	2165370.75002
14S/02E-07A01	PRESSURE 400	24	5747142.5	2162655.25002
14S/02E-07J02	PRESSURE 400	25	5746655.0	2159408.25002
14S/02E-07J03	PRESSURE DEEP ZONE	26	5746476.9	2159735.06998
14S/02E-07L04	PRESSURE 400	27	5743780.0	2159328.00002
14S/02E-07L05	PRESSURE 400	28	5743784.5	2160380.50002
14S/02E-08C03	PRESSURE 400	29	5750055.0	2162036.75002
14S/02E-08M02	PRESSURE 400	30	5747103.0	2159672.50002
14S/02E-09D04	PRESSURE 400	31	5753016.5	2162818.75002
14S/02E-09K02	PRESSURE 400	32	5755450.0	2159946.25002
14S/02E-09N02	PRESSURE 400	33	5752897.5	2158609.50002
14S/02E-10E02	PRESSURE 400	34	5758062.0	2160525.75002
14S/02E-10H01	PRESSURE 400	35	5761492.0	2160761.75002

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
14S/02E-10M02	PRESSURE 400	36	5757853.5	2159387.75002
14S/02E-11B01	PRESSURE 400	37	5766446.0	2162325.25002
14S/02E-11M03	PRESSURE 400	38	5764448.5	2159266.75002
14S/02E-12N02	PRESSURE 180	39	5769893.5	2158219.50002
14S/02E-13F01	PRESSURE 180	40	5769952.5	2154587.75002
14S/02E-13G01	PRESSURE 400	41	5772057.5	2155470.50002
14S/02E-14A01	PRESSURE 400	42	5767367.0	2156210.25002
14S/02E-14L02	PRESSURE 180	43	5764775.5	2155024.75003
14S/02E-14L03	PRESSURE 400	44	5764610.5	2154419.75002
14S/02E-15A01	PRESSURE 400	45	5761774.5	2157015.50002
14S/02E-15C02	PRESSURE 400	46	5759385.5	2157259.00002
14S/02E-15L02	PRESSURE 180	47	5758452.0	2153366.00003
14S/02E-15N01	PRESSURE 400	48	5757522.5	2153353.25002
14S/02E-15P01	PRESSURE 400	49	5758767.5	2153584.50002
14S/02E-16A02	PRESSURE 400	50	5756957.5	2157123.50002
14S/02E-16G01	PRESSURE 400	51	5755957.0	2155999.50002
14S/02E-16H01	PRESSURE 400	52	5756041.0	2156035.25002
14S/02E-17A02	PRESSURE 400	53	5751744.5	2156837.50002
14S/02E-20B03	PRESSURE 900	54	5750210.5	2151407.25003
14S/02E-21E01	PRESSURE 400	55	5753561.0	2150101.50003
14S/02E-21J01	PRESSURE 180	56	5756896.0	2149447.75002
14S/02E-21L01	PRESSURE 180	57	5754605.0	2149175.75002
14S/02E-22B01	PRESSURE 400	58	5760986.0	2152124.75002
14S/02E-22L01	PRESSURE 400	59	5759725.0	2149855.00002
14S/02E-22P02	PRESSURE 180	60	5758952.5	2146937.25002
14S/02E-23M01	PRESSURE 180	61	5762708.0	2149478.75002
14S/02E-24E01	PRESSURE 180	62	5768326.5	2150393.25002
14S/02E-24P02	PRESSURE 400	63	5769670.0	2146858.75002
14S/02E-24Q01	PRESSURE 180	64	5771942.5	2146772.50003
14S/02E-25D04	PRESSURE 180	65	5768019.0	2145519.50003
14S/02E-26J03	PRESSURE 400	66	5766847.5	2143883.00002
14S/02E-26N03	PRESSURE 180	67	5762617.0	2142567.75002
14S/02E-26P01	PRESSURE 180	68	5764519.0	2141615.00003
14S/02E-27C02	PRESSURE 400	69	5759686.0	2145562.00002
14S/02E-27F02	PRESSURE 180	70	5759825.0	2144647.75002
14S/02E-28C01	PRESSURE 400	71	5753983.5	2146953.50002
14S/02E-32D06	PRESSURE 180	72	5746981.0	2141653.75003

STATE WELL NUMBER	AQUIFER	MAP ID	FALSE EASTING[1]	FALSE NORTHING[1]
14S/02E-33P01	PRESSURE BOTH	73	5756348.0	2138806.75003
14S/02E-34A04	PRESSURE 180	74	5761465.0	2141623.00002
14S/02E-34B03	PRESSURE 180	75	5759909.5	2141431.00002
14S/02E-36E01	PRESSURE 180	76	5768600.0	2138685.00002
14S/02E-36G01	PRESSURE 400	77	5770039.0	2139297.50002
14S/03E-06L02	EASTSIDE DEEP	78	5775957.0	2164155.50002
14S/03E-07P02	EASTSIDE SHALLOW	79	5775832.0	2157899.00003
14S/03E-18E02	PRESSURE 400	80	5774633.5	2155704.50003
14S/03E-19Q02	PRESSURE 180	81	5776192.0	2146948.50002
14S/03E-30E03	PRESSURE 400	82	5774081.0	2143975.75002
14S/03E-30F01	PRESSURE 180	83	5775609.5	2144673.00002
14S/03E-31B01	PRESSURE 180	84	5776312.0	2140030.50002
15S/02E-12C01	PRESSURE 180	85	5769441.0	2130513.75002

[1] State Plane Coordinate System, California Zone IV, Feet, North American Datum 1983

Table 6 REQUIREMENTS FOR SAMPLE COLLECTION[1]

ANALYTE	CONTAINER TYPE	SAMPLE VOLUME	PRESERVATIVE	HOLDING TIME
Calcium (Ca)	polyethylene (HDPE[2])	200 mL[3]	HNO_3 pH<2	3 days w/o pres. 6 months w/ pres.
CATION ANION BALANCE[4]	N/A Calculation	N/A Calculation	N/A Calculation	N/A Calculation
Chloride (Cl)[5]	polyethylene (HDPE[1])	100 mL[2]	4±2ºC	28 days
Conductivity (SEC)[5]	polyethylene (HDPE[1])	100 mL[2]	4±2ºC	28 days
Magnesium (Mg)	polyethylene (HDPE[1])	200 mL[2]	HNO_3 pH<2	3 days w/o pres. 6 months w/ pres.
Nitrate (NO3)[5]	polyethylene (HDPE[1])	100 mL[2]	none HSO_4; pH<2	48 hours at 4° C 28 days
pH (Laboratory)	polyethylene (HDPE[1])	30 mL[2]	none	48 hours at 4° C
Potassium (K)	polyethylene (HDPE[1])	200 mL[2]	HNO_3 pH<2	3 days w/o pres. 6 months w/ pres.
Sodium (Na)	polyethylene (HDPE[1])	200 mL[2]	HNO_3 pH<2	3 days w/o pres. 6 months w/ pres.
Sulfate (SO4)	polyethylene (HDPE[1])	100 mL[2]	4±2ºC	28 days
Total Alkalinity (as CaCO3)	polyethylene (HDPE[1])	100 mL[2]	4±2ºC	14 days

[1] = CCL QA Manual and SOPs
[2] = High Density Polyethylene
[3] = only one 0.5 gal (~2L) container is needed for all analyses
[4] = Cation anion balance is a calculation
[5] = Analytes in partial mineral panel, one pint (~500 mL) container is need for analyses

APPENDICES

APPENDIX A

GLOBAL POSITIONING SYSTEM (GPS) TRAINING

Appendix A-1: GPS Training Record

Appendix A-2: TSC1 Asset Surveyor Manual

Appendix A-3: Pro XR/XRS Receiver Manual

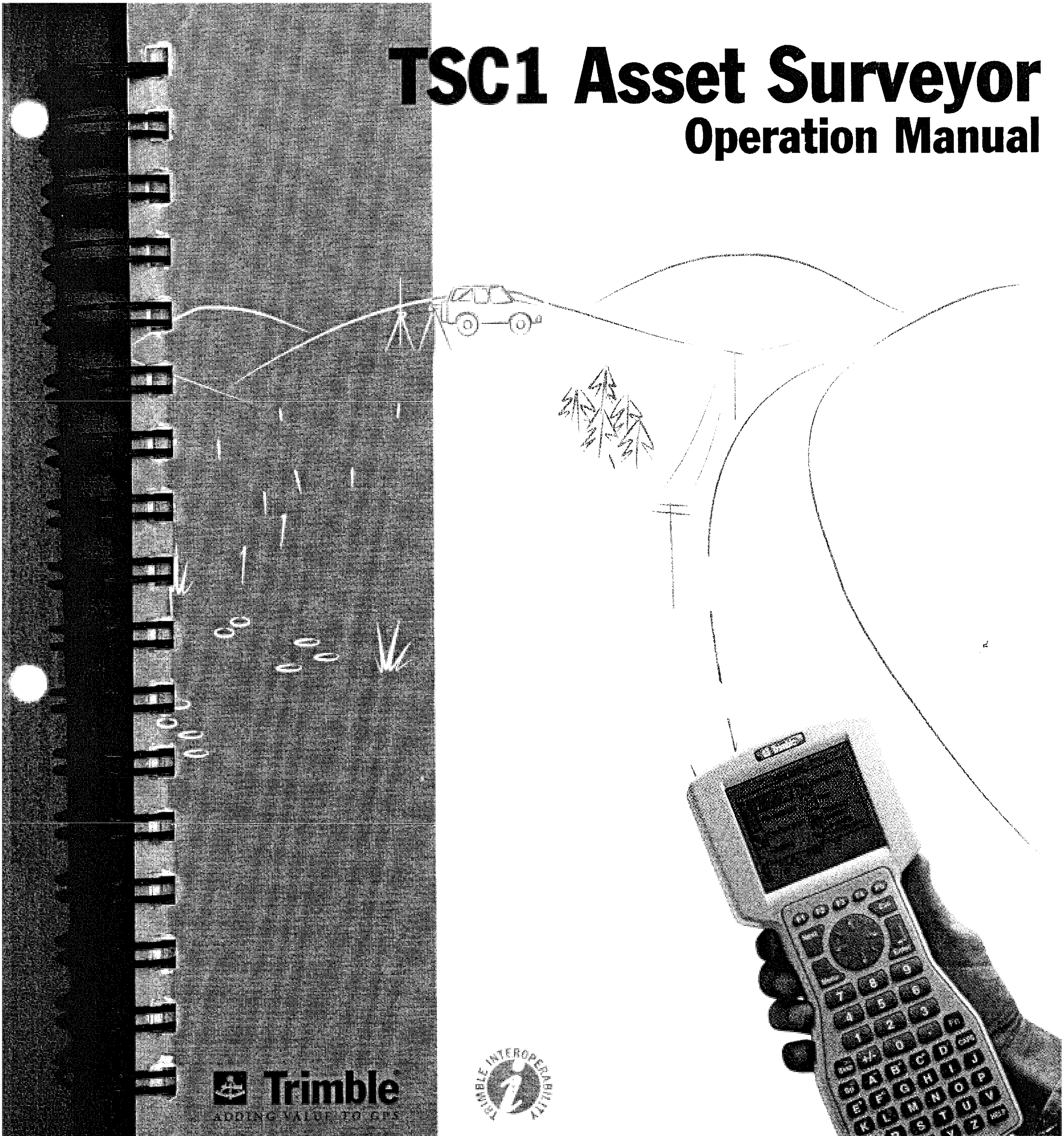
Geographic Positioning System (GPS) Training Record

Name of Trainee
Name of Trainer
Date of Training

	Satisfactory Completion / Understanding
Verification of access to Pathfinder Office software	
Preparation of data dictionary	
Set-up of equipment	
Trimble® TSC1 Asset Surveyor[1]	
Trimble® Pro XR Receiver[1]	
Connector cables	
Batteries (Asset Surveyor and Receiver)	
Confirmation of communication between Asset Surveyor and Receiver	
Acquiring satellites	
Setting up and checking critical settings	
-logging intervals	
-PDOP mask[2]	
Proper packing and unpacking of equipment	
Transferring data files from Asset Surveyor to the computer	

[1] The Agency uses Trimble® products, the GPS industry standard.
[2] PDOP = Position Dilution Of Precision

TSC1 Asset Surveyor
Operation Manual



TSC1 Asset Surveyor

Operation Manual

Part Number 34182-05-ENG

Version 5.00

October 1999

Revision A

Trimble Navigation Limited
Mapping & GIS Systems
645 North Mary Avenue
P.O. Box 3642
Sunnyvale, CA 94088-3642
U.S.A.

1-800-827-8000 in North America
+1-408-481-8000 International
Fax: +1-408-481-7744
www.trimble.com

1 Quick Setup

The instructions in this chapter are a simplified version of the various steps found in Chapters 4, 5, and 6 of this manual. The purpose of the simplified version is to provide quick setup guides with reasonable default values that can be distributed to field crews to ensure proper setup of rover or base station receivers.

Data is logged to the TSC1 with the Asset Surveyor software. For full details on configuration and data collection, refer to the *TSC1 Asset Surveyor Software User Guide*.

Note – The steps outlined in this chapter do not include steps required to collect data using carrier phase information. For instructions on how to collect high accuracy features, see Chapter 7, Carrier Phase Data Collection.

1.1 Before Leaving the Office

1. Install the Pathfinder Office software on your office computer (refer to the *Pathfinder Office Getting Started Guide*).
2. Using the Pathfinder Office software, prepare any data files or data dictionaries you require, and transfer them to the TSC1. If you want to update GPS or attribute information on features stored in a GIS, import the data files and data dictionary into Pathfinder Office and then transfer them to the TSC1. You may also want to transfer any waypoint and coordinate system files to the datalogger.

3. Check that you have all the required equipment, and that it is operational. Set up and connect your GPS system (the appendix for your GPS receiver lists the equipment and shows you how to connect it).
4. If the GPS receiver has an On/Off switch, turn it on (the Series 4000, GPS Total Station 4700, GPS Total Station 4800, Site Surveyor 4400 and 4600LS receivers have an On/Off switch).

   Start the Asset Surveyor software to check that it and the GPS receiver are communicating correctly. If communication is established, the GPS status line appears. If communication fails, an error message pops up on the screen.
5. Check all critical settings in the Asset Surveyor software.

   You should also check non-critical and display settings, especially if the system has been used by someone else recently. For details of how to configure Asset Surveyor, refer to the *TSC1 Asset Surveyor Software User Guide*.
6. Turn everything off and pack it into carrying cases if you have to travel a significant distance to the survey site. Pack spare sets of batteries if you expect to operate the receiver for any length of time.

1.2 In the Field

1. Travel to the survey site, remembering to carry all the required equipment with you.
2. Reassemble the system.
3. If the GPS receiver has an On/Off switch, turn it on. Then start the Asset Surveyor software, if it is not already on.

   Wait until the GPS receiver acquires enough satellites to start computing GPS positions, before beginning to work. The number of satellites being tracked displays on the status line.

You should now change some of the configuration settings as follows:

Main menu

1.	*Configuration*	Highlight *Configuration* then press the [Enter] key

Configuration menu

2.	*GPS rover options*	Press [Enter]
3.	*Logging options*	Press [Enter]

Logging options screen

4.	*Point feature*	Synchronized with the base station
5.	*Line/area*	Synchronized with the base station
6.	*Not in feature*	Synchronized with the base station
7.	*Minimum positions*	3
8.	*Allow GPS update*	'Warn first'
9.	*Warning distance*	'Any'
10.	To accept	Press [Enter]

Position filters screen

11.	*Position mode*	'Manual 3D' or 'Overdet. 3D' depending on canopy density
12.	*PDOP mask*	4 or 6 (depending on receiver)
13.	To accept	Press [Enter]

4. Create a new data file, associating the correct data dictionary with it. Alternatively, re-open an existing data file.
5. Begin collecting data. Collect, review and update all the features necessary.
6. Close the data file.
7. Disconnect and repack the components of the system. Remember to turn off the GPS receiver, if it has an On/Off switch. Return to your office.

1.3 Back in the Office

1. Transfer the data files from the TSC1 to the PC using the Pathfinder Office software.
2. Use the Pathfinder Office software for differential correction, plotting, and exporting the data file(s) to a GIS.
3. Recharge the TSC1 datalogger and GPS receiver batteries.

1.4 Rover Configuration

Use the following procedure to set up your system in a rover configuration.

From the *Utilities* menu, select *Factory defaults*. This resets the Asset Surveyor software to its default configuration and then restarts the datalogger.

Antenna options screen

14. *Height*	Height to antenna's phase center
15. *Measure*	'Vertical'
16. *Type*	For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*
17. *Confirm*	Select 'Per feature', 'Per file', or 'Never'
18. To accept	Press Enter

GPS rover options menu

19. To return to the *Configuration* menu	Press Esc

Configuration menu

20. *Communication options*	Press Enter
21. *Real-time input options*	Press Enter

Real-time input options screen

22. RTCM age limit	5 or 10 (depending on your radio)
23. To accept	Press Enter
24. To return to the *Configuration* menu	Press Esc

Configuration menu

25. To exit the *Configuration* menu	Press Esc

1.4.1 Data Collection

Use the following procedure to set up your system for rover data collection.

Main menu

1. Select *Data collection* and press [Enter]

Data collection menu

2.	Create a data file -or- Open an existing data file	Select *Create new file*: Press [Enter] and then press [Enter] -or- Select *Open existing file*. Press [Enter] Select an existing file to append to or update, and press [Enter]
3.	To exit *Data collection*	Press [Esc] and press [Yes] to confirm exit

1.5 Base Station Configuration

Use the following procedure to set up your system in a base station configuration.

Main menu

1.	*Configuration*	Highlight *Configuration* then press the [Enter] key

Configuration menu

2.	*GPS base station options*	Press [Enter]
3.	*Logging options*	Press [Enter]

Logging options screen

4.	*Measurements*	One to five seconds (depending on rover interval and free space)
5.	To accept	Press [Enter]
6.	To return to the *Configuration* menu	Press [Esc]

Configuration menu

7.	To exit the *Configuration* menu	Press [Esc]

1.5.1 Base Station Data Collection

Use the following procedure to set up your system for base station data collection.

Main menu

1.	*Data collection*	Press Enter

***Data collection* menu**

2.	*Create base file*	Press Enter

***Create File* screen**

3.	Create file	Press Enter

***Antenna options* screen**

4.	*Height*	Height to antenna's phase center
5.	*Measure*	'Vertical'
6.	*Type*	For a list of antenna types, see the *TSC1 Asset Surveyor Software User Guide*
7.	To accept	Press Enter

Reference Position screen

8.	Enter reference position	Type lat/lon (or north/east) and altitude, and press Enter
	-or-	-or-
	Use an existing waypoint	Press WayPt, select the waypoint and press Enter
	-or-	-or-
	Use an approximate position	Press Here and press Enter
	-or-	-or-
	Leave as is and set in the Pathfinder Office software	Press Enter

Base Station screen

9.	To exit *Base station*	Press Enter and press Yes to confirm exit.

Key Symbols

The Asset Surveyor software uses both *hard* (that is, physical) keys on a keypad and *soft* (that is, visual) keys on the datalogger's screen.

Hard (physical) keys on the TSC1 keypad are indicated as follows:

[Enter], [◄], [F1], and so on.

Softkeys on the TSC1 screen are indicated as follows:

[Create], [Del], [Edit], and so on.

A softkey is activated by pressing the corresponding function key ([F1]...[F5]) on the TSC1 keypad.

Warnings, Cautions, Notes, and Tips

Warnings, cautions, notes, and tips draw attention to important information, and indicate its nature and purpose.

Warning – Warnings alert you to situations that could cause personal injury or unrecoverable data loss.

Caution – Cautions alert you to situations that could cause hardware damage or software error.

Note – Notes give additional significant information about the subject to increase your knowledge, or guide your actions.

Tip – Tips indicate a shortcut or other time- or labor-saving hint that can help you make better use of the product.

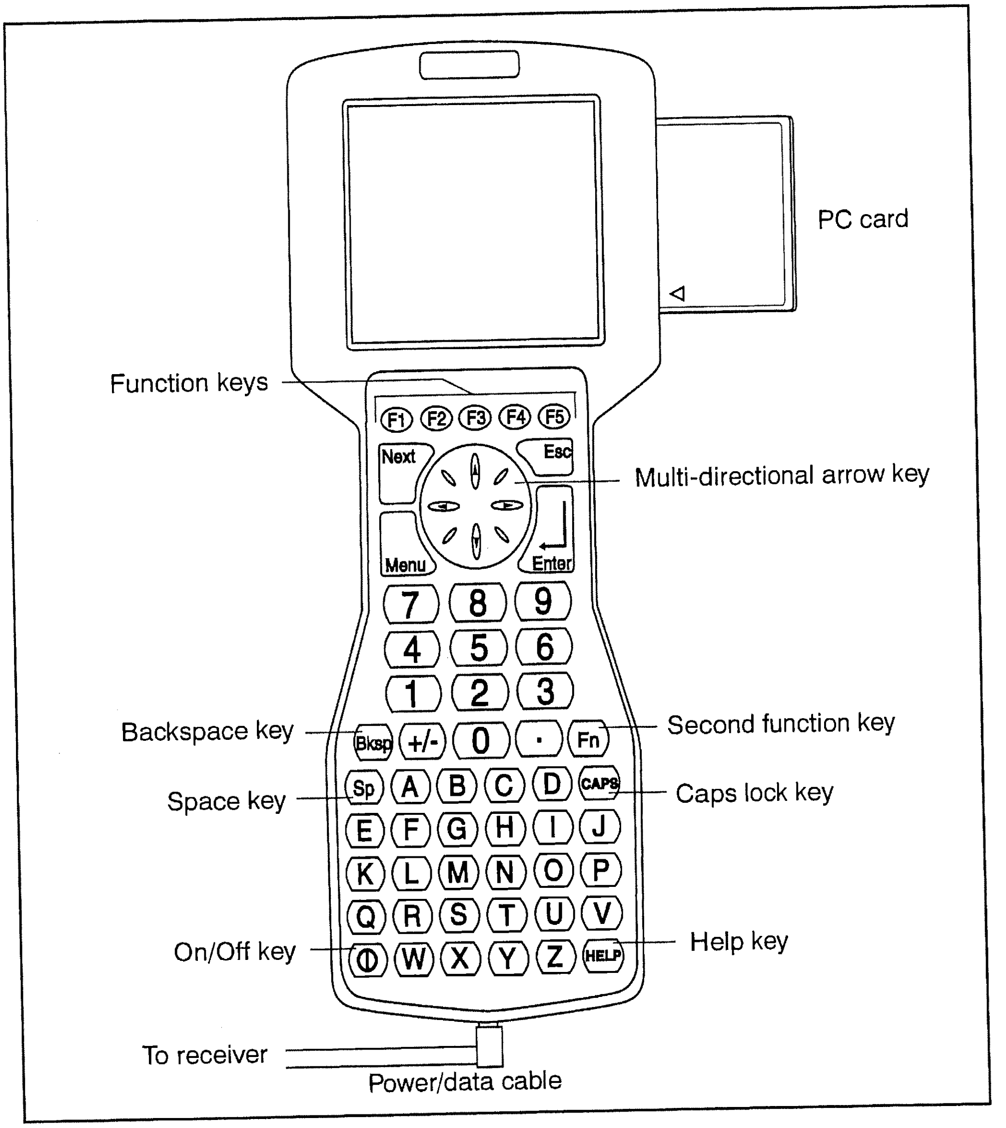


Figure 3-1 Front View of the TSC1 Datalogger

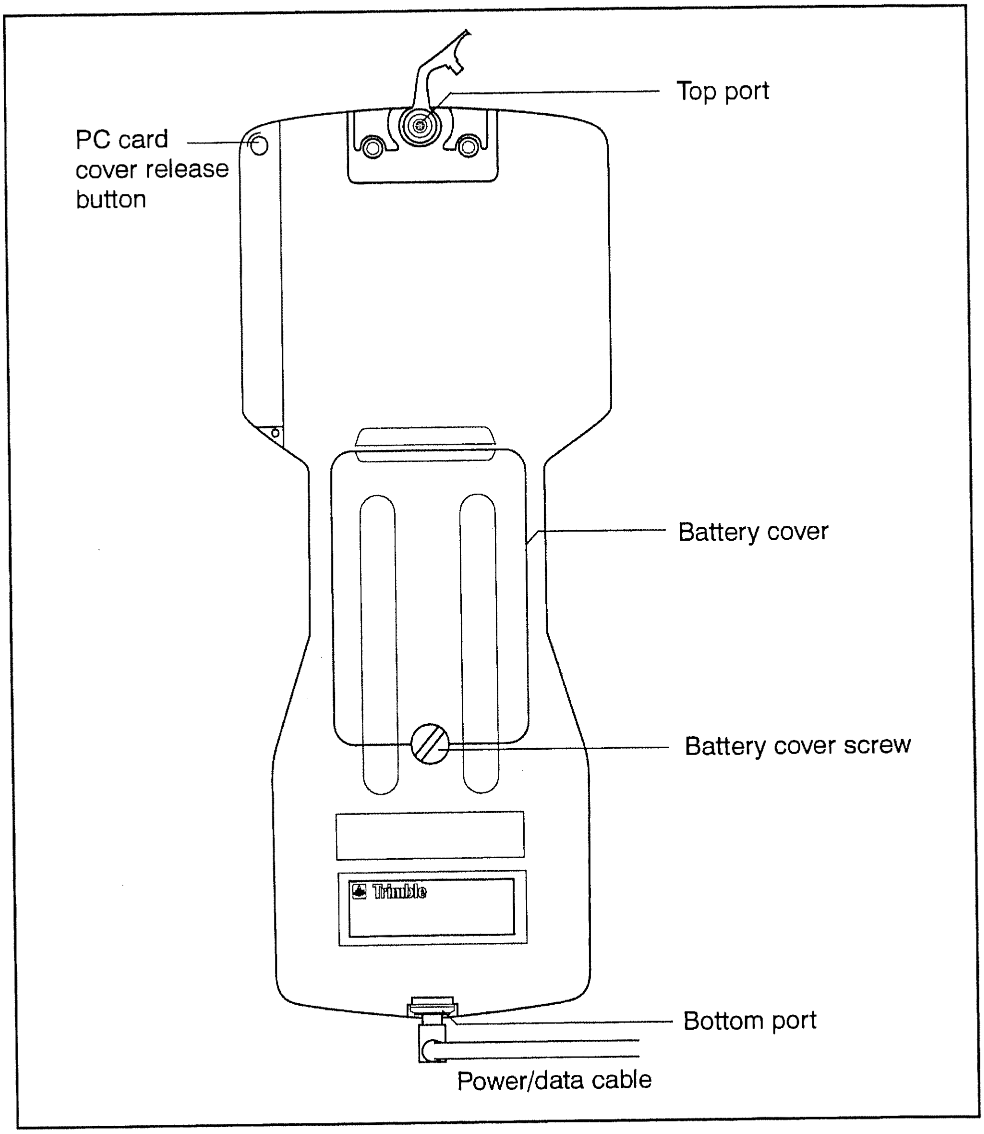


Figure 3-2 Back View of the TSC1 Datalogger

3.2 Turning the TSC1 Datalogger On and Off

To turn on the TSC1 datalogger, make sure that power is supplied (see Power Sources, page 3-11). Then press the green on/off key marked [⏻].

To turn off the TSC1, hold down [⏻] for one second.

Tip – For the location of the [⏻] key and other keys on the TSC1 datalogger's keypad, refer to Figure 3-1.

3.2.1 Hard Keys

Hard keys are the physical keys on the TSC1 keypad, such as [1], [A], [Enter], [▷], [▽], and [Esc]. Use these keys to enter data and to access different screens.

3.2.2 Alternate Keys

Alternate keys give some hard keys a second function. Some of the second functions are displayed on the hard keys in small yellow lettering. To use a second function, press the [Fn] hard key and then press the alternate hard key.

Table 3-1 shows some of the functions that you can access using alternate keys.

Table 3-1 Useful Second Functions

Keys	Function
[Fn] [▽]	Page down
[Fn] [△]	Page up
[Fn] [◁]	Home
[Fn] [▷]	End
[Fn] [Next]	Previous screen
[Fn] [E]	Contrast up
[Fn] [F]	Contrast down

3.2.3 Softkeys

Softkeys are displayed on the bottom line of the TSC1 screen. A softkey corresponds to the adjacent hard key: F1, F2, F3, F4, F5. Press the hard key to activate the softkey on the screen. To activate the Pause softkey, for example, press F1. See Figure 3-3.

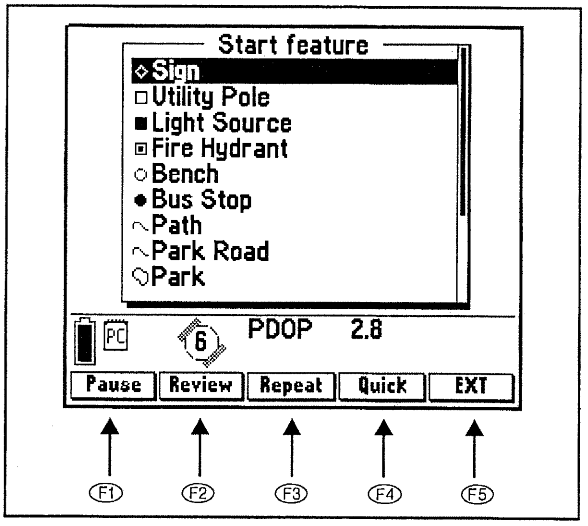


Figure 3-3 How Function Keys Correspond to Softkeys

Softkeys relate to particular forms or fields and only appear when these forms or fields are accessed. For example, the Seg softkey only appears when a line feature is opened for data collection, as this functionality applies to line features only.

3.2.4 Menu Key

To return to the *Main menu* at any time, press the Menu hard key. Use this key in conjunction with the Next key to move around the Asset Surveyor screens quickly.

3.2.5 Next Key

To simplify the task of moving around menus, the [Next] hard key offers quick access to open screens (windows).

3.2.6 Help Key

Press the [HELP] hard key at any time to obtain further information about a topic. When you press it, the *Help* menu appears. To exit *Help*, press [Esc] from the *Help* menu.

3.3 Screen

The TSC1 has an LCD screen. This screen responds to heat, and prolonged exposure to full sunlight can cause it to darken. If the screen does darken, turn it away from direct sunlight until it returns to normal.

Caution – Repeated exposure to direct sunlight can cause the screen to degrade.

3.3.1 Contrast

To increase the screen contrast, press [Fn] [E].

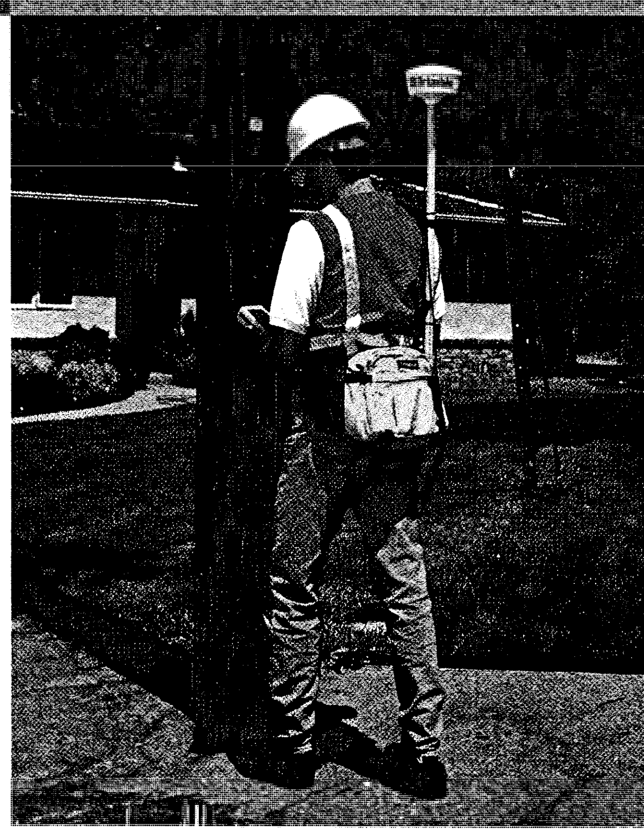
To decrease the screen contrast, press [Fn] [F].

3.3.2 Backlight

To toggle the screen backlight on and off, press [Fn] [L].

Pro XR/XRS

Receiver Manual



Trimble

Pro XR/XRS

Receiver Manual

Part Number 31172-20-ENG

Revision A

May 1998

Trimble Navigation Limited
Mapping and GIS Systems Division
645 North Mary Avenue
P.O. Box 3642
Sunnyvale, CA 94088-3642
U.S.A.

1-800-827-8000 in North America
+1-408-481-8000 International
Fax: +1-408-481-7744
www.trimble.com

4 Pro XR/XRS System Equipment

This chapter provides details of the equipment associated with the Pro XR and Pro XRS receivers and shows how to assemble the equipment.

4.1 Pro XR Receiver Front Panel

The Pro XR receiver, shown in Figure 4-1, is mounted in a weatherproof housing.

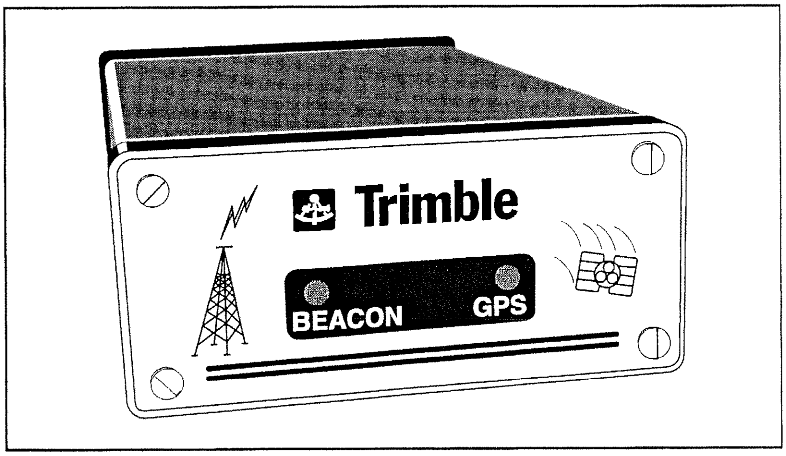


Figure 4-1 Pro XR Receiver Front Panel

4.2.1 Pro XR Status Lights

The two status lights on the front panel of the Pro XR receiver provide the status information listed in Table 4-1.

Table 4-1 Pro XR Status Lights

	GPS	Beacon
OFF	Unit not powered up	Unit not powered up or beacon function is disabled
FAST FLASH	Searching for satellites	Searching for MSK signals
SLOW FLASH	Found one or more satellites. Not enough for a position fix.	Found MSK signal. RTCM data has not been sent to GPS receiver.
ON	Performing position fixes	Good RTCM data is being provided to the GPS receiver

4.3 Back Panel

The Pro XR and Pro XRS receivers have two serial communications ports (RS232) and an antenna cable port. The serial communications ports, shown in Figure 4-3, are 12-pin(m) bulkhead connectors located on the back panel of the Pro XR and Pro XRS receivers.

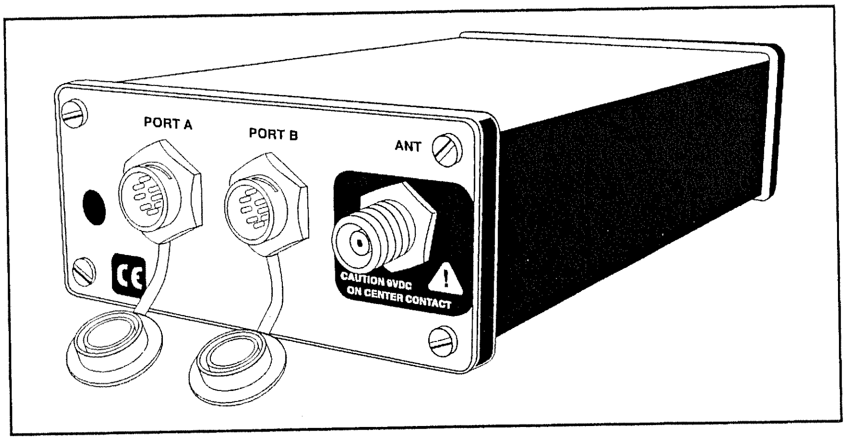


Figure 4-3 Pro XR/XRS Receiver Back Panel

4.3.1 Port A

Port A offers RS232 communication standards. It is designed for NMEA-0183 output and RTCM input.

4.3.2 Port B

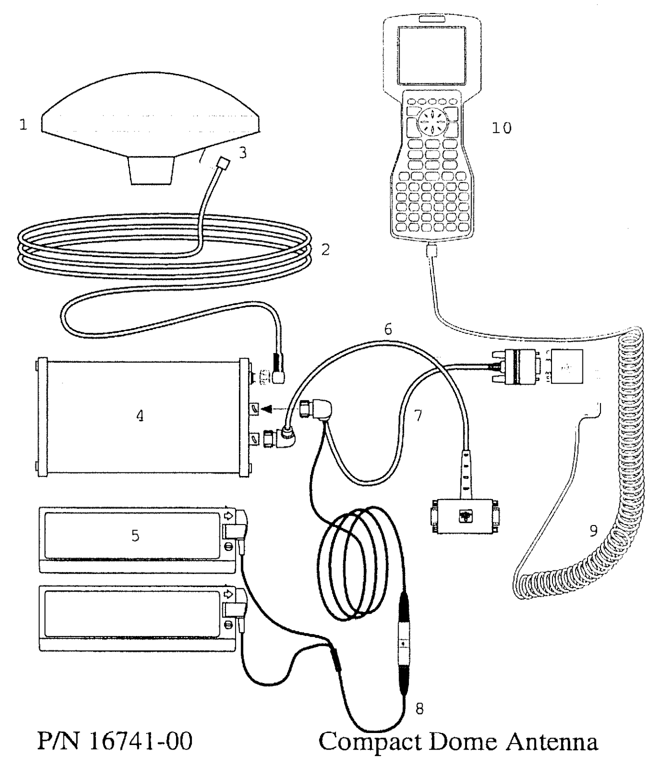
Port B also offers RS232 communication standards. It is designed for two-way data flow, external sensor input and power.

4.3.3 Antenna Port

The antenna connector is a TNC(f) connector located on the far right on the back panel of the Pro XR or Pro XRS receiver.

4.4 GPS Pro XR Cabling

To use the TSC1 handheld with a GPS Pro XR receiver, connect the system as shown in Figure 4-4.



1	P/N 16741-00	Compact Dome Antenna
2	P/N 22628	Antenna Cable
3	P/N 31180	Antenna Cable Adapter
4	P/N 29654-11	12-channel Pro XR receiver
5	P/N 17466	Camcorder Batteries
6	P/N 30232-00	NMEA/RTCM Cable
7	P/N 30231-00	Data/Power Cable
8	P/N 24333	Dual Battery Cable
9	P/N 32287-00	TSC1 Data/ESP Cable
10	P/N 29673-50	TSC1 Handheld

Figure 4-4 GPS Pro XR / TSC1 Connection Diagram

4.7 Pro XR/XRS System Hip Pack

The Pro XR and Pro XRS systems come equipped with an ergonomic hip pack carrying system, see Figure 4-18. The receiver, batteries and antenna are carried in the field using this hip pack/strapping system.

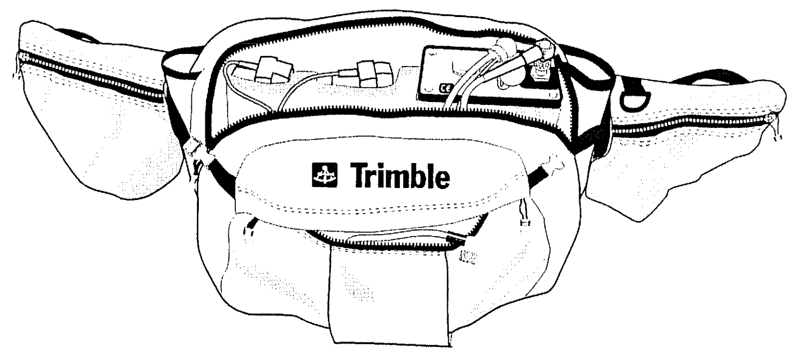


Figure 4-18 Pro XR/XRS System Hip Pack

4.7.1 Pro XR/XRS Hip Pack Contents

The Pro XR and Pro XRS systems are packed so that they are almost ready for use. The items not included in the hip pack are three 1-foot antenna poles, one 6-inch antenna pole and the data collector cable (P/N 30233-00 for TDC1, P/N 30234 for TDC2, or P/N 30236 for Field Computer/MC-V). These are located inside the shipping case.

The large interior of the hip pack contains: the Pro XR or Pro XRS receiver, two camcorder batteries, the power/data cable, and the camcorder power cable. All of these are set up inside the pack and ready for use. The exterior pocket of the hip pack contains a 3-meter antenna cable attached to the receiver and routed through a passage between the large interior pocket and exterior pocket. Both the data collector cable and antenna are routed out of the exterior pocket through the double zipper.

To route the data collector cable:

1. Locate the data collector cable and connect it to the data power cable, DE-9 connector labeled TO RECEIVER.
2. Once connected, feed the coiled cable through the passage and into the exterior pocket.

4.7.2 Wearing and Adjusting the Hip Pack

The Pro XR/XRS hip pack, once adjusted to suit, is comfortable and easy to use. See Figure 4-19.

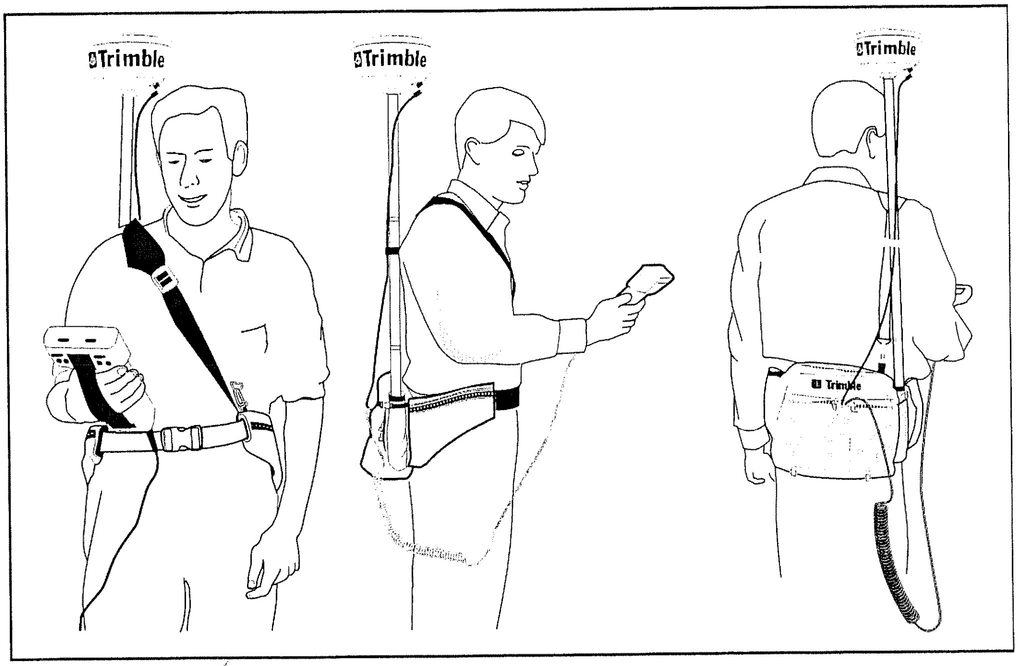


Figure 4-19 View of Hip Pack Setup

Antenna

When wearing the hip pack, the antenna height should be 3-4 inches above your head. The number of antenna pole sections required varies depending on your height. For example, if you are 5'5" tall, you may need two 1-foot and one 6-inch pole sections. If you are 6'2" tall, you may need three 1-foot poles. Try out different pole heights.

To set up the antenna with the hip pack:

1. Attach the pole sections together and connect the antenna onto the top of the pole sections.
2. Attach the pole/antenna to the hip pack.
3. Choose the side of your body that you prefer the antenna to be on and slide the pole sections into the small sleeve on that side of the hip pack.

Hip Pack and Strap

To adjust the hip pack and strap:

1. Connect the strap to the rear D-ring on the side of the pack on which the antenna is located.
2. Connect the other end of the strap to the D-ring on the belt on the opposite of the bag.
3. Slide the antenna pole through the velcro connection on the strap.
4. Put the strap over your head and across your opposite shoulder.

   At this point, the shoulder strap should lead naturally from the antenna pole across your chest to the belt.
5. Buckle the hip pack around your waist/hip area so that the belt buckle is centered in the middle of your body.

   The pack should adjust to fit close to the small of your back.

6. Adjust the front and back straps so the shoulder strap is situated squarely on your shoulder.

7. Put the pack on by slipping the strap over your head and across your body and then buckling the belt of the hip pack.

   The hip pack includes side compression straps that can be pulled towards you to hold the pack firmly and comfortably against your back.

Remove the hip pack/strap by unbuckling the belt and slipping the strap over your head.

The hip pack and strap can also double as a shoulder bag. Tuck the belt portion of the pack into the webbing material on the back of the pack and hook the strap on the large D-rings of the pack. The unit can now be carried on your shoulder instead of around your waist.

The pack has extra room in the interior and exterior pockets for additional items you may need in the field. The hip pack also includes straps on the bottom of the pack to secure an extra sweater or coat while in the field.

4.8 Optional Range Poles and Tripods

Range poles and tripods are very useful when collecting carrier phase data. The height of the antenna can be accurately measured, and the antenna can be held still easily, compared to an antenna mounted from the hip pack.

APPENDIX B

FIELD DOCUMENTATION

Appendix B-1: Example of Field Sheet

Appendix B-2: Example of Chain of Custody Form (COC)

Appendix B-3: Example of Photo-Log

Appendix B-4: Example of Sample Labels

MONTEREY COUNTY WATER RESOURCES AGENCY - COASTAL GROUND WATER MONITORING PROGRAM June 2007

F CODE	SWID	STATUS	AQUIFER	USE	WELL NAME	METER No	PLANT No	SMPLE PT	VISIT DATE	APPT. DATE	SMPLE DATE	SMPLE TIME	SMPLER	REMARKS
886	14S/02E-24E01	ACTIVE	P400	AG	R5P1	4571R8	92205	DL						D'Arrigo Bros. R5P1. Tag #1164. Well is at corner of San Jon Rd an Hwy 183. Go twice then call Ed Mora 206-9164 or Jesse Aragon 90 9073. See photo
331	14S/02E-36E01	ACTIVE	P180	AG	BARDIN 12	0R1749	92428	faucet on booster						T & A. Bardin #12. Tag #1037. Well on Hitchcock Rd. off Blanco b office. Go twice, then call Dennis. See photo
673	14S/02E-13F01	ACTIVE	P180	AG	SAN JON B	R39873	95522	DL						Sea Mist. San Jon well B. Tag #1186. Call Chris. Three day notice. S photo
975	14S/02E-12N02	CSIP-SBI	P180	AG		92593R	91785	DL						Schneider. Domestic well. Tag #2960. Run for 30 min. to stabilize conductivity, EC = 2920 (Jul '04). Call Tim Schneider 449-0874. Tw week notice. Take EC meter, a bucket and last years results. See pho
1055	14S/02E-15A01	CSIP-SUPP	P400	AG	15A01	R69587	94951	DL			6/12/2007	9:05:00 AM		CSIP-SUPP. Well 15A1. PCA site #17. Go twice, then call Bill or Je See photo
1324	14S/02E-15C02	CSIP-SUPP	P400	AG	15C02	42542R		DL			6/12/2007	8:55:00 AM		CSIP-SUPP. Well 15C2. Tag #2838. PCA site #19. Go twice, then c Bill or Jesse. See photo
861	14S/02E-15P01	CSIP-SBA	P400	AG	MORO COJO#1 (YARD)	31535R	95209	DL						Higashi Farms. Moro Cojo #1. By house and shed. Call Peter. 2 day notice. See photo
279	14S/02E-16H01	CSIP-SBA	P400	AG	CONLEY	91R418		DL						Higashi Farms. Connely Ranch well. Tag #2856. Call Peter Odello 5 7926 or Charlie 578-7416. See photo. INACTIVE
2779	14S/02E-21E01	ABAN	P400	AG	MARINA-ARMSTRONG WELL	02384R		DL						Armstrong. Marina-Amstrong well. Tag #2962. SW of MRWPCA, sample from ball valve on pressure/flow control valve. Jack Armstro 455-1901 See photo. INACTIVE
766	14S/02E-22P02	ACTIVE	P180	AG	VIERRA#1	1843T	95485	truck fill valve						Crown Packing. Vierra #1. Tag #1095. Call Bill or Jose. Two day notice. See photo
859	14S/02E-15N01	CSIP-SBA	P400	AG	MORO COJO#2	3538R4	95037	DL						Higashi Farms. Moro Cojo #2. Big yellow truck-fill. Call Peter. 2 day notice. See photo
1282	14S/02E-24P02	ACTIVE	P400	AG	BORONDA SCHOOLHOUSE#1	93258T		DL						Crown Packing. Boronda Schoolhouse well. Tag #1099. Call Bill Sullivan 214-4650 or Jose Luis Lepe 970-6889. Well next to house/metal shed on McFadden Road, close to elem. school. Two day
22929	14S/02E-28H04	ACTIVE	PDEEP	AG	JACKS YARD									New Deep aquifer well located .54 mi W of Cooper Rd & .27 mi S of McFadden Rd on the Nissen Rch

ENVIRONMENTAL ANA' YSIS REQUEST FORM

MONTEREY COUNTY CONSOLID...ED CHEMISTRY LABORATORY
1270 NATIVIDAD ROAD, SALINAS, CALIFORNIA 93906 Phone (831) 755-4516

Shaded areas for laboratory use only

Chain of Custody:

Collected by (Print & sign):	Received by:	Date & Time:
Relinquished by:	Received for Laboratory:	Date & Time:

Client Name:	Report Attention:	
Address:	Copy to:	
City, State, Zip:	Phone:	Fax:

ANALYSES REQUESTED

Laboratory Number	Sample ID or System #	Sample Site or Description	Collection Date & Time	Matrix[1] 1-Routine 2-Repeat 3-Replacement	No. of Containers	Coliform MMO..... ☐ Quanti........ ☐ Low-D............ ☐	Nitrate					

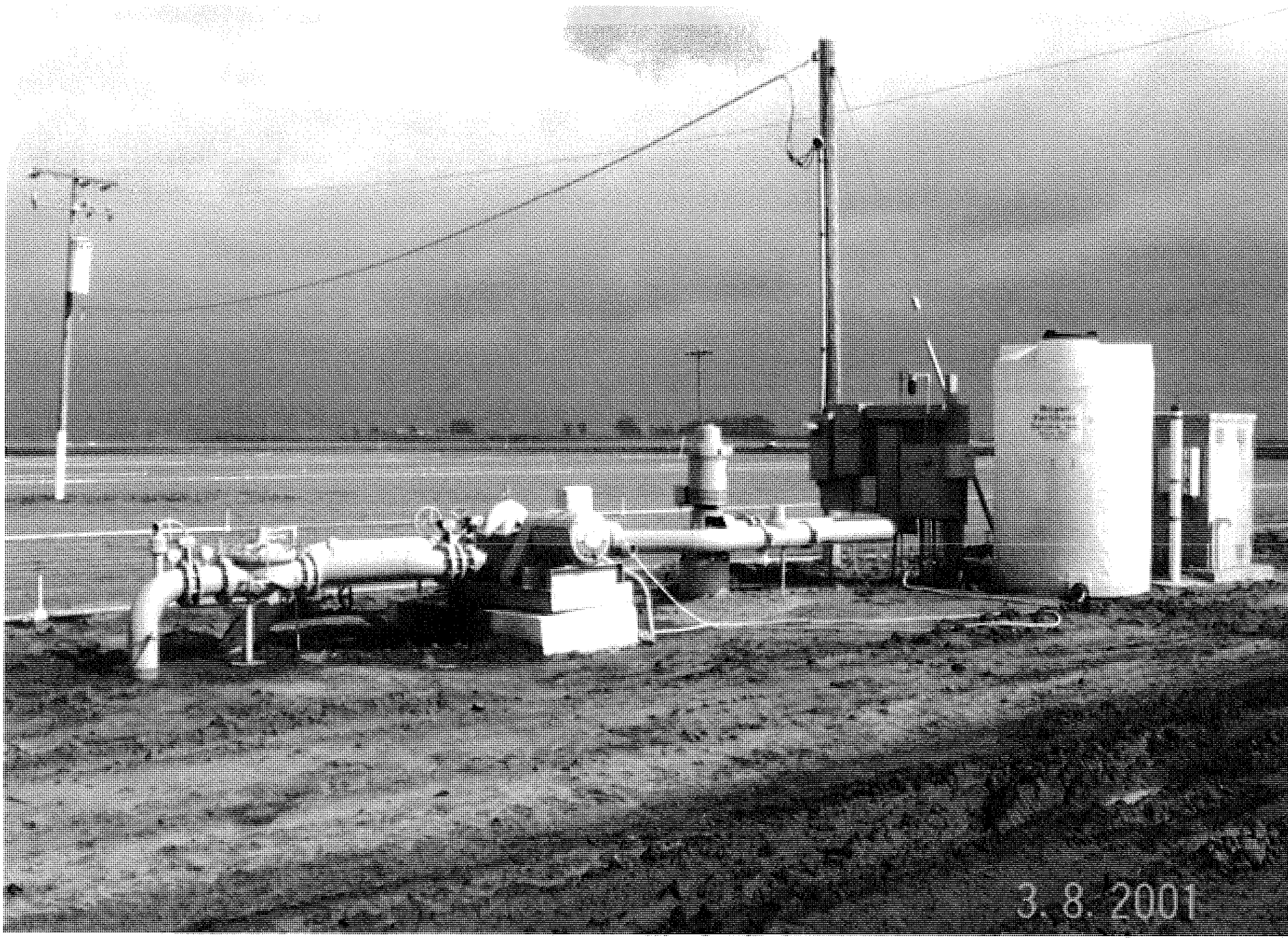
[1] **D**=Drinking Water (Specify as routine, repeat or replacement) **W**=Wastewater (Specify as grab or composite) **O**=Other (identify)

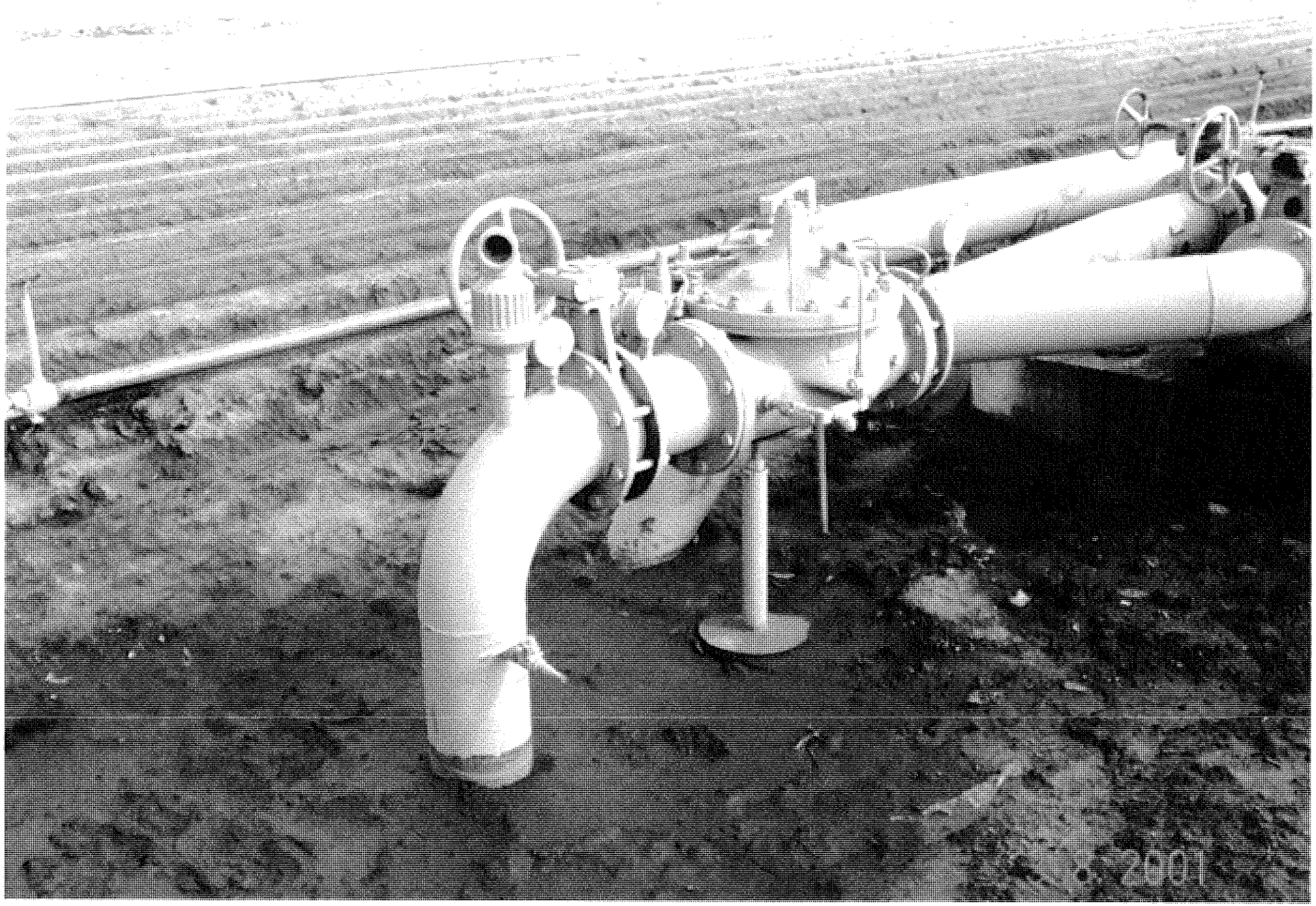
[ ] Payment received with delivery Amount: ____________

Check: ____________ Initials: ____________

Receipt #: ____________ Date: ____________

Sample comments (irregularities/preservation, billing information if different than reporting):


3.8.2001


2001

15S/04E-07A01

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-08M04

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-15D02

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-17P02

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-19H03

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-20B02

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-26G01

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

15S/04E-36H01

Sampling Date: Sampler:

Sampling Time:

Comments:
Complete General Mineral Analyses

APPENDIX C

REVIEW CHECKLISTS

Appendix C-1: Field Activities Review Checklist

Appendix C-2: Laboratory Data Review Checklist

Field Activities Review Checklist

Sampling Location(s): ______________________

Sampling Date: ______________________

Item	Yes	No	NA	Comment
All required information was entered into field sheets in ink, and sheets were signed and dated by the field sampler.				
Deviations from SOPs, along with any pertinent verbal approval authorizations and dates, were documented on the field sheets.				
Samples were collected at the correct sites.				
The correct number of samples for each type of analysis and the correct volume was collected (0.5 gal/ ~2L for complete mineral panel OR one pint/ ~0.5L for partial mineral panel).				
Acceptable sample containers, appropriate for the intended analysis, were used.				
Field blanks were collected, and at the correct frequency (one every 25 samples).				
Field duplicates were collected, and at the correct frequency (one every 25 samples).				
Samples were packed with double-bagged ice and transported at the proper temperature (4±2°C).				
Chain of custody (COC) documents were completed properly.				
Sample holding times were not exceeded during field operations. See Table 6 (QAPP).				

Reviewer's Name (print): ______________________

Reviewer's Signature: ______________________

Reviewer's Title: ______________________

Date of Review: ______________________

Laboratory Data Review Checklist

Sampling Location(s): ______________________________

Sampling Date: ______________________________

Item	Yes	No	NA	Comment
Samples arrived at the laboratory at the proper temperature (4±2°C).				
All requested analyses were performed and were documented in the analytical report.				
Analyses were performed according to the methods specified in the approved QA Project Plan.				
Holding times for extraction and analysis were not exceeded. See Table 6 (QAPP).				
Field Blanks results were below MDLs and were analyzed at a frequency of one every 25 samples.				
Field Duplicate results were ≤ 25% RPD and were analyzed at a frequency of one every 25 samples.				
Method detection limits were included in the report.				
A narrative summarizing the analyses and describing any analysis problems was included in the data report.				
Data qualifiers and flags were explained in the data report.				
Initial calibration data were within laboratory SOP defined acceptance criteria ($r^2 \geq 0.995$) for all analyses.				
Method blanks were performed at 3 per analytical batch, and were below MDL.				
Laboratory Control Sample (LCS) data were included for all analyses for every analytical batch.				
Laboratory Control Sample Results were within 80-120% recovery.				

Item	Yes	No	NA	Comment
Analytical Duplicate data were included for all analyses for every analytical batch.				
Analytical Duplicate results were < 25% RPD.				
Matrix spike data were included for all pertinent analyses for every analytical batch, and recoveries were within 75-125%.				
Matrix spike additions were at 3-10x the native.				
Matrix spike duplicates were ≤ 25% RPD.				
Continuing calibration data were within QAPP defined acceptance criteria (80-120% of initial slope) for all analyses.				

Reviewer's Name (print): ____________________

Reviewer's Signature: ____________________

Reviewer's Title: ____________________

Date of Review: ____________________

APPENDIX D

MONTEREY COUNTY CONSOLIDATED CHEMISTRY LABORATORY

QA MANUAL AND STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

ORGANIZATION AND RESPONSIBILITY

On October 11, 1988, the Monterey County Board of Supervisors, in Resolution No. 88-508, authorized the Director of the County Health Department and the General Manager of Monterey County Flood Control and Water Conservation District (MCFC&WCD) to consolidate laboratory services for their respective programs into one facility. A Laboratory Steering Committee, comprised of representatives from both agencies, was established for the purpose of providing the planning, operation, and future development of the Consolidated Environmental Laboratory.

Each year the Steering Committee develops a Memorandum of Agreement (MOA) that describes and confirms the services to be provided by the Health Department to the Water Resources Agency (formerly the Flood Control and Water Conservation District) and defines the responsibilities of each party. In addition to providing laboratory support for the Health Department and the Water Resources Agency, the Consolidated Chemistry Laboratory provides analytical services to the Monterey Regional Water Pollution Control District, the County Department of Public Works and numerous water supply systems and wastewater treatment facilities.

The Consolidated Environmental Laboratory is accredited by the State Department of to perform tests in the following fields: 1) microbiology of drinking water and waste water; 2) inorganic chemistry and physical properties of drinking water; 3) analysis of toxic chemical elements in drinking water; 4) wastewater inorganic chemistry, nutrients and demand; and 5) toxic chemical elements in wastewater. A list of analyses and methods used in the laboratory is included in Appendix A.

The following is a brief description of the staff support for the Consolidated Chemistry Laboratory:

1. Director - Plans, organizes and controls laboratory operations. Coordinates laboratory interactions with other programs in the Health Department. Administers laboratory budget, billing and purchasing. Develops laboratory policy and procedures and supervises staff.

2. Public Health Chemist – Principal analyst. Performs complex organic and inorganic chemical analysis, evaluates and implements laboratory methods, develops and maintains quality assurance, reports results and maintains records, purchases equipment and supplies, provides technical consultation to Environmental Health and Water Resources Agency. Trains analysts and documents competency

3. Water Quality Specialist- Performs broad range of professional scientific work related to water quality and environmental issues; is proficient in

performing water quality analyses and managing the laboratory water quality database. Interpret and explain regulatory guidelines to clients.

4. Public Health Microbiologists - Assist Public Health Chemist in performing microbiological analyses and performing quality control.

5. Laboratory Assistant - Prepares culture media and reagents, assists in the processing of specimens, performs low to moderately complex environmental analyses and clinical analyses where interpretation or medical judgement is not required.

5. Laboratory Helper - Washes and sterilizes glassware and supplies. Prepares and labels mailing containers and specimen collection kits. Accession laboratory specimens. Sterilizes and disposes infectious waste. Maintains stockroom.

6. Typist-Clerk II - Enters clients and laboratory results into computer. Prints reports/forms. Prepares billing statements; receives and accounts for payments. Distributes laboratory results, and maintains laboratory files.

QUALITY ASSURANCE OJECTIVES FOR MEASUREMENT OF DATA

Quality Assurance (QA) includes all aspects of laboratory operation that affect the accuracy and reliability of sample test results. In addition to quality control of the analytical test process, quality assurance practices include: 1) proper sample collection, receiving and holding, 2) proper maintenance of equipment, 3) accurate data reduction, validation and reporting; and, 4) periodic performance and systems audits.

CUSTODY, HOLDING AND DISPOSAL OF SAMPLES

Quality assurance includes proper labeling of samples, proper completion of the chain of custody/analysis request form, proper collection, preservation and storage of samples, proper accessioning of samples, and proper disposal of the sample.

1) Sample Collection/Labeling. Sample collection is a coordinated effort between the client and the laboratory. The laboratory will provide clients with appropriate sample containers and sample collection/preservation instructions. The laboratory will also request duplicates and blanks according to client's sample plan requirements. All samples submitted for testing should be appropriately labeled. Sample containers provided by our laboratory have a suitable label which should be filled out at the time of sampling by the sample collector. The following information must be provided with all samples:

    a) Sample identification - submitters identification of sample (e.g. well number)

    b) Location - an address or brief description of the place the sample was taken.

    c) Time and date taken.

    d) Name of sample collector.

    e) Any preservatives

2) Chain of Custody/Analysis Request Form. A Chain of Custody/Analysis Request form should accompany all samples (see Appendix B). The Chain of Custody/Analysis Request form must include the following information: submitter name and address; sample identification; location of sample collection; date & time of collection; sample type; analysis to be performed; signatures of persons involved in the collection and chain of possession; and inclusive dates of possession.

3) Sample Receiving. Laboratory personnel receiving samples should assure that samples are properly collected, labeled, and the Custody/Analysis Request form has been completed:

    a) The laboratory assistant receiving the specimen must sign and date the Custody/Analysis Request form. Make sure that any special requests made by the client are recorded under the comments section of the form

    b) Assign each sample a unique laboratory identification number. Place preprinted lab number on analysis request form and sample container. When a sample is collected in multiple containers for different analyses, each container should receive the same laboratory number. (Exception: sample containers for analytes requiring a rapid turnaround time (e.g. coliforms) may receive separate number to expedite reporting).

c) Check that the samples meet the criteria described in Table 1006:I Summary of Special Sampling or Handling Requirements in 18th ed. of *Standard Methods for the Examination of Water and Wastewater* (Appendix C)

   i) Samples should be collected in a suitable container; samples collected in bottles of unknown origin or questionable cleanliness should be brought to the attention of the Water Quality Specialist or the Public Health Chemist.

   ii) Samples should be adequately labeled

   iii) Samples should be checked for proper preservative, holding time, and holding temperature.

   iv) Samples should be adequately sealed. Notify public health chemist if there is evidence of leakage. Verify that adequate sample volume exists to perform requested analysis.

d) NOTE: Samples that are not properly identified or are otherwise unsuitable for testing (e.g. improperly preserved or exceeding holding/ transport time) are recorded on the "Sample Invalidation Log" and the Water Quality Specialist or Public Health Chemist notifies the client. Samples not meeting collection/preservation criteria may be tested only if resampling is impossible; results from such samples must be qualified on the laboratory report by comments describing sample deficiency.

4) When the sample meets criteria for acceptance by the laboratory, required preservatives are added immediately and the sample is stored under conditions specified by the analytical method to be used. For samples requiring thermal preservation, a laboratory refrigerator and freezer is available. The temperature is maintained at 4 degrees and below -10°C respectively. Temperatures are monitored each day.

5) Chain of Custody/Analysis Request forms are given to the clerk to enter into a password protected computer laboratory information management system. Refer to "Water Sample Entry" in Clerical Manual for instructions on sample log-in.

6) Disposal of samples: Upon completion of all analyses, any remaining

sample will be stored for at least one month prior to disposal. Chain-of-Custody form, worksheets and lab reports are retained for three years. NOTE: Longer retention of samples or data may be required when legal action is probable. The samples and any associated extracts or digests are disposed of following recommendations found in the book, *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, Washington, D.C. 1983.

CALIBRATION PROCEDURES AND FREQUENCY

Calibration is the process for determining the correctness of the assigned values of the physical standards used or the scales of the measuring instruments. Calibration accuracy is critically dependent on the reliability of the standards used for the required comparisons. Only the highest quality chemicals are used to provide necessary standard solutions, and due care is exercised in their preparation. The concentrations of the calibration standards bracket the expected concentration of the analyte in the samples. No data is reported beyond the range of calibration of the methodology. The calibration data, when plotted graphically, is referred to as a calibration curve. The calibration must be done under the same instrumental and chemical conditions as those that will exist during the measurement process. The frequency of calibration depends on the accuracy requirements of the investigation and the stability of the instrument used for the measurements:

At a minimum, three different dilutions of the standard will be measured when an analysis is initiated. Correlation coefficient must be > 0.995. Reportable analytical results are those within the range of the standard dilutions used. Do not report values above the highest standard. The lowest reportable value is the Method Detection Limit (MDL), providing that the lowest calibration standard is less than 10 times the MDL.

1) Atomic Absorption Spectrophotometers - Two approaches are used to calibrate atomic absorption spectrophotometers. These methods are direct comparison and standard additions.

    a) Direct comparison is the simple approach, and can be used with many instruments to give a direct readout of the concentration of an element in an unknown sample. To obtain good precision (e.g., 1-2% coefficient of variation), the absorbance levels measured must be about 0.1 to 0.6 units. Standard and sample solutions should be similar in bulk matrix constituents, particularly acid and salt content. Interference suppressants are used in all solutions when required. A number of standards (usually three to five in increasing concentration) as well as a blank, are prepared to cover the concentration range. A volume of type II reagent water with the same amounts of acids as the samples and standards) will be used for calibration blank. These solutions are run in absorbance to check linearity of the calibration curve.

    b) The method of standard additions is used when samples contains severe matrix interference. In this case it is possible to add small amounts of conventional standard solutions, in increasing amounts, to aliquots of each sample. A calibration graph can then be constructed. This method will often be used in work with the graphite furnace.

2) UV-VIS Spectrophotometer - The calibration procedure for the UV-VIS spectrophotometer is similar to that for the A.A. spectrophotometers. An integration interval is not required as the signal is very stable. It is important to use blanks and allow at least 1/2 hour warm up time.

3) PH Meters - The proper calibration of pH meters requires the use of two buffer solutions and a thermometer. The two buffer solutions must cover the expected range of samples to be tested. A third buffer is used to confirm calibration. The pH meter should be calibrated each day. The temperature of the buffers must be entered into the meter.

4) Conductivity Meter - The conductivity meter does not require frequent calibration but should be checked against a known standard each day of use. Recalibrate when there is significant deviation with the value of the standard.

5) Ion Chromatograph- Calibration of the Ion Chromatograph is performed at least once each year and whenever: 1) Controls are out of range; or, 2) the column, suppressor or detector is changed.

6) Inductively Coupled Plasma/Mass Spectrometer – Calibration of the ICP-MS is performed every day of analysis and whenever controls are out of range. See the SOP for more information.

ANALYTICAL PROCEDURES

The laboratory employs only methods approved by Environmental Laboratory Accreditation Program. Analysts must conduct sufficient preliminary tests using the methodology and typical samples to demonstrate competence in the use of the measurement procedure.

Each time an analytical procedure is performed controls are included and duplicate samples and known additions are tested to insure accuracy and precision. Results are not reported unless all controls are within acceptance limits referenced in Standard Methods 18th Edition, 1992.

To monitor reliability of analytical measurements, data is periodically obtained on detection limits, accuracy, precision and recovery.

ACQUISITION, REDUCTION, VALIDATION OF REPORTING DATA

The analytical chemist is responsible for describing and reporting the data in an appropriate manner. In order to insure the accurate transcription, calculation and reporting of analytical data, the chemist will adhere to the following quality assurance procedures.

1) Use documented procedures and record all significant experimental details in such a way that the measurements could be reproduced by a competent analyst at a later date.

2) All measurements are made so that results are representative of the matrix (soil, water, etc.) and conditions being measured.

3) Report data only to the number of significant figures consistent with their limits of uncertainty.

4) Report data with the proper units of concentration. Units should be chosen which clearly indicate whether the concentration is in terms of weight by weight, weight by volume or volume by volume. Unless otherwise specified, all data are calculated and reported in standard units to allow comparison with data reported by other laboratories.

5) The analytical methodology used will be cited. The raw data for each sample, along with reagent blanks, control, and spiked samples will be suitably identified if included in the report. If average values are reported, an expression of the precision, including the number of measurements, must be included.

6) The report should include date and place of sampling, sampling point, the name of the sample collector, identification as to type of sample, date and time of submittal to the lab, date of analysis, name of the analyst, and the result. Any conditions which may effect the interpretation of the data should be noted in the report.. All results will be reviewed by a Water Quality Specialist or Public Health Chemist before a final report is released.

7) Laboratory records will be retained in a permanent file for three years.

8) Retain samples for one month after issuing final report and retain data and documentary evidence for three years.

INTERNAL QUALITY CONTROL

Quality Control (QC) may be defined as those measures undertaken in the laboratory to maintain the analytical testing process within acceptable limits of accuracy and precision.
The Quality Control Program consists of the following elements: documentation of operator competence, recovery of known additions, analysis of externally supplied standards, analysis of method blanks, and testing of replicate samples:

1) Operator competence The principal analyst is responsible for: 1) developing a standardized training syllabus for the methods employed in the laboratory; 2) assuring that test personnel are adequately trained; 3) assessing the competency of test personnel, and 4) maintaining documentation of training and competency of all test personnel.

   a) Before test personnel are permitted to do reportable work , competency in performing the analysis is to be demonstrated. Commonly, the analyst performs replicate analysis under the supervision of the principal analyst. General limits for acceptable work are found in Standard Methods 18th Edition, 1992 in Table 1020 :I.

   b) After initial demonstration of competency, the principal analyst will assure test personnel maintain competency through testing internal or external proficiency test samples at least once each year.

2) With each batch of samples tested, controls will be tested to verify the accuracy of results as described below. Controls used with each method are outlined in Appendix D.

   a) Recovery of known additions as part of all regular analytical protocols except titrimetric and gravimetric methods. Use known additions to verify the absence of matrix effects. Spiked samples shall be analyzed with a minimum frequency of ten percent of the samples per matrix per batch of samples. Spike recovery must be between 80-120% for potable water (75-125% for waste water). When a spike sample fails to meet this criteria, retest all samples following the last acceptable spike sample. Spike recovery calculated as % of the known addition recovered.

   b) Analyze control standards with a minimum frequency of ten percent of the samples per matrix, per batch of samples. If there are less than 10 samples in a batch, at least one per matrix per batch must be analyzed. The concentration of the sample shall be within the working range of the method. Sources of these samples include but are not limited to: performance evaluation samples from the EPA, commercially available standards, or standards prepared in-house but from sources different from calibration standard. Control standards must be within the published acceptance range (for external controls). If the control standard does not have a published acceptance range, recovery of the control should be within 10% of the known value. When a control standard fails to meet this criteria, retest all samples following the last acceptable control.

c) Method blanks will be analyzed with each batch of samples. The use of method blanks provides a measurement of laboratory contamination. Blanks cannot exceed the minimum detection level. See Appendix A.

d) Replicate samples will be analyzed with a minimum frequency of ten percent of samples per matrix, per batch of samples for drinking water. For wastewater the requirement is 5%. If there are less than ten samples per batch, at least one sample per matrix per batch must be analyzed. If the analyte is not detected, replicate matrix spike samples will be analyzed. The percent difference between replicate samples must be within 20% for potable water (25% for wastewater). When a replicate sample fails to meet this criteria, retest all samples following the last acceptable replicates. Duplicate % difference calculated as the difference as a percent of the mean. [100(X1-X2)/avg].

e) In addition to the control standards tested with each run, an external reference standard for each analyte will be tested at least once each quarter.

All of the quality assurance control procedures will be followed in the laboratory. All documentation for these checks should be available for inspection by laboratory management.

PREVENTIVE MAINTENANCE

As part of the QA plan, the laboratory has a comprehensive preventive maintenance program. Balances, spectrophotometers, and other instruments undergo routine maintenance and accuracy checks by a manufacturer's representative or by laboratory personnel as described below. All preventive maintenance performed in-house is documented on preventive maintenance forms. Instrument s which undergo routine professional maintenance have labels affixed to indicate date of last servicing. Manufacturer's instructions and service manuals are readily accessible.

Adequate spare parts are kept on hand to perform routine maintenance and minimize downtime. The spectrophotometers have maintenance contracts that provide for immediate servicing in the event of malfunction. Equipment records documenting preventive maintenance and emergency servicing/repairs are kept for a minimum of three years.

1) Thermometer/temperature-reading instruments: Accuracy of thermometers or recording instruments are checked annually against a certified National Bureau of Standards (NBS) thermometer or one traceable to NBS and conforming to NBS specifications. All thermometers a relabeled with date calibrated and correction factor.

2) Balance: Balance accuracy is verified each week using ASTM type 1 reference weights. Accuracy checks are documented on preventive maintenance chart. Balances are serviced and certified annually through a maintenance contract. Type 1 weights are re-certified at least every five years.

3) pH meter: pH meters are standardized with at least two NIST traceable standard buffers (pH 4.0, 7.0, or 10.0) and compensated for temperature before each series of tests. A third buffer is used to confirm calibration. Date buffer solutions when opened and discard buffer after expiration date on bottle. Buffers prepared from powders are replaced after four weeks.

4) Water deionization unit: Conductivity of the RO and Nanopure water is checked each month. A heterotrophic plate count on Nanopure water is also performed monthly. Filters are changed as indicated by conductivity readings and heterotrophic plate count. Records are maintained on preventive maintenance chart. Water is tested annually for bacteriologic quality and heavy metals.

5) Autoclave: Autoclave charts are used to document date, time, temperature and contents of each load. Chem-di indicators and heat sensitive tape are used with each load to identify materials that have been autoclaved; results are recorded on autoclave chart. Autoclave performance is

checked each month with biological indicator (e.g. spore suspension). Autoclaves are serviced quarterly under maintenance contract. The accuracy of autoclave recording thermometer is checked annually. The autoclave operating temperature is monitored on a weekly basis.

6) Refrigerator: Temperatures are recorded daily and units defrosted and cleaned as needed. All media and reagents stored in the refrigerator are labeled.

7) Freezer: Temperatures are recorded daily. Identify and date materials stored. Defrost and clean semiannually; discard outdated materials.

8) Ultraviolet sterilization lamps: Unit is cleaned monthly by wiping lamps with a soft cloth moistened with ethanol. Test lamps quarterly with UV light meter and replace if they emit less than 70 % of initial output or if agar spread plates containing 200 to 250 microorganisms, exposed to the light for 2 minutes, do not show a count reduction of 99%.

9) Water bath: Fecal coliform water bath is checked twice daily. All other water baths are checked each day of use.

10) Incubator: Check and record temperature twice daily (morning and afternoon) on the shelf areas in use. Locate incubator where room temperature is in the range of 16 to 27O C.

11) Fume hoods/Biological Safety Cabinets: Fume hoods are checked once each month using a velometer; readings are recorded on preventive maintenance chart. Hoods and safety cabinets are certified annually through service contract.

PERFORMANCE AND SYSTEMS AUDITS

Corrective action is required when data is outside of predetermined limits for acceptability. The corrective actions can be triggered by the following quality assessment activities: Control Chart analysis; proficiency evaluation testing; and QA audits.

1) CONTROL CHART ANALYSIS:
The laboratory's quality assessment techniques will be used to maintain the precision and accuracy of all laboratory analyses within a state of statistical control. Precision and accuracy measurements are the best way to assess analytical performance. Precision is the degree of reproducibility of a particular analytical procedure. Accuracy is a measure of the agreement between an experimental determination and the true value.

a) PRECISION - Assess precision by replicate analysis, by repeated analysis of a stable standard, or by analysis of known additions to samples. Precision is specified by the standard deviation of the results. The formula for determining standard deviation (SD) is:

$$SD = \sqrt{\Sigma (X1-X)^2/(N-1)}$$

X1 is the value of the individual measurements; X is the mean of all measurements for a given sample and N is the number of measurements.

The purpose of determining precision is to establish the typical variance of the method in the absence of any matrix influence. In the course of determining precision, there are two cases that indicate there is a problem with the precision data:

i) The measured values show wide variation from one to another for a given day.

ii) The measured values show little variance from one to another for a given day, but the mean and standard deviation show wide variation from one day to another.

If either of the above occurs, factors such as sample homogeneity, instrument calibration, or analyst error should be checked, documented, and corrected. The precision measurements should then be repeated.

b) ACCURACY - The best method to determine accuracy is to spike an alequot of reagent water with a known amount of the constituent being measured and analyze the sample. The amount spiked should be at least five to ten times greater than the analytical detection limit.

To evaluate the data accuracy, the percent recovery of the spike must be determined. The formula for determining percent recovery is:

$$\% \text{ recovery} = [100(S - S1) \div S2]$$

Where S is the concentration of the spiked sample; S1 is the concentration of the unspiked sample; S2 is the concentration of the spike added to the sample.

If the percent recovery deviates significantly from 100% and the method has not demonstrated significant bias, the problem must be detected and corrected prior to continuing the analysis. Sources of this problem include incorrect standard or spike solution concentration or a problem in the procedural detection system.

Precision, accuracy, and detection limits for all methods used in the laboratory is comparable to values referenced in Standard Methods 18th Edition, 1992 and EPA Methods for Chemical Analysis of Water and Wastes, March 1983.

2) PERFORMANCE EVALUATION SAMPLES: The laboratory director is responsible for enrolling the laboratory in ELAP approved proficiency testing program(s) and assuring that proficiency testing is performed for all regulated tests. The principal analyst (Public Health Chemist) will conduct and document internal proficiency testing at least once a year for tests where proficiency testing is not available. Proficiency test samples are treated in the same manner as routine samples (ie. tested the same number of times, tested using personnel who routinely perform testing, tested using routine methods and tested during patient testing).

3) QUALITY ASSURANCE AUDIT: The quality assurance program will be audited quarterly and any deviations from the program will signal corrective action to be taken. Quality assurance audit will be documented in a written report. The audit will include the following aspect:

   a) Competency of test personnel must be evaluated annually and be documented

   b) Evidence of the systematic use of control samples, replicate measurements and reference materials all in conjunction with control charts.

   c) Proper labeling of reagents and samples.

   d) Use of approved methods.

e) Results on blind samples.

f) Acceptable safety equipment and procedures.

g) Quality assurance reports generated on a regular basis.

h) Documentation on equipment performance and maintenance.

i) Training records.

j) All relevant files accessible and organized.

k) Laboratory personnel following good laboratory practices.

l) Laboratory personnel following good measurement practices

The Public Health Chemist will be responsible for initiating and documenting any corrective action necessary. Corrective action will be documented on the appropriate control chart, performance evaluation report, or QA audit report. No data shall be reported until the cause of the problem is located and corrected or the laboratory demonstrates the cause was a random event and no longer affects data. Although the elimination of events requiring corrective action may not be achieved, a reduction in the repetition of these events is the objective of this program.

REFERENCES FOR QUALITY ASSURANCE DOCUMENT

1) Standard Method for the Examination of Water and Wastewater, 18th edition, 1992.

2) Handbook for Analytical Quality Control in Water and Wastewater Laboratories. EPA-600/4-79-019, March 1979, USEPA.

3) Manuals for the Certification of Laboratories Analyzing Drinking Water Criteria and Procedures/Quality Assurance. EPA QAMS-005/80, Interim Guidelines, EPA-570/9-82-009, USEPA.

4) Methods for Chemical Analysis for Water and Waste. EPA-600/4-79-020, March 1983.

Written by: Gerry Guibert & David Holland

Date: May 1993

Revised: January 1999
Revised: September 21, 2004

Approved by: ________________________________

(Laboratory Director's Signature)

Appendix A

Monterey County
Consolidated Chemistry Laboratory

ANALYTICAL METHODS FOR WATER ANALYSIS

PARAMETER	HOLD TIMES	METHOD REFERENCE	MDL	UNITS
Free Chlorine	.25 h; ASAP	SM 4500-Cl G	0.02	mg/L
Total Chlorine	.25 h; ASAP	SM 4500-Cl G	0.05	mg/L
Enterococcus	8 h	IDEXX	1/100 ml	
Heterotrophic Plate Count	8 h	SM 9215 B	1	CFU
E. coli – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	2/100 ml	
Fecal Coliform – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	1/100 ml	
Total Coliform – MPN	6 h waste 8 h source 30 h potable	SM 9221 B	2/100 ml	
Total Coliform – Quantitray	6 h waste 8 h source 30 h potable	SM 9223	1/100 ml	
E. coli – Presence/Absence	30 h potable	SM 9223	1/100 ml	
Total Coliform – P/A	30 h potable	SM 9223	1/100 ml	
pH	.25 h; ASAP	SM4500H B		pH units
Bicarbonate	ASAP (with pH)	SM 2320 B	10	mg/L
Calcium Carbonate	ASAP (with pH)	SM 2320 B	1	mg/L
Carbonate	ASAP (with pH)	SM 2320 B	1	mg/L
Solids	24 h	SM 2540 F	0.1	mL/L
Color Determination	48 h	SM 2120 B	2	CU
Odor	NS; 48 h (rec 6h)	SM 2150 B	1	TON
Turbidity	48 h	SM 2130 B	0.05	NTU
Nitrate	48 h	EPA 300.0	1	mg/L
Nitrite as (N)	48 h	SM 4500 NO2-B	10	ug/L
Total Dissolved Solids	7 d	SM 2540 C	5	mg/L
Total Suspended Solids	7 d	SM 2540 D	5	mg/L
Alkalinity	14 d	SM 2320 B	1.0	mg/L, CaCO3
Bromide	28 d	EPA 300.0	1	mg/L
Chloride	28 d	EPA 300.0	1	mg/L
Fluoride	28 d	EPA 300.0	0.02	mg/L
Sulfate	28 d	EPA 300.0	1	mg/L
Conductivity	28 d	SM 2510 B	1	umhos at 25C
Ammonia (N)	28 d	SM 4500 NH3 F	0.05	mg/L
Orthophosphate	NS; 28 d	SM 4500 P E	0.03	mg/L
Total Phosphorus	28 d	SM 4500 P E	0.03	mg/L

PARAMETER	HOLD TIMES	METHOD REFERENCE	MDL	UNITS
Aluminum	6 months	EPA 200.8	5	ug/L
Antimony	6 months	EPA 200.8	0.5	ug/L
Arsenic	6 months	EPA 200.8	1	ug/L
Barium	6 months	EPA 200.8	0.5	ug/L
Beryllium	6 months	EPA 200.8	0.5	ug/L
Cadmium	6 months	EPA 200.8	0.5	ug/L
Chromium	6 months	EPA 200.8	5	ug/L
Copper	6 months	EPA 200.8	0.5	ug/L
Iron	6 months	SM 3111B	100	ug/L
Lead	6 months	EPA 200.8	0.5	ug/L
Manganese	6 months	EPA 200.8	0.5	ug/L
Mercury	6 months	EPA 200.8	0.25	ug/L
Nickel	6 months	EPA 200.8	0.5	ug/L
Selenium	6 months	EPA 200.8	5	ug/L
Silver	6 months	EPA 200.8	5	ug/L
Thallium	6 months	EPA 200.8	0.5	ug/L
Zinc	6 months	EPA 200.8	5	ug/L
Calcium	6 months	SM 3111B	1.0	mg/L
Magnesium	6 months	SM 3111B	0.1	mg/L
Potassium	6 months	SM 3111B	0.1	mg/L
Sodium	6 months	SM 3111B	0.1	mg/L
Hardness as CaCO3	6 months	SM 2340 B	1.0	mg/L
Boron	6 months	SM 4500 B B	0.1	mg/L

Appen[illegible] B

ENVIRONMENTAL ANA[illegible]YSIS REQUEST FORM

MONTEREY COUNTY CONSOLI[illegible]D CHEMISTRY LABORATORY
1270 NATIVIDAD ROAD, SALINAS, CA[illegible]ORNIA 93906 Phone (831) 755-4516

Shaded areas for laboratory use only

Chain of Custody:

Collected by (Print & sign):	Received by:	Date & Time:
Relinquished by:	Received for Laboratory:	Date & Time:

Client Name:	Report Attention:	
Address:	Copy to:	
City, State, Zip:	Phone:	Fax:

Laboratory Number	Sample ID or System #	Sample Site or Description	Collection Date & Time	Matrix (1) 1-Routine 2-Repeat 3-Replacement	No. of Containers	Coliform	MMO ☐ Quanti ☐ Low-D ☐	Nitrate					

ANALYSES REQUESTED: No. of Containers, Coliform, MMO / Quanti / Low-D, Nitrate

(1) **D**=Drinking Water (Specify as routine, repeat or replacement) **W**=Wastewater (Specify as grab or composite) **O**=Other (identify)

[ ] Payment received with delivery   Amount: ______

Check: ______   Initials: ______

Receipt #: ______   Date: ______

Sample comments (irregularities/preservation, billing information if different than reporting):

SPECIFIC CONDUCTANCE
EPA 120.1/SM 2510 B
umhos at 25°C

Scope and Application:
This method is applicable to drinking, surface and saline waters, domestic and industrial wastes and acid rain.

Summary of Method:
The specific conductance of a sample is measured by use of a self-contained conductivity meter, the YSI Model 32. The conductivity meter is used in the temperature compensated mode.

Sample Criteria & Acceptability:
A minimum of 100 ml sample should be submitted in a clean container provided by the laboratory. Samples can be stored for up to 28 days at 4oC. The samples must be brought to room temperature before testing. If the sample does not meet the above criteria, document it on the worksheet but perform the test.

Reagents:
0.02 Molar Standard Potassium Chloride Solution:

1. Dry 0.85 g of Reagent Grade Potassium Chloride (KCl) for 4 hours at 105°C. Use immediately or store in a desiccator until use.
2. Dissolve 0.7456g of pre-dried potassium chloride in a 1 liter Class A volumetric flask using deionized water.
3. Label the flask with Potassium Standard Solution, 0.7456 g KCl/L, date made, outdate of 3 months, and initial.
4. Alternately, order two 500 ml containers of the Traceable Conductivity Calibration Standard near the 1414 micromho/cm range; from Fisher Scientific, Cat No. 09-328-11.

Control

1. Check deionized water. It should read less than 1 umho. If the reading is higher, clean cell and repeat reading of deionized water. If reading is still high, notify the Chemist.
2. Use current Quality Control sample with each run. The control must be in range before proceeding with specimens. The 0.01 M KCl can be used as control.

Conductance Meter Maintenance:

1. Store cell in deionized water. If the cell has been stored dry, soak in deionized water for 24 hours.
2. Check the platinum black coating on the electrode. If the coating appears thin or if it is flaking off the electrode, the cell should be cleaned and the electrodes replatinized. See "Instruction Manual YSI Model 32 Conductance Meter" pages 11 and 12 for instructions.
3. The electrode should be cleaned and replatinized every four months. Record the preventative maintenance on the "PM Worksheet".

Conductance Meter Calibration Check:

Instrument must be standardized with KCl solution before daily use.

1. Pour 50 ml of the standard potassium chloride solution into a 250 ml beaker. Alternately, immerse the conductivity cell and thermometer in the Rinse Bottle, then transfer to the Read Bottle for actual reading
2. Immerse conductivity cell in sample. The electrodes must be submerged and the electrode chamber must be free of trapped air. Tap the cell to remove any bubbles, and dip it two or three times to assure proper wetting.
3. Rotate the Range Switch to the lowest range position that gives a reading (within range) on the display. An over-range value is indicated by a "1" followed by blanks. An under-range value is indicated by a reading followed by a small letter "u". Readings may be in error when operating in the under range conditions. On the 0.1 – 2 micromho range; allow extra time to stabilize.
4. The conductance value of the solution is displayed on the meter. The units in which it is to be read are determined by the Range Switch, either in mU or in uU (or milli and micro siemens).

   2 uU, 20 uU, 200 uU reading = final result

   2 mU, 20 mU, 200 mU readings x 1000 = final result

5. Use the table below to check accuracy of cell constant:

	Conductivity of 0.01 M KCl
Temperature in Centigrade	Micro-omhos/cm
21	1305
22	1332
23	1359
24	1386
25	1413
26	1441
27	1468
28	1496

6. If the standard is within range, rinse the cell three times with deionized water, and start testing unknowns as described in steps 2-4.

Reporting:

Report results to three significant figures. Report in units of micromhos per centimeter at 25 ^{o}C

References:

1. Instruction Manual YSI Model 32 Conductance Meter", Item 060818, PN A32018 R, October 88 EP
2. Methods for Chemical Analysis of Water and Wastes", EPA- 600: 4-79-020, March 1983, pages 120.1-1 to 120.1-3.
3. "Standard Methods for the Examination of Water and Wastewater", 18th Edition, 1992.

Written by: David Perez, Date: February 1993
Revised: January 12, 2007

Approved by:______________________________
Chemist

pH
SM 4500-H B
Electrometric

Scope and Application
Application to drinking, surface, ground and saline waters as well as acid rain, and wastewater (domestic and industrial.

Principle of Operation
pH is defined as the negative logarithm of the hydrogen ion concentration in moles per liter. The pH scale goes from zero to fourteen with a value of seven units to be considered neutral. Values below seven are acid; values above seven are basic. It is important to note that a one-unit change in pH represents a ten-fold change in the concentration of the hydrogen ion.

pH has a great impact on almost all biological and chemical processes used for water and wastewater treatment, and proper measurement of this value is critical. pH is measured using a pH meter consisting of a potentiometer, glass pH electrode, reference electrode and temperature compensating device. When calibrating the instrument, use two buffers that bracket the expected pH value for greatest accuracy.

Specimen collection and Handling
Collect sample in plastic or glass container. Test sample immediately upon receiving and/or within two hours after collection.

Instrument Calibration:
Two buffer calibration:

1. Fill a 50 ml beaker with up to 30 ml of pH 7 buffer. Add a stir bar and set the knob on the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 7 buffer; make sure that the reference electrode is filled with KCl and is open. Allow the electrode to equilibrate for 5 minutes.

2. Release Standby button and press the pH button. Measure the temperature of the buffer solution and set the temperature control. Turn the large slope knob to 100 and the inner know fully clockwise.

3. Adjust the calibration control until the readout displays 7.00. Press the mv button and record the mv reading on the worksheet. Remove electrodes from the buffer and rinse with deionized water.

4. Fill a 50 ml beaker with up to 30 ml of pH 4 buffer. Add a stir bar and set the knob n the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 4 buffer and allow the electrode to equilibrate for 5 minutes. Press the pH button.

5. Adjust the slope knob until the readout displays 4.00. Press the mv button and record the mv reading on the worksheet. Remove electrodes from the buffer and rinse with deionized water.

6. Fill a 50 ml beaker with up to 30 ml of pH 6.86 buffer. Add a stir bar and set the knob n the magnetic stirrer to the second line on the dial (slow spin). Place the electrode in the pH 6.86 buffer and allow the electrode to equilibrate for 5 minutes. Press the pH button and record the result on the worksheet and quality control graph. PH should be 6.86 ± 0.1; notify chemist if out of range.

7. Rinse the electrodes with deionized water.

8. Record mv readings of calibration buffers. Calculate change in millivolts and divide by 3. The result should be 58 ± 2 mv.

9. If the slope is within limits, begin testing unknowns. If the slope is out of range, re-calibrate the pH meter. If the second calibration slope is out of range, notify the chemist.

Controls

1. Run every tenth specimen in duplicate. The duplicates should be within 20% of each other.

2. Check the 6.86 control buffer after every tenth specimen. Record the results on the worksheet and quality control chart.

Procedure

Once the pH meter has been calibrated, the unknown samples can be tested.

1. Pour 30 ml of unknown (or 50 ml of unknown if also testing for alkalinity) into a 150 ml beaker containing a small stir bar. Start the stirrer. Keep the automatic stirrer at a constant moderate rate (The speed is marked on the dial by a pen marking).
2. Allow the display to stabilize, and record the results on the worksheet.
3. Rinse the electrode with deionized water between specimens. Blot dry with a 'kimwipe'. Do not rub the electrode; the static electricity can alter readings.

Reporting

Report the result to the nearest tenth (0.1).

References:

1. "Method for Chemical analysis of Water and Wastes", EPA 600/4-79-020, Revised March 1983.
2. Standard Methods for the Examination of Water and Wastewater 18th edition 1992

Written by: David Perez
Date: December 1994

Approved by: ______________________________
Chemist

Total Alkalinity
SM 2320 B
Titration

Principle
Total alkalinity is defined as the acid-neutralizing capability of water. It is reported as due to bicarbonate (HCO3), carbonate (CO3), and hydroxide (OH). Unaltered sample is titrated potentiometrically to pH 8.3 endpoint for "carbonate" alkalinity and 4.5 endpoint for "bicarbonate" alkalinity.
Note: Samples with a pH less than 8.3 (i.e. most drinking water samples) are reported as having non-detectable hydroxide and carbonate alkalinity; for these samples total alkalinity is due entirely to the bicarbonate content of the water. Bicarbonate alkalinity (as HCO3) can be calculated from total alkalinity (as CaCO3) by multiplying by a factor of 1.22.
Applicable to drinking and surface waters, domestic and industrial wastes, and saline waters.

Sample Criteria & Acceptability
Samples should be submitted in clean containers provided by the laboratory. A minimum of 100ml of sample should be submitted for testing. Samples, which cannot be tested within 24 hours of collection, should be stored at 4°C and tested within 14 days. If any sample does not meet the above criteria, document it on the worksheet but perform the test.

Equipment
1. pH meter that can read to 0.05 pH units.
2. Two 1,000 ml Class A volumetric flasks.
3. Magnetic stirrer and magnetic stir bars.
4. Two 100 mL beakers.
5. One 250 mL flask
6. One 50 mL graduated cylinder

Reagents
The day before preparing standardize sulfuric acid, dry 0.1 g of Tris Buffer for at least 3 hours at 103 C (overnight is acceptable). After drying, immediately weigh out the Tris buffer. If that is not possible, store the reagent in the desiccators until used.

1. Standardized 0.02 N H_2SO_4 (sulfuric acid) + 0.004 units:

   The concentrated H_2SO_4 and stock 1.0 N H2SO4 may be found in acid cabinet below hood.

   a. Prepare a 1.0 N H H_2SO_4 Stock Solution: Fill a 1,000 ml Class A volumetric flask three quarters full with deionized water. Carefully add 28.0 mL of concentrated H_2SO_4 using a 25 mL and 3 mL Class A volumetric pipette. Fill to the mark with deionized water and mix. Transfer to plastic bottle and label as 1.0 N H_2SO_4 Stock Solution, date made, outdate of 1 year, and initial. Cap tightly.

   b. Prepare a standardized 0.02 N H_2SO_4.
      1. Fill a 1,000 mL Class A volumetric flask three quarters full with deionized water. Carefully add 20.0 mL of the Stock H_2SO_4 using a 20 mL Class A pipette. Fill to mark and mix thoroughly.
      2. Weigh out between 0.0700 to 0.0800 g of Tris buffer using the analytical balance. Record the weight of the Tris Buffer to four places in the "Standard & Reagent Preparation" notebook. Add the buffer to 250 mL flask containing 25 mL of deionized water and stir bar; mix.

3. Add 3 drops of Hach Brom Cresol Green-Methyl Red indicator solution (Hach cat. number 451) to the Tris buffer solution.
4. Fill the titrating buret with the 0.02 N H_2SO_4 solution. Titrate the solution until a stable pink color is reached. Record the volume of reagent used.
5. Calculations:
   Normality of H_2SO_4 = Wt of Tris Buffer (g) ÷ (0.121137 g/meq Tris X mL of 0.02 N H_2SO_4 used)
   Example:
   0.0879 g Tris Buffer ÷ (0.121137 g/meq Tris X 35.7 ml H_2SO_4) = 0.0203 N H H_2SO_4
6. Transfer the 0.02 N H_2SO_4 to a one liter plastic bottle. Record the normality on the bottle, date made, outdate of 3 months, and initial. Store at room temperature.

2. Alternatively, order 0.02 N H_2SO_4 , already prepared and standardized from a vendor such as Fisher Scientific. Record lot on QC worksheet.

Controls

1. Run deionized water as blank. Value of blank should be less than 2 mg/L of calcium carbonate (approximately 0.1 mL of H_2SO_4).

2. Use one quality control standard. This is a solution of sodium bicarbonate (100 mg/l). Run once with each set of samples and record results on control chart. Consult chemist if out of control situation exists.

3. Run every 10th specimen in duplicate. Calculate the relative standard deviation (RSD) of the replicates using the following formula: RSD=SD ÷ mean x 100. The RSD should be less than 10% If the replicates are outside of this range, repeat the specimen a third time. Check with the chemist for instructions.

4. Each quarter an external reference sample is to be analyzed. In the case of results exceeding acceptance values, document corrective action. Place any corrective action records in proficiency file

Procedure:

If applicable, standardize the pH meter each day of use (see supplemental procedure). Record slope with offset on worksheet.

Run the blank and control first. If the control is within range (range found in the "QC Inorganic True Value" binder), run the samples. Repeat the control if it is out of range. Notify the chemist if the control is out of range a second time.

1. Add 50 mL of control or sample to a 100 ml beaker containing a magnetic stir bar. Set magnetic stirrer at low speed.

2. Carefully lower pH probe into the solution. **If the pH is above 8.3 consult principal analyst!**

3. Fill the titrating buret to the zero mark with the standardized H2SO4. Carefully add the H2SO4 to the sample until a pH of 4.5 ± 0.05 is reached.

4. Record the volume of H_2SO_4 added to the sample, to the nearest tenth, on the chemistry worksheet.

5. Rinse the pH electrode with deionized water. Measure out the next sample, refill the buret, and titrate the next specimen.

Calculations:

Use the following formula to calculate the alkalinity as mg/L of calcium carbonate.
Exception: For alkalinity below 20 mg/L use low alkalinity calculation procedure (refer to SM2320B part 5)

mg/L = (mL of H_2SO_4 – 0.1) X normality of H_2SO_4 X (50,000 ÷ ml of sample)
Example (for 50 ml sample):
(28.6 mL – 0.1) X 0.02 X (50,000÷50ml) = 570 mg/L of Calcium Carbonate
or
(28.6 ml – 0.1 ml) X (20) = 570 mg/L of Calcium Carbonate

Reporting

Report in **whole** numbers; round off to 3 significant figures. Examples:
2,902.5 = 2,900; 1,125.9 = 1,130; 23.65 = 24

References

Standard Methods for the Examination of Water and Wastewater 18th edition 1992

Written by: David Perez
Date: January 1993
Revised by: G. R. Guibert
Date: August, 1998

Approved by:____________________________
Principal Analyst

Varian Flame AA Procedure
SM 3111B
For Ca, Mg, Na, K and Fe

Principle:
In flame atomic absorption spectrometry, a sample is aspirated into a flame and atomized. A light beam is directed through the flame, into a monochrometer and into a detector that measures the amount of light absorbed. Because each metal has its own characteristic absorption wavelength, a source lamp composed of that element is used. The amount of energy absorbed in the flame is proportional to the concentration of the element in the sample.

Sample Collection/Handling:
Use metal free collection bottle to collect sample. Collect one liter of sample. Smaller volumes (not less than 200 ml) can be used if necessary. On collection, acidify samples to pH <2 with 1:1 nitric acid, usually 3ml per liter. If samples are not acidified at time of collection, add acid upon receipt in lab and hold for minimum of 16 hours before analysis.[40 CFR 141.23(K)].

Sample Preparation:
Samples containing particulate or organic material require pretreatment before analysis. Samples with a turbidity <1 NTU, no odor and single phase may be analyzed directly. Digest all other samples before determining total metals.

Digestion Procedure for total metals:
Drinking water samples with turbidity >1 NTU can be analyzed following digestion with nitric acid. See procedure SM 3030E (Nitric Acid Digestion). Wastewater samples are better digested using method SM 3030F part b (Nitric Acid-Hydrochloric Acid Digestion). Report as total recoverable metal.

Sample criteria:
Except as noted, specimens that do not meet the criteria below should be immediately reported as "no test" with an explanatory note:

1. Samples submitted in improper collection container.
2. Sample inadequately identified. (Sample has no identification, or cannot be matched to a laboratory request form).
3. Sample quantity insufficient
4. Sample container broken or leaked in transit.

Special Instructions:
All glassware and pipettes used in this procedure must be cleaned using glassware-cleaning procedure. See document in kitchen.

Reagents:
1. Nitric Acid (HNO3). Use high purity nitric acid 1+1.
2. Lanthanum solution (1.11%): Dissolve 58.65 g lanthanum oxide in 250 ml of conc HCL. Add slowly with stirring until dissolved and dilute to about 900 ml. Allow to cool for a few hours then dilute to final 1000 ml volume. Used for Ca, Mg, Na, and K analysis.
3. Calcium solution: Dissolve 630 mg calcium carbonate, CACO3, in 50 ml of 1+5 HCL. If necessary, boil gently to obtain complete solution. Cool and dilute to 1000 mL with water. Used for Fe analysis.
4. Standard Metal solutions: Standard metal solutions are prepared from 1000 mg/l AA or ICP-MS standards purchased from Ricca Chemical company, Spex Certiprep, LabChem, Fisher Scientific or VWR. A standard from EM scientific (ICP Multi-element Standard) is very convenient for calibration standards.
5. Deionized Water from Millipore system – metal free water.

Instrument Set-up:
Use the Varian Spectra 300AA operating in the flame mode with Air Acetylene burner.

1. Turn on exhaust hood. Switch is located in the corner by the Chemistry room refrigerator. Note: Turn switch until it clicks on. If you continue turning the switch after it clicks, the airflow will be reduced.

2. Turn on "Acetylene" gas cylinder located outside in the "Safety Storage" shed. The correct door housing the tank is labeled "Acetylene". Pressure should be set at 8-9 PSI.
   Note: The cylinder valve is opened by turning the handle only 1/4 turn counterclockwise. Replace cylinder when pressure in tank drops below 100 psi. This prevents acetone from entering instrument.

3. Check the Varian Spectra AA 300A unit to see if the burner is installed.

4. Check to see if the cathode lamp required is in the correct socket position, and it is lined up in the "Operating Lamp"
   Note: Lamps are stored in the top drawer located directly across from the GTA 96 Graphite Tube Atomizer (next to hood).

5. Turn on the equipment in the following order (allow a 20 minute warm-up period):
   Note: If the computer is already on, turn it off.
   a. Spectra AA 300A: switch located on lower right front of instrument.
   b. IBM PC and Printer: Turn surge suppressor on (power supply); hit reset button.

Once the unit has been set-up, program the machine for testing by:

1. Start at the "C:" prompt. Press "M" and "Enter".

2. Press "Spectra Flame"

3. Press "Index" (F10). Enter number 10, "Sequence Selection", press "Enter" key.

4. Select element to be tested

5. Press "Sequence Control" (F6). Enter number of samples to be tested.

6. Press "Index" (F10), enter number 6, "Optimization", press "Enter" key.

7. The Screen will display two signal bar graphs. Check the previous week worksheet for the "Photomultiplier voltage" reading.

8. Maximize the lamp signal of the Cathode tube using the two thumbscrews located on the back of the lamp socket (see figure 5.8).
   a. Watch the bar graph as you turn one thumbscrew. Once the value reaches .9 or greater press "Rescale" (F1).
   b. Check the Photomutiplier Voltage display on the screen, after rescaling. If the voltage is higher than the preceding week, continue adjusting and rescaling until the proper voltage is reached. If you are unable to reach the proper voltage, try adjusting the second screw.
   c. Note: Normally the voltage stays the same from week to week, but as the lamp nears the end of its usefulness, the voltage reading will go up. If a new lamp is installed, the starting voltage may be different than the previous lamp. Record millivolt reading on worksheet.

9. After adjusting for maximum signal, hit "Rescale" (F1). The photomultiplier voltage will be displayed. If the reading matches the previous week, record the voltage on the new worksheet. If it is out of range, readjust lamps. If voltage is still out of range, notify Chemist.

10. Press "Index" (F10) key and select "Standards" (number 7). Verify that the values of the standards are correct (see previous worksheet for standard values). To select a value to change, use the up and down arrows. Enter the correct value with the keyboard.

11. Check to see that drain hose, located below the Spectra 300A, is inserted into the drain bottle. (empty after each use).

12. Press "Index" key, enter number 18 (Signal Graphics), and press "Enter".

13. Press "Shift" and "Instrument Zero" (F10).

14. Light burner by pressing ignite button. Aspirate DI water for about 10 minutes. This will allow burner temperature to stabilize.

Standard and Sample Preparation:
Required sample preparation depends on the metal form being measured.

Procedure for Ca, Mg, Na, and K

1. Label the 10 ml beakers with the standard value; label the sample beakers with the last three numbers of the tiny tab number. Using the adjustable pipette, pipette 1.0 ml of sample or standard into each disposable beakers.

2. Add 9.0 ml of 1.11% lanthanum to each sample or standard using the adjustable pipette.

3. Repeat the process once again by diluting 1 ml of the diluted sample to 10 ml with the 1.11% Lanthanum. The samples have now been diluted 1:10 and 1:100. Alternatively use proportionally smaller volumes (i.e. .5 ml sample and 4.5 ml of 1.11% lanthanum).

4. The standards are prepared from stock solutions that when diluted 1:10 will give the necessary concentrations for calibration. The stock solutions are prepared from 1000 ppm standard metal solutions purchased from Ricca Chemical Co. Record dates of preparation and expiration (3 months) in sample prep manual.

5. The final concentration of calibration standards will be,

    1. Ca: 1.00, 3.00, 5.00 and 10.00 mg/l
    2. Mg 0.10, 0.50, 1.00 and 1.50 mg/l
    3. Na 0.10, 0.50, 1.00, 1.50 and 2.50 mg/l
    4. K 0.10, 0.50, 1.00, 1.50 and 2.50 mg/l

6. Set report format: Go back to index by pressing the "Index" (F10) key, then select the "Report Format" (number 13). Here you can enter the name of the operator, batch name, and date. No other changes are usually necessary.

7. Start program: Press the "Start" (F11). The screen will show the message "Select Lamp 3"; press "Start" (F11). The program will now run to completion.

8. Calibration of other Metals besides Fe/Mn: The other metals tested by flame AA does not require an ionization suppressor and can be directly aspirated. See specific method on computer for required calibration standards.

Standard and Sample Preparation: Procedure for Fe:

1. Label the sample beakers with the last three numbers of the tiny tab number. Using the adjustable pipette, pipette 1.0 ml of Ca solution into each disposable beakers.

2. Add 4.0 ml of sample to each beaker using the adjustable pipette.

3. The standards are prepared from 1000 ppm standard metal solutions purchased from LabChem or Spex Certiprep. Add 20 ml Ca solution and 1 ml conc HNO3 to each 100 ml of standard prepared. Record dates of preparation and expiration (3 months) in sample prep manual.

4. The final concentration of Fe calibration standards will be: 0.3, 0.5, 1.0, and 3.00 mg/l

5. Set report format: Go back to index by pressing the "Index" (F10) key, then select the "Report Format" (number 13). Here you can enter the name of the operator, batch name, and date. No other changes are usually necessary.

6. Start program: Press the "Start" (F11). The screen will show the message "Select Lamp 3"; press "Start" (F11). The program will now run to completion.

Quality Control:

1. Analyze a Blank after every 10 samples to verify baseline stability. Rezero when necessary.
2. Duplicate Spikes - replicate spikes are to be performed on 10% of samples. Recovery of spike in drinking water should be between 80% and 120% with a precision of 20%. Recovery of spike in wastewater should be between 75-125% with a precision of 25%. Spike level should not exceed MCL for analyte. Spiking solutions are available from Cresent Chemical Co.or SPEX.
3. External Reference Sample - Analyze a known reference sample after initial calibration and after every ten samples to confirm the test is in control.
4. See Table 3111:III in Standard Methods for recommended concentrations of standards to be run, limits of acceptability, and reported single operator precision data.
5. Analyze External Reference Sample on quarterly basis. Solutions available from APG, ERA or SPEX.

CRITERIA FOR ACCEPTABILITY OF RUN

1. Recoveries of spikes and controls are within acceptable range.
2. Blank values below detection levels.
3. Acceptable levels of precision.

NOTE: If any of the acceptance criteria are not met, the analyst must stop the run, correct the problem and and retest the samples.

OUT OF CONTROL PLAN

No sample should be reported until the all acceptance criteria have met. Or the out-of-control condition has been corrected and any problems or departure from protocol identified.

Trouble Shooting:

1. PROBLEM - poor precision,
   Check alignment of hollow cathode lamp. Check that capillary hose is not clogged. Make sure burner is clean and flame appears smooth and even. Replace pinched or crimped capillary tubing.

2. PROBLEM - error message
   Refer to instrument service manual

3. PROBLEM - Contamination
   Check supplies associated with sample collection for contamination. Check rinse water, sample diluent, pipettes, sample cups. Make sure work area is free from dust.

Shutdown Procedure:
Turn off acetylene, IBM PC,and AA300, and exhaust hood, in that order.

Calculations:
The results will be printed and should be recorded on a worksheet. The dilution factor must be shown and considered in the calculations.

Reporting:

1. The data from the printout should be transferred to the worksheet. Verify that controls were within acceptable range and that duplicates are within range.

2. The lab clerk enters the results into the computer. Results are reported in units and number of significant figures consistent with MDL of method.

References:

1. "Analytical Methods for Flame Atomic Absorption Spectrometry" Varian Techtron Pty, Limited, 1989.

2."Standard Methods for the Examination of Water and Wastewater"
18th Edition 1992 by APHA, AWWA, and the WEF.

Written by: David Holland
Date: January 1999

Approved by:________________________
Laboratory Director

DETERMINATION OF INORGANIC ANIONS
BY ION CHROMATOGRAPHY (EPA METHOD 300.0)
USING THE DIONEX DX-80 ION ANALYZER

PRINCIPLE
This method determines the following inorganic anions: fluoride, chloride, nitrite, bromide, nitrate, phosphate and sulfate.

A small volume of sample (approx. 1 ml) is loaded into the ion chromatograph. The injection valve injects 10 ul of the sample into the flow of eluent. The eluent (a NaHCO3 - Na2CO3 solution) flows continuously through the IC and serves as a carrier for the 10 ul of sample and facilitates in the separation process.

The anions of interest are separated using suppressed conductivity detection, and are identified and quantified by comparing data to those obtain from a standard solution. The major parts of the system are the liquid eluent, high pressure pump, sample injector, guard column, the separator column, the chemical suppressor and the conductivity detector. The guard column protects the separator column, which separates the anions based on their size and charge. The function of the suppressor is to chemically reduce the background conductivity of the electrolytes in the eluent, and to convert the sample anions into a more conductive form. The detector then detects the conductivity of the solution, which varies depending on the concentrations of the anions (higher conductivity indicates a greater concentration of the anion).

SAMPLE CRITERIA
The holding times for drinking water samples are as follows:

Fl^-	28 days
Cl^-	28 days
NO_2^-	48 hours
NO_3^-	48 hours
SO_4^-	28 days
Br^-	28 days

Samples submitted for IC testing routinely should be run within 48 hours of collection, especially for nitrite and nitrate. If testing needs to be delayed, the sample can be preserved with sulfuric acid; preserved samples can be held for up to 28 days and the nitrate results reported as combined Nitrate/Nitrite. Any samples not tested within specified holding times should be identified on the worksheet.

Samples bottles dedicated for IC testing only are placed on the IC bench. As soon as a sample is setup, place it on the white tray for easier storage. After 6 weeks the containers should be emptied and discarded. Nondedicated samples (i.e. those also submitted for additional testing) should be returned to the designated cart after IC testing.

QUALITY ASSURANCE

Operator competency - Ion chromatography may be performed only by analysts who have been trained and who have demonstrated competency with the procedure. One check consists of preparing the calibration standards and calibrating the I.C. An r-value of 0.995 or higher (correlation coefficient of 99.95%) in the linear fit type must be attained for each analyte of interest. Another way to demonstrate competence is to run a minimum of four replicate analyses of an independently prepared sample. Each analyte of interest in the sample should have a known concentration between 5 and 50 times the MDL.

Blank - A blank consisting of nanopure water should be included at the beginning of each run. The results for the blank must be below the MDL for each analyte.

Control standard(s) - Controls representing two concentration levels for each analyte (ICMIX HIGH & ICMIX LOW) must be analyzed as described below. The source of the analytes used to prepare these controls must be different from the source used to prepare the calibration standards. An ICMIX HIGH stock solution of the 7 anions with the following final concentrations:

Anion	*Final Conc*	*Preparation in 500 ml volumetric flask*
Fl^-	20 ppm	10 ml of 1000 ppm Fl std
Cl^-	100 ppm	50 ml of 1000 ppm Cl std
NO2	65.5 ppm	10 ml of 1000 ppm NO2-N std
Br^-	20 ppm	10 ml of 1000 ppm Br std
NO3	100 ppm	50 ml of 1000 ppm NO3 std
PO4	100 ppm	50 ml of 1000 ppm PO4 std
SO4	100 ppm	50 ml of 1000 ppm SO4 std

should be kept on hand. Use this undiluted at the beginning of the run and after every tenth sample. Each week, prepare an ICMIX LOW solution from the ICMIX HIGH solution as follows: Using a 100 ml volumetric flask add 1 ml if ICMIX HIGH using the 1 ml volumetric pipet and fill to mark with nanopure water. Record date made in the IC logbook under Quality Control. Run the IC LOW at the beginning of the days run and after every 10^{th} sample after the IC HIGH. The percent recovery for each anion should be between 90 and 110%.

Duplicate spikes – Duplicate spikes should be run after every tenth sample. The spike should not be less than four times the MDL, and it should increase each anion concentration by more than 25% of the background value. A suitable spike can be prepared by adding one part ICMIX HIGH to three parts sample. The average percent recovery for each anion should be between 80 and 120%. The duplicate spikes should be within 10% of each other. Record average percent recovery of spikes and duplicate percent difference on worksheets. Note: if the concentration of the spike is less than 25% of the background concentration, the spike recovery should not be calculated.

If any of the above control criteria are not met, do not report sample results until the problem has been resolved.

External controls & chart analysis - In addition to the control standards tested with each batch of samples, an external reference standard (i.e. SPEX IC standard or WS proficiency sample) should be tested on a quarterly basis; however we like to run one at the end of each run.

CALIBRATION FOR GOUNDWATER (DRINKING WATER AND MONITORING WELLS):

Calibration for groundwater samples is described below. Calibration should be performed whenever: 1) controls are out of range; 2) a new batch/lot of eluent/regenerant is made or 3) when a column, suppressor or detector is changed.

1. Prepare 1/10, 1/100, 1/1000 dilutions of the calibration standard ordered from Dionex, which contains 20 mg/l fluoride, 100mg/l chloride, 100 mg/L nitrite, 100 mg/L bromide, 100 mg/l nitrate, 200 mg/L phosphate and 100 mg/l sulfate.

2. Run calibration standards beginning with the highest dilution (1/1000) first.

3. Create calibration sequence: File – New – Sequence – Standards – Next. Skip section on Choosing Timebase – name the sequence *calibMMDDYEAR* and initials – Next – Done.

4. Add sequence to batch file before starting

5. After all four calibration standards have been ran, check the calibration curve.

   a) Double click on any of the calibration standards (Cal Std 1). You will get a chromatograph

   b) Click on Calibration Plot icon, upper right corner or click on VIEW – Calibration Plot. You will see a graph of the first analyte along with the correlation coefficient percentage for each analyte. Only anaytes with percentage of 99.5 or greater are acceptable. Generally try for a 99.98% for an average of all seven analytes to pass quality control checks. See the principle analyst if the result is a lesser value.

   c) The mean retention times and detection range are automatic on the DX-80 Ion Analyzer and can not be changed or edited.

PREPARE MDL STUDY

The Method Detection Limit is the lowest concentration of a substance that can be identified with accuracy and confidence by a certain method or analysis.

1) Prepare a Cal Std 1 level each analyte separately using the secondary standards (not Dionex mix)
2) Make seven replicates of this dilution and run through the Ion Analyzer under the Unknown Method.
3) Collect data and calculate the standard deviation for the seven replicates. Multiply the standard deviation values by 3.143. This number will be the Method Detection Limit.

GENERATE BACKLOG REPORT:

1) On a network computer – not the Instrument computer. Double click on LABWORKS icon. Enter password. Click on OK. Click on backlog. Click on analysis code. Click on OK. Type in #ICANION. Click on OK. Click on display report. Click on print. Click on exit until you are out.

2) Check the clipboard to see if a worksheet has been initiated listing samples that need repeat testing; if so, append worksheet with samples on backlog report.
   a) Account for all specimens on backlog report
      i) Samples may have been tested in a previous run but not recorded. Record these results and give to the clerk.
      ii) If a sample appears on the backlog but needs to be tested by a different method (i.e. wastewater), inform the clerk so that the analysis ordered can be modified.
   b) Include any "new" samples on the I.C. bench that have not yet been entered into the computer.

SAMPLE PREPARATION

Groundwater (drinking water and monitoring wells) should be filtered through 0.45 um membrane filters before injection:

1) Rinse the syringe once with the sample water. Then fill syringe with about 10 ml of sample water.
2) Filter a minimum of 2 ml of sample through the 0.45 membrane into a labeled autosampler vial discarding the first few drops.
3) Place autosampler cap on vial and press down using the provided tool. Make sure the cap goes in straight and remove any air bubbles seen in the vial (invert or knock gently).
4) Place sample in autosampler rack. The order in the rack must match that on the schedule. Note: If you suspect the result of a sample to be above that of the calibration standard for an analyte, make an appropriate dilution. Check by measuring conductivity – anything greater than 700 uS will need to be diluted.
5) Include duplicate spikes for every 10^{th} sample. Add 1 part ICMIX high to 3 parts filtered sample. Then IC HIGH, LRB, IC LOW. The laboratory reagent blank (LRB) is necessary to minimize carry over as the IC low is 100 times less than the High. Double check any samples where analyte concentrations are low after a high sample to verify analyte is even detected.

Samples which may contain high concentrations of chloride or organic contaminants (Carmel Area Wastewater District and ESF), are run on the DX-100 and require additional filtering through Dionex OnGuard P, Dionex OnGuard Ag, and Dionex OnGuard H filters before injection. See supplemental procedures.

SYSTEM START-UP:

1) Ensure the **eluent** bottle is at least ¼ full. If it is less, depending on size of run, prepare new eluent (and regenerant):
   a) Prepare 2 liters of a final eluent concentration of 8.0 mM Sodium Carbonate and 1.0 mM Sodium Bicarbonate by diluting one Dionex AS 14A Eluent Concentrate bottle (P/N 057060) into two 1L-volumetric flasks. Bring each to volume (1000 ml) with nanopure water. Makes 2 liters.
   b) Use the designated filter/vacuum flask, a filter funnel, a clean 0.45um membrane filter, and a large magnetic stir bar to degas the eluent. Pour the eluent into the filter funnel and turn on the vacuum. Set the magnetic sticker at medium to high speed. Once all the eluent has been filtered, keep the vacuum and magnetic stirrer on for 15-20 minutes, allowing the eluent to degas.
   c) Turn off the magnetic stirrer and the vacuum. Remove the filter funnel. Carefully decant the degassed eluent into the eluent bottle, without aerating. Make sure the cap is on tightly, and the tubes are securely attached.

2) Whenever new eluent is prepared, new **regenerant** must also be made.
   a) Prepare 2 liters of a final anion regenerant concentration of 72 mN Sulfuric Acid by adding one Dionex Anion Regenerant Concentrate bottle (P/N 057559) to two liters of nanopure water.
   b) Mix in the regenerant in the designated filter flask using the stir bar and degas for 15-20 minutes.
   c) Turn off the magnetic stirrer and the vacuum. Remove the filter funnel. Carefully decant the degassed regenerant into the REGEN bottle, without aerating. Make sure the cap is on tightly, and the tubes are securely attached.

DX-80 OPERATION

1) Turn on nitrogen gas cylinder (main knob only), autosampler (rear right hand corner), ion analyzer (rear panel right hand side) and computer.

2) Double click on Peaknet to open computer program. **File – Panels\Dionex DX-80 System** for the Control Panel.

3) Under the DX-80 Status click on **CONNECT** to connect analyzer to computer

4) Turn on the pump by clicking the **ON** button on the DX-80 Control Panel. **Prime** the pump by turning the pump head waste valve knob counter clockwise and leaving it open for about 5 seconds. Close the pump valve knob by turning clockwise until secure. After changing to new eluent, it is a good idea to leave pump valve open until all air bubbles have been purged – look for the air bubbles coming out the eluent bottle until it reaches the waste line at the pump. This will allow any air bubbles to be pumped to waste instead of through the columns.
5) Allow the system to **equilibrate** for 30 minutes minimum, generally one hour if new eluent is used. Once ready, the **operating pressure** should be 2000+- 300 psi (usu 2100

psi); and the operating **total conductivity** background should be < 30 uS (usually 25.00uS). You can offset the background and zero the reading by clicking the Autozero button on the Control Panel.

6) To begin a run, create a sequence worksheet by clicking on **File – New – Sequence**. (May have to do this twice if worksheet is not already open.)
   a. It will then prompt you to choose Standard or Unknowns. Choose **Unknowns - Next**
   b. Skip **next** screen where it prompts you to specify timebase,
   c. **Estimate** number of unknowns (you can always add or delete samples from sequence when done.
   d. Fill out file name you wish to save the file We save under ***MMDDYEAR*** and **initials**: *(05052002tl)* and press **enter**.
   e. Press **Done** when prompted to exit wizard.
   f. A worksheet will appear where sample identifications can be added after the calibration data (line #5). Follow printed worksheet – first include a *blank, ic low, ic high, lrb*, then the samples. Note for the first set, the lrb is listed as a sample. *Duplicate spikes* are required for every 10^{th} sample or a minimum of 10% of samples. Finish off sequence with a known quality control standard, usually a proficiency standard such as *WS 60* or Ultra QC and another blank (LRB).
   g. Change *dilution factor* if sample was diluted; default is one. Save by pressing the SAVE icon (floppy disk).

7) To start the run – click on **Batch – Edit – Add** – double click on the newly created sequence, or the one you want run – then **Start** to begin.

8) Make sure autosampler vials are in order and the green light is on 'Run' not 'Hold'.

9) Record date, total conductivity and pressure in the log notebook at which the run has started.

10) During or after the run, verify that the blank and QCs (IC HIGH, IC LOW, IC CHECK) are within range. If not stop the run by clicking on **Batch – Stop - after current sample**, and notify principal analyst to investigate and solve the problem before resuming the run.

REPORTING RESULTS

1) When run is complete the analyst performing the run is responsible for recording and reporting results. Review each chromatogram to verify that the peaks were properly identified. Retention times may shift if there was a sudden change in pressure. Changes to the peak name can be made by a right click on the peak and choosing the correct analyte then save.

2) The results are found on the worksheet next to the sample ID and can be exported to an excel file for accuracy calculation:
   a) Click on any sample cell – i.e. ic low, cell will be outlined.

b) Click on **File – Batch Report – Export** (unclick the Printout option- computer is not connected to any printer) – **Excel file format**
c) For sheets to be exported, choose only " **Summary – INJ vs. Area, Ht, Amt**." Unclick the Integration, Calibration, Peak analysis, Summary-INJ vs. Anion, and Audit Trail options as they are extra and rarely needed for our purpose.
d) Click on **Finish** then **OK** on batch menu. Status will appear and when transfer is complete, press **OK** to exit.

3) To copy exported file onto a floppy, right click on Start icon on lower left screen and choose EXPLORE for Windows Explorer. Under **C:\Chromel\Export** folders are the files just exported. Highlight the correct sequence and drag to **A:** drive to copy file. (Make sure you have a floppy disk inserted).

4) Open exported file under an EXCEL program – the instrument computer does not have one so use a network computer. You will see three types of charts: first- Sample vs. Area, second - Sample vs. Height, and third - Sample vs. Amount. Copy all of the **Sample vs. Amount** table to an old/previous excel file.

5) The Excel Results worksheet is permanently saved under **G:\Laboratory\Data\Water\IC Data\2002** under the correct month. It is also saved in Tess' computer under **C:\My Documents\IC Data** and correct year and month. Easiest way to create the worksheet is to open a previously saved file (of the same year and month) and then cut and paste the data. There are two worksheets in each file, one for the complete results, the other for the raw data (the Sample vs Amount table exported from peaknet).
a) Before any changes are made, save the file under a new name: MMDDYY and initials
b) On RAW worksheet, delete old table and replace with recently ran sequence data. Add a column between Sample ID and Fluoride Amount for the dilution factor.
c) Change Date Analyzed and Analyst if applicable. Calibrations are generally done once a month with the most recent noted under Date of Calibration – change if necessary.
d) **Copy** and paste data results from raw worksheet onto Results worksheet under correct sample name. Use the **Paste Special option – Values** - to retain similar fonts on results worksheet. **% Recoveries** will be automatically calculated as will **% Differences**, and **Averages** for the duplicate spikes but references to certain cells may need to be changed for the correct result.
e) Verify that all QC are accurate before entering into labworks.

6) For drinking water, results should be recorded as ND – Not Detected for levels below DLR (Detection Limit for Reporting) as follows:
a) Fluoride 0.1 mg/L
b) Nitrate 2.0 mg/L
c) Sulfate 0.5 mg/L
d) Bromide 0.1 mg/L
e) Chloride, Nitrite, Phosphate 1.0 mg/L

f) Any samples with readings above the calibration range (20 mg/L fluoride, 100 mg/l chloride, nitrite, bromide, nitrate, sulfate, and 200 mg/l phosphate) needs to be diluted and repeated in the next run. List these samples on a new worksheet with the appropriate dilution and place the worksheet on the clipboard.

7) Do not report results if control/spike values do not fall within limits (refer to section on quality control). If controls, spikes, etc. are out of range, notify the principal analyst. If controls are within limits, date and initial the worksheet and give the worksheet to the clerk for data entry. When the worksheet and backlog are returned place them in the binder.

SHUT DOWN

After the run is complete the Ion Analyzer can be shut down. The IC should be shut down on weekends if the system is not in operation on Friday night so as not to damage the suppressor unit:

1) On the Control Panel screen of Peaknet - turn **OFF** pump and **DISCONNECT** DX-80
2) Close Peaknet.
3) Turn off DX-80, autosampler and close nitrogen cylinder valve.

PREVENTIVE MAINTENANCE:

1) Each quarter, replace the bed supports on guard column
2) Maintain the following spare parts. These items are considered consumables:
   a) Anion Refill Kit (Part No. 057069) contains 4 bottles each of AS14A eluent and anion regenerant concentrate.
   b) AS14A anion separator column, 3 mm (Part No. 056901)
   c) AS14G anion guard column (Part No. 056899)
   d) AMMS III suppressor (Part No. 056751)
   e) DS5 Detection Stabilizer (Part No. 057290T)

DOS AND DON'TS

* Try to make additions, changes, and deletions to the sequence during the middle of a run and then save immediately. If the changes are not saved immediately, the program may get confused on which sequence to use and will freeze. If this happens, wait until the current sample is completed, turn off all equipment and wait for about 15 minutes before restarting.

* Be gentle when loading samples onto the autosampler, especially the first rack. If racks are installed too roughly, conveyor belt may get stuck and samples will not be injected in the proper sequence.

REFERENCES:

1) DX-80 Ion Chromatograph with SRS Control Operator's Manual, Dionex Corporation, 2002.
2) Methods for the Determination of Inorganic Substances in Environmental Samples, Method Number 300.0, Determination of Inorganic Anions by Ion Chromatography, John D. Pfaff, U.S. Environmental Protection Agency, 1993.
3) Standard Methods, 18th Edition, 1992. Part 4110.

Originally written by: Johanna Rosen for DX-100
Date: 12-96
Updated by: Theresa Lam for DX-80 Ion Analyzer
Date: 05-02

Approved by: ______________________________
(Lab Director's signature)

Appendix 7-E

Watermaster's Seaside Basin Monitoring and Management Program

SEASIDE BASIN MONITORING AND MANAGEMENT PROGRAM

Approved by the Seaside Groundwater Basin Watermaster Board
May 17, 2006

SEASIDE BASIN MONITORING AND MANAGEMENT PROGRAM

Seaside Groundwater Basin Watermaster Board

- Chairman: Mayor Ralph Rubio, City of Seaside
- Vice Chairman: Bob Costa, Laguna Seca Subarea Landowner
- Secretary/Clerk: Director Michelle Knight, Monterey Peninsula Water Management District
- Treasurer: Mayor Dan Albert, City of Monterey
- Mayor David Pendergrass, City of Sand City
- Steve Leonard, California-American Water Company
- Mayor Joseph Russell, City of Del Rey Oaks
- Jerry Smith, District 4 Supervisor, Monterey County/Monterey County Water Resources Agency
- Paul Bruno, Coastal Subarea Landowner

Seaside Groundwater Basin Watermaster Board Technical Committee

- Andrew Bell, District Engineer, Monterey Peninsula Water Management District
- Curtis Weeks, General Manager, Monterey County Water Resources Agency
- Joe Oliver, Water Resources Manager, Monterey Peninsula Water Management District
- Keith Larson, Director, Water Resources, California-American Water Company
- Dave Berger, General Manager, Monterey Peninsula Water Management District
- John Fischer, Member of the Public
- Steve Leonard, Vice President and Manager, California-American Water Company
- Steve Matarazzo, Community Development Director, City of Sand City
- Tim O'Halloran, Senior Engineer, City of Seaside
- Diana Ingersoll, Deputy City Manager – Resource Management Services, City of Seaside

Seaside Basin Monitoring and Management Program

Table of Contents

<u>List of Figures</u>

<u>Appendices</u>

Seaside Basin Monitoring and Management Program

I.
Introduction

This Seaside Basin Monitoring and Management Program (“Program”) is adopted by the Seaside Basin Watermaster to comply with the Judgment entered in the Seaside Groundwater Basin Adjudication (California American Water v. City of Seaside, Monterey County Superior Court, Case Number M66343) and to ensure that the Seaside Groundwater Basin (“Basin”) is protected and managed as a perpetual source of water for beneficial uses.

The Judgment required the preparation of a comprehensive monitoring and management plan for the Seaside Basin (Monitoring and Management Plan”) consistent with the criteria set forth in Exhibit A (Appendix 1) of the Judgment. The Technical Committee appointed by the Seaside Basin Watermaster Board has chosen to name this document the “Program” versus the “Plan” referred to in the Judgment. This was necessary to clarify that the tasks and schedule set forth in this document is the program that will create the Seaside Basin Monitoring and Management Plan.

The Program sets forth actions that will be taken to: (a) monitor current overdraft conditions and the present threat of potential seawater intrusion into the Coastal Subarea of the Basin; (b) develop and import supplemental water supplies for the purpose of eliminating Basin overdraft and the associated threat of seawater intrusion, and (c) establish procedures that will be implemented to address seawater intrusion should seawater intrude into the onshore portions of the Basin. All costs of undertaking the actions set forth within this Program shall be paid from the Monitoring and Management Program component of the Watermaster Budget, set forth in Section III.L.3.J.iv of the Judgment. The Court’s Decree calls for the Seaside Basin Watermaster to develop a Basin Management Program within one year of the Court’s judgment. The following is a description of the scope of work for the management program, the monitoring program and schedule that will be undertaken by the Watermaster over the next 12 to 18 months to complete the Basin Management Program.

II.

Basin Monitoring Program

A. Basin Overview

The Seaside Groundwater Basin has been characterized as underlying an approximately 19 to 24 square mile area at the northwestern corner of the Salinas Valley, adjacent to Monterey Bay. The general location of the basin and its four subareas are shown in **Figure 1**, which is from a study updating the condition of the basin completed by the Monterey Peninsula Water Management District (MPWMD) in 2005 (Yates and others, 2005. *Seaside Groundwater Basin: Update on Water Resource Conditions*. Prepared for MPWMD, April 14, 2005). The basin underlies a hilly coastal plain that slopes northward toward the Salinas Valley and westward toward Monterey Bay. The basin area includes Sand City, a portion of Monterey, and much of the cities of Seaside and Del Rey Oaks, as well as a portion of unincorporated Monterey County. In addition, the basin underlies most of the land occupied by the former Fort Ord military base. The basin consists of a sedimentary sequence of water-bearing materials that overly the relatively impermeable shales of the Monterey Formation. The two principal geologic units in terms of water supply potential are known as the "Paso Robles aquifer", consisting of interbedded sand, gravel and clay deposits of continental origin, and the underlying "Santa Margarita aquifer", consisting of a loose to weakly-cemented marine sandstone.

B. Basin Monitoring Background

Current water resource monitoring in the Seaside Groundwater Basin can be categorized into the following five principal types: groundwater production monitoring, groundwater level monitoring, groundwater quality monitoring, surface water monitoring, and precipitation monitoring. The history of development and current status of each category is briefly reviewed in this section.

1. Groundwater Production Monitoring

The early history of groundwater development in the Seaside Basin was not well documented. Prior to about 1950, the majority of groundwater extractions in the coastal area were assumed to be associated with small farming operations. The earliest recorded production dates to the mid-1950's, when municipal wells were installed in the coastal area of the basin by several small water systems that were acquired in the mid-1960's and subsequently consolidated into the main California American Water (Cal-Am) system that serves the Monterey Peninsula area. Other early metered production records were kept for wells in the coastal area supplying Fort Ord and the City of Seaside. A coordinated program of collecting and reporting groundwater production in the basin was established by the MPWMD in 1980. This program requires annual reporting of water production (surface water and groundwater) from all sources within the MPWMD's boundary, which encompasses most of the Seaside Basin area. Currently, there is no surface water production from the Seaside Basin, and the only known groundwater production occurring within the basin outside of the MPWMD boundary is limited to production from Monterey County Parks Department wells at the eastern end of the Laguna Seca subarea of the Seaside Basin. In addition to the annual reporting requirement, MPWMD regulations require more comprehensive management for the Cal-Am water distribution system, as this system derives its supply from more than one hydrological management unit (i.e., the Carmel River Basin and Seaside Basin). This is accomplished under MPWMD regulations through the Quarterly Water Supply Budget Strategy program, in which projected production quantities for each of Cal-Am's production sources are developed on a quarterly basis, and actual production is tracked daily.

2. Groundwater Level Monitoring

The earliest groundwater level data collected in the Seaside Basin were from the municipal wells in the coastal area, beginning in the mid-1950's. The coverage was sparse, however, and limited to a small area of the basin. Water level data collection in the coastal area became more consistent when Cal-Am began operations in the mid-1960's, but the lack of long-term, spatially-distributed groundwater level data compromised the ability to rigorously assess the condition of the basin in studies conducted during the 1970's and 1980's. The Monterey County Water Resources Agency (MCWRA) periodically monitored several wells in the basin until that monitoring was curtailed due to budget constraints in the early 1990's. Basic groundwater data collection improved beginning at that same time as the MPWMD undertook a program of installing dedicated monitor wells in each aquifer at key locations in and near the coastal area of the basin. A network of dedicated monitor wells was preferable in that the water level data are more indicative of conditions outside of the direct influence of production wells. The dedicated monitor well network has been expanded since then, and is now comprised of 24 wells at 14 locations in and near the coastal and northern portions of the basin, and an additional 16 wells at 12 locations in and near the Laguna Seca subarea. The locations of monitor and production wells in and near the basin are shown on **Figure 2**. Presently, the MPWMD collects water level data monthly from 19 of the 24 monitor wells in and near the coastal subareas. Seven of these monitor wells are also equipped with automatic dataloggers (i.e., recording pressure transducer units) set to record hourly water levels to complement monitoring as part of the MPWMD Aquifer Storage and Recovery (ASR) program in the basin. The MPWMD collects water level data semi-annually (in Spring and Fall to correspond with anticipated seasonal high and low water levels) from 16 monitor wells in and near the Laguna Seca subarea. In addition to water levels collected by the MPWMD, Cal-Am currently collects and reports to MPWMD monthly water levels from 14 active and inactive production wells in the coastal subareas, and 7 wells in the Laguna Seca subarea. .

3. Groundwater Quality Monitoring

Historically, groundwater quality data were sparse and were not readily available to adequately support characterization of groundwater quality in the basin in the early resource studies conducted in the 1970's and 1980's. In the early 1990's, the MPWMD began a program to collect groundwater quality data from coastal monitor wells in the basin. This program has been expanded since then and now includes twelve (12) monitor wells at six (6) locations (**Figure 3**). Groundwater quality samples are currently collected annually and analyzed for a suite of inorganic parameters (i.e., general minerals) to assess long-term trends or changes that could indicate seawater intrusion. Based on the assessment of data from the MPWMD coastal monitor wells, there has been no indication of seawater intrusion into either of the basin's principal aquifers – the Paso Robles Formation or Santa Margarita Sandstone. In addition to the groundwater quality data collected by the MPWMD from its coastal wells, both the City of Seaside and Cal-Am collect complete general mineral groundwater quality data at least annually from their municipal production wells that serve water for potable use, as per requirements from the California Department of Health Services.

4. Surface Water Monitoring

Because dune sands cover much of the land area over the basin, precipitation falling on the basin does not produce appreciable surface runoff but directly infiltrates through the sandy soils. The exception is Arroyo Del Rey, which drains a portion of the Laguna Seca subarea. The U.S. Geological Survey measured discharge from this channel at Del Rey Oaks from 1966 to 1978, when this recording station was discontinued. The MPWMD re-established this as a recording station in 2002, and continuous streamflow records are currently maintained for this site.

5. Precipitation Monitoring

There are no long-term records of precipitation from monitoring stations within the Seaside Basin. Accordingly, basin precipitation estimates in previous water resources investigations have been based on records from nearby recording stations. The recent hydrogeologic assessment of the basin conducted for Cal-Am relied primarily on long-term records available from the National Oceanographic and Atmospheric Administration (NOAA) Station #045795 in Monterey (CH2M HILL, 2004, *Hydrogeologic Assessment of the Seaside Groundwater Basin*. Prepared for Somach, Simmons & Dunn and California American Water, January 2004. See page 2-2).

C. Basin Monitor Well Construction Program

1. Purpose

Notwithstanding the current groundwater monitoring efforts as described above, the Court recognizes that the present monitor well network is lacking adequate coverage in and near the Northern Coastal subarea of the basin, considered to be most vulnerable to seawater intrusion. Additionally, there are few existing monitor well control points to adequately define conditions along the northern basin boundary in the Northern Inland subarea. This section describes the Watermaster's planned exploratory drilling and monitor well construction activities that are designed to enhance the efficiency and utility of the existing basin monitoring network. This program is based on the description provided in Exhibit A of the *Decision*, attached as Appendix 1 of this program. Any proposed departures from that description and the basis for them are also described herein.

To ensure that the coastal area is adequately monitored to detect potential seawater intrusion, exploratory drilling, geophysical surveying and monitor well construction will be undertaken. Based on current knowledge of the availability of existing subsurface control points in and near the coastal area of the basin, monitor wells shall be initially constructed at a minimum of four (4) additional coastal "sentinel" monitor well sites ("*Sentinel" monitor well sites* refers to the network of monitor well sites closest to the coastline in and near the Seaside Basin, which can serve as a first line of defense in detecting potential seawater intrusion) at approximately 3,000 feet spacing, in the area along the coast northeast of existing monitor well "WMD-PCA-W". It is anticipated that the four coastal sites will be selected from the six potential target areas sites that are shown on **Figure 4**. Four sites are in a line near the coastline and two sites are slightly farther from the coastline and in between the most coastal sites, to provide secondary coverage if seawater intrusion should occur in narrow lobes or fingers. The actual locations for the new coastal "sentinel" well sites must be carefully selected based on nearness to the coastline, coastal erosion potential, site logistics, and long-term access constraints.

In addition, two (2) inland sites near the northern basin boundary shall be selected for exploratory drilling and monitor well construction. The recommended target areas for these sites are also shown on **Figure 4**. Information developed from these inland sites will support an improved understanding of the occurrence and nature of the aquifer systems and groundwater levels in the vicinity of the northern basin boundary where there are no existing monitor or production wells, and will support long-term monitoring in the basin.

As a planning goal, it is anticipated that these new monitor well installations can be completed within approximately 18 months of the Court's approval of this document, as shown in **Figure 5**. A breakdown of the proposed schedule by task is also included in Section V. Based on previous experiences by the MPWMD in installing similar coastal and inland monitor wells in the basin, land availability, authorization and access are key issues that must be overcome to successfully site and construct the monitor wells. The optimal locations for the new coastal monitor wells are along the coastal bluffs of the former Fort Ord military base, on land that is currently under the jurisdiction of the U.S. Army, but ultimately planned for transfer to the California Department of Parks and Recreation (CDPR). Accordingly, approval of such activity in this area of former Fort Ord will require the acquisition of a long-term easement, and will likely include authorizations from the Army Base Realignment And Closure (BRAC) office, the Fort Ord Reuse Authority (FORA), the County of Monterey, and the CDPR. As an alternate option, if land use approvals prove too difficult or lengthy for the coastal bluff locations, consideration will be given to siting the new coastal monitor wells along the inactive railroad alignment through the former Fort Ord coastal area. The Transportation Agency of Monterey County (TAMC) has recently acquired this property from the Union Pacific Railroad. Sites along the railroad alignment are less ideal in that they are approximately 500 to 1,500 feet farther from the coastline than the coastal bluff sites, but the approval process for use of these sites is anticipated to be less time consuming, and the MPWMD has already initiated discussions with TAMC on this issue. In any event, additional documentation from the Court endorsing its order to install the additional coastal monitor wells may be beneficial for the Watermaster to receive timely authorization for these monitor well installations.

As explained above, given the complexity of land use constraints and jurisdictional authority in the local setting, it is not likely that the exploratory drilling program can be conducted in the precise fashion described in Exhibit A of the *Decision*. Additionally, it is not envisioned that the exploratory drilling and geophysical surveys will be conducted as separate advance activities to facilitate subsequent siting of the new monitor well locations. Rather, monitor well clusters shall be installed at each of the carefully selected sites described above, with monitor well design and number of wells at each site guided by the lithologic and geophysical data to be collected in the manner described below. This is based on the MPWMD's past experience with exploratory drilling in the basin, wherein the actual occurrence of, and lithologic conditions within, each aquifer were variable from site to site, making it difficult to presume the monitor well designs and number of wells to be completed in advance. It is also noted that timely completion of the exploratory drilling and monitor well installation program described herein will require specialized drilling contractor services that may not be available locally, and could be limited by contractor availability.

2. Exploratory Borehole Drilling Program

A pilot borehole shall be constructed at each site, with the total depth targeted for the top of the Monterey Formation, which represents the effective base of the freshwater bearing formations at nearby locations in the basin. Total drilling depth at each site is anticipated to be 1,500 to 2,500 feet. Borehole lithologic samples (i.e., grab samples) shall be collected at ten-foot intervals (with the exception of any depths in the borehole at which continuous core samples can be collected). All collected lithologic samples shall be prepared and placed into labeled cases for storage and future inspection.

3. Geophysical Surveys

Upon completion of pilot drilling to the total depth, a complete suite of open borehole geophysical logs shall be run, including resistivity, spontaneous potential, caliper, temperature, gamma ray, and electromagnetic conductivity (EM) logs. These geophysical logs will provide a basis for describing the distribution of aquifers, occurrence of fine-grained interbeds and confining units between aquifers, water quality variations with depth, and the nature of groundwater flow and potential seawater intrusion, as was completed for a recent similar deep coastal monitor well construction project to the north of the Seaside Basin in the City of Marina (Hanson and others, 2002.

Geohydrology of a Deep-Aquifer System Monitoring-Well Site at Marina, Monterey County, California. U.S. Geological Survey Water-Resources Investigations Report 02-4003. Prepared in cooperation with the Monterey County Water Resources Agency (see page 12 for geophysical data description). In addition to the borehole geophysical logs, additional geophysical logging shall be conducted on the deepest cased well at each site and shall include gamma ray and EM logs. This additional logging will allow for comparisons with future annual geophysical logging surveys at each site as part of the ongoing monitoring program for early detection of salinity changes (i.e., potential seawater intrusion) into discrete zones within the aquifer system, that may otherwise go undetected by standard water quality sample collection.

5. New Monitoring Wells

Monitor well design shall be by multiple-well clusters at each site, either in the same or separate boreholes, unless an alternate well construction technique is authorized. Where present at each site, separate well casing strings shall be constructed with screened intervals within each recognized aquifer of the basin (e.g., Aromas Sand, Paso Robles, Santa Margarita) to provide a detailed vertical characterization of water levels and quality through the aquifer system. If observed conditions warrant, more than one well casing may be installed in each aquifer to more discretely characterize variable conditions in specific zones within the aquifer; however, this cannot be determined in advance of the exploratory drilling, as described above. For estimating purposes, it is assumed that four (4) wells will be installed at each well site cluster. The screened interval of each casing string shall be separated from other well completions by isolation seals if multiple wells are constructed in the same borehole. Each monitor well casing shall be a minimum two-inch inside diameter, and the deepest casing string at each well cluster shall be a minimum three-inch inside diameter to accommodate cased well geophysical logging tools.

D. Comprehensive Basin Production, Water Level and Water Quality Program

1. Purpose

The comprehensive monitoring program described herein is intended to guide ongoing data collection efforts in the basin to efficiently and economically provide the pertinent groundwater resource data that will establish a defensible basis for future decision-making by the Watermaster. Monitoring data collection tasks are described according to well location in or near the Seaside Basin. Coastal "sentinel" monitor wells refers to the closest monitor well sites to the coastline. Inland monitor wells refers to the monitor well locations in and near the Northern Inland and Laguna Seca subareas, and those monitor wells in the Southern and Northern Coastal subareas that are not included in the coastal sentinel monitor well network. "Production wells" refers to such wells in all four subareas of the basin.

2. Creation of Consolidated Basic Groundwater Resource Database

Currently, groundwater resource monitoring within the Seaside Basin is being conducted by several entities as described above in Section B. Basin Monitoring Background. A consolidated database will allow pertinent groundwater data to be more efficiently organized, managed and housed in a single location to facilitate: (a) ongoing data collection efforts, (b) data storage and retrieval, (c) distribution of basic data to Watermaster members and other interested parties, and (d) preparation of annual and periodic reports to the Watermaster. A database shall be created to contain all pertinent historical basic groundwater resource data (i.e., well production, level, quality) with proper annotations as to data sources, as well as all ongoing groundwater resource data collected on behalf of the Watermaster. The database will also include pertinent information on well type, location and construction details. In addition to the data organizational benefit, the consolidated database is intended to resolve any differences or discrepancies in existing datasets that have been compiled by separate entities. The MPWMD currently maintains a groundwater database that includes some of the features described herein. The Watermaster will need to determine if the MPWMD's database should be expanded or a new database should be created for this purpose. A breakdown of the proposed schedule by task is shown on Figure 5, and also is included in Section V.

3. Monitoring of Coastal "Sentinel" Monitor Wells

a) Water Level Monitoring

All coastal sentinel monitor wells (existing and proposed) shall be monitored on at least a monthly interval to record manual water level measurements. In addition, all coastal sentinel monitor wells shall be equipped with automatic dataloggers to continuously record groundwater levels in each aquifer measured. The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially and on at least a quarterly basis with the manual water level measurements. All collected data will be entered into the consolidated groundwater resource database on a quarterly basis.

b) Water Quality Monitoring

All coastal sentinel monitor wells (existing and proposed) shall be sampled on a quarterly interval by extraction of water samples (using standard sampling protocols) for chemical analysis by a state-approved laboratory. Parameters to be analyzed will at a minimum include the full general inorganic mineral suite. All collected water quality data will be entered into the consolidated groundwater resource database on a quarterly basis. Proposed new monitor wells may be sampled on a more frequent basis during the first year after construction to establish water quality variability at these locations. In addition, all coastal sentinel monitor wells (existing and proposed) shall be equipped with automatic dataloggers to continuously record groundwater quality (electrical conductivity and/or chloride) in each aquifer measured. The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially and at least quarterly with the chemical analysis data collected at each monitor well. On an annual basis, geophysical logs will be run at the deepest well at each of the new coastal sentinel monitor well sites. Also, an existing inactive Cal-Am production well in the Northern Coastal subarea, known as the “Del Monte Test” well, will be evaluated for possible inclusion with the coastal sentinel monitor well network.

4. Monitoring of Inland Monitor Wells

a) Water Level Monitoring

All inland monitor wells (existing and proposed) shall be monitored for water levels on at least a quarterly interval (This is an increased frequency from the semi-annual to annual water level monitoring recommended in the report: Yates and others, 2002, *Laguna Seca Subarea, Phase III Hydrogeologic Update*, prepared for MPWMD, November 2002 (see page 65)). In addition, at least two monitor well sites in the Laguna Seca subarea shall be equipped with automatic dataloggers to continuously record groundwater levels in each aquifer measured (This follows from a recommendation to instrument monitor wells to better understand water level variations in the report: Yates and others, 2002, *Laguna Seca Subarea, Phase III Hydrogeologic Update,* prepared for MPWMD, Novermber 2002. See page 65). The dataloggers will be set to record no less frequently than a daily interval and will be downloaded at least quarterly. The dataloggers will be calibrated/confirmed initially and on at least a quarterly basis with the manual water level measurements. All collected data will be entered into the consolidated groundwater resource database on a quarterly basis.

b) Water Quality Monitoring

Regularly scheduled water quality monitoring is not anticipated for the inland monitor wells, with the following exceptions: (a) the full general inorganic mineral suite of parameters shall be analyzed initially and quarterly for the first year, for any newly-constructed inland monitor wells to characterize background water quality at new locations, and (b) any water quality monitoring as part of special studies that may be directed by the Watermaster.

5. Monitoring of Production Wells

a) Water Level Monitoring

All active and inactive production wells in the basin owned and/or operated by a Watermaster member shall have static (i.e., non-pumping) water levels collected and recorded a minimum of once per month. It shall be the responsibility of each owner/operator of a Watermaster member production well to report monthly water level measurements to the Watermaster on an annual basis for inclusion of these data in the consolidated groundwater resource database.

b) Water Quality Monitoring

All active production wells in the coastal subareas of the basin owned and/or operated by a Watermaster member shall have a water quality sample from each well collected and analyzed by a state-approved laboratory for the full general inorganic mineral suite a minimum of once per year. It shall be the responsibility of each owner/operator of a Watermaster member production well to report water quality analytical results to the Watermaster on an annual basis for inclusion of these data in the consolidated groundwater resource database.

6. Reporting of Monitoring Data

It is anticipated that initially the Watermaster shall receive and distribute to members and interested parties a summary report of water resources data collected on behalf of the Watermaster on a quarterly basis. The quarterly reports shall include the reporting of water level and water quality data collected from the existing and proposed monitor wells as described herein. In addition, the monitor well data shall be summarized along with other information required in the Watermaster annual reports to be prepared and filed with the Court. Groundwater monitoring data will be prepared to conform to State Standards where appropriate or required.

E. Estimated Monitoring Program Costs

At this time only a preliminary "order of magnitude" estimate (*"Order of magnitude" cost estimates* refers to approximate costs with an estimated accuracy of +/- 40%.) of costs is available for the basin monitoring functions described in this Program. It is anticipated that refined costs will be available once proposals for exploration, monitoring and data management have been received, reviewed and authorized by the Watermaster. One-time costs for exploratory drilling, geophysical surveying and monitor well construction are estimated at $1,080,000. One-time costs for development of the basic groundwater database, and purchase and installation of water level/water quality dataloggers are estimated at $62,000. First year annual costs for groundwater database maintenance, and coastal and inland well monitoring are estimated at $61,680. A more detailed breakdown of estimated monitoring program costs is included in **Figure 6**. "Order of Magnitude" Cost Estimate Summary for Basin Monitoring Program Portion.

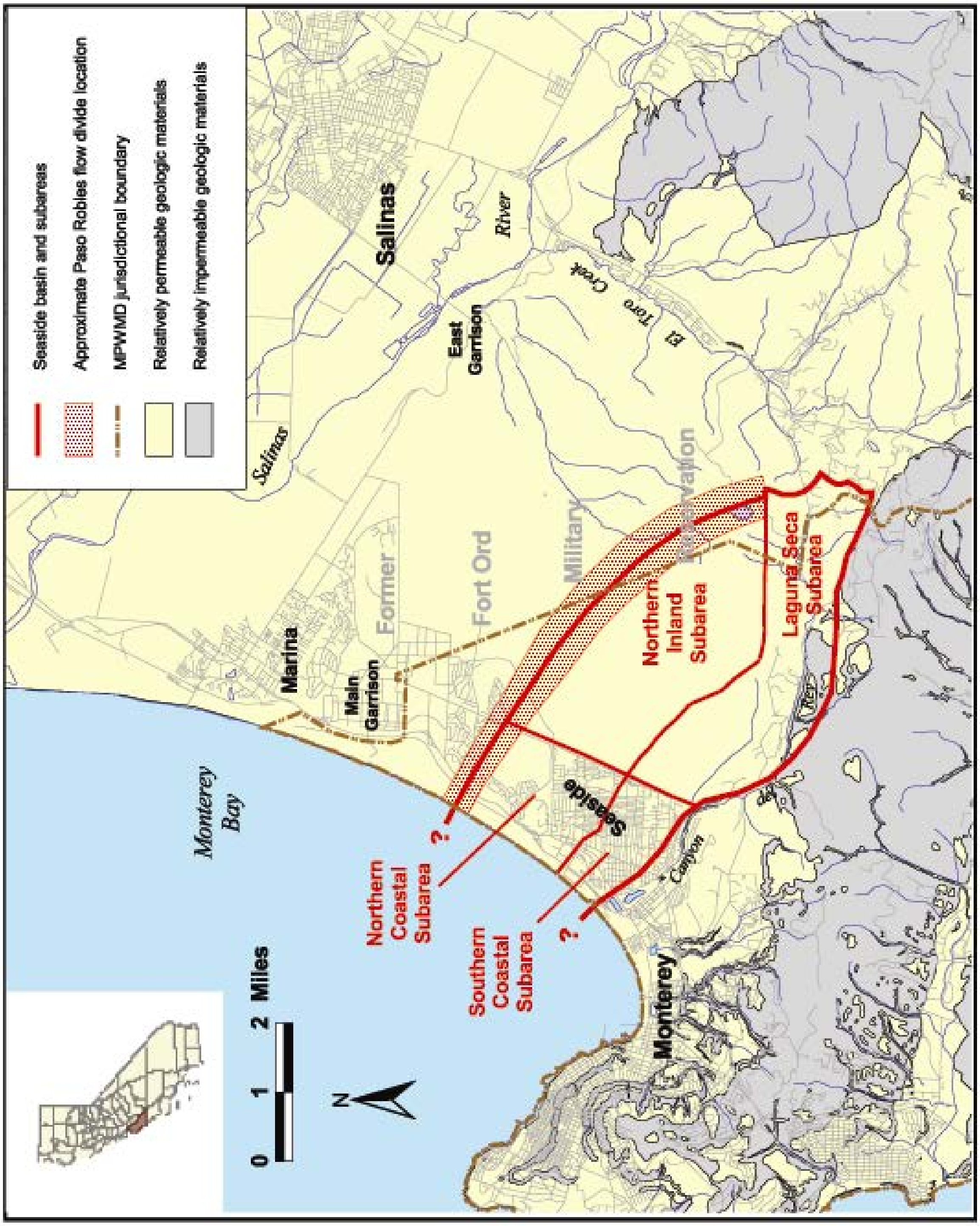


Figure 1. Location of the Seaside Groundwater Basin

Figure 2. Location of Production and Monitor Wells in and Near the Seaside Basin

Figure 3. Location of Existing Coastal Groundwater Quality Monitor Wells in an Near the Seaside Basin

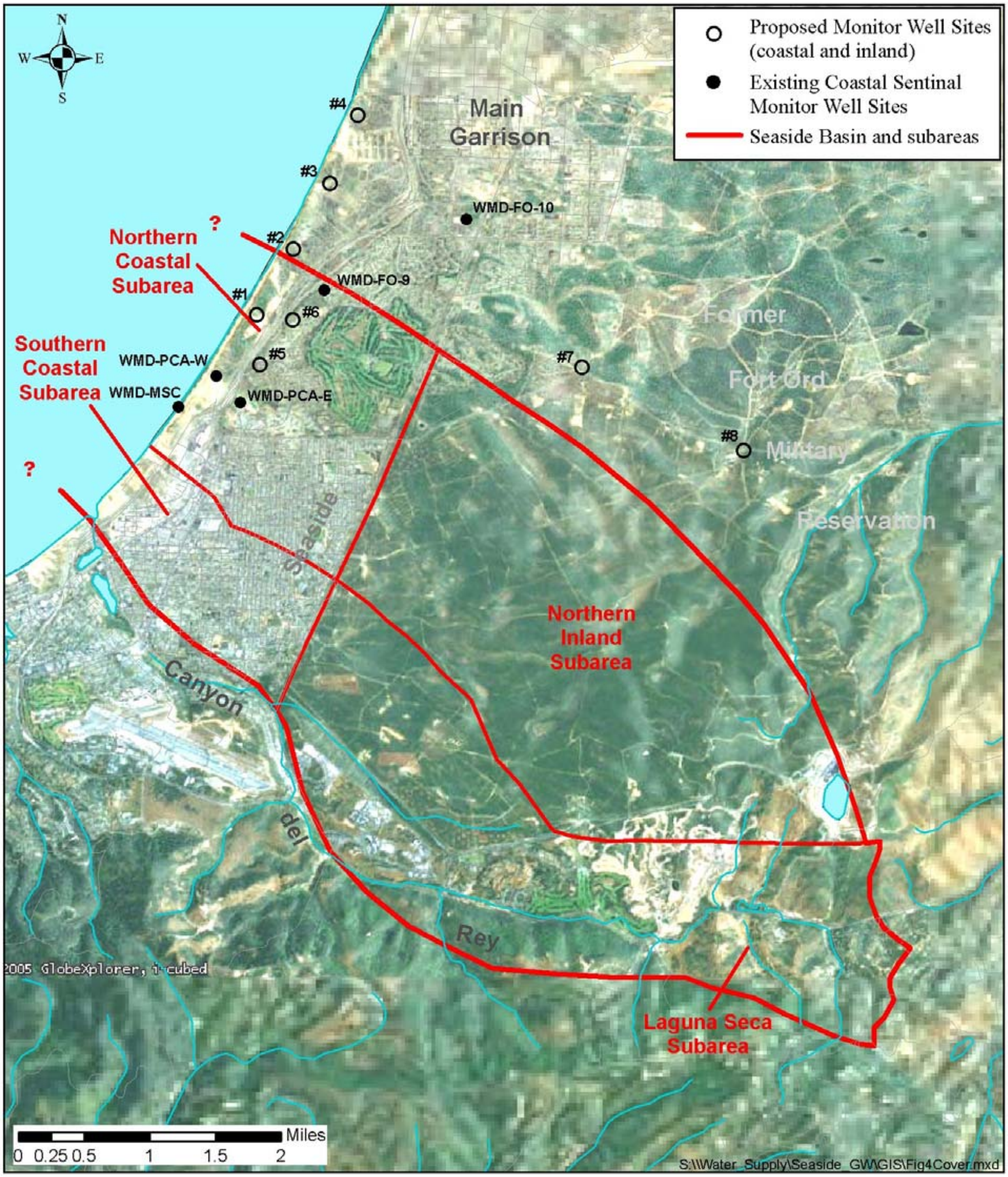


Figure 4. Location of Existing Coastal Sentinel Monitor Well Sites and Proposed Monitor Well Sites (Coastal and Inland) In and Near the Seaside Basin

Figure 5. Schedule by Task for Select Basin Monitoring Program Elements

No.	Task	Duration (Days)	Start	Finish
	Basin Monitor Well Construction Program			
1	Develop scope of services and RFP for consultant program oversight	60	7/1/2006	8/31/2006
2	Review proposals, secure oversight consultant contract	30	9/1/2006	9/30/2006
3	Oversight consultant completes site acquisition approvals	180	10/1/2006	3/31/2007
4	Develop scope of services and request bids for drilling/monitor wells	90	1/1/2007	3/31/2007
5	Review bids, secure contract(s)	30	4/1/2007	4/30/2007
6	Drill, equip and collect initial monitoring data	150	5/1/2007	9/30/2007
7	Prepare and submit completion report to Watermaster	60	9/1/2007	10/31/2007
	Creation of Consolidated Basic Groundwater Resource Database			
1	Develop database RFP	30	7/1/2006	7/31/2006
2	Review proposals, select consultant	30	8/1/2006	8/31/2006
3	Develop and approve database format	30	9/1/2006	9/30/2006
4	Populate database (historical data from all sources)	60	10/1/2006	11/30/2006
5	Populate database (current monitoring data)	30	12/1/2006	12/31/2006
6	Prepare database documentation report	30	1/1/2007	1/31/2007

Prepared for Seaside Basin Watermaster, May 2006

Figure 6. Seaside Basin Monitoring and Management Program "Order of Magnitude" Cost Estimate Summary for Basin Monitoring Program Portion

Task	Cost / Unit	# of Units	Cost / Site	# of Sites	One-Time Cost	Annual Cost
Exploratory drilling / geophysical surveying / monitor well construction						
Assume average TD = 1,800 feet; $100/ft lump sum	$100	1800	$180,000	6	$1,080,000	
Basic groundwater resource database						
Develop / populate: 200 hours	$70	200			$14,000	
Annual maintenance: 40 hours/quarter x 4/yr	$70	160				$11,200
Monitoring of coastal "sentinel" monitor wells						
Purchase/install WL/WQ dataloggers (6 existing wells; 16 new wells)	$2,000	22			$44,000	
Manual WL monitoring: 8 hrs/mo x 12 mo/yr	$70	96				$6,720
WQ sample collection: 3 hrs/pers/site x 2 pers x 4/yr	$70	24	$1,680	8		$13,440
WQ sample lab analyses: $200/sample gen. Minerals x 4/yr x 22 wells	$200	4		22		$17,600
Annual maintenance, WL/WQ dataloggers: 16 hrs/quarter x 4/yr	$70	64				$4,480
Annual geophysical surveys	$1,500			4		$6,000
Monitoring of inland monitor wells						
Manual WL monitoring: 8 hrs/quarter x 4/yr	$70	32				$2,240
Purchase/install WL/WQ dataloggers (2 existing wells)	$2,000	2			$4,000	
TOTAL ONE-TIME COST					**$1,142,000**	
TOTAL ANNUAL COST (first year)						**$61,680**

NOTES:

1. Cost estimates are at the preliminary "order of magnitude" level, with estimated accuracy of +/- 40%.

2. Cost estimates are subject to change as plans and scope are refined by Watermaster

III.
Basin Management Program

A. Development of a Seaside Basin Management Plan

1. Program Objectives

The objectives of the Basin Management Program, as stated in the Court's *Decision*, are to optimize groundwater pumping, control seawater intrusion, and return the Basin to equilibrium through implementation of conservation methods, through the importation of supplemental water for direct use and Basin replenishment.   The Program will serve as the technical roadmap for future basin management decisions to achieve the management objectives in a cost-effective manner while balancing potential socio-economic impacts to users of Seaside Basin groundwater. The Program will be developed in a way that provides flexibility in the future to respond to changing conditions in the basin and new information that becomes available as the basin monitoring program is implemented.

2. Program Development

The Watermaster will oversee the development of the plan, utilizing member agency staff expertise and/or consultants where appropriate to conduct detailed technical analyses and investigations.   The Watermaster should seek available grants and loans for plan development through the California Department of Water Resources or from other resources available to assist in alternative regional solutions that support the plan.

3. Key Program Elements

The Seaside Basin Management program will consist of the following key elements:

a) Development and implementation of a program for collecting and analyzing data related to groundwater production, water levels, water use, land use, rainfall, and other pertinent information useful in managing the basin. The Plan will outline the criteria and protocol to be used in triggering basin management actions. The MPWMD currently has an extensive data collection and management system that includes much of the data that will be required as part of the Seaside Basin Management Program.   The MPWMD program will be evaluated during Plan development for use as a base upon which necessary data collection and storage enhancements can be made.

b) Development of an enhanced Seaside Basin groundwater model to be used in developing improved estimates of natural and secondary basin recharge, Total Useable Storage Space for the Seaside Basin, Operating Safe Yield, Natural Safe Yield, and basin management strategies.   Technical consultants will be utilized for the task of developing a model and modifying existing groundwater models wherever possible. Existing models that will be evaluated for modification include but are not limited to: Laguna Seca Phase III Report (Yates et. al 2002), Sand City Desalination studies (Feeney & Williams, 2004), and Seaside Basin adjudication trial model (Durbin, 2005). No model development cost estimates have been provided in this document. A formal technical review of the models will be conducted in order to develop a scope of work and budget for the project.

c) Development of recommendations regarding implementation of strategies to import supplemental water supplies into the basin, including:
   - Substitution of alternative supplies for Basin groundwater (including in-lieu recharge).
   - Direct aquifer replenishment of pumping in exceedence of basin Natural Safe Yield.

   Potential water sources for the above strategies include reclaimed water for irrigation of large turf areas and/or direct recharge, surplus Carmel River Water for aquifer replenishment during the winter months, and local desalination projects such as that proposed by Sand City and regional desalination project, such as that proposed by California American Water. Supplemental supplies will be evaluated with regard to cost and environmental constraints to implementation. Plan recommendations will include concrete steps for project implementation over specific time periods, including near-term and long-term actions.

d) Development of strategies for redistribution of pumping to avoid various adverse impacts within the basin.

IV.
Seawater Intrusion Contingency Program

A. Objective

If seawater intrusion is detected in a coastal production or monitoring well, it is imperative that pumping stresses be reduced so that the seawater is not pulled further inland or otherwise spread into a larger area of the Basin where it may contaminate additional wells. Accordingly, the objective of the Seawater Intrusion Contingency Program is to set forth the actions that will be undertaken if seawater intrusion is detected in a coastal well to prevent the seawater from contaminating larger portions of the Basin. The purpose of this section is describe how the presence and extent of seawater intrusion will be determined by the analysis of the existing and the future enhanced coastal seawater intrusion water quality monitoring program. The seawater intrusion contingency planning process to address the detection and presence of seawater intrusion will then be discussed.

B. Seawater Intrusion Analysis

In order to detect and determine the extent of seawater intrusion, the mechanism of seawater intrusion must first be defined and then described. The analysis of the water quality monitoring data and mapping of the extent of seawater intrusion will follow.

1. Seawater Intrusion – Description of Problem and Process

Intensification of water use on ground water resources can cause the depletion of groundwater storage and lower groundwater levels in a basin. Declining groundwater levels to an elevation below mean sea level may eventually cause inflow of seawater into aquifers along coastal areas. As seawater moves inland, ground water chloride values increase over time.

2. Seawater Intrusion - Definition

For the purposes of defining when actions described in Section C of the program will be taken, the seaside groundwater basin aquifers will be defined as seawater intruded when the chloride concentrations in a coastal monitor well reach approximately 100 mg/l and 250 mg/l for the Paso Robles and Santa Margarita formations respectively. For a coastal production well, the standard will be when chloride concentrations reach 250 mg/l, given that some production wells have multiple aquifer completions with water quality that reflects a blend from these sources. These standards will be used until more comprehensive standards based on historical water quality data at individual monitor and production wells can be developed. Each monitoring well and production well in the groundwater network will be evaluated on site-specific criteria. In addition, the Watermaster will institute interim standards for notice of potential seawater intrusion so that appropriate preventative actions may be taken. Interim notice for seawater intrusion will be defined as a 50 percent increase above ambient chloride concentrations for any specific monitoring well location. Generally accepted laboratory protocols and hydrogeologic methods will be employed for the determinations of seawater intrusion.

3. Description of Water Quality Related to Seawater Intrusion

The California Safe Drinking Water Secondary Standard for chloride ranges from the recommended maximum for drinking water of 250 mg/L chloride and an upper limit of 500mg/L chloride. By the time chlorides reach the latter concentration, many times the wells are abandoned or destroyed due to unacceptable aesthetic qualities such as taste due to mineralization. The standards mentioned above dictate that, for drinking water purposes, chloride concentrations will be the primary water quality indicator for the determination of seawater intrusion. Other complementary inorganic parameter concentrations will also provide supplemental data for water quality trend analysis and aquifer water quality characterization (calcium, magnesium, sodium, potassium, sulfate, and nitrate) called "fingerprinting". The analysis of these combined parameters will determine aquifer impacts by seawater intrusion.

Background chloride values may vary by aquifer depending on aquifer characteristics. For this reason, chloride values generated from the water quality monitoring program will be referenced to the 100mg/L and 250 mg/L chloride concentrations to determine aquifer impacts by seawater intrusion. In the coastal Salinas Valley, the agricultural community recognizes chloride values under 100mg/L as excellent to good irrigation quality. After determining if seawater intrusion is present, the observance of increasing chloride trends from the baseline up to 250mg/L chloride will be analyzed to determine the advancement of seawater intrusion. It must be noted that seawater intrusion is a gradual process due to the chemical interactions between the geologic formations in the aquifers and seawater. It is critical that the Watermaster Board is kept informed whenever chloride levels reach levels in excess of the interim standard so that appropriate action can be taken.

4. Data Analysis Tools and Data Analysis

The water quality data analysis exercise requires certain tools. These tools include different types of computer software to digitally identify the location of wells, to quality check data, and to generate graphs, diagrams, and chloride contour lines. Before a thorough analysis of the water quality data can begin, the following software will be required:

- Geographic Positioning System (GPS) equipment to provide latitude/longitude location for study wells
- Excel to graph chloride trends for each well
- Water quality graphing software to represent water quality data in "stiff" and "trilinear" diagrams
- ArcView GIS 3.3 to generate chloride contour lines

Once the software is obtained and personnel are trained, immediate evaluation of the existing monitoring data can begin. Compilation of the data in a central database will be required along with data checking for correctness and GPS digital locations for all wells must be obtained. If the exiting study wells have historical data, the first step is to graph the chloride values for each well to determine any increasing trends over time. The next step is to determine the "fingerprint" or the water quality characteristics for each well with the use of stiff diagrams. Stiff diagrams show the complete inorganic suite of water quality data concentrations represented on a graph. This provides instant recognition the "fingerprint" of water being pumped from each of the aquifers. Like aquifer wells will have similar water quality fingerprints. The next water quality graphing step, prior to contouring the well chloride data, is to create a trilinear diagram for multiple wells. The inorganic water quality concentrations for each well will be represented on one graph in comparison to the same constituent concentrations of seawater. This graph enables the analyst to determine inorganic parameter concentration trends toward varying degrees of seawater intrusion. Using generally accepted standards, it must be confirmed whether elevated chloride concentrations are an anomaly or are due to seawater intrusion. The last step in the water quality data analysis is to contour the chloride data for each of the coastal monitoring wells on a map to compare and contrast chloride values. To contour, the following protocol will be followed utilizing ArcView GIS 3.3:

- Create a .dbf file that includes facility codes, chloride values and sampling dates information
- Import .dbf file into Arc-View
- In Arc-View, open a new view
- In the menu bar, under View choose the add Theme button and add the shape file with wells to be contoured
- In the View window, "open the tables of active themes", which will bring up the attributes table
- Open both the .dbf file and the study wells shape file, join the tables
- Choose create contours under Surface in the view window
    - Create contours, select Output Grid Extent option
    - Choose spline method to interpolate surface type field
    - Choose chloride for "Z" value field
    - Choose appropriate weight and number of points (hint: start with default values to see what the default contour looks like)
- Classify quantiles using Legend Editor menu
    - Choose chloride value for value field. Classify according to chloride concentration e.g. 100 mg/L, 250 mg/L, or 500 mg/L
    - Assign line type according to chloride concentrations

After the draft chloride contour map is generated, multiple technical review sessions must take place by all entities, MPWMD, Cal Am, and MCWRA, to evaluate the data representation. This will enable the entities to determine if the data are correctly being represented on the map, and if so, lead to the implementation of an action program. Well production amounts, seasonal precipitation, and water conservation efforts in each of the geographic areas will be useful in interpreting the chloride contour map. Once this first step is completed to determine the baseline chloride contours, a more thorough evaluation will be accomplished once the data is generated from the new coastal dedicated monitoring wells.

Take note that there are other, less routinely used, data analysis tools available to further delineate seawater intrusion and its advancement. Some tools, among others, include water quality stable isotope analysis and periodic well borehole geophysics.

The data analysis of seawater intrusion will be performed on an annual basis beginning January 2007 after the period of monitoring during heavy pumping is completed from May through November 2006.

C. Actions to be Taken Subsequent to Detection of Seawater Within in a Coastal Well

The following actions are to be taken in accordance with Exhibit A of the *Decision (Case No. M66343)*

1. If seawater intrusion is detected in a coastal production or monitoring well ("Contaminated Well"), the Contaminated Well will discontinue pumping and all other wells that produce groundwater from the intruded aquifer that are within one-half mile of the affected monitoring well ("Threatened Wells") will immediately reduce their monthly production to the equivalent of one-half of their average monthly production[1] within the previous five years upon notification from Watermaster of the detection of seawater intrusion within the Contaminated Well.

2. Watermaster shall increase monitoring of groundwater levels within the one-half mile radius of the Contaminated Well to determine if the requisite pumping reductions sufficiently affect groundwater gradients to prevent the further spread of seawater intrusion toward the Threatened Wells. This increased monitoring effort will include installing at least one new monitoring well as a sentinel well between the Contaminated Well and the nearest down-gradient active Threatened Well.

3. After six months of reduced pumping of the Threatened Wells, the threat of further seawater intrusion will be re-evaluated. If the requisite pumping reductions have failed to sufficiently affect groundwater gradients to prevent the further spread of seawater intrusion toward the Threatened Wells, those wells will further reduce their monthly production to the equivalent of one-third of their average monthly production within the previous five years upon notification by Watermaster that such further reductions are required.

4. After another six months of monitoring, the direction of groundwater gradients will again be evaluated. If there continues to be a groundwater gradient that would pull the detected seawater towards the Threatened Wells, then the Threatened Wells shall discontinue pumping, unless in Watermaster's determination, doing so would create a public health and/or safety risk.

5. If, after the initial discovery of the initial seawater intrusion, seawater is encountered

in an additional monitoring or production well, pumping reductions will be required for nearby threatened production wells (i.e., production wells within one half mile of the recently contaminated well) in the same manner as set forth above for first Contaminated Well.

If the implementation of the procedures set forth above cause a production well to reduce its pumping or to cease pumping altogether, all reasonable efforts shall be undertaken by the Watermaster and all other Parties that Produce Groundwater from the Basin to insure that the lost production capacity and associated water supply for that well owner/operator will be replaced by redistributing pumping, or provision of replacement water from other sources.

D. Efforts to Redistribute or Replace Water Lost Because of Seawater Intrusion Contingency Plan

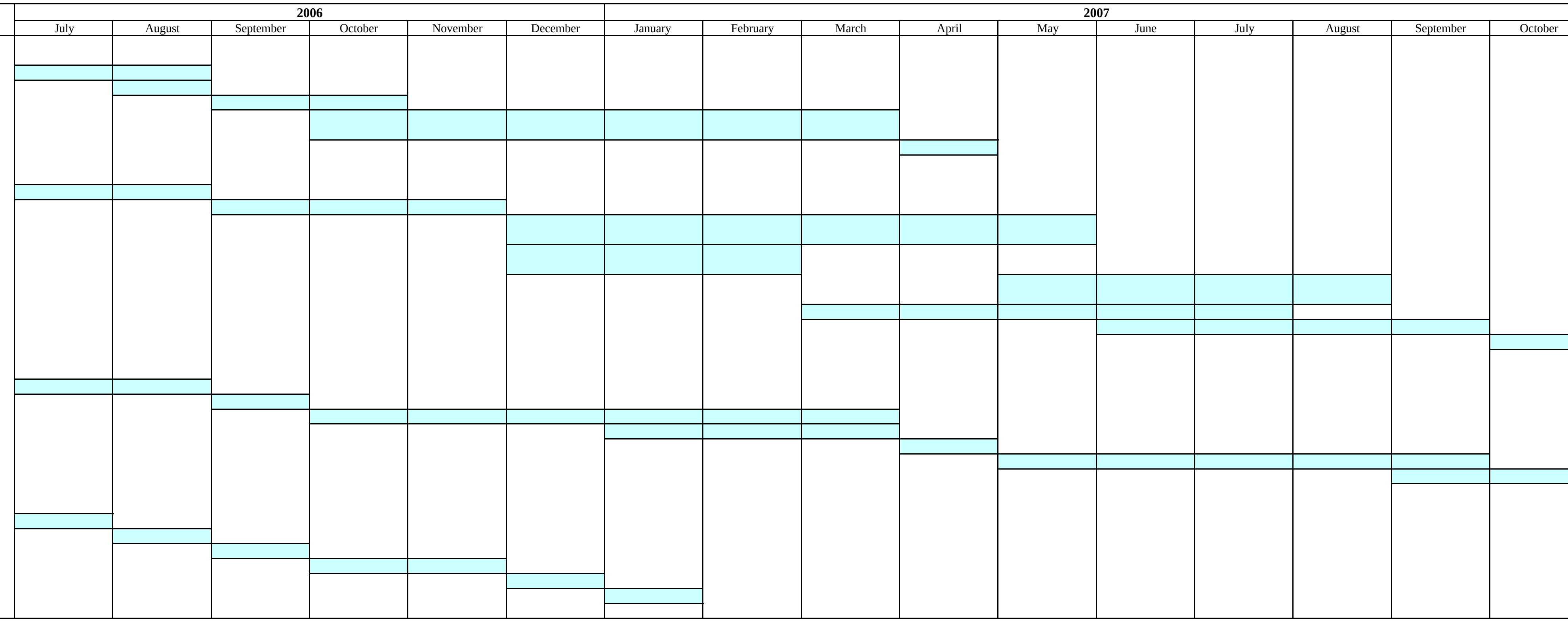
The Monterey Peninsula has faced the constant specter of water shortage for decades. The Monterey Peninsula Water Management District has developed an *Expanded Conservation and Standby Rationing Plan* (included in the program as Appendix 2) that responds to a number of water supply shortage scenarios. Saltwater intrusion and subsequent management of an event will require planning and coordination of all Seaside Basin users

In the event that supplies cannot immediately be replaced with supplies from other Seaside Basin wells or from outside sources, the Monterey Peninsula Water Management District would, in conjunction with California American Water, implement the appropriate actions called for in the *Expanded Conservation and Standby Rationing Plan* (MPWMD Regulation XV, Rules 160 – 175) for the Cal Am service area. The plan will be amended by January 2007 as needed to use detected seawater intrusion episodes as a trigger for the implementation of the plan to also include the Seaside Water Main System.

A contingency planning program will enable quick action to take place to address any seawater intrusion scenario that may arise from the annual analysis of the seawater intrusion water quality.

V. Basin Monitoring and Management Program Implementation Schedule

No.	Task	Duration (Days)	Start	Finish
	Groundwater Modeling for Seaside Basin Through Consultant:			
1	Review (E) groundwater models, select best model for enhancement	61	07/01/2006	08/31/2006
2	Develop scope of services & budget for model enhancement project	29	08/01/2006	08/30/2006
3	Advertise, select consultant, execute contract	59	09/01/2006	10/30/2006
4	Complete model development & calibration, run scenario evaluations, develop improved estimates of basin recharge and safe-yield	180	10/01/2006	03/30/2007
5	Provide training in use of model to Watermaster Technical Committee	29	04/01/2007	04/30/2007
	Seaside Basin Management Program:			
1	Develop scope of services & budget for consultant	60	07/01/2006	08/30/2006
2	Advertise, select consultant, execute contract	90	09/01/2006	11/30/2006
3	Develop Basin Monitoring Plan, Seaside Basin Watermaster Database & data collection & analysis protocol	180	12/01/2006	05/30/2007
4	Evaluate options for importation of supplemental water supplies into the Seaside Basin, develop action plan	89	12/01/2006	02/28/2007
5	Using groundwater model from task above, analyze & develop strategies for improved basin management	122	04/30/2007	08/30/2007
6	Develop action plan to avoid adverse impacts on the basin	152	02/28/2007	07/30/2007
7	Draft Seaside Basin Management Plan Report for Watermaster review	121	06/01/2007	09/30/2007
8	Produce Final Seaside Basin Management Plan	29	10/01/2007	10/30/2007
	Basin Monitor Well Construction Program:			
1	Develop scope of services and RFP for consultant program oversight	60	07/01/2006	08/31/2006
2	Review proposals, secure oversight consultant contract	30	09/01/2006	09/30/2006
3	Oversight consultant completes site acquisition approvals	180	10/01/2006	03/31/2007
4	Develop scope of services and request bids for drilling/monitor wells	90	01/01/2007	03/31/2007
5	Review bids, secure contract(s)	30	04/01/2007	04/30/2007
6	Drill, equip and collect initial monitoring data	150	05/01/2007	09/30/2007
7	Prepare and submit completion report to Watermaster	60	09/01/2007	10/31/2007
	Creation of Consolidated Basic Groundwater Resource Database:			
1	Develop database RFP	30	07/01/2006	07/31/2006
2	Review proposals, select consultant	30	08/01/2006	08/31/2006
3	Develop and approve database format	30	09/01/2006	09/30/2006
4	Populate database (historical data from all sources)	60	10/01/2006	11/30/2006
5	Populate database (current monitoring data)	30	12/01/2006	12/31/2006
6	Prepare database documentation report	30	01/01/2007	01/31/2007



Appendix 1

Exhibit A of the *Decision* in the Superior Court of the State of California in and for the County of Monterey, Case No. M66343

Principles and Procedures of the Seaside Basin Monitoring and Management Plan

Introduction

This document sets forth the criteria that will guide the Watermaster in creating the Seaside Basin Monitoring and Management Plan. It also establishes a procedure for dealing with seawater intrusion, should the same occur, during the time the Watermaster is developing its plan of action to deal with such an eventuality.

Plan Criteria

Within sixty days of entry of the Judgment by the Court, the Watermaster will submit for the Court's approval a Monitoring and Management Plan containing details for implementation of the following actions:

a. *Exploratory borehole drilling program.* About four exploratory boreholes shall be drilled along the shoreline and the northern boundary of the Basin to depths ranging from 500 to 1500 feet, the depth being controlled by the depth of the Monterey formations. Lithologic samples shall be collected and classified for every one foot of drilling. A full suite of geophysical logs shall be collected. The data collected as part of this program shall be compared to other well data in the Seaside Basin to further refine the hydrogeologic conceptual model in the areas between the production wells and saline groundwater.

b. *Geophysical surveys.* Geophysical surveys shall be performed along the shoreline and the northern boundary of the Basin, intersecting the test borehole locations. The results of the geophysical surveys shall be calibrated against the test borehole data. The borehole data and the surveys shall be analyzed to characterize the near shore hydrology and to locate and design new monitoring wells.

c. *New monitoring wells.* About four to six monitoring well clusters shall be drilled and installed along the shoreline and the northern boundary of the Basin. Each cluster shall consist of at least four to five wells to provide a detailed vertical characterization of head and water quality through the aquifer system. The Watermaster shall coordinate the placement of the wells with MPWMD, which already has some monitoring wells in place with plans to drill more, to avoid duplication of effort and cost inefficiencies.

d. *Design and implementation of a piezometric and water quality monitoring program.* Pressure transducers and ionic probes (EC and C1) shall be installed in each well at each cluster. These probes will record water levels and water quality on a frequent interval (every 15 minutes for water levels, and every day for water quality). Where possible, similar probes will be installed in the pumping wells to record water levels and on/off cycles. Grab samples will be obtained periodically to true up the ionic probes. These data will be analyzed to assess the state of seawater intrusion, reveal groundwater barriers within the aquifer system, and more accurately estimate aquifer system parameters.

e. *Development and implementation of a management program.* The objectives of the management program will be to optimize pumping, halt seawater intrusion, and return the Basin to equilibrium through implementation of conservation methods; replacement of water drawdown by substitution of reclaimed water, where appropriate, infusion of imported water into the aquifer; and utilization of controlled pumping schedules through analysis of real-time monitoring.

f. *Develop criteria for use by the Watermaster in determining any modification of the Operating Yield.*

The management program will include periodic review of monitoring information and the use of this review to guide near-term and long-term groundwater pumping. If seawater is detected by the MPWMD monitoring wells currently in place, or by pumping wells, or by the monitoring well system contemplated by this document, the Watermaster shall follow the procedures developed pursuant to the mandate of the following paragraph. If it is detected before such procedures are in place, the Watermaster shall follow the procedure set forth in the *Interim Contingency Procedure to Contain Seawater Intrusion*, infra.

Within one year after entry of the Judgment by the Court, the Watermaster will:
(a) develop improved estimates of the natural and secondary recharge within the Seaside Basin; (b) develop and implement a program for collecting groundwater production, water use, and land use data for the Seaside Basin and appropriate adjacent areas;
(c) develop a suitable groundwater model of the Seaside Basin and appropriate adjacent areas; (d) develop a plan of action to be implemented to avoid various adverse effects in the Basin, including seawater intrusion; and (e) develop a plan of action to contain seawater intrusion, should it occur. The plan of action to avoid adverse effects in the Basin shall include a timeline for the importation of Non-Native water for spreading or injection into the Basin, and for acquisition of recycled water in lieu of Native Water production, and shall outline concrete steps to be taken to secure both Non-Native Water and recycled water.

<u>*Interim Contingency Procedure to Contain Seawater Intrusion*</u>

If Seawater intrusion is detected in the Basin during the development of the Watermaster's Management Plan, the following contingency plan will be set in motion to prevent seawater from contaminating larger portions of the Basin:

a. *Detection in a coastal monitoring well.* If seawater intrusion is detected in a coastal monitoring well, it is imperative that pumping stresses be reduced so that seawater is not pulled inland to producing wells. To accomplish this, all wells that produce from the intruded aquifer that are within one-half mile of the affected monitoring well will reduce their production to the equivalent of one-half their previous five-year pumping average. Monitoring of groundwater levels within the one-half mile radius of the affected well will be increased to determine if groundwater gradients following reductions in pumping have been modified sufficiently to prevent further seawater intrusion. This increase in monitoring effort will include installing at least one new monitoring well as a sentinel between the affected monitoring well and the nearest down-gradient active production well. After six months of reduced pumping, the threat of further seawater intrusion will be re-evaluated. If there continues to be a groundwater gradient that would pull the detected seawater toward producing wells, the pumping wells within one-half mile of the affected monitoring well will further reduce pumping to one-third of their previous five-year pumping average. After another six months of monitoring, the direction of groundwater gradients will again be evaluated. If there continues to be a groundwater gradient that would pull the detected seawater towards producing wells, then the wells with reduced pumping will discontinue pumping. If, after the initial discovery of intrusion, seawater is encountered in an additional monitoring well, pumping reductions will be required for nearby producing wells in the same manner as for the first intruded monitoring well.

b. *Detection in a production well.* If seawater intrusion is encountered in a production well, that well will discontinue pumping. In addition, all wells that produce from the intruded aquifer that are within one-half mile of the affected well will reduce their production to the equivalent of one-half of their previous five-year pumping average. The sequence of threat evaluation, subsequent pumping reductions, and installation of new monitoring wells will be the same as for that in subparagraph a.

f the implementation of the procedures set forth above causes a production well to educe its pumping or to cease pumping altogether, all reasonable efforts must be ndertaken by the Watermaster to insure that lost production will be replaced by edistributing pumping, further conservation efforts on the part of all parties, or provision f replacement water from other sources.

Appendix 2

***Expanded Conservation and Standby Rationing Plan*, by the Monterey Peninsula Water Management District**

REGULATION XV. EXPANDED WATER CONSERVATION AND STANDBY RATIONING PLAN

RULE 160 - GENERAL PROVISIONS

A. All water users within the Monterey Peninsula Water Management District shall be subject to the District's water waste and non-essential water use prohibitions.

B. Prohibitions against water waste and non-essential water use shall be enforced by the District and its designated agents in accordance with Rule 171 (Water Waste Fees).

C. Stage 1 Water Conservation shall be implemented upon the effective date of this regulation.

D. Stage 1 Water Conservation parallels Cal-Am's Phase IV Mandatory Water Conservation program that was designed to meet the Carmel Valley water production limits set by the SWRCB and approved by the Public Utilities Commission. Stages 1 through 3 Water Conservation is intended to achieve the Carmel Valley water production limits set by the State Board. Stage 4 Water Rationing through Stage 7 Water Rationing are intended to respond to limitations in supply caused by inadequate system inflow and storage.

E. Stage 1 Water Conservation through Stage 3 Water Conservation shall apply to water users of the Cal-Am water distribution system where that system derives its source of supply from the Monterey Peninsula Water Resources System (MPWRS) for as long as Cal-Am is subject to water production goals and limitations enforced by the SWRCB.

F. Stage 4 Water Rationing through Stage 7 Water Rationing may apply to all water distribution system users and water users within the Monterey Peninsula Water Resources System as a response to limited water supply. These stages shall also serve as responses to emergency situations where immediate reductions in water use are necessary to ensure public health, safety or welfare. This regulation authorizes the Board of Directors to, from time to time, determine by Resolution that any water distribution system or set of water users within the Monterey Peninsula Water Management District shall be subject to Stages 4 Water Rationing through Stage 7 Water Rationing as provided in this ordinance.

G. As to water derived from the MPWRS, Cal-Am shall maintain unaccounted for water use in its MPWRS distribution system at or below seven (7) percent. Average losses of more than seven (7) percent during the most recent twelve-month period shall be considered water waste. This limitation shall not affect any Cal-Am system east of, and including, the Ryan Ranch subunit.

H. Cal-Am shall amend its Urban Water Management Plan to conform to the policies and procedures described in this ordinance. A copy of the plan and amendment shall be filed with the District within 180 days of the effective date of this ordinance. The plan shall comply with the California Water Code, Division 6, Part 2.6.

Amended by Ordinance No. 119 (3/21/2005)

RULE 161 - STAGE 1 WATER CONSERVATION

A. Stage 1 Water Conservation is defined as the first stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water derived from the MPWRS below regulatory constraints by increasing conservation activities and preparing for further stages of conservation and rationing. During Stage 1 Water Conservation, Cal-Am shall have the goal of maintaining its annual (October 1 through September 30) water production from the Carmel Valley below 11,285 acre-feet. This quantity may be modified by the SWRCB. Assuming a maximum annual production of 4,000 acre-feet from the Seaside Coastal Basin, this equates to a Cal-Am system production limit of 15,285 acre-feet. Each water user deriving water from the Cal-Am system that derives its source of supply from the MPWRS shall comply with District water waste and non-essential water use prohibitions and shall participate to the extent possible in voluntarily reducing water use.

B. All water users with the Monterey Peninsula Water Management District shall comply with water waste and non-essential water use prohibitions.

Rule added by Ordinance No. 92 (1/29/99)

RULE 162 - STAGE 2 WATER CONSERVATION

A. Stage 2 Water Conservation is defined as the second stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water use from the MPWRS below regulatory constraints by requiring implementation of Landscape Water Budgets for large irrigators of three acres or more, large residential water users and water users with dedicated landscape water meters.

B. Stage 2 Water Conservation shall be enforced when Cal-Am production from the MPWRS has exceeded the year-to-date at month-end target as displayed in Table 1.

The monthly distribution of water production shown in Table 1 between sources in the Carmel River Basin and in the coastal subareas of the Seaside Groundwater Basin shall be approved by the Board of Directors as part of the Quarterly Water Supply Strategy and Budget process. The Board shall hold public hearings to consider the water supply budgets for Cal-Am's main system during the Board's regular meetings in September, December, March, and June, at which time the Board may modify Table 1 by Resolution.

Amended by Ordinance No. 119 (3/21/2005)

Table 1
REGULATORY WATER PRODUCTION TARGETS
FOR CALIFORNIA AMERICAN WATER MAIN SYSTEM FROM SOURCES
WITHIN THE MONTEREY PENINSULA WATER RESOURCES SYSTEM

Month	Monthly Target	Year-to-Date At Month-End Target
October	1,379	1,379
November	1,113	2,492
December	984	3,476
January	958	4,434
February	894	5,328
March	1,047	6,375
April	1,209	7,584
May	1,405	8,989
June	1,527	10,516
July	1,628	12,144
August	1,649	13,793
September	1,492	15,285
TOTAL	15,285	

C. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 1 Water Conservation shall remain in force. Requirements may be modified or superseded by actions taken in future stages of the Expanded Water Conservation and Standby Rationing Plan.

D. Implementation of Landscape Water Budgets: All water users required to obtain a Landscape Water Budget under District Rule 172 are required to manage outdoor irrigation within the Landscape Water Budget assigned to the property.

E. Water use in excess of the established Landscape Water Budget shall be considered Water Waste and shall be subject to District Rule 171.

F. Sunset of Stage 2 Water Conservation: Without further action of the Board of Directors, the provisions of Stage 2 Water Conservation shall be rescinded and revert to Stage 1 Water Conservation upon compliance with the year-to-date at month-end production goal for two consecutive months in the subsequent water year.

G. Notice: Cal-Am shall provide an annual reminder notice to MPWRS users with Landscape Water Budgets to report modifications in landscaping which could alter an existing budget.

H. Monthly Consumption Reports: During any Stage 2, 3, 4, 5, 6, or 7, Cal-Am shall provide the District with monthly consumption reports in a format approved by the District. Reports shall be provided within fifteen (15) days of the close of the preceding month.

Rule added by Ordinance No. 92 (1/28/99); Ordinance No. 119 (3/21/05)

RULE 163 - STAGE 3 WATER CONSERVATION

A. Stage 3 Water Conservation is defined as the third stage in the District's Expanded Water Conservation and Standby Rationing Plan that takes action to maintain Cal-Am water use in the MPWRS below regulatory constraints. It is triggered when the year-to-date at month-end production target for Cal-Am from the MPWRS is exceeded twice by the average of Cal-Am's year-to-date production from the MPWRS for each month during the October through March period or exceeded once by the average of Cal-Am's year-to-date production from the MPWRS for each month during the April through September period. It provides a procedure to enable emergency temporary increases in the upper block volume rates and requires increased action by Cal-Am to reduce unaccounted-for water and monthly reporting of actions taken. Stage 3 Water Conservation may also be triggered upon Resolution of the Board of Directors when there is a need for an immediate water use reduction in response to an unexpected water production increase.

Upon implementation of Stage 3 Water Conservation, Cal-Am shall immediately submit a plan to the General Manager to reduce unaccounted for water uses to seven (7) percent or less measurered by the most recent twelve-month rolling average and shall immediately act on such plan. Cal-Am shall provide a progress report to the Board of Directors monthly until Stage 3 is sunset.

B. Regulatory Trigger: Stage 3 Water Conservation shall be enforced when any of the following criteria has been met: 1) the average of Cal-Am's year-to-date production from the MPWRS for each month has exceeded the year-to-date at month-end production target for Cal-Am from the MPWRS as displayed in Table 1 for a second time during the period from October 1 through March 31 in any water year, or 2) the average of Cal-Am's year-to-date production from the MPWRS for each month has exceeded the year-to-date at month-end production target for Cal-Am from the MPWRS as displayed in Table 1 once during the period from April 1 through September 30 in any water year, or 3) a Resolution has been adopted by the Board in accord with Section C below.

C. Emergency Trigger: Stage 3 Water Conservation shall be implemented upon Resolution of the Board of Directors when there is need for an immediate water use reduction requirement in response to an unexpected water production increase.

D. Sunset of Stage 3 Water Conservation: Without further action by the Board of Directors, the provisions of Stage 3 Water Conservation shall be rescinded upon compliance with the year-to-date at month-end production goal for two consecutive months in the subsequent water year. Water users of Cal-Am when that water system derives water from the MPWRS shall revert to Stage 1 Water Conservation.

Regulatory compliance during a period of Stage 4 Water Rationing shall not cause a sunset of this provision.

E. Notice: Cal-Am shall provide notice of mandatory water conservation with each bill prepared for water users of the Cal-Am system

F. Cal-Am Emergency Use Rates: Cal-Am shall implement the California Public Utilities Commission (CPUC) approved emergency rate schedule to respond to Stage 3 water reduction requirements. Cal-Am shall file an Advice Letter with the CPUC to implement Emergency Use Rates, however, only after it has first met and conferred with the District at least five days in advance of that filing. The General Manager may waive this time period for good cause.

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 164 - STAGE 4 WATER RATIONING

A. Stage 4 Water Rationing is defined as the fourth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 15 percent reduction goal from system production limits for non-Cal-Am water users. Fifteen percent reductions in the Cal-Am system are achieved through Stage 3 Water Conservation.

B. Trigger.

1. Water Supply Limitation Trigger. Stage 4 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 4 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 27,807 acre-feet and greater than 21,802 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.

2. Emergency Trigger. Stage 4 Water Rationing shall be implemented upon Resolution of the Board of Directors when there is need for an immediate water use reduction requirement in response to an unexpected water supply shortage.

C. Requirements previously imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.

D. The provisions of Stage 3 Water Conservation shall be implemented for all water users of the Cal-Am water distribution system, unless specifically exempt from Stage 4 Water Rationing by action of the Board of Directors.

E. Sunset of Stage 4 Water Rationing.

1. Water Supply Availability. Stage 4 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 27,807 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 4 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.

2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of

Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 4 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.

3. Emergency. Upon correction of a water supply limitation caused by an emergency, Stage 4 Water Rationing shall sunset without action by the Board.

F. Notice.

1. Upon direction of the General Manager, all water distribution system operators affected by Stage 4 Water Rationing shall notify water users of the system that reductions in water use are necessary and that stricter water rationing may be imminent. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.

2. As appropriate, Cal-Am shall notify its water users that excessive use rates will be imposed upon the effective date of Stage 4 Water Rationing.

3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 4 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 165 - STAGE 5 WATER RATIONING

A. Stage 5 Water Rationing is defined as the fifth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 20 percent reduction goal from the system production limit. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that intensify water use.

B. Implementation.

1. Water Supply Limitation Trigger. Stage 5 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 5 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 21,802 acre-feet and greater than 15,615 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.

   The General Manager may delay implementation of Stage 5 Water Rationing to ensure adequate operation of the program. Delays authorized by the General Manager shall not exceed 90 days.

2. Emergency. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 20 percent reductions in water use from a distribution system's production limit are necessary to ensure public health, safety or welfare.

C. Sunset of Stage 5 Water Rationing.

1. Water Supply Availability. Stage 5 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 21,802 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 5 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.

2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 5 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert

to Stage 2 Water Conservation.

If Cal-Am production exceeds the year-to-date at month's end production goal as shown in Rule 162, Table 1, Cal-Am water users shall revert to Stage 2 Water Conservation.

D. Affected Water Users. Stage 5 Water Rationing shall apply to all water users within the MPWRS. As necessary to ensure adequate water supplies, the Board of Directors may act within its discretion to authorize activation of Stage 5 Water Rationing within one or more water distribution systems in the District.

E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 4 Water Conservation shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.

F. Moratorium. On October 1 following implementation of Stage 5 Water Rationing, the District shall suspend the issuance of water permits associated with intensification in use. This provision shall not suspend the issuance of water permits that utilize public or private Water Use Credits or where issuance of a permit is required by prior agreement of the District.

G. Reduction Goal. Stage 5 Water Rationing achieves water use reductions of 20 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.

H. Notice.

1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing. Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.

2. All water distribution system operators affected by Stage 5 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form

at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.

3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 5 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 5 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

I. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, "other," Non-Revenue Metered Use, and Reclaimed Water Users.

J. Reduced Annual Cal-Am Annual Production During Stage 5 Water Rationing. The Cal-Am annual production limit shall be reduced by 20 percent during Stage 5 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.

K. Non-Cal-Am Annual Production Limits During Stage 5 Water Rationing. Available production for other water distribution systems subject to Stage 5 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.

L. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of that portion of Cal-Am that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.

1. <u>Residential Water Users</u>. Each residential water user either served by a water meter reported as "single-family residential" by the water distribution system or served by a private well shall have an equal portion of the water available to the single-family residential category based upon the number of residents reported on the survey form.

2. Multi-Family Residential Water Users. Each multi-family residential water user either served by a water meter reported as "multi-family residential" by the water distribution system or served by a private well shall have an equal portion of the water available to the multi-family residential category based upon the number of residents reported on the survey form with the following exception:

   a. Multi-family residential sites with common laundry facilities on a separate water meter shall receive a one-unit water ration for each dwelling unit that has access to the facility. Each dwelling unit located on the multi-family residential site that has access to the common laundry facility shall have the dwelling unit ration reduced by one unit of water.

3. Commercial/Industrial Water Users. Each commercial/industrial water user either served by a water meter reported as "commercial" or "industrial" by the water distribution system shall have a base ration determined by applying the current commercial water use factors.

   a. Mixed Use Water Users. Mixed-use water users shall be classified as commercial uses for the purposes of this program.

4. Public Authority. Public Authority Uses shall be rationed by jurisdiction. Each Public Authority water user may combine multiple accounts or connections when the accounts are located within one jurisdiction.

5. Golf Courses. Golf Courses supplied water exclusively by the Cal-Am or non-Cal-Am water distribution systems or wells may be rationed individually or, upon request to the General Manager, as a group.

6. Other. Water users utilizing portable water meters or hydrant meters shall be required to employ Best Management Practices. Cal-Am shall be required to report monthly to the District the location and responsible party for all portable water meters and the amount of use from those meters. As deemed necessary to achieve the imposed reduction in use, the District may condition use of temporary connections.

7. Non-Revenue Metered Users. Non-Revenue Metered Uses shall be rationed as a group with the following exception:

   a. Irrigation required by the Mitigation Program adopted when the Water Allocation Program Environmental Impact Report was adopted in 1990, and as required by SWRCB Order No. WR 95-10, shall not be subject to reductions in use. Required irrigation of the riparian corridor shall be identified and reported separately from other non-revenue metered uses.

8. Non-Cal-Am Wells. Regulations for rationing non-Cal-Am wells located within the MPWRS that are not supplying water to a distribution system shall be considered by the Board prior to implementation of Stage 5 Water Rationing.

9. Recycled Water Users. Recycled Water Irrigation Areas receiving water from the CAWD/PBCSD Wastewater Reclamation Project shall be subject to Stages 5 Water Rationing and higher for potable water used during an interruption or emergency, in accordance with contractual agreements between the District and the respective owners of the Recycled Water Irrigation Areas.

   a. Before Project Expansion Is Completed. Under the agreements operative before the Project Expansion is Completed (as the capitalized terms are defined in Rule 23.5), the owners of the Recycled Water Irrigation Areas shall have the respective irrigation requirements thereof satisfied to the same degree as any non-Project golf course or open space which derive their source of supply from the Cal-Am system. The irrigation requirements of the Recycled Water Irrigation Areas will be determined based on the most-recent non-rationed four-year average irrigation water demand, including both Recycled Water and potable water, for each Recycled Water Irrigation Areas. The use of Recycled Water, when available in sufficient quantities to satisfy the irrigation requirements of the Recycled Water Irrigation Areas, shall not be restricted by this requirement.

      Each Recycled Water Irrigation Area shall be entitled to receive the average irrigation requirement determined above, reduced by the percentage reduction required by the current stage of rationing. If the quantity of Recycled Water that is available is less than the quantity of water that the Recycled Water Irrigation Area is entitled to, potable water shall be provided to make up the difference and satisfy the irrigation requirements of the Recycled Water Irrigation Area to the same degree that the irrigation requirements of non- Project golf course and open space users are being satisfied.

      The District shall ensure that the water provided during water rationing is of adequate quality. If the quality does not satisfy the contractual agreement operative before the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), potable water shall be provided in sufficient quantities to improve the quality of the reclaimed water.

This Subsection L.9.a shall cease to be operative once the Project Expansion is deemed to be Completed (as the capitalized terms are defined in Rule 23.5), and shall thereafter be of no force or effect.

b. When Project Expansion Is Completed. Under the agreements operative once the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), the owners of the Recycled Water Irrigation Areas shall have the respective irrigation requirements thereof satisfied to the same degree as any non-Project golf course or open space which derives its source of supply from the Cal-Am system. The irrigation requirements of the Recycled Water Irrigation Areas will be determined based on the most-recent non-rationed four-year average irrigation water demand, including both Recycled Water and potable water, for each respective Recycled Water Irrigation Area.

Each Recycled Water Irrigation Area shall be entitled to receive the average irrigation requirement determined above, reduced by the percentage reduction required by the current stage of rationing. If the quantity of Recycled Water that is available is less than the quantity of water that the Recycled Water Irrigation Area is entitled to, potable water shall be provided to make up the difference and satisfy the irrigation requirements of the Recycled Water Irrigation Areas to the same degree that the irrigation requirements of non-Project golf course and open space users are being satisfied.

The preceding sentence shall not apply to the extent that the irrigation requirements of any Recycled Water Irrigation Area are met with water legally available to Buyer from any source other than the Carmel River System or the Seaside Groundwater Basin, including percolating ground water underlying Buyer's Property, to make up any such difference.

When Recycled Water (as defined in Rule 23.5) is available in sufficient quantities to satisfy the irrigation requirements of the Recycled Water Irrigation Areas, such irrigation shall not be subject to Stages 5 Water Rationing and higher, and neither potable water nor any water described in the preceding sentence (whether or not it is potable) shall be used for irrigation of the Recycled Water Irrigation Areas except to the extent allowed in the circumstances described in the next two sentences.

If there is an Interruption in Recycled Water deliveries to any Recycled Water Irrigation Area(as the capitalized terms are defined in Rule 23.5), the temporary use of potable water for irrigating each such Recycled Water Irrigation Area is authorized in the manner described in Rule 23.5, Subsection F.

If MPWMD has adopted an ordinance in response to any emergency caused by drought, or other threatened or existing water shortage pursuant to section 332 of the Monterey Peninsula Water Management Law, said ordinance shall prevail over contrary provisions of this Rule. Notwithstanding the preceding sentence, potable water shall be made available for irrigating tees and greens of the Recycled Water Irrigation Areas in sufficient quantities to maintain them in good health and condition during an Interruption, without any limitation on the duration.

The District shall have no obligation to furnish potable water for irrigation of the Recycled Water Irrigation Areas except in the circumstances set forth above in this Subsection L.9.b.

If (1) an emergency or major disaster is declared by the President of the United States, or (2) a "state of war emergency," "state of emergency," or "local emergency," as those terms are respectively defined in Government Code section 8558, has been duly proclaimed pursuant to the California Emergency Services Act, with respect to all or any portion of the territory of MPWMD, the provisions of this Subsection L.9.b shall yield as necessary to respond to the conditions giving rise to the declaration or proclamation.

This Subsection L.9.b shall be of no force or effect until the Project Expansion is deemed Completed (as the capitalized terms are defined in Rule 23.5), and shall thereafter be operative and of full force and effect.

Added by Ordinance No. 119 (3/21/2005)

<u>RULE 166 - STAGE 6 WATER RATIONING</u>

A. Stage 6 Water Rationing is defined as the sixth stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 35 percent reduction goal from system production limits. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that utilize water credits.

B. Implementation.

1. <u>Water Supply Limitation Trigger</u>. Stage 6 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 6 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 15,615 acre-feet and greater than 9,610 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.

2. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 35 percent reductions in water use from a distribution systems production limit are necessary to ensure public health, safety or welfare.

C. Sunset of Stage 6 Water Rationing.

1. <u>Water Supply Availability.</u> Stage 6 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 15,615 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 6 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.

2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 6 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.

D. Affected Water Users. Stage 6 Water Rationing shall apply to all water users within the Monterey Peninsula Water Resources System. As necessary to ensure adequate water supplies, the Board of Directors may act within its discretion to authorize activation of Stage 6 Water Rationing within one or more water distribution systems in the District.

E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 5 Water Rationing shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.

F. Moratorium. On October 1 following implementation of Stage 6 Water Rationing, the District shall suspend the issuance of water permits that utilize a public or private Water Use Credit.

G. Reduction Goal. Stage 6 Water Rationing achieves water use reductions of 35 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.

H. Notice

1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing. Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.

2. All water distribution system operators affected by Stage 6 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.

3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 6 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of

private wells during Stage 6 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

I. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, "other," Non-Revenue Metered Use, and Reclaimed Water Users.

J. Reduced Annual Cal-Am Annual Production During Stage 6 Water Rationing. The Cal-Am annual production limit shall be reduced by 35 percent during Stage 6 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.

K. Non-Cal-Am Annual Production Limits During Stage 6 Water Rationing. Available production for other water distribution systems subject to Stage 6 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.

L. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use and by taking into consideration residential water needs to ensure health, safety and welfare. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of that portion of Cal-Am that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.

1. All water users shall be rationed by user category as outlined in Rule 165 (Stage 5 Water Rationing).

M. The Board shall consider adopting restrictions on non-residential outdoor water use that may include any or all of the following: Limit outdoor watering to one day per week, one day every other week, or prohibit outdoor irrigation with water from the effected water resource system(s); prohibit irrigation of non-turf areas with water from the affected water resource system(s); reduce golf course irrigation from the effected water distribution system(s) to a percentage of the amount required to water tees, greens and landing areas only. The use of reclaimed water, when available, shall not be restricted by this requirement.

N. Elimination or modification of commercial/industrial variances for Best Management Practices. The General Manager shall be authorized to require a percentage reduction of all commercial/industrial water users granted a variance for complying with BMPs for the type of use. The amount of the percentage reduction shall be determined by the General Manager following review of the success of commercial/industrial rationing during Stage 5 Water Rationing prior to Stage 6 Water Rationing.

O. All water users shall cease operation and maintenance of all ornamental water uses (fountains, ponds, etc.) that use water from the effected water supply system(s). Ornamental water uses supplied with water from other sources shall clearly display information about the source of water on or immediately adjacent to the use;

P. Prohibition on Use of Water for Dust Control. The use of water from the Monterey Peninsula Water Resources System shall be prohibited for dust control purposes, except by prior approval of the General Manager. Decisions of the General Manager shall be final.

Rule added by Ordinance No. 92 (1/29/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 167 - STAGE 7 WATER RATIONING

A. Stage 7 Water Rationing is defined as the seventh stage in the District's Expanded Water Conservation and Standby Rationing Plan that responds to a drought situation or emergency water supply shortage with a 50 percent reduction goal from system production limits. Reductions are achieved by water use cutbacks by user category and by per-capita water rations and a moratorium on water permits that utilize water credits.

B. Implementation.

1. Water Supply Limitation Trigger. Stage 7 Water Rationing shall apply to all water users whose source of supply is derived from the MPWRS. Stage 7 Water Rationing shall become effective on June 1 or such earlier date as may be set by the Board following the District's May Board meeting if total usable storage in the MPWRS on May 1 is less than 9,610 acre-feet. If total usable storage is equal to or greater than 27,807 acre-feet on May 1, no water rationing shall be imposed.

2. Implementation shall also occur following urgency action by Resolution of the Board of Directors declaring that an emergency situation exists and immediate 50 percent reductions in water use from a distribution system's production limit are necessary to ensure public health, safety or welfare.

C. Sunset of Stage 7 Water Rationing.

1. Water Supply Availability. Stage 7 Water Rationing shall continue to have force and effect until rescinded by Resolution of the Board of Directors upon a determination that the total usable storage in the MPWRS is greater than 9,610 acre-feet. This determination will normally be made at the Board's May meeting. However, a determination to rescind Stage 7 Water Rationing as early as the following January Board meeting can be made if the total usable storage in the MPWRS is equal to or greater than 27,807 acre-feet on January 1.

2. In the event total usable storage is greater than 27,807 acre-feet, the General Manager shall review Cal-Am's year-to-date production. Upon compliance with the monthly year-to-date goals specified in Table 1 of Rule 162 and, unless otherwise specified in the Resolution rescinding Stage 7 Water Rationing, water users shall revert to Stage 1 Water Conservation. If Cal-Am's year-to-date production exceeds the year-to-date goal specified in Table 1 of Rule 162, Cal-Am water users shall revert to Stage 2 Water Conservation.

D. Affected Water Users. Stage 7 Water Rationing shall apply to all water users within the Monterey Peninsula Water Resources System. As necessary to ensure adequate water supplies, the Board of Directors may act within its discretion to authorize activation of Stage 7 Water Rationing within one or more water distribution systems in the District.

E. Requirements imposed by implementation of the Expanded Water Conservation and Standby Rationing Plan through Stage 6 Water Rationing shall remain in force. Requirements may be modified or superseded by actions taken in this or future stages of the Expanded Water Conservation and Standby Rationing Plan.

F. Reduction Goal. Stage 7 Water Rationing achieves water use reductions of 50 percent of the Cal-Am and non-Cal-Am system production limits in each user category as follows: Residential single-family and multi-family, commercial/ industrial, public authority, golf course, "other," non-revenue metered uses, and reclaimed water users.

G. Notice.

1. Cal-Am shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the Cal-Am system via first-class mail at least thirty (30) days before the first day of rationing.

   Further, Cal-Am shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, Cal-Am shall provide each responsible party with a survey form upon request.

2. All water distribution system operators affected by Stage 7 Water Rationing shall provide written notice of mandatory water rationing to every residence and to every non-residential business or water user within the water distribution system via first-class mail at least thirty (30) days before the first day of rationing. Further, the distribution system operator shall send monthly reminders of water rationing in the water bill along with information showing the water ration and the quantity of the water ration consumed by the responsible party. Finally, the water distribution system operator shall provide each responsible party with a survey form at least once each calendar year. Water distribution system operators shall ensure that notices provided or required by the District shall be distributed to the system water users.

3. The District shall contact all water users of private wells not supplying water to a distribution system within the MPWRS at least thirty (30) days before the first day of Stage 7 Water Rationing. Contact shall be via first class mail and shall explain the restrictions placed on the use of private wells during Stage 7 Water Rationing and shall provide and/or request additional information from the private well owner as deemed necessary for the efficient operation of the program.

H. Rations by Category. Water rations shall be determined by user category. Each water user within the Monterey Peninsula Water Resources System shall be classified in one of the following groups: Residential Single-Family and Multi-Family, Commercial/Industrial, Public Authority, Golf Course, "other," Non-Revenue Metered Use, and Reclaimed Water Users.

I. Reduced Annual Cal-Am Annual Production During Stage 7 Water Rationing. The Cal-Am annual production limit shall be reduced by 50 percent during Stage 7 Water Rationing. The resulting production limit shall be further reduced by a water rationing contingency determined by the Board. Seven (7) percent of the remainder shall be the maximum Cal-Am unaccounted for water use ration. The remaining water shall be the Cal-Am annual production limit for all user categories.

J. Non-Cal-Am Annual Production Limits During Stage 7 Water Rationing. Available production for other water distribution systems subject to Stage 7 Water Rationing shall be determined using the same methodology as for Cal-Am without including a deduction for unaccounted for water uses. The non-Cal-Am annual production limit for the Monterey Peninsula Water Resources System shall be used as the maximum production limit.

K. Establishing the Rations. Rations for each user category shall be determined by the General Manager by dividing the reduced available production by the percentage of use and by taking into consideration residential water needs to ensure health, safety and welfare. The percentage of use for each user group shall be determined by the most recent unrationed reporting year (July 1 through June 30) data provided by Cal-Am for water users of the Cal-Am distribution system that derives water from the MPWRS, and by data provided by the District from its annual well reporting program for non-Cal-Am distribution systems.

1. All water users shall be rationed by user category as outlined in Rule 165 (Stage 5 Water Rationing).

L. The Board shall reconsider adopting restrictions on non-residential outdoor water use that may include any or all of the following not adopted during Stage 6 Water Rationing: Limit outdoor watering to one day per week, one day every other week, or prohibit outdoor irrigation with water from the effected water resource system(s); prohibit irrigation of non-turf areas with water from the effected water resource system(s); reduce golf course irrigation from the effected water distribution system(s) to a percentage of the amount required to water tees, greens and landing areas only. The use of reclaimed water, when available, shall not be restricted by this requirement.

M. Elimination or modification of commercial/industrial variances for Best Management Practices. The General Manager shall be authorized to require a percentage reduction of all commercial/industrial water users granted a variance for complying with BMPs for the type of use. The amount of the percentage reduction shall be determined by the General Manager following review of the success of commercial/industrial rationing during Stage 6 Water Rationing prior to Stage 7 Water Rationing.

N. Prohibition On The Use of Portable Water Meters and Hydrant Meters. Water users utilizing portable water meters or hydrant meters shall be required to cease use of water from the effected water supply system(s). Each water user reporting as “other” by the distribution system shall be notified by the distribution system operator of this requirement. Portable water meters shall be returned to the water company at least 30 days before the implementation of Stage 7 Water Rationing.

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 168 - WATER BANKS

A. Water banks shall be available to each water user during Stages 5 through 7 Water Rationing. A water bank shall allow each water user to accrue the unused portion of a monthly ration for use in the current calendar year.

B. Water banks shall be reset to zero on January 1 of each year. Ten (10) percent of the remaining water bank on December 31 shall be credited to the following year's water bank for three months to allow the establishment of a new bank.

C. On April 1, each water bank shall be reduced by the amount of banked water carried over on January 1. Water banks may not carry less than a zero balance.

Rule added by Ordinance No. 92 (1/28/99)

RULE 169 - WATER RATIONING VARIANCE

A. The General Manager shall assign additional water beyond the ration established in Stage 4 Water Rationing through Stage 7 Water Rationing in the following circumstances upon submittal of the appropriate variance request form and fees.

B. The following variances shall be considered for additional water during Stages 4 through 7 Water Rationing.

1. Medical and/or sanitation needs certified by a doctor;

2. Hospital and/or health care facilities that have achieved all Best Management Practices for those uses;

3. Drinking water for large livestock;

4. Commercial/Industrial users that can demonstrate compliance with all BMPs appropriate for the type of use and where there is minimal exterior water use on the water meter or water supply serving the use;

5. Leaks, when an invoice is provided by a licensed plumber or contractor;

6. Commercial Laundromats with signs advising full loads only;

7. Business in a home on a case-by-case basis;

8. Riparian irrigation when required as a condition of a riverbank restoration permit issued by the District or as a condition of a riverbank erosion protection permit issued by the District.

9. Emergency, extreme, or unusual situations on a case-by-case basis;

C. No Variance. The following categories of water use shall not qualify for special consideration under the provisions of this regulation:

1. Visitors other than those occupying short-term residential housing as defined in Rule 11 (Definitions) when the property owner has submitted a completed survey form with the applicable information about the occupancy of the site;

2. Irrigation, other than variances allowed by Rule 169 of this regulation.

3. Filling spas, ponds, fountains, etc.;

4. Long-term leaks that are not repaired after reasonable notice.

D. Waiver of Excess Fees by Variance Application. Any qualifying water user may seek to have all or part of the water waste fee for excess water use waived or forgiven through the Rationing Variance process set forth in this Rule. Any water user may seek relief from the water waste fee upon substantial evidence that the excess water use was beyond the user's control, and was not reasonably correctable in a timely fashion due to special and unique circumstances. Due diligence must be shown to forgive any water waste caused by a leak; under no circumstance shall a leak justify the forgiveness of an excess use fee for more than three billing periods. The applicant shall further demonstrate that all reasonable means have been taken to conserve water and minimize future water use.

1. The General Manager or his agent may grant any application to waive water waste fees upon submittal of the appropriate evidence to warrant a variance. All applicants for variance shall submit the appropriate Variance Request Form and processing fee of $60. Any action to waive a water waste fee shall be recorded in writing and include a written explanation to substantiate and justify the waiver;

2. Although inspections shall not be required in all cases, District staff shall use spot or random inspections as necessary to verify an applicant's eligibility for a water rationing variance.

3. Each person making written application for a variance shall be notified in writing of the disposition of their application. Decisions of the General Manager are final.

Rule added by Ordinance 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 170 - WATER USE SURVEY

A. Stage 1 Water Conservation Survey

1. Cal-Am shall conduct a confidential survey of all water users of the Cal-Am system that derive their source of supply from the MPWRS. This survey shall be required upon the effective date of this regulation. The survey shall request information to determine the number of permanent residents in each dwelling unit and the lot size of each residential site with permitted water service; the types of uses and amount of water use on non-residential sites; and the number of users and types of use(s) served by each water meter. Only information deemed appropriate for the effective operation of this program will be requested.

   Cal-Am shall conduct the survey within 45 days of the effective date of Stage 1 Water Conservation. Survey forms shall be completed by the responsible party and returned to Cal-Am within 30 days of mailing. The District shall have visual access to this data during Stages 1 through 3 Water Conservation and shall be provided with a summary of the results of the survey by census tract within 105 days of the effective date of Stage 1 Water Conservation. Cal-Am shall maintain survey information by census tract and shall provide unrestricted access to individual water use records when the District is actively investigating a variance, appeal or other rationing program action.

B. Stage 4 Water Rationing Survey.

1. The General Manager shall conduct a survey of MPWRS water users not deriving their source of supply from Cal-Am prior to effective date of Stage 5 Water Rationing. The survey shall request information to determine the number of permanent residents in each dwelling unit and the lot size of each residential site with permitted water use; the types of uses and amount of water use on non-residential sites; and the number of users and types of use(s) served by each water meter or connection. Only information deemed appropriate for the effective operation of this program will be requested.

2. The District shall mail the survey form to water users not supplied water by Cal-Am. Survey forms shall be completed by the responsible party and returned to the District within 30 days of mailing. The District shall preserve the confidentiality of this survey data.

C. Administration of Survey Data.

1. <u>Cal-Am Water Users</u>. Cal-Am shall maintain survey data for all MPWRS water users supplied water by Cal-Am and shall provide the District with access to all data. Cal-Am shall provide the District with an annual

summary of survey information, or more frequently as required by the General Manager. Cal-Am shall preserve the confidentiality of survey data.

2. Non-Cal-Am Water Users. During Stage 5 Water Rationing through Stage 7 Water Rationing, the District shall maintain survey data for all water users supplied water from non-Cal-Am sources subject to those stages.

3. A full or partial survey may be conducted as deemed necessary by the District to maintain accurate data.

4. District staff shall maintain the confidentiality of Cal-Am and non-Cal-Am residential customer survey data. Violations of this provision shall be enforced as a misdemeanor under District law.

D. Reporting.

1. Responsibility of Water User.

a. Each responsible party shall be responsible for accurately reporting the number of permanent residents in the dwelling unit or units or other information deemed appropriate for the effective operation of the program as requested on the survey form.

b. Upon activation of a water meter, each responsible party shall complete a survey form.

i. Cal-Am Water Users. The completed survey form shall be submitted to Cal-Am by customers of that distribution system.

ii. Non-Cal-Am Water Users. The completed survey form shall be submitted to the District or its agent by all other distribution systems users required to complete a survey form during Stage 5 Water Rationing through Stage 7 Water Rationing.

c. All responsible parties shall submit revised survey forms whenever there is a change in the number of permanent residents in a residential dwelling unit or whenever there is a change in a water user category in non-residential uses. Revised survey forms should be submitted to the appropriate party as indicated in Rule 170, D, 1, b.

d. Property owners of short-term residential housing rentals shall provide information about the average number of annual occupants and the average rate of occupancy to the appropriate party as indicated in Rule 170, D, 1, b.

2. Misrepresentation Violation. Any water user intentionally over-reporting the number of permanent residents in a dwelling unit or other information pertinent to establishing a water ration during Stages 4, 5, 6 and 7 Water Rationing may be charged with a misdemeanor punishable as an infraction as provided by Section 256 of the Monterey Peninsula Water Management District Law, Statutes of 1981, Chapter 986. Violations carry a maximum penalty of up to $250 for each offense. Each separate day or portion thereof during which any violation occurs or continues without a good-faith effort by the responsible water user to correct the violation, may be deemed to constitute a separate offense, and upon conviction thereof, may be separately punishable.

3. Penalties for Misreporting. In addition to any charge for misrepresenting information as provided in Rule 170, D-2, any or all of the following may be further imposed by the General Manager or his agent during Stages 4, 5, 6 and 7 Water Rationing where the violation occurs and continues without a good-faith effort by the responsible water user to correct the violation. Decisions pursuant to this rule are appealable under Rule 70 (Appeals).

   a. Intentional misrepresentation may be considered a violation of the water waste provisions and shall subject the water user to a fee for water waste; and/or

   b. Intentional misrepresentation may cause the loss of any water bank accrued and shall cause the responsible party to be ineligible to accrue a water bank for a period of sixty (60) months; and/or

   c. Intentional misrepresentation may cause the assignment of a reduced water ration that may be as low as a ration for one person for a period of twelve (12) months following implementation of Stages 4, 5, 6 or 7 Water Rationing.

4. Audit. The District may periodically audit the survey data for accuracy. Upon question, the District may request additional evidence of residency to demonstrate the number of permanent residents at that site as defined in Rule 11 (Definitions).

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 171 - WATER WASTE FEES

A. Each occurrence of Water Waste or Non-Essential Water Use, as those terms are defined by Rule No. 11 (Definitions), which continues after the water user has had reasonable notice to cease and desist that type of water use shall constitute a flagrant occurrence.

B. A $50 fee per day or portion thereof shall be assessed for each flagrant occurrence of Water Waste or Non-Essential Water Use. The fee shall accumulate daily until the occurrence is corrected.

C. A $150 fee per day or portion thereof shall be imposed for each subsequent occurrence (including multiple occurrences) of Water Waste or Non-Essential Water Use which occurs within 18 months of the first occurrence. The fee shall accumulate daily until the occurrence is corrected.

D. All fees shall be paid within 30 days.

E. Within the 30 day period, a water user may seek waiver or forgiveness of all or part of the Water Waste fees on the basis of hardship. The water user must provide the District with a written explanation as to why the fees should not be collected. Staff shall be authorized to determine whether or not fees should be waived in full or in part, with the final decision resting with the General Manager.

F. After 30 days, fees which have not been paid or waived may result in a lien being placed on the property served by the water account.

G. Repeated occurrences or Water Waste or Non-Essential Water Use, which continue or occur after the water user has had a reasonable notice to cease and desist that type of water use, or which continues or occurs after the water user has had a reasonable opportunity to cure any defect causing that type of water use, shall provide cause for the placement of a flow restrictor within the water line or water meter.

H. Decisions pursuant to this rule are appealable under Rule 70 (Appeals).

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 172 - LANDSCAPE WATER AUDITS

A. Landscape Water Audits shall be conducted under the supervision of an individual who has been certified by the Irrigation Association to conduct audits and establish Landscape Water Budgets. Each audit shall be signed by that person, who shall attest that the audit was performed under his/her direction.

B. Landscape Water Audits and Landscape Water Budgets shall be offered by the District and/or Cal-Am or their agent free of charge to all water users of Cal-Am with dedicated landscape meters, large irrigated areas over three acres, and large residential water users. Water use records shall be reviewed annually to identify new water users required to establish a Landscape Water Budget by this rule. Cal-Am shall provide the District with copies of all completed Landscape Water Audits and Landscape Water Budgets.

1. Cal-Am water users shall be required to obtain Landscape Water Audits and establish Landscape Water Budgets if the property:

    a. Has a dedicated landscape water meter; or

    b. Is an irrigated area of greater than three acres; or

    c. Is a large residential water user.

2. All Landscape Water Budgets must be prepared by an individual certified by the Irrigation Association.

3. All water users required to complete a Landscape Water Audit and establish a Landscape Water Budget shall have the option of obtaining a Landscape Water Audit and Landscape Water Budget from Landscape Irrigation Auditor of their choice at their own expense if the auditor is certified by the Irrigation Association.

4. Landscape Water Audits not conducted by the District and/or Cal-Am shall be reported on a Landscape Water Budget Application. Landscape Water Budget Applications shall be submitted to Cal-Am. Cal-Am shall forward a copy to the District within ten (10) days. Landscape Water Audits not performed by the District or Cal-Am are subject to review and acceptance by the District. Landscape Water Audits and Landscape Water Budgets rejected by the District may be appealed to the Board of Directors pursuant to Rule 70 (Appeals).

5. Landscape Irrigation Auditors shall arrange on-site visits to compile water records to review historic use, measure irrigated sites, identify plant materials by general groups, determine irrigation water requirements, and estimate potential dollar and water savings. Landscape Irrigation Auditors shall also develop system testing strategies, check pressure and flow rates, and conduct water application distribution tests. Data shall

be collected to determine irrigation uniformity and efficiency. Soil samples shall be examined to determine soil types and root zone depths. Landscape Irrigation Auditors shall observe system operations, locate irrigation zones, prepare site audit maps and visually identify broken or misaligned equipment. All data from field tests shall be summarized and this information used to generate monthly irrigation base schedules. A copy of the Landscape Water Budget Application shall be provided to the water user. One copy of the Landscape Water Budget Application shall be submitted to Cal-Am. Cal-Am shall forward a copy to the District within ten (10) days.

6. Cal-Am shall provide quarterly compliance status notices to each water user required to follow a mandatory Landscape Water Budget.

C. Modifications To Audited Landscapes. Following significant modification to an existing audited landscape, a new Landscape Water Audit shall be conducted to establish an appropriate Landscape Water Budget. It shall be the responsibility of the property owner to ensure that a Landscape Water Audit is conducted within 60 days of any such change and to submit a new Landscape Water Budget Application to Cal-Am.

D. Reporting and Analysis. Cal-Am shall preserve water use records and budgets for water users subject to this provision of law for such time as the Expanded Water Conservation and Standby Rationing Plan remains effective. Updated Landscape Water Budgets shall supersede previous data. Quarterly, a report shall be compiled by Cal-Am and provided to the District showing the account information and comparing the Landscape Water Budget with actual consumption. During Stages 2 and 3, Cal-Am shall provide the District with monthly consumption reports for all customers with Landscape Water Budgets.

E. Landscape Irrigation Restrictions in the Cal-Am system that derives its source of supply from the MPWRS. Unless watering is by drip irrigation, through a hand-held hose with a positive action shut-off nozzle, or performed by a professional gardener or landscaper, the following schedule shall apply:

1. Odd Numbered Properties shall water after 5 p.m. or before 9 a.m. on Saturdays and Wednesdays only. This schedule shall also apply to properties located on the South or West side of the street in cities where no street address is available.

2. Even Numbered Properties shall water after 5 p.m. or before 9 a.m. on Sundays and Thursdays only. This schedule shall also apply to properties located on the North or East side of the street in cities where no street address is available.

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

RULE 173 - REGULATION OF MOBILE WATER DISTRIBUTION SYSTEMS

A. No person, extractor, owner or operator shall operate a mobile water distribution system without first securing a written permit from the District. In accordance with Monterey County Code (e.g., Title 15.20), no applications will be accepted or permitted for bulk hauled water for permanent potable use. Applications for establishment of a mobile water distribution system shall be made pursuant to Rule 22 (Action On Application For Permit To Create/Establish A Water Distribution System) and shall be investigated, considered, determined, and acted upon on the same terms and conditions as provided for the approval, conditional approval or denial of a creation establishment permit as stated in that rule. The application shall identify each source of supply and the location of each use. For any subpotable mobile water distribution system within the California-American Water Company (Cal-Am) service area, a condition of approval shall require that Cal-Am be notified so that a back-flow protection device can be installed pursuant to Monterey County Code Title 17.

B. In the event prior authorization is not obtained by reason of an emergency or health related situation, authorization for the Mobile Water Distribution System permit shall be sought from the District by submittal of a complete application compliant with Rule 21, within five working days following commencement of the emergency or health related event.

C. Delivery and/or receipt of water from an unpermitted Mobile Water Distribution System shall be deemed water waste, and shall be subject to fine, restriction, and cease and desist order as set forth in Rule 171.

Rule added by Ordinance No. 92 (1/28/99); amended by Ordinance No. 96 (3/19/2001)

RULE 174 - REGULATION OF WELL OWNERS/OPERATORS AND EXTRACTORS

A. During a water supply emergency, each owner/operator or extractor of a private water well or other water-gathering facility shall comply with the provisions of this regulation, as they relate to such well.

Rule added by Ordinance No. 92 (1/28/99)

RULE 175 - WATER RATIONING ENFORCEMENT

A. Enforcement During Stages 4 through 7 Water Rationing.

1. Courtesy Notice. For the first instance of excess water use beyond the ration in Stages 4 through 7 Water Rationing, a water user shall be given written notice by the water system operator of the excess use and shall be notified that such violation constitutes water waste and a water waste fee of $50 per day shall be collected in the event the water user again exceeds that user's water ration during any future billing cycle under Stages 4 through 7 Water Rationing. If the water user complies with all water rationing and water waste and non-essential water use requirements during the next month following the first instance of excess use, the excess use fee shall be deferred.

   If the water user again exceeds that user's water ration during any following month, the water waste fee of $50 per day shall be imposed immediately and shall accumulate daily until the occurrence is corrected.

2. Second Offense. Upon the second occurrence of excess water use (including any prior excess water use during any prior stage) a water user shall be charged with water waste and assessed a fee of $150 per day for the second offense, plus the previously deferred $50 first offense fee, by the District or its agent. The $150 fee shall accumulate daily until the occurrence is corrected.

3. Third Offense.

   A third occurrence of excess water use (including any prior excess water use during any prior stage) shall result in an excess water use charge equivalent to the Cal-Am per unit water charge at the water user's level of use multiplied by the number of units over a water ration, plus $150 per day as provided in Rule 171 (Water Waste Fees). A third occurrence of excess water use shall provide cause for the installation of a flow restrictor in the water meter or water supply providing water to the property where the over-use occurred. Restrictors shall remain in place until conditions are reduced to Stage 2 Water Conservation or a less restrictive stage. All costs for the installation and removal of a flow restrictor shall be charged to the property owner of the site subjected to this action.

4. Fourth Offense. A fourth occurrence of water use in excess of the water ration shall result in fees and charges listed for a third offense and shall result in the installation of a flow restrictor by the system operator in the water meter or water supply providing water to the property where the over-use occurred. Restrictors shall remain in place until conditions are reduced to Stage 3 Water conservation or to a less restrictive stage. All costs for the installation and removal of a flow restrictor shall be charged to the property owner of the site subjected to this action.

B. Flow Restrictor Exemption. Exemptions to the installation of a flow restrictor as a means to enforce the water ration shall occur when there are provable risks to the health, safety and/or welfare of the water user. An exemption shall be made for water meters serving three or more multi-family dwelling units by substituting an excess water use charge of $150 times the number of dwelling units located on the meter during each month in which a violation of the water ration occurs. The responsible party shall be liable for payment of all excess water use charges.

C. All notices and assessments of water waste and/or excess water use charges made by a water distribution system operator shall be reported to the District.

Rule added by Ordinance No. 92 (1/28/99); Amended by Ordinance No. 119 (3/21/2005)

Appendix 7F

List of Water Quality Monitoring Network Monitoring Sites

Appendix 7-F. List of Water Quality Monitoring Network Monitoring Sites

Site Name	Water System Name	Well Screen Information			Coordinates (NAD 83)		Monitoring Data Range	
		Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Screen Length (ft)	Latitude	Longitude	First Year	Last Year
2700536-002	CORRAL DE TIERRA ESTATES WC	-	-	-	36.570	-121.726	6/9/2002	10/24/2017
2700536-004	CORRAL DE TIERRA ESTATES WC	120	250	130	36.570	-121.726	9/8/2002	12/26/2019
2700775-001	TIERRA VERDE MWC	200	356	156	36.568	-121.731	8/7/1986	5/31/2015
2700775-002	TIERRA VERDE MWC	100	440	340	36.567	-121.731	2/26/2004	12/19/2019
2701142-001	HORN WS	54	100	46	36.587	-121.712	8/7/1986	1/8/2019
2701227-001	SAN BENANCIO SCHOOL WS	320	460	140	36.578	-121.717	6/23/2006	5/30/2012
2701367-002	TIERRA MEADOWS HOA WS	220	260	40	36.565	-121.734	3/24/2006	12/6/2012
2701681-001	EXXON STATION WS	40	200	160	36.578	-121.727	12/28/2005	9/13/2019
2701740-001	BLUFFS WS	271	309	38	36.639	-121.705	4/6/1987	12/10/2019
2701740-012	BLUFFS WS	-	-	-	36.626	-121.687	6/25/2008	3/7/2018
2701822-001	ROBLEY PROPERTY MWS	335	585	250	36.557	-121.741	9/11/1986	12/16/2019
2701822-002	ROBLEY PROPERTY MWS	320	390	70	36.557	-121.744	9/3/2003	12/16/2019
2701935-001	MOUNT TORO RANCHOS MWA	-	-	-	36.544	-121.670	4/28/2003	3/26/2018
2701935-002	MOUNT TORO RANCHOS MWA	550	830	280	36.544	-121.670	6/23/2003	12/17/2019
2701959-001	TIERRA VISTA MWC	230	250	20	36.555	-121.696	6/5/1997	12/31/2019
2702030-001	CYPRESS COMMUNITY CHURCH WS	370	430	60	36.582	-121.728	3/30/2011	10/2/2019
2702315-001	CORRAL DE TIERRA COUNTRY CLUB WS	180	440	260	36.568	-121.727	3/25/2004	12/10/2019
2710006-004	CAL AM WATER COMPANY - AMBLER PARK	160	360	200	36.575	-121.725	7/2/1984	12/11/2019
2710006-005	CAL AM WATER COMPANY - AMBLER PARK	160	420	260	36.574	-121.727	6/19/1990	12/4/2018
2710006-006	CAL AM WATER COMPANY - AMBLER PARK	160	460	300	36.575	-121.725	4/7/1994	12/11/2019
2710006-009	CAL AM WATER COMPANY - AMBLER PARK	-	-	-	36.576	-121.716	9/13/2011	12/11/2019
2710012-007	CWSC SALINAS HILLS	260	540	280	36.606	-121.699	10/20/1986	10/11/2018
2710017-008	MARINA COAST WATER DISTRICT	160	1540	1380	36.672	-121.782	9/19/1984	12/17/2019
2710017-009	MARINA COAST WATER DISTRICT	970	1170	200	36.677	-121.779	1/6/1986	12/17/2019
2710017-026	MARINA COAST WATER DISTRICT	-	-	-	36.662	-121.755	11/5/1985	12/17/2019
2710017-027	MARINA COAST WATER DISTRICT	-	-	-	36.667	-121.751	8/7/1985	12/17/2019
2710017-028	MARINA COAST WATER DISTRICT	-	-	-	36.662	-121.746	8/7/1985	12/17/2019
2710017-033	MARINA COAST WATER DISTRICT	-	-	-	36.660	-121.741	5/4/2011	12/17/2019
2710017-034	MARINA COAST WATER DISTRICT	-	-	-	36.649	-121.727	12/7/2011	12/17/2019

Site Name	Water System Name	Well Screen Information			Coordinates (NAD 83)		Monitoring Data Range	
		Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Screen Length (ft)	Latitude	Longitude	First Year	Last Year
2710021-003	CAL AM WATER COMPANY - TORO	-	-	396	36.571	-121.745	9/15/1987	10/8/2019
2710021-004	CAL AM WATER COMPANY - TORO	-	-	200	36.571	-121.744	11/10/1987	12/11/2019
AGC100000001-CCGC_0108	-	-	-	-	36.645	-121.717	3/10/2014	3/10/2014
AGC100000001-CCGC_0132	-	-	-	-	36.659	-121.736	3/13/2014	3/13/2014
AGC100000001-CCGC_0615	-	-	-	-	36.664	-121.736	8/25/2015	8/25/2015
AGL020003793-DOM	-	-	-	-	36.569	-121.736	12/30/2017	12/30/2017
AGL020003810-CCGC_0108	-	271	309	38	36.645	-121.717	6/1/2017	5/1/2019
AGL020003815-HOME_BM	-	-	-	-	36.631	-121.709	6/1/2017	5/1/2019
AGL020003815-HOME_KG	-	-	-	-	36.630	-121.704	6/1/2017	5/1/2019
AGL020003815-HOME_SM	-	-	-	-	36.632	-121.717	6/1/2017	5/1/2019
AGL020028240-RIVER1_I	-	-	-	-	36.622	-121.684	11/28/2017	9/23/2019
AGL020028240-RIVER2_I	-	-	-	-	36.623	-121.682	11/28/2017	9/23/2019

Appendix 7-G (Ag Order 4.0)

Central Coast Ag Order 4.0 Monitoring and Reporting Program

STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

GENERAL WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS

ORDER NO. R3-2021-0040

April 15, 2021

ORDER

Table of Contents

Attachments

THE CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, CENTRAL COAST REGION FINDS:

Part 1, Section A. Findings

Background and Purpose

1. As described in the Water Quality Control Plan for the Central Coastal Basin (Basin Plan), the central coast region of California represents approximately 7.2 million acres of land. There are approximately 540,000 acres of irrigated land and approximately 3,000 agricultural operations that may be generating wastewater that falls into the category of discharges of waste from irrigated lands.

2. The central coast region has more than 17,000 miles of surface waters (linear streams/rivers) and approximately 4,000 square miles of groundwater basins that are, or may be, affected by discharges of waste from irrigated lands. Of the nine hydrologic regions in the state, the central coast region is the most groundwater dependent region with approximately 86% of its water supply being derived from groundwater.

3. The State Water Resources Control Board (State Water Board) and Regional Water Quality Control Boards (Regional Water Boards) are the principal state agencies with primary responsibility for the coordination and control of water quality for the health, safety and welfare of the people of the state pursuant to the Porter-Cologne Water Quality Control Act (Porter-Cologne Act, codified in Water Code Division 7). The legislature, in the Porter-Cologne Act, directed the state, through the Water Boards, to exercise its full power and jurisdiction to protect the quality of the waters in the state from degradation and to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible, and considering precipitation, topography, population, recreation, agriculture, industry, and economic development (Water Code section 13000).

4. Since the issuance of the first Agricultural Order in 2004 and subsequent Agricultural Orders in 2012 and 2017, the California Regional Water Quality Control Board, Central Coast Region (Central Coast Water Board) has compiled additional and substantial empirical data demonstrating that water quality conditions in agricultural areas of the region continue to be severely impaired or polluted by waste discharges from irrigated agricultural operations and activities that impair beneficial uses. The main impacts from irrigated agriculture in the central coast region are nitrate discharges to groundwater and associated drinking water impacts, nutrient discharges to surface water, pesticide discharges

and associated toxicity, sediment discharges, and degradation of riparian and wetland areas and the associated impairment or loss of beneficial uses.

5. The objectives of this Order are:

   a. Protect and restore beneficial uses and achieve water quality objectives specified in the Basin Plan for commercial irrigated agricultural areas in the central coast region by:
      i. Minimizing nitrate discharges to groundwater,
      ii. Minimizing nutrient discharges to surface water,
      iii. Minimizing toxicity in surface water from pesticide[1] discharges,
      iv. Protecting riparian and wetland habitat, and
      v. Minimizing sediment discharges to surface water.
   b. Effectively track and quantify achievement of 5.a.i through 5.a.v over a specific, defined time schedule.
   c. Comply with the State's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy), the State Antidegradation Policy, relevant court decisions such as those pertaining to Coastkeeper *et al* lawsuits, the precedential language in the Eastern San Joaquin Watershed Agricultural Order, and other relevant statutes and water quality plans and policies, including total maximum daily loads in the central coast region.

6. This Order regulates discharges of waste from irrigated lands by requiring individuals subject to this Order to comply with the terms and conditions set forth herein to ensure that such discharges do not cause or contribute to the exceedance of any regional, state, or federal numeric or narrative water quality objectives or impair any beneficial uses in waters of the state and of the United States.

7. Water Code section 13260(a) requires that any person discharging waste or proposing to discharge waste that could affect the quality of the waters of the state, other than into a community sewer system, must file with the appropriate Regional Board a report of waste discharge (ROWD) containing such information and data as may be required by the Central Coast Water Board, unless the Central Coast Water Board waives such requirement.

8. Water Code section 13263(a) requires the Central Coast Water Board to prescribe waste discharge requirements (WDRs), or waive WDRs, for the discharge. The requirements must implement the Basin Plan and must take into

[1] A pesticide is any substance intended to control, destroy, repel, or otherwise mitigate a pest. The term pesticide is inclusive of all pest and disease management products, including insecticides, herbicides, fungicides, nematicides, rodenticides, algicides, etc.

consideration the beneficial uses to be protected and the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and the provisions of Water Code section 13241.

9. Water Code section 13263(b) states that, in prescribing requirements, the Central Coast Water Board need not authorize the utilization of the full waste assimilation capacities of the receiving waters.

10. Water Code section 13263(e) states that for WDRs, “Upon application by any affected person, or on its own motion, the regional board may review and revise requirements. All requirements shall be reviewed periodically.”

11. This Order does not create a vested right to discharge; all discharges are a privilege, not a right, as described in Water Code section 13263(g).

12. Water Code section 13263(i) authorizes the Central Coast Water Board to prescribe general WDRs for a category of discharges if the Central Coast Water Board finds or determines that all the criteria listed below apply to the discharges in that category. Discharges associated with irrigated agricultural operations that will be regulated under this Order are consistent with these criteria and therefore a general order is appropriate.

    a. The discharges are produced by the same or similar operations.
    b. The discharges involve the same or similar type of waste.
    c. The discharges require the same or similar treatment standards.
    d. The discharges are more appropriately regulated under general WDRs than individual WDRs.

13. Water Code section 13243 authorizes the Central Coast Water Board, in WDRs, to specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.

14. Water Code section 13267(a) authorizes the Central Coast Water Board to, in establishing or reviewing waste discharge requirements, or in connection with any action to any plan or requirement authorized by the Porter-Cologne Act, investigate the quality of any waters of the state within the region. The monitoring and reporting requirements as set forth in Attachment B are established under Water Code section 13267(b).

15. Water Code section 13267(c) authorizes the Central Coast Water Board or its authorized representatives to, in conducting an investigation of the quality of waters of the state within the region, inspect the facilities of the Discharger upon consent, issuance of a warrant, or in an emergency affecting public health or safety, to ascertain compliance with this Order and to ascertain whether the

purpose of the Porter-Cologne Act are being met. Inspections under Water Code section 13267(c) include sampling and monitoring.

16. Water Code section 13304 authorizes the Central Coast Water Board to, upon making the requisite findings, issue a cleanup and abatement order (CAO) that requires Dischargers to provide emergency and long-term alternative water supplies or replacement water service, including wellhead treatment, to each affected public water supplier or private well owners. A CAO is a separate action from this Order; this Order does not require Dischargers to provide alternative water supplies or replacement water.

Public Participation Process

17. In August 2017, Central Coast Water Board staff held a series of listening sessions throughout the central coast region to solicit stakeholder input on potential improvements to the previous agricultural order. The Central Coast Water Board discussed the input received from stakeholders during the September 2017 board meeting.

18. In February 2018, the Central Coast Water Board published an initial study to begin soliciting input related to environmental review for the California Environmental Quality Act (CEQA), in preparation for developing a draft Environmental Impact Report (EIR). A 73-day public comment period was held for the initial study. In March 2018, Central Coast Water Board staff held a series of public CEQA scoping meetings throughout the region. Input received during the public comment period and public scoping meetings has been considered in the development of the draft EIR.

19. In March and May 2018, Central Coast Water Board meetings included informational items dedicated to a review of water quality conditions associated with agricultural activities and discharges. The March 2018 informational item focused on surface water quality conditions and agricultural discharges and the May 2018 informational item focused on groundwater quality conditions and nitrate impacts to groundwater. Both informational items incorporated presentations from several outside speakers.

20. In September 2018, the Central Coast Water Board's public meeting was dedicated to a workshop for agricultural order stakeholders. Panels of agricultural, environmental, and environmental justice representatives gave presentations to the board in response to a series of questions staff proposed:

   a. What can growers and the regional board do to demonstrate quantifiable progress to minimize nitrate discharge to groundwater to achieve water quality objectives?

b. What can growers and the regional board do to demonstrate quantifiable progress to minimize nutrient discharge to surface waters to achieve water quality objectives?
c. What can growers and the regional board do to demonstrate quantifiable progress to minimize toxicity in surface waters from pesticide discharges to achieve water quality objectives?
d. What can growers and the regional board do to ensure that riparian and wetland habitat is protected due to agricultural activities and discharges?
e. What can growers and the regional board do to demonstrate quantifiable progress to minimize sediment discharge to achieve water quality objectives?
f. How can the regional board use discharge permit requirements to ensure current and future affordable, safe, and clean water for drinking and environmental uses?

21. In November 2018, the Central Coast Water Board published a set of five conceptual options tables that serve as the Central Coast Water Board's framework to address the questions posed in the September 2018 meeting. The Central Coast Water Board reviewed and discussed the options tables during its public meeting in November, and a 64-day written public comment period was subsequently held to solicit detailed stakeholder input. Central Coast Water Board staff held a series of outreach meetings throughout the region during the comment period.

22. In March 2019, after the 64-day public comment period, the Central Coast Water Board published updated versions of the five conceptual options tables. During the public meetings in March and May 2019, the Central Coast Water Board discussed the updated tables and received additional stakeholder comment.

23. In September 2019, during its public meeting, the Central Coast Water Board held a workshop focused on co-managing food safety and environmental protection, the role of riparian vegetation in water quality and beneficial use protection, and Discharger experiences with food safety challenges.

24. On February 21, 2020, the Central Coast Water Board published the draft Order and draft EIR and began a 45-day public comment period. The comment period was extended twice and closed on June 22, 2020.

25. In June 2020, Central Coast Water Board staff conducted three outreach meetings, which included presentations of the draft Order and draft EIR, and a question and answer session for attendees. These outreach meetings were conducted virtually via the Zoom platform, due to the COVID-19 pandemic.

26. Beginning on September 10, 2020 and continuing to January 8, 2021, the Central Coast Water Board held 10 days of Board meetings to receive oral comments

from the public and to discuss the draft Order. During these meetings, three of which were devoted entirely to receiving public comment and Board engagement with stakeholders, the Board deliberated on the draft Order using a consensus-based approach through which they directed staff on the development of a revised Order.

27. On January 26, 2021, the Central Coast Water Board circulated a revised draft Order for a 30-day public comment period that closed on February 25, 2021. Central Coast Water Board staff subsequently considered the public comments and developed a proposed Order for Board consideration during an April 14-15, 2021, public hearing.

28. The Central Coast Water Board, in a public hearing held on April 14-15, 2021, has heard and considered all comments pertaining to the discharge and proposed Order.

29. After considering all comments pertaining to this General Permit during a public hearing on April 14-16, 2021, this Order was found consistent with the findings in this Part 1 and Attachment A.

30. Any person aggrieved by this action of the Central Coast Water Board may petition the State Water Board to review the action in accordance with California Water Code section 13320 and title 23 California Code of Regulations sections 2050 and following. The State Water Board must receive the petition by 5:00 p.m., within 30 calendar days of the date of adoption of this Order at the following address, except that if the thirtieth day following the date of adoption falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Board by 5:00 p.m. on the next business day:

State Water Resources Control Board
Office of Chief Counsel
P.O. Box 100, 1001 I Street
Sacramento, CA 95812-0100

Or by email at **waterqualitypetitions@waterboards.ca.gov**

For instructions on how to file a petition for review, see **http://www.waterboards.ca.gov/public_notices/petitions/water_quality/wqpetition_instr.shtml**.

Scope of Order

Irrigated Lands and Agricultural Discharges Regulated Under this Order

31. This Order regulates (1) discharges of waste from commercial irrigated lands, including, but not limited to, land planted to row, vineyard, field and tree crops where water is applied for producing commercial crops; (2) discharges of waste from commercial nurseries, nursery stock production, and greenhouse operations with soil floors that do not have point source-type discharges and are not currently operating under individual WDRs; and (3) discharges of waste from lands that are planted to commercial crops that are not yet marketable, such as vineyards and tree crops.

32. Discharges from irrigated lands regulated by this Order include discharges to surface water and groundwater, through mechanisms such as irrigation return flows, percolation, tailwater, tile drain water, stormwater runoff flowing from irrigated lands, stormwater runoff conveyed in channels or canals resulting from the discharge from irrigated lands, and runoff resulting from frost control or operational spills. These discharges can contain wastes that could affect the quality of waters of the state and impair beneficial uses.

33. This Order also regulates agricultural activities such as the removal or degradation of riparian vegetation resulting in the loss or degradation of instream beneficial uses.

Dischargers Regulated Under this Order

34. This Order regulates both landowners and operators of commercial irrigated lands on or from which there are discharges of waste or activities that could affect the quality of any surface water or groundwater or result in the impairment of beneficial uses (Dischargers). Dischargers are responsible for complying with the conditions of this Order. Both the landowner and the operator of the irrigated agricultural land are Dischargers under this Order. The Central Coast Water Board will hold both the landowner and the operator liable for noncompliance with this Order, regardless of whether the landowner or the operator is the party to enroll under this Order.

35. For the purposes of this Order, irrigated lands producing commercial crops are those operations that have one or more of the following characteristics:

    a. The landowner or operator has obtained a pesticide use permit from a local County Agricultural Commissioner;

b. The crop is sold, including but not limited to 1) an industry cooperative, 2) a harvest crew/company, or 3) a direct marketing location, such as certified Farmers Markets;
c. The federal Department of Treasury Internal Revenue Service for 1040 Schedule F Profit or Loss from Farming is used to file federal taxes.

36. The electronic Notice of Intent (eNOI) serves as a report of waste discharge (ROWD) for the purposes of this Order.

37. The Central Coast Water Board recognizes that certain limited resource growers[2] (as defined by the U.S. Department of Agriculture) may have difficulty achieving compliance with this Order. The Central Coast Water Board will prioritize assistance for these growers, including but not limited to technical assistance, grant opportunities, and necessary flexibility to achieve compliance with this Order (e.g., adjusted monitoring, reporting, or time schedules).

Agricultural Dischargers Not Covered Under this Order and Who Must Apply for Individual Waste Discharge Requirements

38. This Order does not cover point source-type discharges from commercial nurseries, nursery stock production, greenhouses, or other operations. This Order does not cover discharges of waste from fully contained greenhouse operations (i.e., those that have no groundwater discharge due to impermeable floors but may have other discharges associated with the operation). These operations must either eliminate all such discharges of waste or submit a ROWD to apply for individual WDRs as set forth in Water Code section 13260.

Enforcement for Noncompliance

39. The State Water Board's Water Quality Enforcement Policy (Enforcement Policy) describes progressive enforcement action for violations of WDRs when appropriate. However, the Enforcement Policy recommends formal enforcement as a first response to more significant violations. Progressive enforcement is an escalating series of actions that allows for the efficient and effective use of enforcement resources to 1) assist cooperative Dischargers in achieving compliance; 2) compel compliance for repeat violations and recalcitrant violators; and 3) provide a disincentive for noncompliance. Progressive enforcement

[2] The term "Limited Resource Farmer or Rancher" means a participant:

- With direct or indirect gross farm sales not more than the current indexed value in each of the previous two years, and
- Who has a total household income at or below the national poverty level for a family of four, or less than 50 percent of county median household income in each of the previous two years.

A Self-Determination Tool is available to the public and may be completed on-line or printed and completed hardcopy at the USDA website: **Limited Resource Farmer/Rancher Self Determination Tool**.

actions may begin with informal enforcement actions such as a verbal, written, or electronic communication between the Central Coast Water Board and a Discharger. The purpose of an informal enforcement action is to quickly bring the violation to the Discharger's attention and to give the Discharger an opportunity to return to compliance as soon as possible. The highest level of informal enforcement is a Notice of Violation.

40. The Enforcement Policy recommends formal enforcement actions for the highest priority violations, chronic violations, and/or threatened violations. Violations of this Order that will be considered a priority include, but are not limited to:

    a. Failure to obtain required regulatory coverage;
    b. Failure to achieve numeric limits;
    c. Falsifying information or intentionally withholding information required by applicable laws, regulations, or an enforcement order;
    d. Failure to monitor or provide complete and accurate information as required;
    e. Failure to pay annual fees, penalties, or liabilities; and
    f. Failure to submit required reports on time.

41. Water Code section 13350 provides that any person who violates WDRs may be 1) subject to administrative civil liability imposed by the Central Coast Water Board or State Water Board in an amount of up to $5,000 per day of violation, or up to $10 per gallon of waste discharged; or 2) subject to civil liability imposed by a court in an amount of up to $15,000 per day of violation, or up to $20 per gallon of waste discharged. The actual calculation and determination of administrative civil penalties must be consistent with the Enforcement Policy and the Porter-Cologne Act.

Additional Findings and Regulatory Considerations

42. Attachment A to this Order, incorporated herein, includes additional findings that further describe the Water Board's legal and regulatory authority; compliance with CEQA requirements; applicable plans and policies adopted by the State Water Board and the Central Coast Water Board that contain regulatory conditions that apply to the discharge of waste from irrigated lands; and the rationale for this Order, including descriptions of the environmental and agricultural resources in the central coast region and impacts to water quality and beneficial uses from agricultural discharges.

43. The Central Coast Water Board encourages Dischargers to participate in third-party groups or programs (e.g., certification program, watershed group, water quality coalition, monitoring coalition, or other third-party effort) to facilitate and document compliance with this Order. Third-party programs can be used to implement outreach and education, monitoring and reporting, management practice and/or water quality improvement projects. Regionally scaled third-party

programs addressing multiple Order requirements are preferred to provide economies of scale to reduce Discharger costs, maximize effectiveness, and streamline Water Board oversight; however, watershed- or basin-scale third-party programs of limited scope may be appropriate under certain circumstances and should be coordinated to the extent practicable for consistency and effectiveness. Commodity group certification programs may also be effective in facilitating compliance with this Order. Dischargers participating in an Executive Officer approved third-party program may be subject to permit fee reductions or alternative compliance pathways that substantively comply with this Order.

44. The Central Coast Water Board acknowledges that it will take time to develop meaningful and effective third-party programs that facilitate compliance with this Order. The Order considers this by allowing an initial grace period for the phasing in of various requirements. The phasing in of various requirements is also intended to allow Water Board staff time to develop online reporting tools and templates and to conduct outreach and education to help Dischargers and service providers come up to speed on the new requirements.

45. Third-party programs are discussed in **Part 2, Section A**. The Central Coast Water Board will provide more detailed third-party expectation documents and/or third-party program requests for proposals (RFPs) to inform and solicit third-party program proposals for Executive Officer consideration.

46. The Executive Officer may make non-substantive changes to the Order to correct typographical errors or to maintain consistency within the Order or between the Order and its Attachments, e.g., to conform changes made during the Order development process that were inadvertently not carried through the entire Order. The Board will provide public notice of the non-substantive changes.

IT IS HEREBY ORDERED that Order No. R3-2017-0002 is terminated as of the effective date of this Order except for the purposes of enforcement, and that pursuant to Water Code sections 13260, 13263, and 13267, Dischargers enrolled in this Order, their agents, successors, and assigns, must comply with the following terms and conditions to meet the provisions contained in Water Code Division 7 and regulations, plans, and policies adopted thereunder.

Part 2, Section A. Enrollment, Fees, Termination, General Provisions, and Third-Party Programs

1. This Order is effective upon adoption by the Central Coast Water Board.

2. Except where stated otherwise, all requirements of this Order apply to all Dischargers.

Enrollment

3. Enrollment in this Order requires the submittal of the electronic Notice of Intent (eNOI) pursuant to Water Code section 13260. Submittal of all other technical reports pursuant to this Order is required pursuant to Water Code section 13267. Failure to submit technical reports or the attachments in accordance with the time schedules established by this Order or Monitoring and Reporting Program (MRP), or failure to submit a complete technical report (i.e., of sufficient technical quality to be acceptable to the Executive Officer), may subject the Discharger to enforcement action pursuant to Water Code sections 13261, 13268, or 13350. Dischargers must submit technical reports in the format specified by the Executive Officer.

4. Dischargers who are not currently enrolled in the existing agricultural order must submit to the Central Coast Water Board a complete eNOI prior to discharging. Upon submittal of a complete and accurate eNOI, the Discharger is enrolled under this Order, unless otherwise informed by the Executive Officer.

5. Dischargers who were enrolled in Order R3-2017-0002 as of the effective date of this Order are automatically enrolled in this Order. Within 120 days of Order adoption, enrolled Dischargers must update their eNOI.

6. In the case where an operator may be operating for a period of less than 12 months, the landowner must submit the eNOI. In all other cases, either the landowner or the operator must submit the eNOI. Both the landowner and the operator are Dischargers and considered a responsible party for compliance with the requirements of this Order.

7. **Prior to any discharge or commencement of activities that may cause a discharge**, including land preparation prior to crop production, any Discharger

proposing to control or own a new operation or ranch that has the potential to discharge waste that could directly or indirectly reach waters of the state and/or affect the quality of any surface water and/or groundwater must submit an eNOI.

8. **Within 60 days** of any change in operation or ranch information, the Discharger must update the eNOI.

9. **Within 60 days** of any change in control or ownership of an operation, ranch, or land presently owned or controlled by the Discharger, the Discharger must notify the succeeding owner and operator of the existence of this Order.

10. **Within 60 days** of acquiring control or ownership of an existing operation or ranch, the succeeding Discharger must submit an eNOI.

11. Dischargers must submit all the information required in the eNOI form, including but not limited to the following information for the operation and individual ranch:

    a. Assessor parcel numbers (APNs) covered by enrollment,
    b. Landowner(s),
    c. Operator(s),
    d. Contact information,
    e. Third-party program membership,
    f. Location of operation, including specific ranch(es),
    g. Map with discharge locations and groundwater wells identified,
    h. Type and number of groundwater wells located on ranch parcels,
    i. Total and irrigated acreage,
    j. Crop types grown,
    k. Irrigation system type,
    l. Discharge type,
    m. Chemical use,
    n. Slope,
    o. Impermeable surfaces,
    p. Presence and location of any waterbodies on or adjacent to the ranch.
    q. Status of drinking water notification to well users

12. Dischargers or groups of Dischargers seeking regulatory requirements tailored to their specific operation, ranch, geographic area, or commodity may submit an ROWD to obtain an individual order and MRP, or request the development of a general order for a specific type of discharge (e.g., commodity-specific general order). This Order remains applicable to those Dischargers until the Central Coast Water Board adopts such an individual order, MRP, or general order, and, if applicable, the Dischargers are enrolled in the general order.

13. Dischargers seeking enrollment in this Order must submit a statement of understanding of the conditions of this Order and MRP signed by the Discharger

(landowner or operator) with the eNOI. If the operator signs and submits the electronic NOI, the operator must provide a copy of the complete NOI form to the landowner(s).

14. Coverage under this Order is not transferable to any person except after the succeeding Discharger's submittal to the Central Coast Water Board of an updated eNOI and approval by the Executive Officer.

Fees

15. Dischargers must pay a fee to the State Water Resources Control Board in compliance with the fee schedule contained in Title 23 California Code of Regulations.

16. Dischargers must pay any relevant third-party program fees (e.g., Surface Water Third-Party Monitoring Program (aka Cooperative Monitoring Program or CMP) necessary to comply with monitoring and reporting conditions of this Order or they must comply with monitoring and reporting requirements individually.

17. For Dischargers who choose to participate in a third-party program, failure to pay third-party program fees voids a selection or notification of the option to participate in the third-party program and hence requires Dischargers to immediately comply with individual groundwater protection and/or surface water protection requirements.

Termination

18. **Immediately**, if a Discharger wishes to terminate coverage under this Order for the operation or an individual ranch, the Discharger must submit a complete Notice of Termination (NOT), in a format specified by the Executive Officer. Termination from coverage is the date the termination request is approved, unless specified otherwise. All discharges must cease before the date of termination, and any discharges on or after the date of termination are violations of this Order, unless covered by other WDRs or waivers of WDRs. All required monitoring and reporting are due **within 60 days of the termination or March 1 following the termination date**, whichever is sooner, unless otherwise directed by the Executive Officer.

General Provisions

19. The unauthorized discharge of any waste not specifically regulated by this Order, is prohibited.

20. The discharge of waste at a location or in a manner different from that described in the eNOI is prohibited.

21. Dischargers must comply with the Monitoring and Reporting Program (MRP), incorporated herein as Attachment B.

22. All forms, reports, documents, and laboratory data must be submitted to the Central Coast Water Board electronically through the State Water Board's database systems (e.g., GeoTracker, CEDEN,[3] etc.).

23. Dischargers are defined in this Order as both the landowner and the operator of irrigated agricultural land on or from which there are discharges of waste from irrigated agricultural activities that could affect the quality of any surface water or groundwater. The Central Coast Water Board will hold both the landowner and the operator liable for noncompliance with this Order.

24. The Executive Officer may propose, and the Central Coast Water Board may adopt, individual WDRs for any Discharger at any time.

25. The Central Coast Water Board or the Executive Officer may, at any time, terminate applicability of this Order with respect to an individual Discharger upon written notice to the Discharger.

26. Noncompliance with requirements in this Order is grounds for enforcement action and/or termination of coverage for waste discharges under this Order, subjecting the Discharger to enforcement under the Water Code for further discharges of waste to surface water or groundwater.

27. The fact that it would have been necessary to halt or reduce the permitted discharge activity to maintain compliance with this Order is not a defense for the Discharger's violations of this Order.

28. Provisions of this Order are severable. If any provision of this Order is found invalid, the remainder of this Order will not be affected.

29. Upon the Central Coast Water Board's or Executive Officer's request and within a reasonable timeframe, Dischargers must submit any information required to determine compliance with this Order or to determine whether there is cause for modifying or terminating this Order.

30. Under authority of Water Code section 13267(c), the Discharger must allow the Central Coast Water Board, or an authorized representative, upon consent or other documents as may be required by law, to do the following:

    a. Enter upon the Discharger's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this Order,

[3] CEDEN is the California Environmental Data Exchange Network.

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order,
c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order, and
d. Collect samples from and monitor waters of the state within or bordering property subject to this Order, at reasonable times for the purposes of assuring compliance with this Order or as otherwise authorized by the Water Code. The sampling and monitoring may include and is not limited to domestic and irrigation wells, surface receiving waters, and edge of field discharges to surface waters.

31. This Order may be reopened to address changes in statutes, regulations, plans, policies, or case law that govern water quality requirements for the discharges regulated herein.

Order Effectiveness Evaluation

32. To facilitate an adaptive management process to inform modifications to the Order, the Central Coast Water Board will receive annual updates from its staff and, as appropriate, third party groups or programs during public meetings regarding the implementation of this Order. The purpose of the updates is to evaluate and report out on individual discharger and third-party group compliance; identify successes, challenges, and emerging science and management practices; consider potential Order modifications as may be appropriate at five-year intervals; and generally inform the Board and public regarding the Order's effectiveness towards achieving the stated objectives.

Third-Party Programs

33. Dischargers may comply with portions of this Order by participating in third-party groups or programs (e.g., certification program, watershed group, water quality coalition, monitoring coalition, or other third-party effort) approved by the Executive Officer. In this case, the third-party will assist individual Dischargers in achieving compliance with this Order, including implementing water quality improvement projects and required monitoring and reporting as described in the MRP. Compliance with the requirements of this Order is still required for all members of the third-party program; however, the third-party may propose modified monitoring and reporting for approval by the Executive Officer. Third-party program proposals will be evaluated on a case-by-case basis relative to their ability to document compliance with this Order as part of a request for proposal process and as further informed by a forthcoming third-party expectations document.

34. Interested persons may seek discretionary review by the Central Coast Water Board of the Executive Officer's approval or denial of the following work plans:

- Third-party program groundwater quality trend monitoring and reporting.
- Third-party program surface receiving water quality trend monitoring and reporting.
- Individual and third-party program follow-up surface receiving water implementation.

35. Interested persons seeking discretionary review by the Central Coast Water Board must submit their request in writing no later than 30 days from the date of the Executive Officer's approval or denial of the work plans noted above.

36. This Order includes specific provisions and an alternative compliance pathway for third-party programs that will also be subject to a third-party request for proposal process and Executive Officer review and approval. Dischargers participating in a third-party administered alternative compliance pathway program, and that remain in good standing as defined in this Order and/or Executive Officer approved third-party work plan, are subject to the third-party program requirements in lieu of individual requirements as specified. The third-party alternative compliance pathway program's assessment and evaluation for groundwater protection and the regional groundwater quality trend monitoring program described in **Part 2, Section C.1** must be closely aligned and coordinated such that they are effectively measuring the objectives the programs are trying to achieve.

37. Third-party program proposals must include and identify specific membership eligibility requirements, for approval by the Executive Officer, to evaluate whether third-party program members are in good standing. Members that are not in good standing with the membership eligibility requirements lose their membership and must immediately comply with individual groundwater protection and/or surface water protection requirements. At a minimum, third-party program proposals must include membership eligibility requirements and follow-up consequences that are triggered, including revocation of membership eligibility, to address the following scenarios where members are no longer in good standing:

   a. Non-payment of fees
   b. Non-submittal of information
   c. Non-participation in education/outreach or site visits
   d. Failure to implement / adapt management practices

38. Consistent with the Water Board's Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program (NPS Policy), the ineffectiveness of a third-party program through which a Discharger participates in nonpoint source control efforts cannot be used as a justification for lack of individual

discharger compliance. Dischargers continue to be responsible for complying with this Order individually.

39. Dischargers who elect to join one or more third-party programs to facilitate compliance with this Order must retain their membership with the third parties in good standing. If the Discharger does not meet the requirements of membership in a particular third-party program, then the Discharger is responsible for complying with all requirements in this Order individually. If the Discharger is in good standing of another third-party program for another purpose, that third-party program's requirements still apply. For example, a Discharger may no longer be a member in good standing of the third-party alternative compliance pathway program but could still be a member in good standing for a third-party surface receiving water quality trend monitoring and reporting program. For this example, Dischargers may become eligible to rejoin the third-party alternative compliance pathway program by demonstrating compliance with individual groundwater protection requirements.

40. Dischargers who elect to join an approved third-party program must notify the approved third-party program administrator of their election to participate in the third-party program within 60 days of: 1) approval of the third-party program, and/or 2) the Discharger's enrollment in this Order, whichever is later.

41. The third-party program administrator must notify the Central Coast Water Board of Dischargers electing to participate within 90 days of the third-party program approval, and then provide member participation updates on a quarterly basis thereafter. At a minimum, participating Discharger information provided to the Central Coast Water Board must include operation enrollment information (e.g., AW numbers and operation names) and ranch enrollment information (e.g., GeoTracker AGL numbers and ranch names) in a format specified by the Executive Officer.

42. Third-party programs must meet the following minimum criteria:

    a. Effectiveness of scale and scope – The program must be of sufficient scale and scope relative to its intended purpose to maximize Discharger participation, implementation effectiveness and Order compliance. Although regionally scaled programs are preferred, watershed- or basin-scale programs will be considered as needed to address localized water quality issues.
    b. Clearly stated goals and objectives – The program must have meaningful and clearly stated goals, objectives, and associated performance metrics relevant to the Order requirements that are the focus of the program.
    c. Management and administration – The program must have a well-defined and robust governance and administrative structure with clearly defined roles and responsibilities.

d. Capacity and expertise – The program must demonstrate sufficient technical, managerial, and financial capacity to successfully achieve its goals and objectives.
e. Physical presence – The program should have a physical presence in the central coast region, including staff and a headquarters, that can assist its members on a continual and as-needed basis. If the third-party program administrator does not have or plan to have a physical presence in the region, they must demonstrate they can effectively establish, maintain, and engage with core membership without a headquarters in the central coast region.
f. Transparency and accountability – The program must provide regular assessments of its performance relative to its stated goals and objective based on meaningful performance metrics. This includes reporting of water quality data and farm-level data as needed to document compliance with this Order.
g. Membership and fee accounting – The program must track and provide ongoing accounting of its Discharger membership and fees to document Discharger compliance.
h. Data management – The program must upload data as required by this Order to the Water Boards' various data management systems (e.g., CEDEN, GeoTracker, etc.).
i. Member requirements – The program must have clearly stated and enforced Discharger membership eligibility requirements and report out on them as needed to document compliance.
j. Coordination – The program must consider and coordinate with other third-party programs/groups or local entities as may be appropriate to create consistency; leverage the efforts, infrastructure and expertise of others; and streamline the program to maximize effectiveness (e.g., coordination with Groundwater Sustainability Agencies [GSAs], flood control management agencies, watershed restoration and management entities, etc.).
k. Continuing education – The program must include continuing education opportunities as appropriate either directly through the program or through coordination with other third-party programs/groups or local entities to ensure its members obtain technical skills and assistance necessary to achieve compliance with the limits established in this Order. In the instance of third-party monitoring programs, membership outreach and education should be implemented to inform members about the monitoring results relative to meeting specific water quality objectives, numeric targets, numeric interim quantifiable milestones, or numeric limits.
l. Specific project plan documents – The program must have a detailed work plan including a Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP) as may be appropriate based on the program goals and objectives and associated Order requirements.

43. The Central Coast Water Board's review of third-party program proposals will consider the criteria outlined above relative to overall program effectiveness, with an emphasis on approving programs that can effectively assist their members in complying with the requirements of this Order.

Part 2, Section B. Planning, Education, Management Practices, and CEQA

Farm Water Quality Management Plan (Farm Plan)

1. Dischargers must develop, implement, and update as necessary a Farm Water Quality Management Plan (Farm Plan) for each ranch. A current copy of the Farm Plan must be maintained by the Discharger and must be submitted to the Central Coast Water Board upon request. At a minimum, the Farm Plan must include the discrete sections listed below. Additional details regarding each section are included in subsequent sections of this Order. Certain elements included in the Farm Plan must be reported on; however, in general, the Farm Plan is a planning and recordkeeping tool used by Dischargers to manage various aspects of their agricultural operation.

    a. Irrigation and Nutrient Management Plan (INMP)
    b. Pesticide Management Plan (PMP)
    c. Sediment and Erosion Management Plan (SEMP)
    d. Water Quality Education
    e. CEQA Mitigation Measure Implementation

2. The INMP, PMP, and SEMP sections of the Farm Plan must include information on management practice implementation and assessment. Elements of the INMP are reported on in the Total Nitrogen Applied report or INMP Summary report. Elements of all the sections listed above are reported on in the Annual Compliance Form (ACF). Additional information on the monitoring and reporting requirements related to each of these sections is included in the MRP.

3. Where required by the Executive Officer based on groundwater quality or surface water quality conditions or exceedances of the numeric targets, numeric interim quantifiable milestones, or numeric limits established in this Order, the Farm Plan must incorporate ranch-level groundwater or surface water discharge monitoring information described in the MRP. The ranch-level groundwater and surface water discharge monitoring must be designed and implemented to inform improved management practices to protect groundwater and surface water quality.

4. Dischargers must maintain all records related to compliance with this Order for a minimum of ten years. Records include, but are not limited to, monitoring information, calculations, management practice implementation and assessment, education records, and all required reporting and information used to submit

complete and accurate reports. Third parties that have been approved by the Executive Officer to assist Dischargers with complying with this Order, for example in the form of water quality monitoring, must also maintain all records for a minimum of ten years. Records must be submitted to the Central Coast Water Board upon request or as required by this Order or an approved work plan.

Continuing Education

5. Dischargers must attend outreach and education events annually to obtain technical skills and assistance necessary to achieve compliance with the numeric targets, numeric interim quantifiable milestones, and numeric limits established by this Order. Outreach and education events should focus on meeting water quality objectives and protecting beneficial uses by identifying water quality problems, implementing pollution prevention strategies, and implementing management practices and assessment designed to protect water quality and beneficial uses and resolve water quality problems to achieve compliance with this Order. Records of participation in continuing education must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

6. Dischargers who exceed the fertilizer nitrogen application targets or limits, nitrogen discharge targets or limits, numeric interim quantifiable milestones, or surface receiving water limits must complete additional relevant water quality education sufficient to fully inform the implementation of additional or improved management practices and assessment to avoid future exceedances.

7. A copy of this Order and MRP must be kept at the ranch for reference by operating personnel. Key operating and site management personnel must be familiar with the content of both documents.

Management Practice Implementation and Assessment

8. Dischargers must implement management practices and assessment, as necessary, to improve and protect water quality, protect beneficial uses, achieve compliance with applicable water quality objectives, achieve the numeric targets, numeric interim quantifiable milestones, and numeric limits established in this Order. Management practices implementation and assessment must be documented in the appropriate section of the Farm Plan (e.g., irrigation and nutrient management practices and assessment must be documented in the INMP section of the Farm Plan). Dischargers must report on management practice implementation and assessment in the ACF, as described in the MRP. Dischargers may demonstrate management practice effectiveness at ranch-level or watershed-scale.

CEQA Mitigation Measure Implementation, Monitoring, and Reporting

9. Impacts and mitigation measures identified in CEQA Mitigation Monitoring and Reporting Program (MMRP) are set forth in the Final Environmental Impact Report (FEIR) at Appendix D, which is incorporated by reference. Mitigation measures identified in the FEIR for this Order are required to be implemented as described in Appendix D unless exempted by another law or regulation. These mitigation measures will substantially reduce environmental effects of the project. The mitigation measures included in this Order have eliminated or substantially lessened all significant effects on the environment, where feasible. Where noted, some of the mitigation measures are within the responsibility and jurisdiction of other public agencies. Such mitigation measures can and should be adopted, as applicable, by those other agencies.

10. Dischargers must report on mitigation measure implementation electronically in the Annual Compliance Form (ACF), as described in the MRP.

Part 2, Section C.1. Groundwater Protection

1. Dischargers may not be subject to all provisions of **Part 2, Section C.1** if they are members in good standing with the third-party alternative compliance pathway program included within **Part 2, Section C.2**.

Phasing

2. Ranches are assigned the Groundwater Phase Area of the groundwater basin where the ranch is located based on the relative level of water quality and beneficial use impairment and risk to water quality. All ranches are assigned a Groundwater Phase Area of 1, 2, or 3. Groundwater Phase 1 areas represent greater water quality impairment and higher risk to water quality relative to Groundwater Phase 2 and 3 areas.

3. The requirements and implementation schedules for groundwater protection are based on the groundwater phase areas, listed in **Table C.1-1** and shown on the maps in **Figure C.1-1**.

4. In the event that a ranch spans multiple Groundwater Phase areas, the ranch will be assigned the earlier phase. For example, a ranch that spans both Groundwater Phase 1 and Groundwater Phase 2 areas will be assigned to Groundwater Phase 1.

5. The Groundwater Phase Area assigned to each ranch will be displayed on the ranch eNOI in GeoTracker.

Irrigation and Nutrient Management Plan

6. Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses both groundwater and surface water. This section applies to the groundwater related INMP requirements and the surface water related INMP requirements are contained within **Part 2, Section C.3** of this Order. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of the INMP related to groundwater protection must include:

   a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the ACF, Total Nitrogen Applied (TNA) report, and INMP Summary report.
   b. Planning and management practice implementation and assessment that results in compliance with the fertilizer nitrogen application limits in **Table C.1-2** and the nitrogen discharge targets and limits in **Table C.1-3**.
   c. Descriptions of all irrigation, nutrient, and salinity management practices implemented and assessed on the ranch.
   d. When INMP certification is required, e.g., as a follow-up action or as a consequence for not meeting the quantifiable milestones and time schedules below, the INMP certification shall include the following:

      The person signing this Irrigation and Nitrogen Management Plan (INMP) certifies, under penalty of law, that the INMP was prepared under his/her direction and supervision, that the information and data reported is to the best of his/her knowledge and belief, true, accurate, and complete, and that he/she is aware that there are penalties for knowingly submitting false information. The qualified professional signing the INMP may rely on the information and data provided by the Discharger and is not required to independently verify the information and data.

      The qualified professional signing the INMP below further certifies that he/she used sound irrigation and nitrogen management planning practices to develop irrigation and nitrogen application recommendations and that the recommendations are informed by applicable training to minimize nitrogen loss to surface water and groundwater. The qualified professional signing the INMP is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by the Discharger in a manner that is inconsistent with the INMP's recommendations for nitrogen application. This certification does not create any liability or claims for environmental violations.

Qualified professional certification:
"I, ____________________, certify this INMP in accordance with the statement above."

___________________________ (Signature)

The discharger additionally agrees as follows:

"I, ____________________, Discharger, have provided information and data to the certifier above that is, to the best of my knowledge and belief, true, accurate, and complete, that I understand that the certifier may rely on the information and data provided by me and is not required to independently verify the information and data, and that I further understand that the certifier is not responsible for any damages, loss, or liability arising from subsequent implementation of the INMP by me in a manner that is inconsistent with the INMP's recommendations for nitrogen application. I further understand that the certification does not create any liability for claims for environmental violations."

Quantifiable Milestones and Time Schedules

7. As shown in **Table C.1-2**, the fertilizer nitrogen application limits go into effect December 31, 2023.

8. As shown in **Table C.1-3**, the nitrogen discharge targets go into effect December 31, 2023 and nitrogen discharge limits go into effect December 31, 2027.

Fertilizer Nitrogen Application Limits

9. Dischargers must not apply fertilizer nitrogen ($\mathbf{A_{FER}}$) at rates greater than the limits in **Table C.1-2.** Compliance with fertilizer nitrogen application limits is assessed for each specific crop reported in the TNA report or INMP Summary report.

Nitrogen Discharge Targets and Limits

10. This Order requires Dischargers to submit information on nitrogen applied (**A**) and nitrogen removed (**R**). This Order also establishes nitrogen discharge targets and limits based on the calculation of nitrogen applied minus nitrogen removed (**A-R**) using the formulas below. Nitrogen must not be discharged at rates greater than the targets and limits in **Table C.1-3**. Compliance with nitrogen discharge targets and limits is assessed annually for the entire ranch in the INMP Summary

report through one of the **three compliance pathways** shown below. Compliance with all pathways is not required.

Compliance Pathway 1:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R = \text{Nitrogen Discharge}$$

OR

Compliance Pathway 2:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$$

OR

Compliance Pathway 3:

$$A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R = \text{Nitrogen Discharge}$$

In all formulas, $R = R_{HARV} + R_{SEQ} + R_{SCAVENGE} + R_{TREAT} + R_{OTHER}$

a. A_{FER} is the amount of fertilizer nitrogen applied in pounds per acre.
b. **C** is the compost discount factor used to represent the amount of compost nitrogen mineralized during the year that the compost was applied.
c. A_{COMP} is the total amount of compost nitrogen applied in pounds per acre.
d. **O** is the organic fertilizer discount factor used to represent the amount of nitrogen mineralized during the first 12 weeks in the year it was applied.
e. A_{ORG} is the total amount of organic fertilizer or amendment nitrogen applied in pounds per acre.
f. A_{IRR} is the amount of nitrogen in pounds per acre applied in the irrigation water estimated from the volume required for crop evapotranspiration (ET) or volume of water applied.
g. **R** is the amount of nitrogen removed from the field through harvest, sequestration, or other removal methods, in pounds per acre.
h. R_{HARV} is the amount of nitrogen removed from the field through harvest or other removal of crop material.
i. R_{SEQ} is the amount of nitrogen removed from the field through sequestration in woody materials of permanent or semi-permanent crops.
j. $R_{SCAVENGE}$ is the amount of nitrogen credited as removed from the field through nitrogen scavenging cover crops utilized during the wet/rainy season, nitrogen scavenging high carbon amendments during the wet/rainy season, or high carbon woody materials applied as mulch to the crop ground surface.
k. R_{TREAT} is the amount of nitrogen removed from the ranch through a quantifiable treatment method (e.g., bioreactor).

l. **R_{OTHER}** is the amount of nitrogen removed from the ranch through other methods not previously quantified.

11. The Central Coast Water Board encourages the use of irrigation water nitrogen as a method of reducing the amount of fertilizer nitrogen applied to crops. The use of irrigation water nitrogen is typically referred to as "pump and fertilize" and is incentivized through compliance pathway 2 and 3 in **Table C.1-3**. The amount of irrigation water nitrogen is not used in the compliance calculation in these compliance pathways. The amount of irrigation water nitrogen must be reported regardless of the compliance pathway.

12. The Central Coast Water Board encourages the use of compost to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state's Healthy Soils Initiative. All compost nitrogen (**A_{COMP}**) applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of compost is incentivized through the option for Dischargers to use a compost "discount" factor (**C**). Dischargers may use the compost discount factor provided by the Central Coast Water Board in the MRP or may determine their own discount factor. The discounted compost nitrogen must, at a minimum, represent the amount of compost mineralized during the year the compost was applied to the ranch. If the Discharger uses their own compost discount factor, they must maintain records of the method used to determine the compost discount factor in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.

13. The Central Coast Water Board encourages the use of organic fertilizers and amendments to improve soil health, nutrient and carbon sequestration, and water holding capacity consistent with the state's Healthy Soils Initiative. All organic fertilizer and amendment nitrogen (**A_{ORG}**) applied to the ranch must be reported in the TNA report or INMP Summary report; however, the use of organic fertilizers and amendments is incentivized through the option for Dischargers to use an organic fertilizer "discount" factor (**O**). Dischargers may use the organic fertilizer discount factor associated with the products C:N ratio, provided by the Central Coast Water Board in the MRP. The discounted organic fertilizer nitrogen must, at a minimum, represent the amount of organic fertilizer mineralized during the first 12 weeks the organic fertilizer was applied to the ranch. The Discharger must maintain records of the organic products used and their associated C:N ratios in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request. The following products are not eligible to receive an organic fertilizer discount: a) products with no organic compounds (long chain carbon) molecules, such as conventional fertilizer, slow release fertilizers, b) products that do not depend on microbial mineralization to release nitrogen to mineral form to make it available for crop uptake, c) products without

C:N ratio information available, and d) organic liquid fertilizers that are in the liquid and/or emulsified form (excluding organic foliar applications).

14. The amount of **crop material** removed through harvest or other methods (**R_{HARV}**) must be calculated using the formula described below. Dischargers must either use the crop-specific conversion coefficient values found in the MRP or develop their own conversion coefficient values following the approved method in the MRP. If Dischargers develop their own conversion coefficient, they must maintain information on the method used in the Farm Plan, and these records must be submitted to the Central Coast Water Board upon request.

    R_{HARV} = Conversion Coefficient x Material Removed

    a. The **Conversion Coefficient** is a crop-specific coefficient used to convert from units of material removed per acre to units of nitrogen removed per acre.
    b. **Material Removed** is the amount of nitrogen-containing material removed from the field, in units of pounds per acre.

15. The amount of nitrogen removed through **sequestration** in woody material of permanent or semi-permanent crops (**R_{SEQ}**) must be estimated by the Discharger. Dischargers must maintain records detailing how they estimated the amount of nitrogen sequestered in their permanent crops. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

16. The Central Coast Water Board encourages Dischargers to implement best management practices that reduce nitrogen leaching in the wet/rainy season and improve soil healthy. Dischargers may claim a nitrogen scavenging credit (**$R_{SCAVENGE}$**) one time per year for each ranch acre by utilizing any of the four options provided by the Central Coast Water Board in the MRP. The total acres receiving the nitrogen scavenging credit may not exceed the ranch acres. Dischargers electing to claim the nitrogen scavenging credit must ensure that their cover crop, high carbon amendment, or high carbon woody materials meets the definitions of a nitrogen scavenging cover crop, nitrogen scavenging high carbon amendment, or high carbon woody materials as noted in the MRP and Definitions. Substantiating records for this credit must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

17. The Central Coast Water Board encourages Dischargers to develop and implement innovative methods for removing nitrogen from the environment to improve water quality. Dischargers may use treatment methods (e.g., bioreactors) on their ranch by participating in collective treatment programs or

systems[4] to remove nitrogen from groundwater or surface water and may count this towards their nitrogen removal (**R**) value if they are able to quantify the amount of nitrogen removed from ranch discharge to groundwater or surface water. This quantified removal through treatment or other innovative methods must be reported as **R_{TREAT}**. Dischargers electing to account for this nitrogen removal must monitor the volume and concentration of water entering and exiting the ranch or collective treatment system and calculate the amount of nitrogen removed. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

18. If Dischargers remove additional nitrogen through means other than removing crop material (**R_{HARV}**), sequestration (**R_{SEQ}**), scavenging credit (**$R_{SCAVENGE}$**), or treatment methods (**R_{TREAT}**), they must quantify and report this additional removal as **R_{OTHER}**. Dischargers must maintain records detailing how they calculated **R_{OTHER}**. These records must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request.

19. The discharge of nitrogen in excess of the nitrogen discharge **targets** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, and increased monitoring and/or reporting.

20. The discharge of nitrogen in excess of the nitrogen discharge **limits** in **Table C.1-3** may result in additional requirements, including obtaining additional education, INMP certification by a qualified professional, implementing additional or improved management practices, increased monitoring and reporting, and/or progressive enforcement actions.

21. Dischargers who apply more fertilizer nitrogen (**A_{FER}**) than the fertilizer nitrogen application limits in **Table C.1-2** to any specific crop **and** who are able to demonstrate compliance with the **final** nitrogen discharge limits, as shown in **Table C.1-3**, are exempt from the fertilizer nitrogen application limit.

22. Dischargers who can quantifiably demonstrate that their ranches pose no threat to surface water quality or groundwater quality may submit a technical report to the Executive Officer for review. If approved, the Discharger is not required to conduct the nitrogen application (**A**) or removal (**R**) monitoring and reporting or to submit the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. The technical report must demonstrate that nitrogen applied at the ranch does not percolate below the root zone in an amount that could

[4] Collective treatment programs or systems may be installed or implemented outside the ranch boundaries at a downstream or downflow collective discharge point from multiple ranches to remove nitrogen from groundwater or surface water from each ranch participating in the collective treatment program or system.

degrade groundwater and does not migrate to surface water through discharges, including drainage, runoff, or sediment erosion. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.

23. Dischargers who can quantifiably demonstrate that their ranch is achieving the **final** nitrogen discharge limits , as shown in **Table C.1-3,** are not required to submit the nitrogen removal (**R**) reporting in the INMP Summary report, regardless of what Groundwater Phase area the ranch is in. Example situations where this may apply include participation in an approved third-party program that certifies that the Discharger is meeting the final discharge limit and will continue to do so for the duration of the Discharger's participation in the approved third-party program, or by submitting a technical report, subject to Executive Officer review, that quantifies the amount of nitrogen discharge based on the volume and nitrogen concentration of all discharges from the ranch. In these situations, confirmation of membership in the approved third-party program or Executive Officer approval of a submitted technical report constitute compliance with the nitrogen removed (**R**) reporting requirement in the INMP Summary report. This exemption only applies to removal (**R**) in the INMP Summary report; all other requirements, including the TNA report, still apply as described in this Order. Dischargers must provide the Executive Officer with annual updates to confirm that the exemption is still applicable. Failure to provide sufficient annual updates confirming that the exemption is still applicable will result in an immediate reinstatement of the requirement to submit the nitrogen removal (R) reporting information in the INMP Summary report for applicable Dischargers. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway for groundwater protection.

24. Dischargers, groups of dischargers or commodity groups who can quantify the amount of nitrogen discharged from their ranch or for specific crops or via specific management practices by directly monitoring it at the points of discharge can propose an alternative monitoring methodology to comply with the nitrogen discharge targets and limits, in lieu of using the A-R compliance formulas. Example situations where this may apply includes greenhouse, nursery, container production or intensive crop production where irrigation and drain water is captured and allows for direct monitoring of discharges. For these types of situations, it may be easier to monitor nitrogen discharge than to calculate the amount of nitrogen removed at harvest for each one of the many different crops and plants being grown. Dischargers must submit a request to the Executive

Officer with a technical report of the methodology proposed to quantify nitrogen discharges. The methodology must include enough information to quantify the amount of nitrogen discharged and confirm compliance with the nitrogen discharge targets and limits, as shown in **Table C.1-3** or **Table C.2-2** (for Dischargers participating in the Third-Party Alternative Compliance Pathway Program for Groundwater Protection described in **Part 2, Section C.2**). Acceptable methodologies must include direct measurements of the volume and nitrogen concentration of the water discharged from each ranch per acre and year. Executive Officer approval of the method(s) must be granted before the discharger begins reporting nitrogen discharge based on the proposed methodology. Dischargers who obtain Executive Officer approval to directly monitor their nitrogen discharge from their ranches will not be required to submit nitrogen removal (R) reporting in the INMP Summary report. Dischargers electing to use this approach are still eligible to participate in the third-party alternative compliance pathway program for groundwater protection.

25. The initial 2027 nitrogen discharge limits, as shown in **Table C.1-3** will be re-evaluated based on Discharger reported nitrogen applied and removed data, new science, and management practice implementation and assessment before becoming effective.

Monitoring and Reporting

26. Dischargers must report on management practice implementation and assessment electronically in the **ACF**, as described in the MRP.

27. Dischargers must record and report total nitrogen applied to all crops grown on the ranch, electronically in the TNA report form, as described in the MRP.

28. Dischargers must track and record the following elements of the INMP Summary report that are not included in the TNA report: total nitrogen removed from the ranch and information on irrigation water application and discharge volumes. Dischargers must submit this information electronically in the INMP Summary report form as described in the MRP.

29. The INMP Summary report contains the same nitrogen application information as the TNA report, plus additional information related to nitrogen removed and irrigation management. **Therefore, the INMP Summary report satisfies the TNA report requirement and an additional TNA report is not required to be submitted when the INMP Summary report is submitted to the Central Coast Water Board**.

30. Dischargers must conduct **irrigation well monitoring and reporting prior to the start of groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.

31. Dischargers must conduct **on-farm domestic well monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP.

32. Dischargers must conduct **groundwater quality trend monitoring and reporting**, either individually or as part of a third-party effort, as described in the MRP. This requirement applies to all Dischargers enrolled in this Order, regardless of how many wells are currently present on their ranch.

    a. Dischargers who elect to perform groundwater quality trend monitoring and reporting as part of a **third-party** effort must form or join a third-party. The third-party must submit a work plan for Executive Officer review by the dates and covering the areas specified in the MRP unless it is associated with the Third-Party Alternative Compliance Pathway for Groundwater Protection described in **Part 2, Section C.2**. The work plan must be approved by the Executive Officer prior to implementation. Once approved by the Executive Officer, the work plan must be implemented.
    b. Dischargers who elect to perform groundwater quality trend monitoring and reporting individually must submit a work plan for Executive Officer review, by the date specified in the MRP, based on their ranch location. The work plan must be approved by the Executive Office prior to implementation. The work plan must describe how the ranch-level groundwater quality trend monitoring program will evaluate groundwater quality trends over time and assess the impacts of agricultural discharges on groundwater quality. Once approved by the Executive Officer, the work plan must be implemented. Dischargers without a well on their property may comply with individual ranch-level groundwater quality trend monitoring and reporting requirements by implementing one of the options specified in the MRP.

33. When required by the Executive Officer based on groundwater quality data or significant and repeated exceedance of the nitrogen discharge targets or limits, Dischargers must complete **ranch-level groundwater discharge monitoring and reporting**, either individually or as part of a third-party effort as described in the MRP. Water Board staff will coordinate with Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming requirement. When ranch-level groundwater discharge monitoring and reporting is required, a work plan, including a SAP and QAPP, must be submitted for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. Ranch-level groundwater discharge monitoring may be discontinued with the approval of the Executive Officer when the Discharger comes into compliance with the nitrogen discharge targets or limits, or the discharge has otherwise ceased.

Part 2, Section C.2. Third-Party Alternative Compliance Pathway for Groundwater Protection

1. Dischargers that are members in good standing in the third-party alternative compliance pathway program are subject to the provisions of this **Part 2, Section C.2**, unless otherwise stated. For purposes of this section, such Dischargers are referred to as “participating Dischargers.”

   Participating dischargers:

   a. Are not subject to fertilizer nitrogen application limits in **Table C.1-2**, which are enforceable by the Central Coast Water Board.
   b. Are not subject to nitrogen discharge limits in **Table C.1-3**, which are enforceable by the Central Coast Water Board.
   c. Are subject to targets, which if exceeded result in consequences outlined in this **Part 2, Section C.2**.
   d. Are not subject to ranch-level groundwater discharge monitoring and reporting.
   e. Are generally provided more time to achieve fertilizer nitrogen application targets and nitrogen discharge targets, relative to non-participating dischargers.

2. Prior to the initiation of the work plan process outlined below and in the MRP for this third-party alternative compliance pathway program, entities wishing to implement the third-party alternative compliance pathway program described in this **Part 2, Section C.2** must submit a third-party alternative compliance pathway program proposal consistent with the third-party program requirements outlined in **Part 2, Section A** of this Order, as well as the request for proposal process and associated third-party program expectations document forthcoming after Order adoption. For purposes of this section, the entity approved to implement the third-party alternative compliance pathway is referred to as the approved third-party alternative compliance pathway program administrator.

3. Participating Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses groundwater. The INMP is a section of the Farm Plan and must be maintained in the Farm Plan and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the INMP Summary report. At a minimum, the elements of the INMP related to groundwater and surface water protection for participating Dischargers in a third-party program must include:

   a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the Annual Compliance form (ACF), Total Nitrogen Applied (TNA) report, and INMP Summary report.

b. Planning and management practice implementation and assessment that results in compliance with the fertilizer nitrogen application targets in **Table C.2-1,** the nitrogen discharge targets in **Table C.2-2**, and groundwater protection area targets to be determined and approved by the Executive Officer.
c. Descriptions of all irrigation, nutrient, and salinity management practices implemented and assessed on the ranch.

Quantifiable Milestones and Time Schedules

4. As shown in **Table C.2-1**, the fertilizer nitrogen application targets go into effect December 31, 2024 for participating Dischargers in the third-party alternative compliance pathway.

5. As shown in **Table C.2-2**, the nitrogen discharge targets go in to effect during the third year of this Order (December 31, 2024) for participating Dischargers in the third-party alternative compliance pathway.

Fertilizer Nitrogen Application Targets

6. Participating Dischargers must not apply fertilizer nitrogen ($\mathbf{A}_{FER}$) at rates greater than the **targets** in **Table C.2-1.** Compliance with fertilizer nitrogen application targets is assessed annually for each specific crop reported in the TNA report or INMP Summary report.

7. Participating Dischargers that apply fertilizer nitrogen ($\mathbf{A}_{FER}$) at rates greater than the **targets** in **Table C.2-1** one year after the compliance date are subject to follow-up by the approved third-party program administrator, which could include additional education and/or implementation of additional or improved management practices.

8. Participating Dischargers that apply fertilizer nitrogen ($\mathbf{A}_{FER}$) at rates greater than the **targets** in **Table C.2-1** for a two-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with the individual groundwater protection requirements in **Part 2, Section C.1**. Water Board staff will coordinate with participating Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming individual groundwater protection requirements.

Nitrogen Discharge Targets

9. Participating Dischargers must not discharge nitrogen at rates greater than the **targets** in **Table C.2-2**. Compliance with nitrogen discharge targets is assessed

annually for the entire ranch using INMP Summary report information. Participating Dischargers must comply with at least one of the nitrogen discharge compliance pathways described in **Part 2, Section C.1** by the compliance date.

10. The final year 2028 nitrogen discharge **targets**, as shown in **Table C.2-2** will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, management practice effectiveness assessment and evaluation, and groundwater protection area collective numeric interim and final targets before becoming effective.

11. Participating Dischargers that discharge nitrogen in excess of the nitrogen discharge **targets** in **Table C.2-2** one year after the compliance date are subject to follow-up by the approved third-party alternative compliance pathway program administrator, which could include additional education and/or implementation of additional or improved management practices.

12. Participating Dischargers that discharge nitrogen in excess of the year 2024 or 2026 nitrogen discharge **targets** in **Table C.2-2** for a two-year running average, must obtain annual INMP certification by a qualified professional until nitrogen discharge targets are achieved for a two-year running average. The INMP certification must include the certification language outlined in **Part 2, Section C.1**.

13. Participating Dischargers that discharge nitrogen in excess of the final nitrogen discharge target in **Table C.2-2** for a three-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with individual groundwater protection requirements in **Part 2, Section C.1**. Water Board staff will coordinate with participating Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming individual groundwater protection requirements.

Groundwater Protection Areas, Formulas, Values, and Targets

14. The approved third-party alternative compliance pathway program administrator, on behalf of its participating Dischargers, must develop and submit incremental 35%, 70%, and 100% work plans for Executive Officer approval, as described in the MRP. The 35% and 70% work plans will be subject to Executive Officer approval following a 30-day written public period and a public meeting to receive public comments and board input.

15. The incremental draft and final work plans must include the following:

a. Clearly defined objectives and scientific justification for all proposed groundwater protection (GWP) areas, formulas, values, and collective numeric interim and final targets.

b. Scientific justification in support of the proposed GWP areas with respect to, but not limited to, geology, hydrogeology, groundwater basin and subbasin areas, recharge areas, land uses, cropping patterns, and potential membership coverage by acreage and number of members. The proposed GWP areas, formula, values, and collective interim and final targets must be tied together and scaled in a way that will allow for the effective evaluation of water quality and beneficial use protection and compliance with GWP interim and final targets on both a collective and individual basis.

c. A program to assess and evaluate the performance and effectiveness of the third-party alternative compliance pathway program's collective numeric interim and final targets in achieving tangible groundwater quality improvements over time at the individual GWP area scale. The assessment and evaluation program must be scaled – spatially and temporally – in coordination with the regional groundwater quality trend monitoring program described in **Part 2, Section C.1** of the third-party program over time.

d. Criteria and associated follow-up actions or consequences that the third-party alternative compliance pathway program administrator will implement if individual participating Dischargers do not meet collective numeric interim and final targets, and third-party program membership eligibility requirements including membership probation and revocation to address recalcitrant participating Dischargers.

16. The final work plans must be approved by the Executive Officer prior to implementation. Once approved by the Executive Officer, the work plans must be implemented.

17. Compliance with the collective numeric interim and final targets for a GWP area shall be determined by aggregating data from participating Dischargers within a GWP area to determine if the combined nitrogen discharge is achieving collective compliance with the GWP Area numeric interim and final targets.

18. Although compliance with GWP collective numeric interim and final targets is assessed using the combined nitrogen discharge of participating Dischargers in a GWP area, GWP collective numeric interim and final targets must be designed such that there is a clear and quantifiable means of assessing individual ranch level contribution to the success or failure of complying with the GWP area collective numeric interim and final targets.

19. Participating Dischargers in a GWP area that exceed the GWP collective numeric interim or final targets by 20% or more, as evaluated individually and on an annual basis, are subject to follow-up by the approved third-party alternative compliance pathway program administrator, which could include additional education or implementation of additional or improved management practices.

20. All participating Dischargers in a GWP area that exceeds the collective numeric interim and final GWP targets by 20% or more for a 3-year running average after the compliance date, are no longer eligible to participate in the third-party alternative compliance pathway program and must comply with the individual groundwater protection requirements in **Part 2, Section C.1**.

Monitoring and Reporting

21. Participating Dischargers must submit ACF, TNA, and INMP Summary information according to requirements outlined in **Part 2, Section C.1**, and as described in the MRP.

22. Participating Dischargers must submit ACF, TNA, and INMP Summary information accordingto the groundwater phase assigned to each ranch. Groundwater phases are outlined in **Part 2, Section C.1**.

23. Participating Dischargers must submit groundwater monitoring and reporting information according to requirements outlined in **Part 2, Section C.1** and as described in the MRP, either individually or as part of a third-party program.

Part 2, Section C.3. Surface Water Protection

Priority Areas (Individual)

1. Ranches are assigned the Surface Water Priority area of the HUC-8 watershed where the ranch is located based on the relative level of water quality, beneficial use impairment and risk to water quality. All ranches are assigned a Surface Water Priority of 1, 2, 3, or 4. Surface Water Priority Area 1 areas represent greater water quality impairment and higher risk to water quality relative to Surface Water Priority Areas 2, 3, and 4.

2. The follow-up surface receiving water implementation requirements for surface water protection are based on the surface water priority areas, listed in **Table C.3-1** and shown on the map in **Figure C.3-1**.

3. In the event that a ranch spans multiple Surface Water Priority areas, the ranch will either be assigned the earlier priority or will be assigned the priority of the watershed or drainage unit that the ranch drains or discharges to, if specific discharge information is provided to the Central Coast Water Board.

4. The Surface Water Priority assigned to each ranch will be displayed in the ranch eNOI in GeoTracker.

Priority Areas (Third-Party Program)

5. Ranches that are enrolled as part of an approved third-party follow-up surface receiving water implementation program are assigned the third-party program Surface Water Priority of high priority, medium priority, or low priority where the ranch is located, as shown in **Table C.3-1.3P** and the map shown in **Figure C-3.1. 3P**.

6. In the event that a ranch spans multiple third-party program Surface Water Priority areas, the ranch will either be assigned the earlier priority or will be assigned the priority of the watershed or drainage unit that the ranch drains or discharges to, if specific discharge information is provided to the Central Coast Water Board.

7. The third-party program Surface Water Priority assigned to each ranch will be displayed in the ranch eNOI in GeoTracker.

Irrigation and Nutrient Management

8. Dischargers must develop and implement an Irrigation and Nutrient Management Plan (INMP) that addresses both groundwater and surface water. This section applies to the surface water related INMP requirements and the groundwater related INMP requirements are contained within **Part 2, Section C.1** of this Order. The INMP is a section of the Farm Plan, must be maintained in the Farm Plan (see **Part 2, Section B** and Farm Plan paragraph 14 below), and submitted to the Central Coast Water Board upon request. Summary information from the INMP must be submitted in the ACF, as described in the MRP.

Pesticide Management

9. Dischargers must develop and implement a Pesticide Management Plan (PMP). The PMP is a section of the Farm Plan, must be maintained in the Farm Plan (see **Part 2, Section B** and Farm Plan paragraph 14 below), and submitted to the Central Coast Water Board upon request. Summary information from the PMP must be submitted in the ACF, as described in the MRP.

Sediment and Erosion Management

10. Dischargers must develop and implement a Sediment and Erosion Management Plan (SEMP). The SEMP is a section of the Farm Plan, must be maintained in the Farm Plan (see **Part 2, Section B** and Farm Plan paragraph 14 below), and submitted to the Central Coast Water Board upon request. Summary information from the SEMP must be submitted in the ACF, as described in the MRP.

Impermeable Surfaces

11. Ranches with either 50 to 100 percent of fields covered by impermeable surfaces (defined in Attachment C of this Order), or with greater than or equal to 22,500 square feet (0.5 acre) of impermeable surfaces must manage stormwater discharge duration, rate, and volume as described below.

    a. Stormwater discharge intensity from fields with impermeable surfaces must not exceed the stormwater discharge intensity from equivalent permeable field area for any storm event up to and including the 10-year storm event. The *Santa Barbara Urban Hydrograph Method* [5] and the *Rational Method* [6] are two methods for determining the stormwater discharge intensity match, however other similar methods to determine stormwater discharge intensity may be used.

    b. Stormwater discharge volume from fields with impermeable surfaces must not exceed the stormwater discharge volume from equivalent permeable field area for any storm event up to and including the 95th percentile, 24-hour storm event. The *Curve Number Method* [7] is a method for determining the stormwater discharge volume match, however other similar methods to determined stormwater discharge volume may be used.

    c. Description and time schedules of management practices, treatment, and/or control measures implemented to meet design storm requirements and mitigate for increased stormwater runoff from impermeable surfaces must be kept in the Farm Plan. Methods for assessing the effectiveness of each management practice, treatment, and/or control measure include calculation of peak and runoff volumes, visual inspection, photo documentation, and local precipitation event data, however other storm event measurement types and recordkeeping that determine the effectiveness of management practices may be used.

Farm Plan

12. At a minimum, the elements of the Farm Plan related to surface water protection must include:

    a. Monitoring and recordkeeping necessary to submit complete and accurate reports, including the ACF.

---

[5] The Santa Barbara Urban Hydrograph Method is based on the curve number approach and is useful for sheet flow over a plane surface, called overland flow.
[6] The Rational Method is used to determine peak discharge from runoff in a given area.
[7] The Curve Number Method was developed by the Soil Conservation Service to estimate runoff from rainfall on agricultural fields and provides runoff depth that can be used to calculate runoff volume.

b. Planning and management practice implementation and assessment that results in compliance with the surface water limits in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity that apply to a ranch based on the ranch location.

c. Descriptions of all management practices implemented on the ranch, as follows:

i. All irrigation, nutrient, and salinity management practices (i.e., INMP).
ii. All pesticide management practices (i.e., PMP), including pesticide application characteristics (e.g., timing, formulations, wind, and rainfall monitoring, etc.) and any integrated pest management (IPM) practices implemented (e.g., scouting, beneficial insects, etc.).
iii. All sediment, erosion, irrigation, stormwater, road, agricultural drainage pump, and impermeable surface management practices (i.e., SEMP).

Quantifiable Milestones and Time Schedules

13. Dischargers in an area **with an established TMDL** (**Figure C.3-2** for Nutrient TMDL areas, **Figure C.3-3** for Pesticide and Toxicity TMDL areas, and **Figure C.3-4** for Sediment TMDL areas) for a pollutant must not cause or contribute to an exceedance of the pollutant's surface receiving water limit in **Table C.3-2** for nutrients, **Table C.3-4** for pesticides and toxicity, and **Table C.3-6** for sediment in accordance with the compliance dates specified in the applicable table.

14. Dischargers in an area **without an established TMDL** for a pollutant must not cause or contribute to an exceedance of the pollutant's surface receiving water limit in **Table C.3-3** for nutrients, **Table C-3.5** for pesticides and toxicity, and **Table C.3-7** for turbidity in accordance with the compliance dates specified in the applicable table.

15. The surface receiving water limits in **Table C.3-3** for nutrients, **Table C-3.5** for pesticides and toxicity, and **Table C.3-7** for turbidity, apply to all Dischargers unless a specific surface receiving water limit based on a TMDL in **Table C.3-2** for nutrients, **Table C.3-4** for pesticides and toxicity, and **Table C.3-6** for sediment applies to a Discharger.

16. Dischargers in areas where the water quality for a pollutant is better (i.e., of higher quality) than the applicable limit in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity must

not cause or contribute to an increase of that pollutant in receiving waters, except as consistent with the antidegradation findings of this Order.

17. The discharge of pollutants from a ranch that cause or contribute to an exceedance of the applicable limits after the compliance date in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity may result in additional requirements, including obtaining additional education, implementing additional or improved management practices, follow-up monitoring and reporting, ranch-level surface discharge monitoring and reporting, and progressive enforcement actions.

Monitoring and Reporting

18. Dischargers must complete **surface receiving water monitoring and reporting** as described in the MRP, either individually or through a third-party monitoring program approved by the Executive Officer. Dischargers, either individually or through a third-party monitoring program, must submit a work plan, including a SAP and QAPP as described the MRP, for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. The work plan must include applicable monitoring for the pollutants in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity and must describe the actions that will be taken to achieve the limits in the tables.

19. Dischargers must develop a **follow-up surface receiving water implementation work plan**, either individually or through a third-party program. The work plan due date is based on the Surface Water Priority of the ranch.

    a. Individual Dischargers that are not part of a third-party program approved to develop and implement follow-up surface receiving water implementation work plan(s) must submit an individual work plan by the dates specified below, based on the ranch's Surface Water Priority Area defined in **Table C.3-1** of the Order:
        i. March 1, 2023 for Surface Water Priority 1 areas
        ii. March 1, 2024 for Surface Water Priority 2 areas
        iii. March 1, 2025 for Surface Water Priority 3 areas
        iv. March 1, 2026 for Surface Water Priority 4 areas

    b. Third-party program(s) approved to develop and implement follow-up surface receiving water implementation work plan(s) on behalf of participating Dischargers must submit work plan(s) by the dates specified below, based on the third-party program surface water priority area. Third-party program surface water priority areas are defined in **Table C.3-1.3P** of the Order:

i. March 1, 2024 for High Priority areas
ii. March 1, 2026 for Medium Priority areas
iii. March 1, 2028 for Low Priority and All Other areas

c. The work plan must include numeric interim quantifiable milestones and follow-up actions, such as outreach, education, and management practice implementation and assessment, and, where applicable for pollutant source identification and abatement, additional surface receiving water monitoring locations. Numeric quantifiable milestones include numeric interim quantifiable milestones for relevant constituents (e.g., pollutant load or concentration) and numeric interim quantifiable milestones for management practices implemented that confirm progress towards reducing the discharge of relevant constituents (e.g., volume of discharge water diverted to treatment systems, treatment system pollutant reduction, distance of riparian area improvements, acres no longer receiving conventional pesticide applications). The work plan must include a SAP and QAPP. The work plan must describe the implementation measures that will be taken to reduce the discharge of relevant pollutants and achieve the applicable surface water numeric limits by the compliance dates in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity. The work plan must be submitted for Executive Officer review prior to implementation. Once approved, the work plan must be implemented.

d. Prior to the applicable compliance dates in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity, Dischargers who elect to participate in a third-party program to develop and implement their work plan will not be subject to ranch-level surface discharge monitoring and reporting.

e. Work plans must take into consideration the level of water quality impairment identified through surface receiving water monitoring. Work plans for areas with persistent exceedances of the surface water limits in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity must identify follow-up actions to restore degraded areas and meet surface receiving water limits (e.g., numeric interim quantifiable milestones, outreach, education, management practice implementation and assessment) and additional surface receiving water monitoring locations for pollutant source identification and abatement. Work plans for areas that are already achieving the surface water limits in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity must identify actions to be taken to protect the high-quality areas (e.g., numeric interim quantifiable milestones, outreach and education). Numeric quantifiable milestones include numeric interim quantifiable milestones for relevant constituents (e.g., pollutant load or concentration) and numeric interim quantifiable milestones for management practices implemented that confirm progress towards reducing the discharge of relevant constituents (e.g., volume of discharge water diverted to treatment systems, treatment system pollutant reduction, distance of riparian area improvements, acres no longer receiving conventional pesticide applications).

f. Dischargers who elect to develop their work plan individually and whose ranches are located in areas where surface receiving water monitoring shows an exceedance of an applicable surface water limit in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity after the applicable compliance deadline may be subject to ranch-level surface discharge monitoring and reporting.

20. When required by the Executive Officer, based on surface receiving water quality data or significant and repeated exceedance of the surface water quality limits in **Table C.3-2** (TMDL areas) and **Table C.3-3** (non-TMDL areas) for nutrients, **Table C.3-4** (TMDL areas) and **Table C-3.5** (non-TMDL areas) for pesticides and toxicity, and **Table C.3-6** (TMDL areas) for sediment and **Table C.3-7** (non-TMDL areas) for turbidity, Dischargers must complete **ranch-level surface discharge monitoring and reporting** as described in the MRP. Dischargers can complete this requirement either individually or as part of a third-party program effort. Water Board staff will coordinate with Dischargers prior to the Executive Officer invoking this requirement to determine if non-compliance is the result of unforeseen or uncontrollable circumstances and to provide the Discharger with 90-day advanced notice of the forthcoming requirement. When ranch-level surface discharge monitoring and reporting is required, a work plan, including a SAP and QAPP, must be submitted for Executive Officer review prior to implementation. Once approved by the Executive Officer, the work plan must be implemented. Ranch-level surface discharge monitoring may be discontinued with the approval of the Executive Officer when the Discharger comes into compliance with the surface receiving water limits, or the discharge has otherwise ceased.

21. Dischargers must report on nutrient, pesticide, and sediment and erosion control management practice implementation and assessment electronically in the ACF, as described in the MRP.

22. Dischargers whose ranches have impermeable surfaces must report on stormwater management practice implementation and assessment electronically in the ACF, as described in the MRP.

23. Dischargers with waterbodies within or bordering their ranch must measure and report the current riparian area (average width and length, in feet) in the ACF, as described in the MRP.

Part 2, Section D. Additional Requirements and Prohibitions

Waste Discharge Control and Prohibitions

1. Except in compliance with this Order, Dischargers must not cause or contribute to exceedances of applicable water quality objectives, as defined in Attachment A, must protect all beneficial uses for inland surface waters, enclosed bays, and estuaries, and for groundwater, as outlined in sections 3.3.2 and 3.3.4 of the Basin Plan, and must prevent nuisance as defined in Water Code section 13050.

2. Dischargers must achieve applicable Total Maximum Daily Load (TMDL) Load Allocations (LAs) by achieving the surface water receiving limits established in this Order. Dischargers must incorporate planning elements from applicable TMDLs into the appropriate section of their Farm Plan and, as appropriate, into their follow-up surface receiving water implementation work plan(s).

3. Dischargers that anticipate exceeding a limit or condition of the Order after the final compliance date has passed may request a time schedule order pursuant to Water Code section 13300 for the Central Coast Water Board's consideration. A time schedule order must be requested 18 months in advance of a Discharger or a group of Dischargers anticipating that they will not be able to achieve the receiving water limit by the compliance date. At a minimum, the request for a time schedule order must include information outlined in Attachment A (Additional Findings). Dischargers may either individually request a time schedule order or may jointly request a time schedule order with other Dischargers subject to the same groundwater or surface receiving water limit.

4. The discharge of rubbish, refuse, trash, irrigation tubing or tape, or other solid wastes into surface waters is prohibited. The placement of such materials where they discharge or have the potential to discharge to surface waters is prohibited.

5. The discharge of chemicals such as fertilizers, fumigants, pesticides, herbicides, or rodenticides down a groundwater well casing is prohibited.

6. The discharge of chemicals, including those used to control wildlife (such as bait traps or poison), directly into surface waters or groundwater is prohibited. The placement of chemicals in a location where they may be discharged to surface waters or groundwater is prohibited.

7. Dischargers who apply fertilizers, fumigants, pesticides, herbicides, rodenticides, or other chemicals through an irrigation system must have functional and properly maintained backflow prevention devices installed at the well or pump to prevent pollution of groundwater and surface water that comply with any applicable DPR requirements or local ordinances. Backflow prevention devices used to protect water quality must be those approved by the United States Environmental Protection Agency (USEPA), DPR, State Water Board Division of Drinking Water, or the local public health or water agency.

8. Dischargers must properly destroy all abandoned groundwater wells, exploration holes or test holes, as defined by Department of Water Resources (DWR) Bulletin 74-81 and revised in 1988, in such a manner that they will not produce water or act as a conduit for mixing or otherwise transfer groundwater or waste pollutants between permeable zones or aquifers. Well destruction must be performed in compliance with any applicable DWR requirements or local ordinances (including local well destruction permitting requirements).

9. This Order does not authorize the discharge of pollutants from point sources to waters of the United States, including wetlands. Where required, Dischargers must obtain authorization for such discharges by obtaining a Clean Water Act (CWA) section 402 National Pollutant Discharge Elimination System (NPDES) permit or a CWA section 404 dredge and fill permit.

10. Dischargers who utilize containment structures (such as retention ponds or reservoirs) to achieve treatment or control of the discharge of waste must manage, construct, and maintain such containment structures to avoid discharges of waste to groundwater and surface water that cause or contribute to exceedances of water quality objectives or impairment of beneficial uses. Dischargers may choose the method of compliance appropriate for the individual ranch, which may include, but is not limited to:

    a. Implementing chemical treatment (such as enzymes);
    b. Implementing biological treatment (such as wood chips);
    c. Recycling or reusing contained water to minimize infiltration or discharge of waste;
    d. Minimizing the volume of water in the containment structure to minimize percolation of waste; and/or
    e. Minimizing percolation of waste via a synthetic, concrete, clay, or low permeability soil liner.

11. Dischargers must implement proper handling, storage, disposal, and management of fertilizers, fumigants, pesticides, herbicides, rodenticides, and other chemicals to prevent or control the discharge of waste to waters of the state that causes or contributes to exceedances of water quality standards. All chemical storage areas must have appropriate secondary containment structures to protect water quality and prevent discharge through spillage, mixing, or seepage.

12. Dischargers must implement water quality protective management practices (such as source control or treatment) to prevent erosion, reduce stormwater runoff quantity and velocity, and hold fine particles in place.

13. Dischargers must minimize the presence of bare soil vulnerable to erosion and soil runoff to surface waters and implement erosion control, sediment, and stormwater management practices in non-cropped areas, such as unpaved roads and other heavy use areas.

14. Dischargers who utilize agricultural drainage pumps must implement management practices to dissipate flow and prevent channel and/or streambank erosion resulting in increased sediment transport and turbidity within surface water.

15. Dischargers must comply with any applicable stormwater permits.

16. Dischargers must implement best practicable treatment or control (BPTC) measures for the construction and maintenance of farm roads to minimize erosion and sediment discharges that contribute to nonpoint source pollution.

17. Dischargers must ensure that all farm roads are, to the extent possible, hydrologically disconnected from waters of the state by installing disconnecting drainage features, increasing the frequency of (inside) ditch drain relief as needed, constructing out-sloped roads, constructing energy dissipating structures, avoiding concentrating flows in unstable areas, and performing inspection and maintenance as needed to optimize access road performance.

18. Dischargers must ensure that farm road surfacing, especially within a segment leading to waters of the state, minimizes sediment delivery to waters of the state and maximizes road integrity.

19. Dischargers must ensure that farm roads are out-sloped whenever possible to promote even drainage of the farm road surface, prevent the concentration of stormwater flow within an inboard or inside ditch, and to prevent disruption of the natural sheet flow pattern off a hill slope to waters of the state.

20. Farm road stormwater drainage structures must not discharge onto unstable slopes, earthen fills, or directly into waters of the state. Drainage structures must discharge onto stable areas with straw bales, slash, vegetation, and/or rock riprap.

21. If used, chemical toilets or holding tanks must be maintained in a manner appropriate for the frequency and conditions of usage, sited in stable locations, and located outside of areas bordering surface waterbodies.

22. Dischargers who produce and apply compost in-house must comply with the following requirements:

    a. Materials and activities on-site must not cause, threaten to cause, or contribute to conditions of pollution, contamination, or nuisance;
    b. Activities must be set back at least 100 feet from the nearest surface waterbody and/or the nearest water supply well;
    c. Dischargers must implement practices to minimize or eliminate the discharge of waste that may adversely impact the quality or beneficial uses of waters of the state;
    d. Dischargers must manage the application of water to compost (including from precipitation events) to reduce the generation of wastewater;
    e. Working surfaces must be designed to prevent, to the greatest extent possible, ponding, infiltration, inundation, and erosion, notwithstanding precipitation events, equipment movement, and other aspects of the facility operations;
    f. Dischargers must maintain the following records in the Farm Plan. These records must be submitted to the Central Coast Water Board upon request.
        i. Total operational footprint of compost activities (in acres), including ancillary activities;
        ii. Compost operation records to provide background information on the composting operation history and a description of methods and operation used, including the following: feedstock types, volumes, sources, and suppliers. Description of the method of composting (e.g., windrow, static, forced air, mechanical). Description of how residuals are removed from the feedstocks and managed and/or disposed of.
        iii. Description of water supply.
        iv. Map detailing the location and size (in acres) of the working surface used for the storage of incoming feedstocks, additives, and amendments (receiving area); active and curing composting; final product; drainage patterns; location of any groundwater monitoring wells and water supply wells within and/or near the property boundary; location and distance (in feet) to nearby water supply wells (e.g., municipal supply, domestic supply, agricultural wells) from the nearest property boundary of the operation; identification of all surface waterbodies, including streams, ditches, canals, and other drainage

courses; and distances from the nearest property boundary of the operation to these surface waterbody areas.

v. Records of appropriate monitoring (dependent on method of composting) for composting to develop final product (temperature, turning, air flow, etc.).

vi. Records of final product use, including locations and volumes.

23. Disturbance (e.g., removal, degradation, or destruction) of existing, naturally occurring, and established native riparian vegetative cover (e.g., trees, shrubs, and grasses), unless authorized or exempted (e.g., Clean Water Act [CWA] section 404 permit and CWA section 401 certification, WDRs, waivers of WDRs, a California Department of Fish and Wildlife [CDFW] Lake and Streambed Alteration Agreement, or municipal ordinance), is prohibited. Dischargers must avoid disturbance in riparian areas to minimize waste discharges and protect water quality and beneficial uses.

24. In the case where disturbance of riparian areas is authorized, Dischargers must implement appropriate and practicable measures to avoid, minimize, and mitigate erosion and discharges of waste.

Additional Requirements

25. Upon the Central Coast Water Board's request, Dischargers must submit information regarding compliance with any DPR adopted or approved surface water or groundwater protection requirements to the Central Coast Water Board.

26. Upon the Central Coast Water Board's request, Dischargers must submit proof of an approved Lake and Streambed Alteration Agreement or other authorization or release from the CDFW to the Central Coast Water Board for any work conducted within the bed, bank, and channel, including riparian areas, of parcels enrolled in this order, that has the potential to result in erosion and discharges of waste to waters of the State.

27. Upon the Central Coast Water Board's request, Dischargers must submit proof of a Clean Water Act section 404 dredge and fill permit from the United States Army Corps of Engineers (USACE) for any work that has the potential to discharge wastes considered "fill" material, such as sediment, to waters of the United States to the Central Coast Water Board.

28. Dischargers must comply with DWR Bulletin 74-81 and supplement 74-90, Water Code sections 13700 through 13755, and any local permitting requirements associated with installation of new wells.

29. This Order does not authorize any act that results in the taking of a threatened or endangered species or any act that is now prohibited, or becomes prohibited in

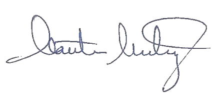
the future, under either the California Endangered Species Act (Fish and Game Code sections 2050 to 2097) or the federal Endangered Species Act (16 U.S.C. sections 1531 to 1544). If a "take" will result from any act authorized under this Order, the Dischargers must obtain authorization for an incidental take prior to taking action. Dischargers are responsible for meeting all applicable requirements of the California and federal Endangered Species Acts for the discharge authorized by this Order.

30. Dischargers or a representative authorized by the Discharger must sign technical reports submitted to the Central Coast Water Board to comply with this Order. Any person signing or submitting a document must provide the following certification, whether written or implied:

"In compliance with Water Code section 13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision, following a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

CERTIFICATION

I, Matthew T. Keeling, Executive Officer, do hereby certify that this General Order with all its attachments is a full, true, and correct copy of an order adopted by the California Regional Water Quality Control Board, Central Coast Region on April 15, 2021.



Matthew T. Keeling, Executive Officer

Tables and Figures

Tables and Figures related to Part 2, Section C.1. Groundwater Protection

Table C.1-1. Groundwater Phase Areas

Groundwater Basin[1]	Groundwater Phase
Gilroy-Hollister Valley - Llagas Area	Phase 1, Phase 2
Salinas Valley - Forebay Aquifer	Phase 1, Phase 2
Salinas Valley - Upper Valley Aquifer	Phase 1, Phase 2
Santa Maria River Valley - Santa Maria	Phase 1, Phase 2
Santa Ynez River Valley	Phase 1, Phase 3
Corralitos - Pajaro Valley	Phase 2
Gilroy Hollister Valley - North San Benito	Phase 2
Salinas Valley - 180/400 Foot Aquifer	Phase 2
Salinas Valley - East Side Aquifer	Phase 2
San Luis Obispo Valley	Phase 2
All Other Basins and Areas Outside of Basins	Phase 3

[1]As defined in the 2019 California Department of Water Resources Bulletin 118.

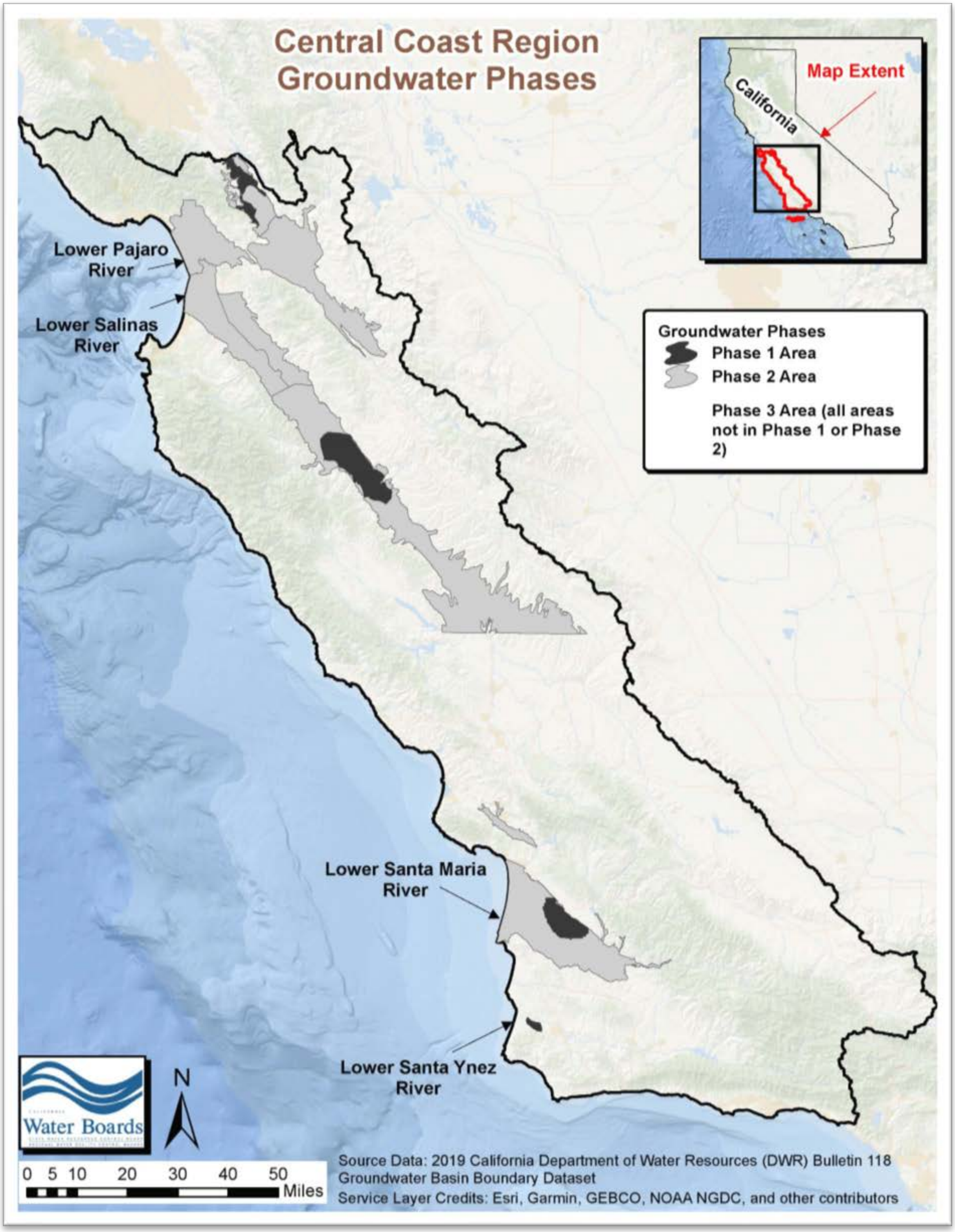


Figure C.1-1: Groundwater Phase Areas

Table C.1-2. Compliance Dates for Fertilizer Nitrogen Application Limits

Crop	90th Percentile A_{FER} =	Compliance Date	85th Percentile A_{FER} =	Compliance Date
Broccoli	295	12/31/2023	280	12/31/2025
Cauliflower	310		285	
Celery	360		330	
Lettuce	275		255	
Spinach	245		230	
Strawberry	320		295	
All Other Crops	500		480	

Note: For crops grown for less than one year (e.g., broccoli, lettuce, etc.), units are in pounds of nitrogen per acre per crop. In the situation where a Discharger grows a crop more than once during the year, e.g. grows a spring lettuce and a fall lettuce, the application limit applies to each of the crops separately: no more than 275 pounds of nitrogen per acre can be applied to the spring lettuce crop and no more than 275 pounds of nitrogen per acre can be applied to the fall lettuce crop. The two lettuce crops can be reported on separately or can be averaged together. For crops grown for more than one year (e.g., grapes, trees, etc.), units are in pounds of nitrogen per acre per year. The 90th and 85th percentile fertilizer nitrogen application limits were determined by using year 2014 to 2019 total nitrogen applied (TNA) reporting information.

Table C.1-3. Compliance Dates for Nitrogen Discharge Targets and Limits

	Compliance Date		
Compliance Pathway 1 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R =$	Target	500	12/31/2023
	Target	400	12/31/2025
	Limit	300	12/31/2027
	Limit	200	12/31/2031
	Limit	150	12/31/2036
	Limit	100	12/31/2041
	Limit	50	12/31/2051
OR			
	Compliance Date		
Compliance Pathway 2 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$	Target	A = R	12/31/2023
	Target	A = R	12/31/2025
	Limit	A = R	12/31/2027
	Limit	A = R	12/31/2031
	Limit	A = R	12/31/2036
	Limit	A = R	12/31/2041
	Limit	A = R	12/31/2051
OR			
	Compliance Date		
Compliance Pathway 3 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R =$	Target	300	12/31/2023
	Target	200	12/31/2025
	Limit	100	12/31/2027
	Limit	0	12/31/2031
	Limit	-50	12/31/2036
	Limit	-100	12/31/2041
	Limit	-150	12/31/2051

Note: All units are in pounds of nitrogen per acre per year and represent all crops grown and harvested on the entire ranch. The initial 2027 nitrogen discharge limits will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, and management practice implementation and assessment before becoming effective.

$\mathbf{A_{FER}}$ is the amount of fertilizer nitrogen applied in pounds per acre.
C is the compost discount factor used to represent the amount of compost nitrogen mineralized during the year that the compost was applied.
$\mathbf{A_{COMP}}$ is the total amount of compost nitrogen applied in pounds per acre.
$\mathbf{A_{IRR}}$ is the amount of nitrogen in pounds per acre applied in the irrigation water estimated from the volume required for crop evapotranspiration (ET) or volume of water applied.
O is the organic fertilizer discount factor used to represent the amount of nitrogen mineralized during the first 12 weeks in the year it was applied.
$\mathbf{A_{ORG}}$ is the total amount of organic fertilizer or amendment nitrogen applied in pounds per acre.
R is the amount of nitrogen removed from the field through harvest, sequestration, or other removal methods, in pounds per acre.

Note: Report due dates to confirm compliance with the fertilizer application limits and nitrogen discharge targets and limits are included in the MRP.

Tables and Figures related to Part 2, Section C.2. Third-Party Alternative Compliance Pathway for Groundwater Protection

Table C.2-1. Compliance Dates for Fertilizer Nitrogen Application Targets (Alternative Compliance Pathway)

Crop	90th Percentile A_{FER} =	Compliance Date	85th Percentile A_{FER} =	Compliance Date
Broccoli	295	12/31/2024	280	12/31/2026
Cauliflower	310		285	
Celery	360		330	
Lettuce	275		255	
Spinach	245		230	
Strawberry	320		295	
All Other Crops	500		480	

Note: For crops grown for less than one year (e.g., broccoli, lettuce, etc.), units are in pounds of nitrogen per acre per crop. In the situation where a Discharger grows a crop more than once during the year, e.g. grows a spring lettuce and a fall lettuce, the application limit applies to each of the crops separately: no more than 275 pounds of nitrogen per acre can be applied to the spring lettuce crop and no more than 275 pounds of nitrogen per acre can be applied to the fall lettuce crop. The two lettuce crops can be reported on separately or can be averaged together. For crops grown for more than one year (e.g., grapes, trees, etc.), units are in pounds of nitrogen per acre per year. The 90th and 85th percentile fertilizer nitrogen application targets were determined by using year 2014 to 2019 total nitrogen applied (TNA) reporting information.

Table C.2-2. Compliance Dates for Nitrogen Discharge Targets (Alternative Compliance Pathway)

	Target	Compliance Date
Compliance Pathway 1 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) + A_{IRR} - R =$	500	12/31/2024
	400	12/31/2026
	300	12/31/2028
OR		
Compliance Pathway 2 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) = R$	**Target**	**Compliance Date**
	A = R	12/31/2024
	A = R	12/31/2026
	A = R	12/31/2028
OR		
Compliance Pathway 3 $A_{FER} + (C \times A_{COMP}) + (O \times A_{ORG}) - R =$	**Target**	**Compliance Date**
	300	12/31/2024
	200	12/31/2026
	100	12/31/2028

Notes: All units are in pounds of nitrogen per acre per year and represent all crops grown and harvested on the entire ranch. All compliance pathway variables are defined above under **Table C.1-3**. The final 2028 nitrogen discharge targets will be re-evaluated based on discharger reported nitrogen applied and removed data, new science, management practice implementation and assessment, and third-party GWP collective numeric interim and final targets before becoming effective.

Tables and Figures related to Part 2, Section C.3. Surface Water Protection

Table C.3-1. Surface Water Priority Areas

HUC-8 Number[1]	HUC-8 Name	Surface Water Priority
18060008	Santa Maria	Priority 1
18060005	Salinas	Priority 2
18060002	Pajaro	Priority 3
18060015	Monterey Bay	Priority 3
18060010	Santa Ynez	Priority 3
18050003	Coyote	Priority 4
18050006	San Francisco Coastal South	Priority 4
18060004	Estrella	Priority 4
18060006	Central Coastal	Priority 4
18060003	Carrizo Plain	Priority 4
18060007	Cuyama	Priority 4
18060009	San Antonio	Priority 4
18060013	Santa Barbara Coastal	Priority 4
18060014	Santa Barbara Channel Islands	Priority 4
18070101	Ventura	Priority 4

[1]As defined by the National Hydrography Dataset Plus Watershed Boundary Dataset

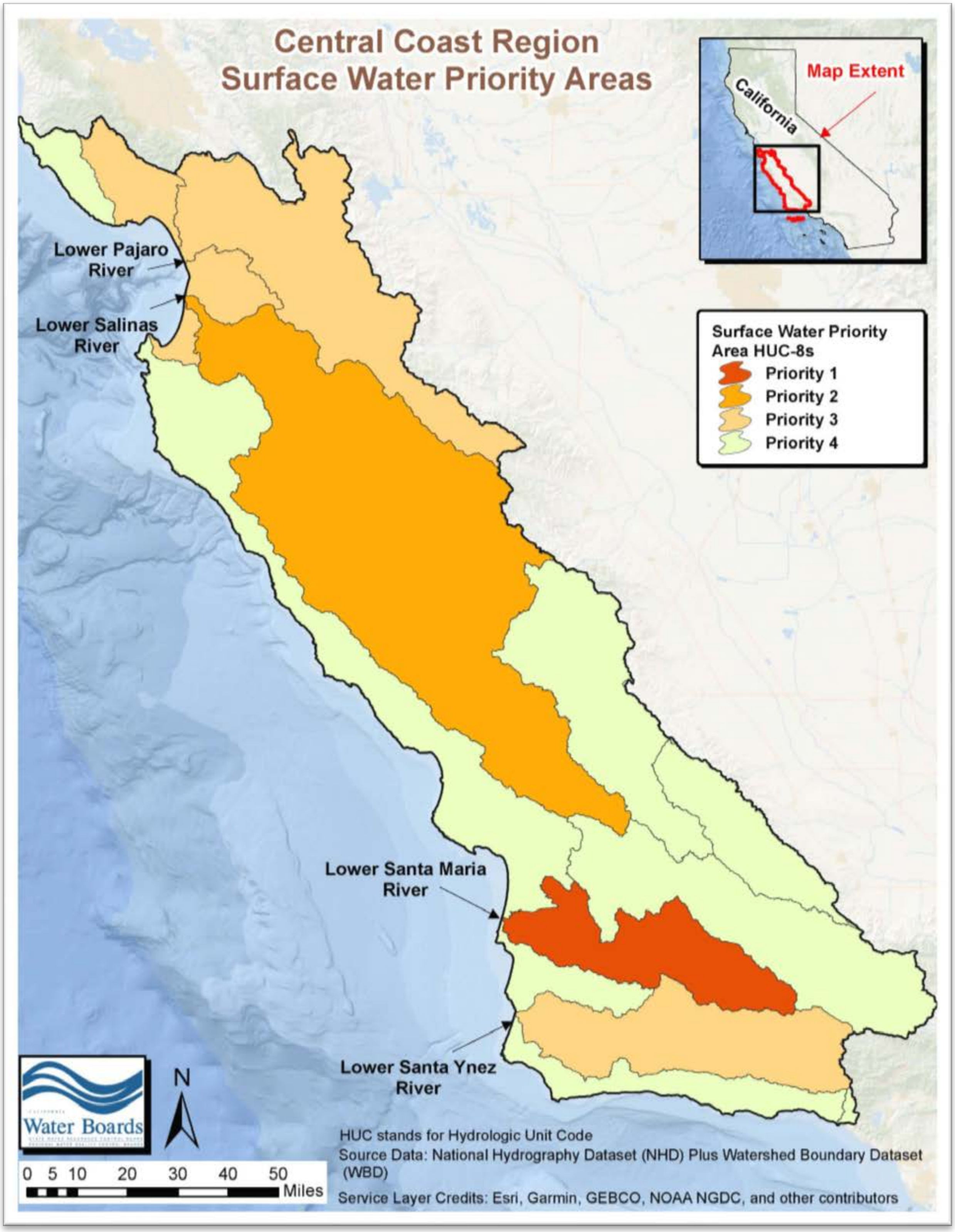


Figure C-3.1: Surface Water Priority Areas

Table C.3-1.3P. Surface Water Priority Areas (Third-Party Program)

High Priority	
305FUF	Furlong Creek at Frazier Lake Road
309ALG	Salinas Reclamation Canal at La Guardia
309CCD	Chualar Creek west of Highway 101
309CRR	Chualar Creek North Branch east of Highway 101
309ESP	Espinosa Slough upstream from Alisal Slough
309JON	Salinas Reclamation Canal at San Jon Road
309MER	Merrit Ditch upstream of Highway 183
309NAD	Natividad Creek upstream of Salinas Reclamation Canal
309OLD	Old Salinas River at Monterey Dunes Way
309QUI	Quail Creek at culvert on east side of Highway 101
309TEH	Tembladero Slough at Haro Street
312BCC	Bradley Canyon Creek at Culvert
312BCJ	Bradley Channel at Jones Street
312GVS	Green Valley at Simas
312MSD	Main Street Canal upstream of Ray Road at Highway 166
312OFC	Oso Flaco Creek at Oso Flaco Lake Road
312ORC	Orcutt Solomon Creek upstream of Santa Maria River
312ORI	Orcutt Solomon Creek at Highway 1
312SMA	Santa Maria River at Estuary
Medium Priority	
305BRS	Beach Road Ditch at Shell Road
305CAN	Carnadero Creek upstream of Pajaro River
305CHI	Pajaro River at Chittenden Gap
305FRA	Pajaro River Millers Canal at Frazier Lake Road
305LCS	Llagas Creek at Southside Avenue
305PJP	Pajaro River at Main Street
305SJA	San Juan Creek at Anzar Road
305TSR	Tequisquita Slough upstream of Pajaro River at Shore Road
305WCS	Watsonville Creek at Elkhorn Road / Hudson Landing
309ASB	Alisal Slough at White Barn
309BLA	Blanco Drain below Pump
309GAB	Gabilan Creek at Boronda Road
309MOR	Moro Cojo Slough at Highway 1
309RTA	Santa Rita Creek at Santa Rita Creek Park
310LBC	Los Berros Creek at Century Road
310PRE	Prefumo Creek at Calle Joaquin
310USG	Arroyo Grande Creek at old USGS Gauge
310WRP	Warden Creek at Wetlands Restoration Preserve
312OFN	Little Oso Flaco Creek
312SMI	Santa Maria at Highway 1
313SAE	San Antonio Creek at San Antonio Road east
314SYN	Santa Ynez River at 13^{th}
315BEF	Bell Creek at Winchester Canyon Park
315FMV	Franklin Creek at Mountain View Lane
315GAN	Glenn Annie Creek
315LCC	Los Carneros Creek at Calle Real

Low Priority	
305COR	Salsipuedes Creek downstream of Corralitos Creek upstream of HWY 129
305WSA	Watsonville Slough at San Andreas Road
309GRN	Salinas River (Mid) at Elm Road in Greenfield
309SAC	Salinas River at Chualar
309SAG	Salinas River at Gonzales River Road Bridge
309SSP	Salinas River (Lower) at Spreckles Gauge
310CCC	Chorro Creek upstream of Chorro Flats
314SYF	Santa Ynez River at Flordale
314SYL	Santa Ynez River at River Park
315APF	Arroyo Paredon Creek at Foothill Bridge
All Other Areas	Low priority also includes all other areas not in high or medium priority areas

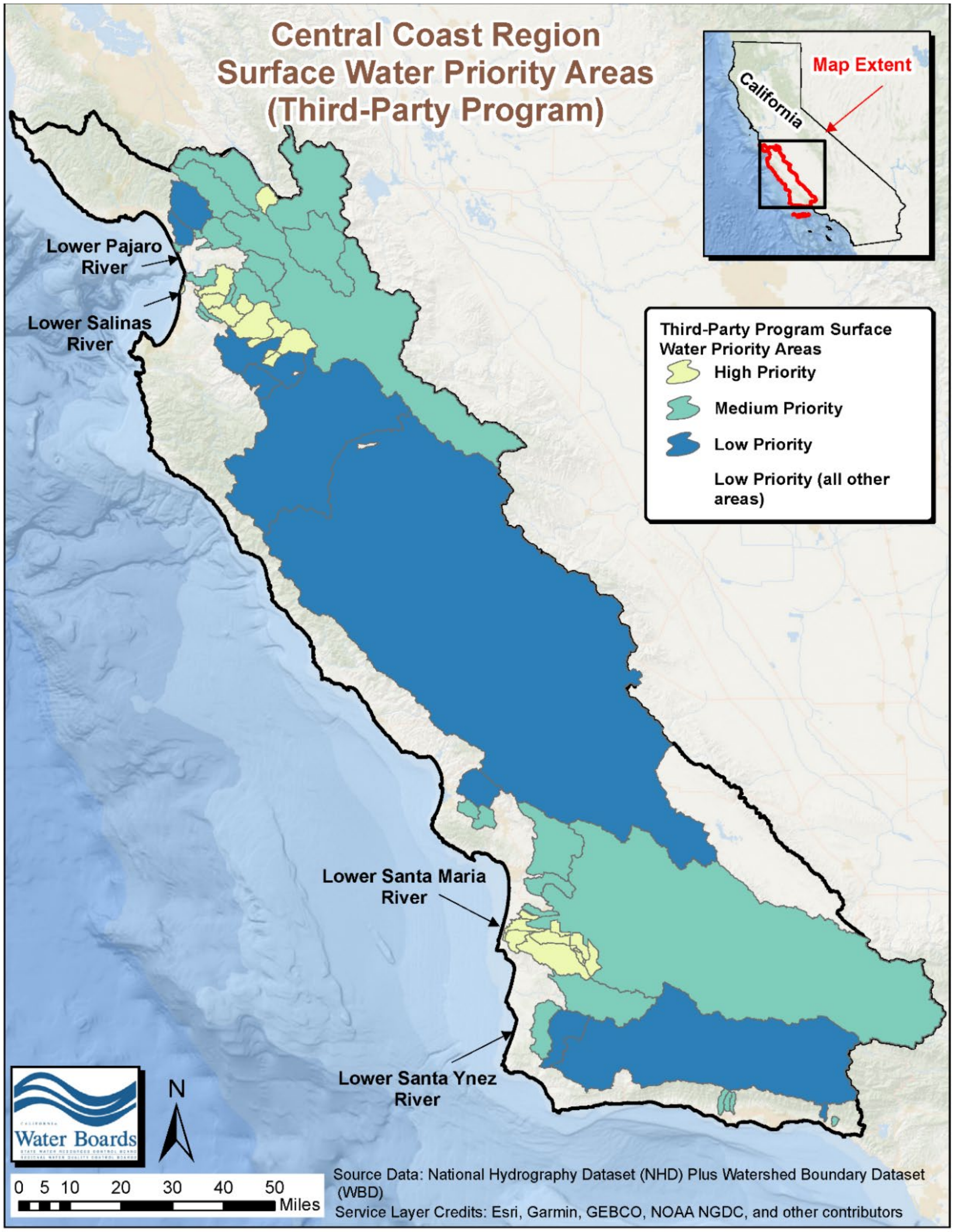


Figure C-3.1.3P: Surface Water Priority Areas (Third-Party Program)

Table C.3-2. Compliance Dates for Nutrient Limits (TMDL areas)

TMDL Project Name	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Arroyo Paredon Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Bell Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Franklin Creek Nutrients TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Franklin Creek Nutrients TMDL	Total Nitrogen, as N	Water Column	Wet Season: 8.0	mg/L	3/4/2034
Franklin Creek Nutrients TMDL	Total Phosphorous	Water Column	Wet Season: 0.3	mg/L	3/4/2034
Franklin Creek Nutrients TMDL	Total Nitrogen, as N	Water Column	Dry Season: 1.1	mg/L	3/4/2044
Franklin Creek Nutrients TMDL	Total Phosphorous	Water Column	Dry Season: 0.075	mg/L	3/4/2044
Glen Annie Canyon, Tecolotito Creek, & Carneros Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Los Berros Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Los Osos Creek, Warden Creek, and Warden Lake Wetland Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

TMDL Project Name	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Lower Salinas River Watershed Nutrient TMDL	Ammonia (Un-Ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Lower Salinas River Watershed Nutrient TMDL	Total Nitrogen, as N4	Water Column	Wet Season: 8.0	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Wet Season: 8.0	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Wet Season: 0.3	mg/L	5/7/2034
Lower Salinas River Watershed Nutrient TMDL	Total Nitrogen, as N4	Water Column	Dry Season: 1.7	mg/L	5/7/2044
Lower Salinas River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Dry Season: 1.4 – 6.41	mg/L	5/7/2044
Lower Salinas River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.07 – 0.131	mg/L	5/7/2044
Pajaro River Watershed Nutrient TMDL	Ammonia (Un-ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

TMDL Project Name	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Pajaro River Watershed Nutrient TMDL	Total Nitrogen, as N	Water Column	Wet Season: 8.0	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Wet Season: 8.0	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Wet Season: 0.3	mg/L	12/31/2032
Pajaro River Watershed Nutrient TMDL	Total Nitrogen, as N5	Water Column	Dry Season: 1.1 – 2.11	mg/L	7/12/2041
Pajaro River Watershed Nutrient TMDL	Nitrate, as N	Water Column	Dry Season: 1.8 – 3.91	mg/L	7/12/2041
Pajaro River Watershed Nutrient TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.04 – 0.141	mg/L	7/12/2041
San Luis Obispo Creek Nitrate TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032
Santa Maria River Watershed Nutrients TMDL	Ammonia (Un-Ionized), as N3	Water Column	0.025	mg/L	12/31/2032
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	10.0	mg/L	12/31/2032

TMDL Project Name	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	Wet Season or Year-Round: 5.7 – 8.01	mg/L	5/22/2034
Santa Maria River Watershed Nutrients TMDL	Orthophosphate, as P	Water Column	Wet Season or Year-Round: 0.08 – 0.31	mg/L	5/22/2034
Santa Maria River Watershed Nutrients TMDL	Nitrate, as N	Water Column	Dry Season: 4.3	mg/L	5/22/2044
Santa Maria River Watershed Nutrients TMDL	Orthophosphate, as P	Water Column	Dry Season: 0.19	mg/L	5/22/2044

[1]The Lower Salinas River Watershed Nutrient TMDL, Pajaro River Watershed Nutrient TMDL, and Santa Maria River Watershed Nutrient TMDL include load allocations for specific waterbody reaches within the TMDL project area. The limits for those TMDLs are summarized in this table as ranges; however, the exact load allocation values for each reach apply as described in the TMDL and Basin Plan and will be assessed as numeric limits for the purposes of this Order.
[2]mg/L is milligrams per liter.
[3]Calculated using total ammonia and onsite instream measurements (field measurements) of pH and water temperature.
[4]Total nitrogen TMDL load allocation applies to Moro Cojo Slough only.
[5]Total nitrogen TMDL load allocation applies to the following sloughs: Watsonville, Harkins, Gallighan, and Struve.

Table C.3-3. Compliance Dates for Nutrient Limits (Non-TMDL areas)

Constituent Group	Constituent	Matrix	Limit	Units[1]	Compliance Date
Nutrients	Nitrate, as Nitrogen	Water Column	10.0	mg/L	12/31/2032
Nutrients	Ammonia (un-ionized), as Nitrogen[2]	Water Column	0.025	mg/L	12/31/2032

[1]mg/L is milligrams per liter.
[2]Calculated using total ammonia and onsite instream measurements (field measurements) of pH and water temperature.

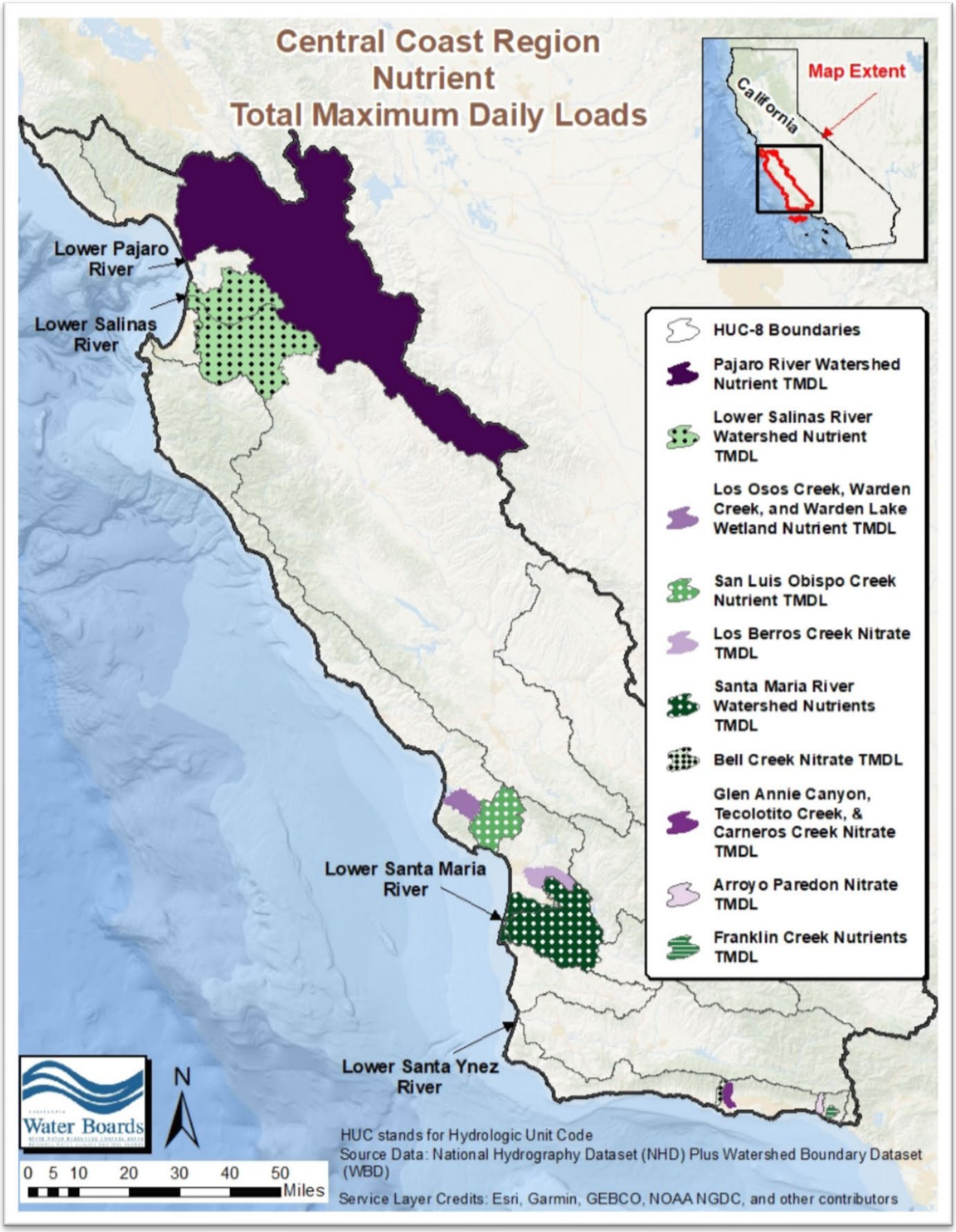


Figure C.3-2: Nutrient TMDL Areas

Table C.3-4. Compliance Dates for Pesticide and Toxicity Limits (TMDL areas)

TMDL Project Name	Constituent[1]	Matrix	Limit[2]	Units[3]	Compliance Date
Arroyo Paredon Diazinon TMDL	Additive Toxicity (Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032
Arroyo Paredon Diazinon TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Chlorpyrifos[4]	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Diazinon[4]	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032
Lower Salinas River Watershed Chlorpyrifos and Diazinon TMDL	Additive Toxicity (Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032

TMDL Project Name	Constituent[1]	Matrix	Limit[2]	Units[3]	Compliance Date
Lower Salinas River Watershed Sediment Toxicity and Pyrethroids in Sediment TMDL	Additive Toxicity (Pyrethroids)	Sediment	Sum of Pyrethroid TU < 1.0	TU	12/31/2032
Lower Salinas River Watershed Sediment Toxicity and Pyrethroids in Sediment TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with *Hyalella azteca*	Survival endpoint	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Additive Toxicity (Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Chlorpyrifos	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032

TMDL Project Name	**Constituent[1]**	**Matrix**	**Limit[2]**	**Units[3]**	**Compliance Date**
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with *Hyalella azteca*	Survival and reproduction endpoints	12/31/2032
Pajaro River Watershed Chlorpyrifos and Diazinon TMDL	Aquatic Toxicity	Water Column	No significant toxic effect, 7-day, chronic exposure with *Ceriodaphnia dubia*	Survival and reproduction endpoints	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Additive Toxicity (Chlorpyrifos and Diazinon)	Water Column	Sum of Additive Toxicity, TU ≤ 1.0	TU	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Chlorpyrifos	Water Column	CCC: 0.015 CMC: 0.025	µg/L	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Diazinon	Water Column	CCC: 0.10 CMC: 0.16	µg/L	12/31/2032

TMDL Project Name	Constituent[1]	Matrix	Limit[2]	Units[3]	Compliance Date
Santa Maria River Watershed Toxicity and Pesticide TMDL	Malathion	Water Column	CCC: 0.028 CMC: 0.17	µg/L	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Additive Toxicity (Pyrethroids)	Sediment	Sum of Pyrethroid TU ≤ 1.0	TU	12/31/2032
Santa Maria River Watershed Toxicity and Pesticide TMDL	Aquatic Toxicity	Sediment	No significant toxic effect, 10-day, chronic exposure with *Hyalella azteca*	Survival endpoint	Not Defined[5]
Santa Maria River Watershed Toxicity and Pesticide TMDL	Aquatic Toxicity	Water Column	No significant toxic effect, 6-8 day, chronic exposure with *Ceriodaphnia dubia*	Survival and reproduction endpoints	Not Defined[5]
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4’-DDT (p,p-DDT)	Sediment	6.5	µg/kg o.c.	10/29/2044

TMDL Project Name	Constituent[1]	Matrix	Limit[2]	Units[3]	Compliance Date
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4'-DDE (p,p-DDE)	Sediment	5.5	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	4,4'-DDD (p,p-DDD)	Sediment	9.1	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Total DDT (Sediment)	Sediment	10.0	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Chlordane	Sediment	1.7	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Dieldrin	Sediment	0.14	µg/kg o.c.	10/29/2044
Santa Maria River Watershed Toxicity and Pesticide TMDL	Endrin	Sediment	550.0	µg/kg o.c.	10/29/2044

TMDL Project Name	**Constituent[1]**	**Matrix**	**Limit[2]**	**Units[3]**	**Compliance Date**
Santa Maria River Watershed Toxicity and Pesticide TMDL	Toxaphene	Sediment	20.0	µg/kg o.c.	10/29/2044

[1]Toxic units and/or additive toxicity units are calculated using the relevant biological indicators, as described in the applicable TMDL, e.g. LC50, CCC, or CMC.
[2]CCC is Criterion Continuous Concentration or chronic (4-day (96-hour) average), not to be exceeded more than once in a three year period; CMC is Criterion Maximum Concentration or acute (1- hour average) not to be exceeded more than once in a three year period; the sum of additive toxicity is calculated by dividing each measured chemical concentration by that chemical's criterion (CCC or CMC) and summing those values as defined in the staff report for the respective TMDL project.
[3]µg/L is micrograms per liter; µg/kg is micrograms per kilogram; ng/g is nanograms per gram; o.c. means normalized for sediment organic carbon content; ppb is parts per million.
[4]Apply only when one of the two compounds (chlorpyrifos or diazinon) is present.
[5]A time schedule for aquatic toxicity was not identified in the Santa Maria River Watershed Toxicity and Pesticide TMDL; therefore, Dischargers in this area must comply with the aquatic toxicity compliance date defined in Table C.3-2.

Table C-3.5. Compliance Dates for Pesticide and Toxicity Limits (Non-TMDL areas)

Constituent Group	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Pesticides	Acetamiprid	Water Column	2.10	µg/L	12/31/2032
Pesticides	Atrazine	Water Column	60.0	µg/L	12/31/2032
Pesticides	Bifenthrin	Sediment	0.52	µg/g o.c.	12/31/2032
Pesticides	Chlorpyrifos	Water Column	0.023	µg/L	12/31/2032
Pesticides	Chlorpyrifos	Sediment	1.77	µg/g o.c.	12/31/2032
Pesticides	Clothianidin	Water Column	0.05	µg/L	12/31/2032
Pesticides	Cyanazine	Water Column	27.0	µg/L	12/31/2032
Pesticides	Cyfluthrin	Sediment	1.08	µg/g o.c.	12/31/2032
Pesticides	Cypermethrin	Sediment	0.38	µg/g o.c.	12/31/2032
Pesticides	Danitol (fenpropathrin)	Sediment	1.10	µg/g o.c.	12/31/2032
Pesticides	Demeton-s-methyl sulfoxide (oxydemeton-methyl)	Water Column	46	µg/L	12/31/2032
Pesticides	Diazinon	Water Column	0.105	µg/L	12/31/2032
Pesticides	Dichlorvos	Water Column	0.0058	µg/L	12/31/2032
Pesticides	Dimethoate	Water Column	0.50	µg/L	12/31/2032
Pesticides	Dinotefuran	Water Column	23.5	µg/L	12/31/2032
Pesticides	Disulfoton (Disyton)	Water Column	0.01	µg/L	12/31/2032
Pesticides	Diuron	Water Column	80.0	µg/L	12/31/2032
Pesticides	Esfenvalerate	Sediment	1.54	µg/g o.c.	12/31/2032
Pesticides	Fenvalerate	Sediment	1.54	µg/g o.c.	12/31/2032
Pesticides	Glyphosate	Water Column	26,600	µg/L	12/31/2032
Pesticides	Imidacloprid	Water Column	0.01	µg/L	12/31/2032
Pesticides	Cyhalothrin, lambda	Sediment	0.45	µg/g o.c.	12/31/2032
Pesticides	Linuron	Water Column	0.09	µg/L	12/31/2032
Pesticides	Malathion	Water Column	0.049	µg/L	12/31/2032
Pesticides	Methamidophos	Water Column	4.50	µg/L	12/31/2032
Pesticides	Methidathion	Water Column	0.66	µg/L	12/31/2032
Pesticides	Paraquat	Water Column	< 36.9	µg/L	12/31/2032
Pesticides	Parathion-methyl	Water Column	0.25	µg/L	12/31/2032
Pesticides	Permethrin	Sediment	10.83	µg/g o.c.	12/31/2032

Constituent Group	Constituent	Matrix	Limit[1]	Units[2]	Compliance Date
Pesticides	Phorate	Water Column	0.21	µg/L	12/31/2032
Pesticides	Phosmet	Water Column	0.80	µg/L	12/31/2032
Pesticides	Simazine	Water Column	40.0	µg/L	12/31/2032
Pesticides	Thiacloprid	Water Column	0.97	µg/L	12/31/2032
Pesticides	Thiamethoxam	Water Column	0.74	µg/L	12/31/2032
Pesticides	Trifluralin	Water Column	2.40	µg/L	12/31/2032
Toxicity	Sediment Toxicity	Sediment	No significant effect based on chronic or acute toxicity to applicable test organism	Survival, growth, and reproduction endpoints[3]	12/31/2032
Toxicity	Water Column Toxicity	Water Column	No significant effect based on chronic or acute toxicity to applicable test organism	Survival, growth, and reproduction endpoints[3]	12/31/2032
Toxicity	Toxic Units	Sediment	Sum of additive toxicity ≤ 1	Toxic Unit (TU)[4]	12/31/2032
Toxicity	Toxic Units	Water Column	Sum of additive toxicity ≤ 1	Toxic Unit (TU)[4]	12/31/2032

[1]Attachment A to this Order describes the sources of the limits established in this table.
[2]µg/L is micrograms per liter; µg/kg is micrograms per kilogram; ng/g is nanograms per gram; o.c. means normalized for sediment organic carbon content; ppb is parts per million.
[3]Toxicity determinations will be pass/fail based on a comparison of the test organism's response (survival, growth, and reproduction) to the water sample compared to the control using the Test of Significant Toxicity (TST statistical approach), or a statistical t-test, based on the toxicity provisions in the State Water Board *Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries in California* (in draft). If a sample is declared "fail" (i.e., toxic) for any endpoint, then the limit is not met. The most sensitive test species for each constituent must be used when evaluating toxicity.
[4]Toxic units (TU) and/or additive toxicity units are calculated using the relevant biological indicators, e.g. LC50, CCC, or CMC as follows: Calculate additive toxicity for organophosphate pesticides in non-TMDL watersheds as defined in the TMDL for Chlorpyrifos and Diazinon in the Lower Salinas River Watershed; and calculate TUs for pyrethroid pesticides in non-TMDL watersheds as defined in the TMDL for Sediment Toxicity and Pyrethroids in the Lower Salinas River Watershed.

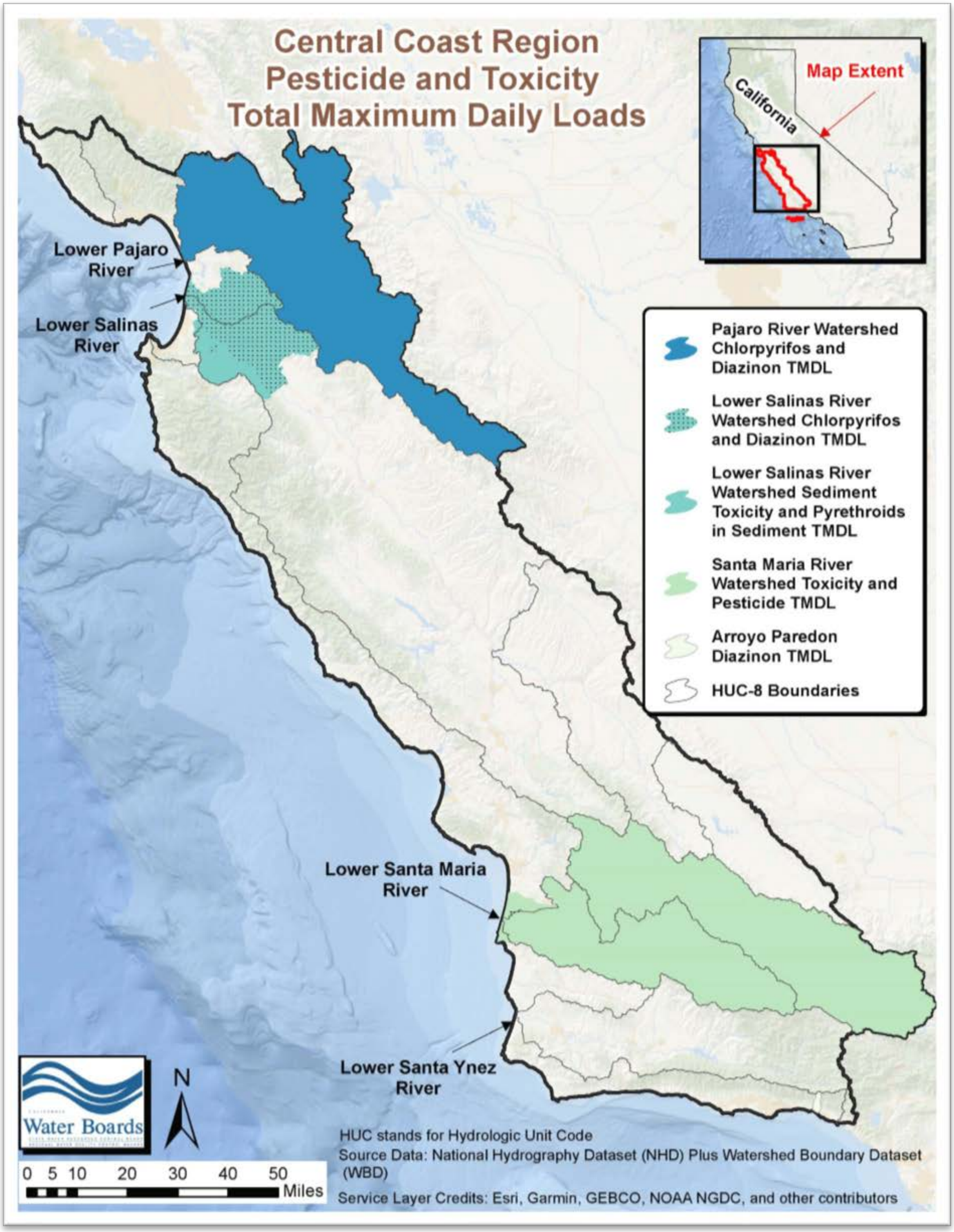


Figure C.3-3: Pesticide and Toxicity TMDL Areas

Table C.3-6. Compliance Dates for Sediment Limits (TMDL areas)

TMDL Project Name	Constituent	Limit[1]	Units	Compliance Date
Morro Bay Sediment TMDL	Sediment	285 – 6,662	Tons of sediment per year	12/3/2053
Pajaro River Watershed Sediment TMDL	Sediment	447 – 4,114	Tons of sediment per year	11/27/2051

[1]The Morro Bay Sediment TMDL and Pajaro River Watershed Sediment TMDL include load allocations for specific waterbody reaches within the TMDL project area. The limits for those TMDLs are summarized in this table as ranges; however, the exact load allocation values for each reach apply as described in the TMDL and Basin Plan and will be assessed as numeric limits for the purposes of this Order.

Table C.3-7. Compliance Dates for Turbidity Limits (Non-TMDL areas)

Constituent Group	Constituent	Beneficial Use	Limit	Units[1]	Compliance Date
Physical Parameters and General Chemistry	Turbidity	WARM	40.0	NTU	12/31/2032
Physical Parameters and General Chemistry	Turbidity	COLD	25.0	NTU	12/31/2032

[1]NTU is nephelometric turbidity units

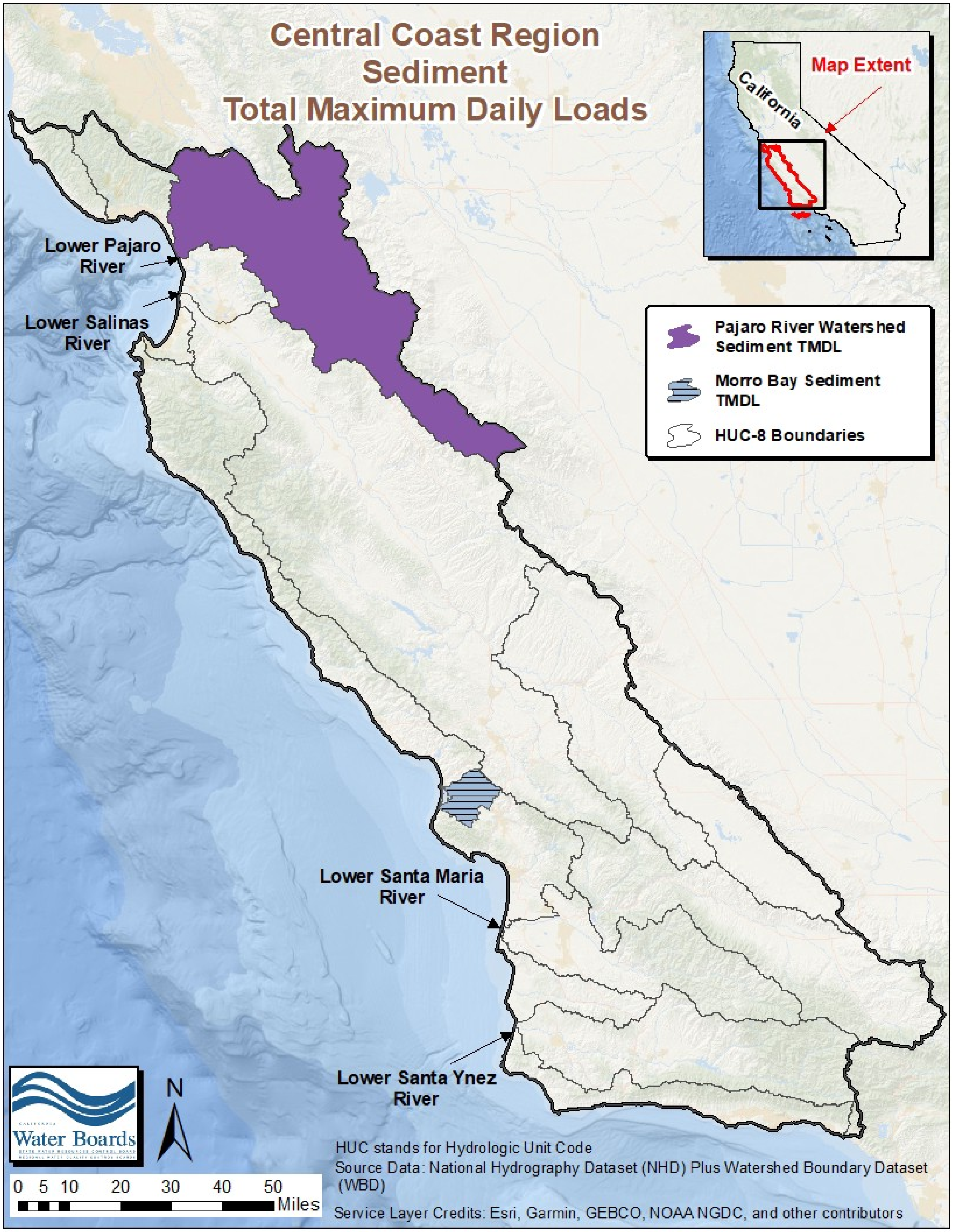


Figure C.3-4: Sediment TMDL Areas

Appendix 7-G (Ag Order 3.0)

Central Coast Ag Order 3.0 Monitoring and Reporting Program

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

MONITORING AND REPORTING PROGRAM ORDER NO. R3-2017-0002-01

TIER 1

DISCHARGERS ENROLLED UNDER CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS

This Monitoring and Reporting Program Order No. R3-2017-0002-01 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R3-2017-0002 (Order) includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 1 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 1:	
Part 1:	Surface Receiving Water Monitoring and Reporting *(cooperative or individual)*
Part 2:	Groundwater Monitoring and Reporting *(cooperative or individual)*

Pursuant to Water Code section 13269(a)(2), monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.

MONITORING AND REPORTING BASED ON TIERS

The Order and MRP include criteria and requirements for three tiers, based upon those characteristics of individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste (amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-01, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-01 to Order No. R3-2017-0002-01.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 1 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2.

A. Surface Receiving Water Quality Monitoring

1. Dischargers must elect a surface receiving water monitoring option (cooperative monitoring program or individual receiving water monitoring) to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).

2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.

3. Dischargers (individually or as part of a cooperative monitoring program) must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP); this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No. R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.

5. The Sampling and Analysis Plan must include the following minimum required components:
   a. Monitoring strategy to achieve objectives of the Order and MRP;
   b. Map of monitoring sites with GIS coordinates;
   c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303(d) List of Impaired Waterbodies (List of Impaired Waterbodies);
   d. Identification of beneficial uses and applicable water quality standards;
   e. Identification of applicable Total Maximum Daily Loads;
   f. Monitoring parameters;
   g. Monitoring schedule, including description and frequencies of monitoring events;

h. Description of data analysis methods;

6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines[1] and SWAMP templates[2], the receiving water quality monitoring QAPP must include the following minimum required components:
    a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
    b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
    c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that will ensure that the QA Project Plan is implemented as prescribed.
    d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.

[1] USEPA. 2001 (2006) USEPA Requirements for Quality Assurance Project Plans (QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5

[2] http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa

7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.

8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

Surface Receiving Water Quality Monitoring Sites

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs (e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

Surface Receiving Water Quality Monitoring Parameters

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:

    a. Flow Monitoring;
    b. Water Quality (physical parameters, metals, nutrients, pesticides);
    c. Toxicity (water and sediment);
    d. Assessment of Benthic Invertebrates.

11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls

12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.

13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).

15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow) capable of creating significant ponding, erosion or other water quality problem. A significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.

16. Dischargers (individually or as part of a cooperative monitoring program) must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

B. Surface Receiving Water Quality Reporting

Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

<u>Surface Receiving Water Quality Monitoring Annual Report</u>

2. **By July 1, 2017,** and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
    a. Signed Transmittal Letter;
    b. Title Page;
    c. Table of Contents;
    d. Executive Summary;
    e. Summary of Exceedance Reports submitted during the reporting period;
    f. Monitoring objectives and design;
    g. Monitoring site descriptions and rainfall records for the time period covered;
    h. Location of monitoring sites and map(s);
    i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
    j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
    k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
    l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;
    m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);
    n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
    o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
    p. Sampling and analytical methods used;
    q. Copy of chain-of-custody forms;
    r. Field data sheets, signed laboratory reports, laboratory raw data;
    s. Associated laboratory and field quality control samples results;
    t. Summary of Quality Assurance Evaluation results;

u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
w. Conclusions.

PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

A. Groundwater Monitoring

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.

2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.

3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring (**March - June)** and one sample collected during fall **(September - December)**.

4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality

control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.

5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below: http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf

6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch that exceed 10 mg/L nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

   The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

   For all other domestic wells not on a Discharger's farm/ranch but that may be impacted by nitrate, the Central Coast Water Board will notify the users promptly.

   The drinking water notification and confirmation letters required by this Order are available to the public.

B. Groundwater Reporting

1. **Within 60 days of sample collection,** Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
   a. GeoTracker Ranch Global Identification Number

b. Field point name (Well Name)
c. Field Point Class (Well Type)
d. Latitude
e. Longitude
f. Sample collection date
g. Analytical results
h. Well construction information (e.g., total depth, screened intervals, depth to water), as available

2. Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:

a. Number of groundwater wells present at each farm/ranch
b. Identification of any groundwater wells abandoned or destroyed (including method destroyed) in compliance with the Order
c. Use for fertigation or chemigation
d. Presence of back flow prevention devices
e. Number of groundwater wells used for agricultural purposes
f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells).

PART 3. GENERAL MONITORING AND REPORTING REQUIREMENTS

A. Submittal of Technical Reports

1. Dischargers must submit reports in a format specified by the Executive Officer. A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

   "In compliance with Water Code §13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The

Discharger must clearly indicate on the cover of the report (typically an electronic submittal) that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately (in a separate electronic file) unredacted pages (to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

B. Central Coast Water Board Authority

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to $1000 per day.

2. The Water Board needs the required information to determine compliance with Order No.R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No.R3-2017-0002.

John M. Robertson
Executive Officer

March 8, 2017
Date

Table 1. Major Waterbodies in Agricultural Areas[1]

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek[2]	31023	Los Osos Creek
30510	Beach Road Ditch[2]	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek[2]	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller’s Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River (above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek[2]	31310	San Antonio Creek[2]
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek[2]
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

[1] At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

[2] These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.

Table 2. Surface Receiving Water Quality Monitoring Parameters

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Photo Monitoring		
Upstream and downstream photographs at monitoring location		With every monitoring event
WATER COLUMN SAMPLING		
Physical Parameters and General Chemistry		
Flow (field measure) (CFS) following SWAMP field SOP[9]	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	”
Electrical Conductivity (field measure) (µS/cm)	2.5	”
Dissolved Oxygen (field measure) (mg/L)	0.1	”
Temperature (field measure) (^{o}C)	0.1	”
Turbidity (NTU)	0.5	”
Total Dissolved Solids (mg/L)	10	”
Total Suspended Solids (mg/L)	0.5	”
Nutrients		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	”
Total Ammonia (mg/L)	0.1	”
Unionized Ammonia (calculated value, mg/L))		”
Total Phosphorus (as P) (mg/L)	0.02	
Soluble Orthophosphate (mg/L)	0.01	”
Water column chlorophyll a (µg/L)	1.0	“
Algae cover, Floating Mats, % coverage	-	“
Algae cover, Attached, % coverage	-	“
Water Column Toxicity Test		
Algae - *Selenastrum capricornutum (*96-hour chronic; Method1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – *Ceriodaphnia dubia* (7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	”
Midge - *Chironomus spp.* (96-hour acute; Alternate test species in EPA 821-R-02-012)	-	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
Pesticides[2] /Herbicides (µg/L)		
Organophosphate Pesticides		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	”
Diazinon	0.005	”
Dichlorvos	0.01	”
Dimethoate	0.01	”
Dimeton-s	0.005	”
Disulfoton (Disyton)	0.005	”
Malathion	0.005	”
Methamidophos	0.02	”
Methidathion	0.02	“
Parathion-methyl	0.02	“
Phorate	0.01	“
Phosmet	0.02	“
Neonicotinoids		
Thiamethoxam	.002	“
Imidacloprid	.002	“
Thiacloprid	.002	“
Dinotefuran	.006	“
Acetamiprid	.01	“
Clothianidin	.02	“
Herbicides		
Atrazine	0.05	“
Cyanazine	0.20	“
Diuron	0.05	“
Glyphosate	2.0	“
Linuron	0.1	“
Paraquat	0.20	“
Simazine	0.05	“
Trifluralin	0.05	“
Metals (µg/L)		
Arsenic (total) [5,7]	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) [6,7]	10	“
Cadmium (total & dissolved) [4.5,7]	0.01	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Copper (total and dissolved) [4,7]	0.01	“
Lead (total and dissolved) [4,7]	0.01	“
Nickel (total and dissolved) [4,7]	0.02	“
Molybdenum (total) [7]	1	“
Selenium (total)[7]	0.30	“
Zinc (total and dissolved) [4.5,7]	0.10	“
Other (µg/L)		
Total Phenolic Compounds[8]	5	2 times in 2017, once in spring (April-May) and once in fall (August-September)
Hardness (mg/L as CaCO3)	1	“
Total Organic Carbon (ug/L)	0.6	“
SEDIMENT SAMPLING		
Sediment Toxicity - *Hyalella azteca* 10-day static renewal (EPA, 2000)		2 times each year, once in spring (April-May) and once in fall (August-September)
Pyrethroid Pesticides in Sediment (µg/kg)		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring (April-May) and once in fall (August-September) of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	“
Bifenthrin	2	“
Beta-cyfluthrin	2	“
Cyfluthrin	2	“
Esfenvalerate	2	“
Permethrin	2	“
Cypermethrin	2	“
Danitol	2	“
Fenvalerate	2	“
Fluvalinate	2	“
Other Monitoring in Sediment		
Chlorpyrifos (µg/kg)	2	“
Total Organic Carbon	0.01%	“
		“
Sediment Grain Size Analysis	1%	“

[1]Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plans implemented by individual growers.
[2]Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.
[3] Reporting Limit, taken from SWAMP where applicable.
[4] Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.

[5]Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.
[6]Http://www.coastalagro.com/products/labels/9%25BORON.pdf; Boron is applied directly or as a component of fertilizers as a plant nutrient.
[7]Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.
[8]http://cat.inist.fr/?aModele=afficheN&cpsidt=14074525; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.
[9]See SWAMP field measures SOP, p. 17
mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;
NTU – Nephelometric Turbidity Units; CFS – cubic feet per second.

Table 3. Groundwater Sampling Parameters

Parameter	RL	Analytical Method[3]	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as $CaCO_3$		EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations[1] EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate (SO4)	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N)[2] or Nitrate as N	0.1		

[1]General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater monitoring and laboratory analysis.
[2]The MRP allows analysis of "nitrate plus nitrite" to represent nitrate concentrations (as N). The "nitrate plus nitrite" analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.
[3]Dischargers may use alternative analytical methods approved by EPA.
RL – Reporting Limit; µS/cm – micro siemens per centimeter

Table 4. Tier 1 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)

REQUIREMENT	TIME SCHEDULE[1]
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP) for Surface Receiving Water Quality Monitoring *(individually or through cooperative monitoring program)*	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring *(individually or through cooperative monitoring program)*	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data *(individually or through cooperative monitoring program)*	Each January 1, April 1, July 1, and October 1

Submit surface receiving water quality Annual Monitoring Report *(individually or through cooperative monitoring program)*	By July 1 2017; annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit groundwater monitoring results	Within 60 days of the sample collection

[1] Dates are relative to adoption of this Order, unless otherwise specified.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

MONITORING AND REPORTING PROGRAM ORDER NO. R3-2017-0002-02

TIER 2

DISCHARGERS ENROLLED UNDER THE CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS

This Monitoring and Reporting Program Order No. R3-2017-0002-02 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands*, Order No. R3-2017-0002 (Order) includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 2 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 2:

Part 1: Surface Receiving Water Monitoring and Reporting *(cooperative or individual)*
Part 2: Groundwater Monitoring and Reporting *(cooperative or individual)*
Total Nitrogen Applied Reporting *(required for subset of Tier 2 Dischargers if farm/ranch growing any crop with high nitrate loading risk to groundwater);*
Part 3: Annual Compliance Form

Pursuant to Water Code section 13269(a)(2), monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.

MONITORING AND REPORTING BASED ON TIERS

The Order and MRP include criteria and requirements for three tiers, based upon those characteristics of the individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste (amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-02, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-02 to Order No. R3-2017-0002-02.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 2 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2. Time schedules are shown in Table4.

A. Surface Receiving Water Quality Monitoring

1. Dischargers must elect a surface receiving water monitoring option (cooperative monitoring program or individual receiving water monitoring) to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).

2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.

3. Dischargers (individually or as part of a cooperative monitoring program) must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP); this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No.R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.

5. The Sampling and Analysis Plan must include the following minimum required components:
    a. Monitoring strategy to achieve objectives of the Order and MRP;
    b. Map of monitoring sites with GIS coordinates;

c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303(d) List of Impaired Waterbodies (List of Impaired Waterbodies);
d. Identification of beneficial uses and applicable water quality standards;
e. Identification of applicable Total Maximum Daily Loads;
f. Monitoring parameters;
g. Monitoring schedule, including description and frequencies of monitoring events;
h. Description of data analysis methods;

6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines[1] and SWAMP templates[2], the receiving water quality monitoring QAPP must include the following minimum required components:
   a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
   b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
   c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that

[1] USEPA 2001 (2006) USEPA requirements for Quality Assurance Project Plans (QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5
[2] http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa

will ensure that the QA Project Plan is implemented as prescribed.

d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.

7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.

8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

Surface Receiving Water Quality Monitoring Sites

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs (e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

Surface Receiving Water Quality Monitoring Parameters

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:

a. Flow Monitoring;
b. Water Quality (physical parameters, metals, nutrients, pesticides);
c. Toxicity (water and sediment);
d. Assessment of Benthic Invertebrates.

11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls

12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.

13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).

15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow) capable of creating significant ponding, erosion or other water quality problem. A

significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.

16. Dischargers (individually or as part of a cooperative monitoring program) must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

B. Surface Receiving Water Quality Reporting

Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

Surface Receiving Water Quality Monitoring Annual Report

2. **By July 1, 2017,** and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
   a. Signed Transmittal Letter;
   b. Title Page;
   c. Table of Contents;
   d. Executive Summary;
   e. Summary of Exceedance Reports submitted during the reporting period;
   f. Monitoring objectives and design;
   g. Monitoring site descriptions and rainfall records for the time period covered;
   h. Location of monitoring sites and map(s);
   i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
   j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
   k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
   l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;
   m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);

n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
p. Sampling and analytical methods used;
q. Copy of chain-of-custody forms;
r. Field data sheets, signed laboratory reports, laboratory raw data;
s. Associated laboratory and field quality control samples results;
t. Summary of Quality Assurance Evaluation results;
u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
w. Conclusions.

PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

A. Groundwater Monitoring

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.

2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring

parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.

3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring (**March - June)** and one sample collected during fall **(September - December)**.

4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.

5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below: http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf

6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch, that exceed 10 mg/L of nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

   The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

   For all other domestic wells not on a Discharger's farm/ranch but that may be impacted by nitrate, the Central Coast Water Board will notify the users promptly.

The drinking water notification and confirmation letters required by this Order are available to the public.

B. Groundwater Reporting

1. **Within 60 days of sample collection,** Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
   a. GeoTracker Ranch Global Identification Number
   b. Field point name (Well Name)
   c. Field Point Class (Well Type)
   d. Latitude
   e. Longitude
   f. Sample collection date
   g. Analytical results
   h. Well construction information (e.g., total depth, screened intervals, depth to water), as available

2. Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:
   a. Number of groundwater wells present at each farm/ranch
   b. Identification of any groundwater wells abandoned or destroyed (including method destroyed) in compliance with the Order
   c. Use for fertigation or chemigation
   d. Presence of back flow prevention devices
   e. Number of groundwater wells used for agricultural purposes
   f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells).

C. Total Nitrogen Applied Reporting

1. By March 1, 2018, and by March 1 annually thereafter, Tier 2 Dischargers growing any crop with a high potential to discharge nitrogen to groundwater must record and report total nitrogen applied for each specific crop that was irrigated and grown for commercial purposes on that farm/ranch during the preceding calendar year (January through December).

   Crops with a high potential to discharge nitrogen to groundwater are: beet, broccoli, cabbage, cauliflower, celery, Chinese cabbage (napa), collard, endive, kale, leek, lettuce (leaf and head), mustard, onion (dry and green), spinach, strawberry, pepper (fruiting), and parsley.

Total nitrogen applied must be reported on the Total Nitrogen Applied Report form as described in the Total Nitrogen Applied Report form instructions.

Total nitrogen applied includes any product containing any form or concentration of nitrogen including, but not limited to, organic and inorganic fertilizers, slow release products, compost, compost teas, manure, and extracts.

2. The Total Nitrogen Applied Report form includes the following information:
    a. General ranch information such as GeoTracker file numbers, name, location, acres.
    b. Nitrogen concentration of irrigation water
    c. Nitrogen applied in pounds per acre with irrigation water
    d. Nitrogen present in the soil
    e. Nitrogen applied with compost and amendments
    f. Specific crops grown
    g. Nitrogen applied in pounds per acre with fertilizers and other materials to each specific crop grown
    h. Crop acres of each specific crop grown
    i. Whether each specific crop was grown organically or conventionally
    j. Basis for the nitrogen applied
    k. Explanation and comments section
    l. Certification statement with penalty of perjury declaration
    m. Additional information regarding whether each specific crop was grown in a nursery, greenhouse, hydroponically, in containers, and similar variables.

PART 3. ANNUAL COMPLIANCE FORM

Tier 2 Dischargers must submit annual compliance information, electronically, on the Annual Compliance Form. The purpose of the electronic Annual Compliance Form is to provide information to the Central Coast Water Board to assist in the evaluation of threat to water quality from individual agricultural discharges of waste and measure progress towards water quality improvement and verify compliance with the Order and MRP. Time schedules are shown in Table 4.

A. Annual Compliance Form

1. **By March 1, 2018, and updated annually thereafter by March 1**, Tier 2 Dischargers must submit an Annual Compliance Form electronically, in a

format specified by the Executive Officer. The electronic Annual Compliance Form includes, but is not limited to the following minimum requirements[1]:

a. Question regarding consistency between the Annual Compliance Form and the electronic Notice of Intent (eNOI);
b. Information regarding type and characteristics of discharge (e.g., number of discharge points, estimated flow/volume, number of tailwater days);
c. Identification of any direct agricultural discharges to a stream, lake, estuary, bay, or ocean;
d. Identification of specific farm water quality management practices completed, in progress, and planned to address water quality impacts caused by discharges of waste including irrigation management, pesticide management, nutrient management, salinity management, stormwater management, and sediment and erosion control to achieve compliance with this Order; and identification of specific methods used, and described in the Farm Plan consistent with Order Provision 44.g., for the purposes of assessing the effectiveness of management practices implemented and the outcomes of such assessments;
e. Proprietary information question and justification;
f. Authorization and certification statement and declaration of penalty of perjury.

PART 5. GENERAL MONITORING AND REPORTING REQUIREMENTS

A. Submittal of Technical Reports

1. Dischargers must submit reports in a format specified by the Executive Officer. A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

   "In compliance with Water Code §13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".

[1] Items reported in the Annual Compliance Form are due by March 1, 2018, and annually thereafter, unless otherwise specified.

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The Discharger must clearly indicate on the cover of the report (typically an electronic submittal) that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately (in a separate electronic file) unredacted pages (to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

B. Central Coast Water Board Authority

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to $1000 per day.

2. The Water Board needs the required information to determine compliance with Order No. R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No. R3-2017-0002.

____

John M. Robertson
Executive Officer

March 8, 2017
____
Date

Table 1. Major Waterbodies in Agricultural Areas[1]

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek[2]	31023	Los Osos Creek
30510	Beach Road Ditch[2]	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek[2]	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller's Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek[2]	31310	San Antonio Creek[2]
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek[2]
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

[1] At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

[2] These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.

Table 2. Surface Receiving Water Quality Monitoring Parameters

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Photo Monitoring		
Upstream and downstream photographs at monitoring location		With every monitoring event
WATER COLUMN SAMPLING		
Physical Parameters and General Chemistry		
Flow (field measure) (CFS) following SWAMP field SOP[9]	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	”
Electrical Conductivity (field measure) (µS/cm)	2.5	”
Dissolved Oxygen (field measure) (mg/L)	0.1	”
Temperature (field measure) (^{o}C)	0.1	”
Turbidity (NTU)	0.5	”
Total Dissolved Solids (mg/L)	10	”
Total Suspended Solids (mg/L)	0.5	”
Nutrients		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	”
Total Ammonia (mg/L)	0.1	”
Unionized Ammonia (calculated value, mg/L))		”
Total Phosphorus (as P) (mg/L)	0.02	
Soluble Orthophosphate (mg/L)	0.01	”
Water column chlorophyll a (µg/L)	1.0	“
Algae cover, Floating Mats, % coverage	-	“
Algae cover, Attached, % coverage	-	“
Water Column Toxicity Test		
Algae - *Selenastrum capricornutum (*96-hour chronic; Method1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – *Ceriodaphnia dubia* (7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	”
Midge - *Chironomus spp.* (96-hour acute; Alternate test species in EPA 821-R-02-012)	-	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
Pesticides[2] /Herbicides (µg/L)		
Organophosphate Pesticides		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	”
Diazinon	0.005	”
Dichlorvos	0.01	”
Dimethoate	0.01	”
Dimeton-s	0.005	”
Disulfoton (Disyton)	0.005	”
Malathion	0.005	”
Methamidophos	0.02	”
Methidathion	0.02	“
Parathion-methyl	0.02	“
Phorate	0.01	“
Phosmet	0.02	“
Neonicotinoids		
Thiamethoxam	.002	“
Imidacloprid	.002	“
Thiacloprid	.002	“
Dinotefuran	.006	“
Acetamiprid	.01	“
Clothianidin	.02	
Herbicides		
Atrazine	0.05	“
Cyanazine	0.20	“
Diuron	0.05	“
Glyphosate	2.0	“
Linuron	0.1	“
Paraquat	0.20	“
Simazine	0.05	“
Trifluralin	0.05	“
Metals (µg/L)		
Arsenic (total) [5,7]	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) [6,7]	10	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Cadmium (total & dissolved) [4,5,7]	0.01	“
Copper (total and dissolved) [4,7]	0.01	“
Lead (total and dissolved) [4,7]	0.01	“
Nickel (total and dissolved) [4,7]	0.02	“
Molybdenum (total) [7]	1	“
Selenium (total)[7]	0.30	“
Zinc (total and dissolved) [4,5,7]	0.10	“
Other (µg/L)		
Total Phenolic Compounds[8]	5	2 times in 2017, once in spring (April-May) and once in fall (August-September)
Hardness (mg/L as CaCO3)	1	“
Total Organic Carbon (ug/L)	0.6	“
SEDIMENT SAMPLING		
Sediment Toxicity - *Hyalella azteca* 10-day static renewal (EPA, 2000)		2 times each year, once in spring (April-May) and once in fall (August-September)
Pyrethroid Pesticides in Sediment (µg/kg)		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring (April-May) and once in fall (August-September) of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	“
Bifenthrin	2	“
Beta-cyfluthrin	2	“
Cyfluthrin	2	“
Esfenvalerate	2	“
Permethrin	2	“
Cypermethrin	2	“
Danitol	2	“
Fenvalerate	2	“
Fluvalinate	2	“
Other Monitoring in Sediment		
Chlorpyrifos (µg/kg)	2	“
Total Organic Carbon	0.01%	“
		“
Sediment Grain Size Analysis	1%	“

[1]Monitoring is ongoing through all five years of the Order, unless otherwise specified. Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plan.
[2]Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.

[3] Reporting Limit, taken from SWAMP where applicable.
[4] Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.
[5]Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.
[6]Http://www.coastalagro.com/products/labels/9%25BORON.pdf; Boron is applied directly or as a component of fertilizers as a plant nutrient.
[7]Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.
[8]http://cat.inist.fr/?aModele=afficheN&cpsidt=14074525; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.
[9]See SWAMP field measures SOP, p. 17
mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;
NTU – Nephelometric Turbidity Units; CFS – cubic feet per second;

Table 3. Groundwater Monitoring Parameters

Parameter	RL	Analytical Method[3]	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as CaCO3	1	EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations[1] EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate (SO4)	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N)[2] or Nitrate as N	0.1		

[1]General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater sampling and laboratory analysis.
[2]The MRP allows analysis of "nitrate plus nitrite" to represent nitrate concentrations (as N). The "nitrate plus nitrite" analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.
[3]Dischargers may use alternative analytical methods approved by EPA.
RL – Reporting Limit; µS/cm – micro siemens per centimeter

Table4. Tier 2 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)

REQUIREMENT	TIME SCHEDULE[1]
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP) for Surface Receiving Water Quality Monitoring (*individually or through cooperative monitoring program*)	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring (*individually or through cooperative monitoring program*)	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data (*individually or through cooperative monitoring program*)	Each January 1, April 1, July 1, and October 1
Submit surface receiving water quality Annual Monitoring Report *(individually or through cooperative monitoring program*)	By July 12017: annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit electronic Annual Compliance Form	March 1, 2018 and every March 1 annually thereafter
Submit groundwater monitoring results	Within 60 days of the sample collection
Tier 2 Dischargers with farms/ranches growing high risk crops: Report total nitrogen applied on the Total Nitrogen Applied form	March 1, 2018 and every March 1annually thereafter

[1] Dates are relative to adoption of this Order or enrollment date for Dischargers enrolled after the adoption of this Order, unless otherwise specified.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

MONITORING AND REPORTING PROGRAM
ORDER NO. R3-2017-0002-03

TIER 3

DISCHARGERS ENROLLED UNDER
CONDITIONAL WAIVER OF WASTE DISCHARGE REQUIREMENTS FOR DISCHARGES FROM IRRIGATED LANDS

This Monitoring and Reporting Program Order No. R3-2017-0002-03 (MRP) is issued pursuant to California Water Code (Water Code) sections 13267 and 13269, which authorize the California Regional Water Quality Control Board, Central Coast Region (hereafter Central Coast Water Board) to require preparation and submittal of technical and monitoring reports. Water Code section 13269 requires a waiver of waste discharge requirements to include as a condition, the performance of monitoring and the public availability of monitoring results. *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands,* Order No. R3-2017-0002 (Order), includes criteria and requirements for three tiers. This MRP sets forth monitoring and reporting requirements for **Tier 3 Dischargers** enrolled under the Order. A summary of the requirements is shown below.

SUMMARY OF MONITORING AND REPORTING REQUIREMENTS FOR TIER 3:

Part 1:	Surface Receiving Water Monitoring and Reporting *(cooperative or individual)*
Part 2:	Groundwater Monitoring and Reporting *(cooperative or individual)* Total Nitrogen Applied Reporting *(required for subset of Tier 3 Dischargers if farm/ranch growing any crop with high nitrate loading risk to groundwater);*
Part 3:	Annual Compliance Form
Part 5:	Individual Surface Water Discharge Monitoring and Reporting
Part 6:	Irrigation and Nutrient Management Plan *(required for subset of Tier 3 Dischargers if farm/ranch has High Nitrate Loading Risk)*
Part 7:	Water Quality Buffer Plan *(required for subset of Tier 3 Dischargers if farm/ranch contains or is adjacent to a waterbody impaired for temperature, turbidity or sediment)*

Pursuant to Water Code section 13269(a)(2), monitoring requirements must be designed to support the development and implementation of the waiver program, including, but not limited to, verifying the adequacy and effectiveness of the waiver's conditions. The monitoring and reports required by this MRP are to evaluate effects of discharges of waste from irrigated agricultural operations and individual farms/ranches on waters of the state and to determine compliance with the Order.

MONITORING AND REPORTING BASED ON TIERS

The Order and MRP includes criteria and requirements for three tiers, based upon those characteristics of the individual farms/ranches at the operation that present the highest level of waste discharge or greatest risk to water quality. Dischargers must meet conditions of the Order and MRP for the appropriate tier that applies to their land and/or the individual farm/ranch. Within a tier, Dischargers comply with requirements based on the specific level of discharge and threat to water quality from individual farms/ranches. The lowest tier, Tier 1, applies to dischargers who discharge the lowest level of waste (amount or concentration) or pose the lowest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. The highest tier, Tier 3, applies to dischargers who discharge the highest level of waste or pose the greatest potential to cause or contribute to an exceedance of water quality standards in waters of the State or of the United States. Tier 2 applies to dischargers whose discharge has a moderate threat to water quality. Water quality is defined in terms of regional, state, or federal numeric or narrative water quality standards. Per the Order, Dischargers may submit a request to the Executive Officer to approve transfer to a lower tier. If the Executive Officer approves a transfer to a lower tier, any interested person may request that the Central Coast Water Board conduct a review of the Executive Officer's determination.

PART 1. SURFACE RECEIVING WATER MONITORING AND REPORTING REQUIREMENTS

The surface receiving water monitoring and reporting requirements described herein are generally a continuation of the surface receiving water monitoring and reporting requirements of Monitoring and Reporting Program Order No. 2012-0011-03, as revised August 22, 2016, with the intent of uninterrupted regular monitoring and reporting during the transition from Order No. R3-2012-0011-03 to Order No. R3-2017-0002-03.

Monitoring and reporting requirements for surface receiving water identified in Part 1.A. and Part 1.B. apply to Tier 3 Dischargers. Surface receiving water refers to water flowing in creeks and other surface waters of the State. Surface receiving water monitoring may be conducted through a cooperative monitoring program on behalf of Dischargers, or Dischargers may choose to conduct surface receiving water monitoring and reporting individually. Key monitoring and reporting requirements for surface receiving water are shown in Tables 1 and 2. Time schedules are shown in Table 5.

A. Surface Receiving Water Quality Monitoring

1. Dischargers must elect a surface receiving water monitoring option (cooperative monitoring program or individual receiving water monitoring) to comply with surface receiving water quality monitoring requirements, and identify the option selected on the Notice of Intent (NOI).

2. Dischargers are encouraged to choose participation in a cooperative monitoring program (e.g., the existing Cooperative Monitoring Program or a similar program) to comply with receiving water quality monitoring requirements. Dischargers not participating in a cooperative monitoring program must conduct surface receiving water quality monitoring individually that achieves the same purpose.

3. Dischargers (individually or as part of a cooperative monitoring program) must conduct surface receiving water quality monitoring to a) assess the impacts of their waste discharges from irrigated lands to receiving water, b) assess the status of receiving water quality and beneficial use protection in impaired waterbodies dominated by irrigated agricultural activity, c) evaluate status, short term patterns and long term trends (five to ten years or more) in receiving water quality, d) evaluate water quality impacts resulting from agricultural discharges (including but not limited to tile drain discharges), e) evaluate stormwater quality, f) evaluate condition of existing perennial, intermittent, or ephemeral streams or riparian or wetland area habitat, including degradation resulting from erosion or agricultural discharges of waste, and g) assist in the identification of specific sources of water quality problems.

Surface Receiving Water Quality Sampling and Analysis Plan

4. **By March 1, 2018, or as directed by the Executive Officer**, Dischargers (individually or as part of a cooperative monitoring program) must submit a surface receiving water quality Sampling and Analysis Plan (SAAP) and Quality Assurance Project Plan (QAPP); this requirement is satisfied if an approved SAAP and QAPP addressing all surface receiving water quality monitoring requirements described in this Order has been submitted pursuant to Order No.R3-2012-0011 and associated Monitoring and Reporting Programs. Dischargers (or a third party cooperative monitoring program) must develop the Sampling and Analysis Plan to describe how the proposed monitoring will achieve the objectives of the MRP and evaluate compliance with the Order. The Sampling and Analysis Plan may propose alternative monitoring site locations, adjusted monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water. The Executive Officer must approve the Sampling and Analysis Plan and QAPP.

5. The Sampling and Analysis Plan must include the following minimum required components:
    a. Monitoring strategy to achieve objectives of the Order and MRP;
    b. Map of monitoring sites with GIS coordinates;

c. Identification of known water quality impairments and impaired waterbodies per the 2010 Clean Water Act 303(d) List of Impaired Waterbodies (List of Impaired Waterbodies);
d. Identification of beneficial uses and applicable water quality standards;
e. Identification of applicable Total Maximum Daily Loads;
f. Monitoring parameters;
g. Monitoring schedule, including description and frequencies of monitoring events;
h. Description of data analysis methods;

6. The QAPP must include receiving water and site-specific information, project organization and responsibilities, and quality assurance components of the MRP. The QAPP must also include the laboratory and field requirements to be used for analyses and data evaluation. The QAPP must contain adequate detail for project and Water Board staff to identify and assess the technical and quality objectives, measurement and data acquisition methods, and limitations of the data generated under the surface receiving water quality monitoring. All sampling and laboratory methodologies and QAPP content must be consistent with U.S. EPA methods, State Water Board's Surface Water Ambient Monitoring Program (SWAMP) protocols and the Central Coast Water Board's Central Coast Ambient Monitoring Program (CCAMP). Following U.S. EPA guidelines[1] and SWAMP templates[2], the receiving water quality monitoring QAPP must include the following minimum required components:
    a. Project Management. This component addresses basic project management, including the project history and objectives, roles and responsibilities of the participants, and other aspects.
    b. Data Generation and Acquisition. This component addresses all aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and quality control activities are employed and are properly documented. Quality control requirements are applicable to all the constituents sampled as part of the MRP, as described in the appropriate method.
    c. Assessment and Oversight. This component addresses the activities for assessing the effectiveness of the implementation of the project and associated QA and QC activities. The purpose of the assessment is to provide project oversight that

[1] USEPA. 2001 (2006) USEPA Requirements for Quality Assurance Project Plans (QA/R-5) Office of Environmental Information, Washington, D.C. USEPA QA/R-5
[2] http://waterboards.ca.gov/water_issues/programs/swamp/tools.shtml#qa

will ensure that the QA Project Plan is implemented as prescribed.

d. Data Validation and Usability. This component addresses the quality assurance activities that occur after the data collection, laboratory analysis and data generation phase of the project is completed. Implementation of these elements ensures that the data conform to the specified criteria, thus achieving the MRP objectives.

7. The Central Coast Water Board may conduct an audit of contracted laboratories at any time in order to evaluate compliance with the QAPP.

8. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may also revise the Sampling and Analysis Plan, including adding, removing, or changing monitoring site locations, changing monitoring parameters, and other changes as necessary to assess the impacts of waste discharges from irrigated lands to receiving water.

<u>Surface Receiving Water Quality Monitoring Sites</u>

9. The Sampling and Analysis Plan must, at a minimum, include monitoring sites to evaluate waterbodies identified in Table 1, unless otherwise approved by the Executive Officer. The Sampling and Analysis Plan must include sites to evaluate receiving water quality impacts most directly resulting from areas of agricultural discharge (including areas receiving tile drain discharges). Site selection must take into consideration the existence of any long term monitoring sites included in related monitoring programs (e.g. CCAMP and the existing CMP). Sites may be added or modified, subject to prior approval by the Executive Officer, to better assess the pollutant loading from individual sources or the impacts to receiving waters caused by individual discharges. Any modifications must consider sampling consistency for purposes of trend evaluation.

<u>Surface Receiving Water Quality Monitoring Parameters</u>

10. The Sampling and Analysis Plan must, at a minimum, include the following types of monitoring and evaluation parameters listed below and identified in Table 2:

    a. Flow Monitoring;
    b. Water Quality (physical parameters, metals, nutrients, pesticides);
    c. Toxicity (water and sediment);
    d. Assessment of Benthic Invertebrates.

11. All analyses must be conducted at a laboratory certified for such analyses by the State Department of Public Health (CDPH) or at laboratories approved by the Executive Officer. Unless otherwise noted, all sampling, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, U.S. EPA, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link: http://www.cdph.ca.gov/certlic/labs/Documents/ELAPLablist.xls

12. Water quality and flow monitoring is used to assess the sources, concentrations, and loads of waste discharges from individual farms/ranches and groups of Dischargers to surface waters, to evaluate impacts to water quality and beneficial uses, and to evaluate the short term patterns and long term trends in receiving water quality. Monitoring data must be compared to existing numeric and narrative water quality objectives.

13. Toxicity testing is to evaluate water quality relative to the narrative toxicity objective. Water column toxicity analyses must be conducted on 100% (undiluted) sample. At sites where persistent unresolved toxicity is found, the Executive Officer may require concurrent toxicity and chemical analyses and a Toxicity Identification Evaluation (TIE) to identify the individual discharges causing the toxicity.

Surface Receiving Water Quality Monitoring Frequency and Schedule

14. The Sampling and Analysis Plan must include a schedule for sampling. Timing, duration, and frequency of monitoring must be based on the land use, complexity, hydrology, and size of the waterbody. Table 2 includes minimum monitoring frequency and parameter lists. Agricultural parameters that are less common may be monitored less frequently. Modifications to the receiving water quality monitoring parameters, frequency, and schedule may be submitted for Executive Officer consideration and approval. At a minimum, the Sampling and Analysis Plan schedule must consist of monthly monitoring of common agricultural parameters in major agricultural areas, including two major storm events during the wet season (October 1 – April 30).

15. Storm event monitoring must be conducted within 18 hours of storm events, preferably including the first flush run-off event that results in significant increase in stream flow. For purposes of this MRP, a storm event is defined as precipitation producing onsite runoff (surface water flow) capable of creating significant ponding, erosion or other water quality problem. A

significant storm event will generally result in greater than 1-inch of rain within a 24-hour period.

16. Dischargers (individually or as part of a cooperative monitoring program) must perform receiving water quality monitoring per the Sampling and Analysis Plan and QAPP approved by the Executive Officer.

B. Surface Receiving Water Quality Reporting

Surface Receiving Water Quality Data Submittal

1. Dischargers (individually or as part of a cooperative monitoring program) must submit water quality monitoring data to the Central Coast Water Board electronically, in a format specified by the Executive Officer and compatible with SWAMP/CCAMP electronic submittal guidelines, each January 1, April 1, July 1, and October 1.

Surface Receiving Water Quality Monitoring Annual Report

2. **By July 1, 2017,** and every July 1 annually thereafter, Dischargers (individually or as part of a cooperative monitoring program) must submit an Annual Report, electronically, in a format specified by the Executive Officer including the following minimum elements:
   a. Signed Transmittal Letter;
   b. Title Page;
   c. Table of Contents;
   d. Executive Summary;
   e. Summary of Exceedance Reports submitted during the reporting period;
   f. Monitoring objectives and design;
   g. Monitoring site descriptions and rainfall records for the time period covered;
   h. Location of monitoring sites and map(s);
   i. Tabulated results of all analyses arranged in tabular form so that the required information is readily discernible;
   j. Summary of water quality data for any sites monitored as part of related monitoring programs, and used to evaluate receiving water as described in the Sampling and Analysis Plan.
   k. Discussion of data to clearly illustrate compliance with the Order and water quality standards;
   l. Discussion of short term patterns and long term trends in receiving water quality and beneficial use protection;

m. Evaluation of pesticide and toxicity analyses results, and recommendation of candidate sites for Toxicity Identification Evaluations (TIEs);
n. Identification of the location of any agricultural discharges observed discharging directly to surface receiving water;
o. Laboratory data submitted electronically in a SWAMP/CCAMP comparable format;
p. Sampling and analytical methods used;
q. Copy of chain-of-custody forms;
r. Field data sheets, signed laboratory reports, laboratory raw data;
s. Associated laboratory and field quality control samples results;
t. Summary of Quality Assurance Evaluation results;
u. Specify the method used to obtain flow at each monitoring site during each monitoring event;
v. Electronic or hard copies of photos obtained from all monitoring sites, clearly labeled with site ID and date;
w. Conclusions.

PART 2. GROUNDWATER MONITORING AND REPORTING REQUIREMENTS

Groundwater monitoring may be conducted through a cooperative monitoring and reporting program on behalf of growers, or Dischargers may choose to conduct groundwater monitoring and reporting individually. Qualifying cooperative groundwater monitoring and reporting programs must implement the groundwater monitoring and reporting requirements described in this Order, unless otherwise approved by the Executive Officer. An interested person may seek review by the Central Coast Water Board of the Executive Officer's approval or denial of a cooperative groundwater monitoring and reporting program.

Key monitoring and reporting requirements for groundwater are shown in Table 3.

A. Groundwater Monitoring

1. Dischargers must sample private domestic wells and the primary irrigation well on their farm/ranch to evaluate groundwater conditions in agricultural areas, identify areas at greatest risk for nitrogen loading and exceedance of drinking water standards, and identify priority areas for follow up actions.

2. Dischargers must sample at least one groundwater well for each farm/ranch on their operation, including groundwater wells that are located within the property boundary of the enrolled county assessor parcel numbers (APNs). For farms/ranches with multiple groundwater wells, Dischargers must sample all domestic wells and the primary irrigation well. For the purposes of this MRP, a "domestic well" is any well that is used or may be used for domestic

use purposes, including any groundwater well that is connected to a residence, workshop, or place of business that may be used for human consumption, cooking, or sanitary purposes. Groundwater monitoring parameters must include well screen interval depths (if available), general chemical parameters, and general cations and anions listed in Table 3.

3. Dischargers must conduct two rounds of monitoring of required groundwater wells during calendar year 2017; one sample collected during spring (**March - June)** and one sample collected during fall **(September - December)**.

4. Groundwater samples must be collected by a qualified third party (e.g., consultant, technician, person conducting cooperative monitoring) using proper sampling methods, chain-of-custody, and quality assurance/quality control protocols. Groundwater samples must be collected at or near the well head before the pressure tank and prior to any well head treatment. In cases where this is not possible, the water sample must be collected from a sampling point as close to the pressure tank as possible, or from a cold-water spigot located before any filters or water treatment systems.

5. Laboratory analyses for groundwater samples must be conducted by a State certified laboratory according to U.S. EPA approved methods; unless otherwise noted, all monitoring, sample preservation, and analyses must be performed in accordance with the latest edition of *Test Methods for Evaluating Solid Waste*, SW-846, United States Environmental Protection Agency, and analyzed as specified herein by the above analytical methods and reporting limits indicated. Certified laboratories can be found at the web link below: http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/resources4growers/2016_04_11_labs.pdf

6. If a discharger determines that water in any domestic well exceeds 10 mg/L of nitrate as N, the discharger or third party must provide notice to the Central Coast Water Board within 24 hours of learning of the exceedance. For domestic wells on a Discharger's farm/ranch that exceed 10 mg/L nitrate as N, the Discharger must provide written notification to the users within 10 days of learning of the exceedance and provide written confirmation of the notification to the Central Coast Water Board.

   The drinking water notification must include the statement that the water poses a human health risk due to elevated nitrate concentration, and include a warning against the use of the water for drinking or cooking. In addition, Dischargers must also provide prompt written notification to any new well users (e.g. tenants and employees with access to the affected well), whenever there is a change in occupancy.

For all other domestic wells not on a Discharger's property, the Central Coast Water Board will notify the users promptly.

The drinking water notification and confirmation letters required by this Order are available to the public.

B. Groundwater Reporting

1. **Within 60 days of sample collection,** Dischargers must coordinate with the laboratory to submit the following groundwater monitoring results and information, electronically, using the Water Board's GeoTracker electronic deliverable format (EDF):
   a. GeoTracker Ranch Global Identification Number
   b. Field point name (Well Name)
   c. Field Point Class (Well Type)
   d. Latitude
   e. Longitude
   f. Sample collection date
   g. Analytical results
   h. Well construction information (e.g., total depth, screened intervals, depth to water), as available

2. Dischargers must submit groundwater well information required in the electronic Notice of Intent (eNOI) for each farm/ranch and update the eNOI to reflect changes in the farm/ranch information within 30 days of the change. Groundwater well information reported on the eNOI includes, but is not limited to:
   a. Number of groundwater wells present at each farm/ranch
   b. Identification of any groundwater wells abandoned or destroyed (including method destroyed) in compliance with the Order
   c. Use for fertigation or chemigation
   d. Presence of back flow prevention devices
   e. Number of groundwater wells used for agricultural purposes
   f. Number of groundwater wells used for or may be used for domestic use purposes (domestic wells)

C. Total Nitrogen Applied Reporting

1. By March 1, 2018, and by March 1 annually thereafter, Tier 3 Dischargers growing any crop with a high potential to discharge nitrogen to groundwater must record and report total nitrogen applied for each specific crop that was irrigated and grown for commercial purposes on that farm/ranch during the preceding calendar year (January through December).

   Crops with a high potential to discharge nitrogen to groundwater are: beet, broccoli, cabbage, cauliflower, celery, Chinese cabbage (napa), collard, endive, kale, leek, lettuce (leaf and head), mustard, onion (dry and green), spinach, strawberry, pepper (fruiting), and parsley.

Total nitrogen applied must be reported on the Total Nitrogen Applied Report form as described in the Total Nitrogen Applied Report form instructions.

Total nitrogen applied includes any product containing any form or concentration of nitrogen including, but not limited to, organic and inorganic fertilizers, slow release products, compost, compost teas, manure, and extracts.

2. The Total Nitrogen Applied Report form includes the following information:
    a. General ranch information such as GeoTracker file numbers, name, location, acres.
    b. Nitrogen concentration of irrigation water
    c. Nitrogen applied in pounds per acre with irrigation water
    d. Nitrogen present in the soil
    e. Nitrogen applied with compost and amendments
    f. Specific crops grown
    g. Nitrogen applied in pounds per acre with fertilizers and other materials to each specific crop grown
    h. Crop acres of each specific crop grown
    i. Whether each specific crop was grown organically or conventionally
    j. Basis for the nitrogen applied
    k. Explanation and comments section
    l. Certification statement with penalty of perjury declaration
    m. Additional information regarding whether each specific crop was grown in a nursery, greenhouse, hydroponically, in containers, and similar variables.

PART 3. ANNUAL COMPLIANCE FORM

Tier 3 Dischargers must submit annual compliance information, electronically, on the Annual Compliance Form. The purpose of the electronic Annual Compliance Form is to provide information to the Central Coast Water Board to assist in the evaluation of threat to water quality from individual agricultural discharges of waste and measure progress towards water quality improvement and verify compliance with the Order and MRP. Time schedules are shown in Table 5.

A. Annual Compliance Form

1. **By March 1, 2018, and updated annually thereafter by March 1**, Tier 3 Dischargers must submit an Annual Compliance Form electronically, in a format specified by the Executive Officer. The electronic Annual Compliance Form includes, but is not limited to the following minimum requirements[1]:
    a. Question regarding consistency between the Annual Compliance Form and the electronic Notice of Intent (eNOI);
    b. Information regarding type and characteristics of discharge (e.g., number of discharge points, estimated flow/volume, number of tailwater days);
    c. Identification of any direct agricultural discharges to a stream, lake, estuary, bay, or ocean;
    d. Identification of specific farm water quality management practices completed, in progress, and planned to address water quality impacts caused by discharges of waste including irrigation management, pesticide management, nutrient management, salinity management, stormwater management, and sediment and erosion control to achieve compliance with this Order; and identification of specific methods used, and described in the Farm Plan consistent with Order Provision 44.g., for the purposes of assessing the effectiveness of management practices implemented and the outcomes of such assessments:
    e. Proprietary information question and justification;
    f. Authorization and certification statement and declaration of penalty of perjury.

PART 5. INDIVIDUAL SURFACE WATER DISCHARGE MONITORING AND REPORTING REQUIREMENTS

Monitoring and reporting requirements for individual surface water discharge identified in Part 5.A. and Part 5.B. apply to Tier 3 Dischargers with irrigation water or stormwater discharges to surface water from an outfall. Outfalls are locations where irrigation water and stormwater exit a farm/ranch, or otherwise leave the control of the discharger, after being conveyed by pipes, ditches, constructed swales, tile drains, containment structures, or other discrete structures or features that transport the water. Discharges that have commingled with discharges from another farm/ranch are considered to have left the control of the discharger. Key monitoring and reporting requirements for individual surface water discharge are shown in Tables 4A and 4B. Time schedules are shown in Table 5.

[1] Items reported in the Annual Compliance Form are due by March 1 2018, and annually thereafter, unless otherwise specified.

A. Individual Surface Water Discharge Monitoring

1. Tier 3 Dischargers must conduct individual surface water discharge monitoring to a) evaluate the quality of individual waste discharges, including concentration and load of waste (in kilograms per day) for appropriate parameters, b) evaluate effects of waste discharge on water quality and beneficial uses, and c) evaluate progress towards compliance with water quality improvement milestones in the Order.

<u>Individual Sampling and Analysis Plan</u>

2. **By March 1, 2018, or as directed by the Executive Officer**, Tier 3 Dischargers must submit an individual surface water discharge Sampling and Analysis Plan (SAAP) and QAPP to monitor individual discharges of irrigation water and stormwater that leaves their farm/ranch from an outfall. The Sampling and Analysis Plan and QAPP must be submitted to the Executive Officer; this requirement is satisfied if an approved SAAP and QAPP addressing all individual surface water discharge monitoring requirements described in this Order has been submitted pursuant to Order No.R3-2012-0011 and associated Monitoring and Reporting Programs.

3. The Sampling and Analysis Plan must include the following minimum required components to monitor irrigation water and stormwater discharges:
    a. Number and location of outfalls (identified with latitude and longitude or on a scaled map);
    b. Number and location of monitoring points;
    c. Description of typical irrigation runoff patterns;
    d. Map of discharge and monitoring points;
    e. Sample collection methods;
    f. Monitoring parameters;
    g. Monitoring schedule and frequency of monitoring events;

4. The QAPP must include appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, quality control activities, and documentation.

5. The Sampling and Analysis Plan and QAPP, and any proposed revisions are subject to approval by the Executive Officer. The Executive Officer may require modifications to the Sampling and Analysis Plan or Tier 3 Dischargers may propose Sampling and Analysis Plan modifications for Executive Officer approval, when modifications are justified to accomplish the objectives of the MRP.

Individual Surface Water Discharge Monitoring Points

6. Tier 3 Dischargers must select monitoring points to characterize at least 80% of the estimated maximum irrigation run-off discharge volume from each farm/ranch based on that farm's/ranch's typical discharge patterns[1], including tailwater discharges and discharges from tile drains. Sample must be taken when irrigation activity is causing maximal run-off. Load estimates will be generated by multiplying flow volume of discharge by concentration of contaminants. Tier 3 Dischargers must include at least one monitoring point from each farm/ranch which drains areas where chlorpyrifos or diazinon are applied, and monitoring of runoff or tailwater must be conducted within one week of chemical application. If discharge is not routinely present, Discharger may characterize typical run-off patterns in the Annual Report. See Table 4A for additional details.

7. Tier 3 Dischargers must also monitor storage ponds and other terminal surface water containment structures that collect irrigation and stormwater runoff, unless the structure is (1) part of a tail-water return system where a major portion of the water in such structure is reapplied as irrigation water, or (2) the structure is primarily a sedimentation pond by design with a short hydraulic residence time (96 hours or less) and a discharge to surface water when functioning. If multiple ponds are present, sampling must cover at least those structures that would account for 80% of the maximum storage volume of the containment features. See Table 4B for additional details. Where water is reapplied as irrigation water. Dischargers shall document reuse in the Farm Plan.

Individual Surface Water Discharge Monitoring Parameters, Frequency, and Schedule

8. Tier 3 Dischargers must conduct monitoring for parameters, laboratory analytical methods, frequency and schedule described in Tables 4A and 4B. Dischargers may utilize in-field water testing instruments/equipment as a substitute for laboratory analytical methods if the method is approved by U.S. EPA, meets reporting limits (RL) and practical quantitation limits (PQL) specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.

[1] The requirement to select monitoring points to characterize at least 80% of the estimated maximum irrigation run-off based on typical discharge patterns is for the purposes of attempting to collect samples that represent a majority of the volume of irrigation run-off discharged; however the Board recognizes that predetermining these locations is not always possible and that sampling results may vary. The MRP does not specify the number or location of monitoring points to provide maximum flexibility for growers to determine how many sites necessary and exact locations are given the anticipated site-specific conditions.

9. Tier 3 Dischargers must initiate individual surface water discharge monitoring per an approved Sampling and Analysis Plan and QAPP, unless otherwise directed by the Executive Officer.

B. Individual Surface Water Discharge Reporting

Individual Surface Water Discharge Monitoring Data Submittal

By March 1, 2018, and annually thereafter by March 1, Tier 3 Dischargers must submit individual surface water discharge monitoring data and information to the Central Coast Water Board electronically, in a pdf format, containing at least the following items, or as otherwise approved by the Executive Officer:

a. Electronic laboratory data
- All reports of results must contain Ranch name and Global ID, site name(s), project contact, and date.
- Electronic laboratory data reports of chemical results shall include analytical results, as well as associated quality assurance data including method detection limits, reporting limits, matrix spikes, matrix spike duplicates, laboratory blanks, and other quality assurance results required by the analysis method.
- Electronic laboratory data reports of toxicity results shall include summary results comparable to those required in a CEDEN file delivery, including test and control results. For each test result, the mean, associated control performance, calculated percent of control, statistical test results and determination of toxicity, must be included. Test results must specify the control ID used to calculate statistical outcomes.
- Field data results, including temperature, pH, conductivity, turbidity and flow measurements, any field duplicates or blanks, and field observations.
- Calculations of un-ionized ammonia concentrations
- Calculations of total flow and pollutant loading (for nitrate, pesticides if sampled, total ammonia, and turbidity) (include formulas);

b. Narrative description of typical irrigation runoff patterns;
c. Location of sampling sites and map(s);
d. Sampling and analytical methods used;
e. Specify the method used to obtain flow at each monitoring site during each monitoring event;
f. Photos obtained from all monitoring sites, clearly labeled with location and date;
g. Sample chain-of-custody forms do not need to be submitted but must be made available to Central Coast Water Board staff, upon request.

PART 6. IRRIGATION AND NUTRIENT MANAGEMENT PLAN

Monitoring and reporting requirements related to the Irrigation and Nutrient Management Plan (INMP) identified in Part 6.A., and 6.B, apply to Tier 3 Dischargers identified by the Executive Officer that are newly enrolled in Order No. R3-2017-0002, and Tier 3 Dischargers that were subject to Irrigation and Nutrient Management Plan Requirements in Order R3-2012-0011 per MRP Order No. R3-2012-0011-03 Time schedules are shown in Table 5.

A. Irrigation and Nutrient Management Plan Monitoring

1. Tier 3 Dischargers required in Order No. R3-2012-0011 to develop and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional, are required to update (as necessary) and implement their INMP throughout the term of this Order.

2. The Executive Officer will assess whether an INMP is required for new Tier 3 Dischargers that enroll in Order No. R3-2017-0002 during the term of the Order. The Executive Officer will use the criteria established in Order No. R3-2012-0011 to make this assessment. If a Tier 3 Discharger is required to develop an INMP, the Tier 3 discharger must develop and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional, **within 18 months** of the Executive Officer's assessment of the INMP requirement.
3. The purpose of the INMP is to budget and manage the nutrients applied to each farm/ranch considering all sources of nutrients, crop requirements, soil types, climate, and local conditions in order to minimize nitrate loading to surface water and groundwater in compliance with this Order. The professional certification of the INMP must indicate that the relevant expert has reviewed all necessary documentation and testing results, evaluated total nitrogen applied relative to typical crop nitrogen uptake and nitrogen removed at harvest, with consideration to potential nitrate loading to groundwater, and conducted field verification to ensure accuracy of reporting.
4. Tier 3 Dischargers required to develop and initiate implementation an (INMP) must include the following elements in the INMP. The INMP is not submitted to the Central Coast Water Board, with the exception of the INMP Effectiveness Report:
    a. Proof of INMP certification;
    b. Map locating each farm/ranch;
    c. Identification of crop nitrogen uptake values for use in nutrient balance calculations;

d. Record keeping annually by either Method 1 or Method 2:

e. To meet the requirement to record total nitrogen in the soil,dischargers may take a nitrogen soil sample (e.g. laboratory analysis or nitrate quick test) or use an alternative method to evaluate nitrogen content in soil, prior to planting or seeding the field or prior to the time of pre-sidedressing, or at an alternative time when it is most effective to determine nitrogen present in the soil that is available for the next crop and to minimize nitrate leaching to groundwater. The amount of nitrogen remaining in the soil must be accounted for as a source of nitrogen when budgeting, and the soil sample or alternative method results must be maintained in the INMP.

f. Identification of irrigation and nutrient management practices in progress (identify start date), completed (identify completion date), and planned (identify anticipated start date) to reduce nitrate loading to groundwater to achieve compliance with this Order.

g. Description of methods Discharger will use to verify overall effectiveness of the INMP.

5. Tier 3 Dischargers must evaluate the effectiveness of the INMP. Irrigation and Nutrient Management Plan effectiveness monitoring must evaluate reduction in new nitrogen[1] loading potential based on minimized fertilizer use and improved irrigation and nutrient management practices in order to minimize new nitrogen loading to surface water and groundwater. Evaluation methods used may include, but are not limited to analysis of groundwater well monitoring data or soil sample data, or analysis of trends in new nitrogen application data.

B. Irrigation and Nutrient Management Plan Reporting

1. **By March 1, 2019**, Tier 3 Dischargers required to develop and initiate implementation of an INMP must submit an INMP Effectiveness Report to evaluate reductions in nitrate loading to surface water and groundwater based on the implementation of irrigation and nutrient management practices in a format specified by the Executive Officer. Dischargers in the same groundwater basin or subbasin may choose to comply with this requirement as a group by submitting a single report that evaluates the overall effectiveness of the broad scale implementation of irrigation and nutrient management practices identified in individual INMPs to protect groundwater. Group efforts must use data from each farm/ranch (e.g., data from individual groundwater wells, soil samples, or nitrogen application). The INMP

[1] New nitrogen is nitrogen from fertilizers, amendments, and other nitrogen sources applied other than nitrogen present in groundwater.

Effectiveness Report must include a description of the methodology used to evaluate and verify effectiveness of the INMP.

PART 7. WATER QUALITY BUFFER PLAN

Monitoring and reporting requirements related to the Water Quality Buffer Plan identified in Part 7.A. and Part 7.B. apply to Tier 3 Dischargers that have farms/ranches *that contain or are adjacent to waterbody identified on the List of Impaired Waterbodies as impaired for temperature, turbidity, or sediment).* Time schedules are shown in Table 5.

A. **Water Quality Buffer Plan**

1. **By 18 months following enrollment in Order No. R3-2017-0002 of a Tier 3 farm/ranch**, Tier 3 Dischargers adjacent to or containing a waterbody identified on the List of Impaired Waterbodies as impaired for temperature, turbidity or sediment must submit a Water Quality Buffer Plan (WQBP) to the Executive Officer that protects the listed waterbody and its associated perennial and intermittent tributaries. The purpose of the Water Quality Buffer Plan is to prevent waste discharge, comply with water quality standards (e.g., temperature, turbidity, sediment), and protect beneficial uses in compliance with this Order and the following Basin Plan requirement:

   Basin Plan (Chapter 5, p. V-13, Section V.G.4 – Erosion and Sedimentation, *"A filter strip of appropriate width, and consisting of undisturbed soil and riparian vegetation or its equivalent, must be maintained, wherever possible, between significant land disturbance activities and watercourses, lakes, bays, estuaries, marshes, and other water bodies. For construction activities, minimum width of the filter strip must be thirty feet, wherever possible…."*

2. The Water Quality Buffer Plan must include the following or the functional equivalent, to address discharges of waste and associated water quality impairments:

   a. A minimum 30 foot buffer (as measured horizontally from the top of bank on either side of the waterway, or from the high water mark of a lake and mean high tide of an estuary);
   b. Any necessary increases in buffer width to adequately prevent the discharge of waste that may cause or contribute to any excursion above or outside the acceptable range for any Regional, State, or Federal numeric or narrative water quality standard (e.g., temperature, turbidity);

c. Any buffer less than 30 feet must provide equivalent water quality protection and be justified based on an analysis of site-specific conditions and be approved by the Executive Officer;
d. Identification of any alternatives implemented to comply with this requirement, that are functionally equivalent to described buffer;
e. Schedule for implementation;
f. Maintenance provisions to ensure water quality protection;
g. Annual photo monitoring;

2. The WQPB must be submitted using the Water Quality Buffer Plan form, or, if an alternative to the WQBP is submitted, in a format approved by the Executive Officer.

3. **By March 1, 2019**, Tier 3 Dischargers that submitted a WQBP pursuant to Order No. R3-2012-0011 or Order No. R3-2017-0002, are required to update (as necessary) and implement their WQBP, and annually submit a WQBP Status Report of their WQBP implementation using the Water Quality Buffer Plan form, or, if an alternative to the WQBP was submitted, an Alternative to WQBP Status Report, electronically, in a format approved by the Executive Officer.

PART 8. GENERAL MONITORING AND REPORTING REQUIREMENTS

A. Submittal of Technical Reports

1. Dischargers must submit reports in a format specified by the Executive Officer (reports will be submitted electronically, unless otherwise specified by the Executive Officer). A transmittal letter must accompany each report, containing the following penalty of perjury statement signed by the Discharger or the Discharger's authorized agent:

   "In compliance with Water Code §13267, I certify under penalty of perjury that this document and all attachments were prepared by me, or under my direction or supervision following a system designed to assure that qualified personnel properly gather and evaluate the information submitted. To the best of my knowledge and belief, this document and all attachments are true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment".

2. If the Discharger asserts that all or a portion of a report submitted pursuant to this Order is subject to an exemption from public disclosure (e.g. trade secrets or secret processes), the Discharger must provide an explanation of how those portions of the reports are exempt from public disclosure. The

Discharger must clearly indicate on the cover of the report (typically an electronic submittal) that the Discharger asserts that all or a portion of the report is exempt from public disclosure, submit a complete report with those portions that are asserted to be exempt in redacted form, submit separately (in a separate electronic file) unredacted pages (to be maintained separately by staff). The Central Coast Water Board staff will determine whether any such report or portion of a report qualifies for an exemption from public disclosure. If the Central Coast Water Board staff disagrees with the asserted exemption from public disclosure, the Central Coast Water Board staff will notify the Discharger prior to making such report or portions of such report available for public inspection.

B. Central Coast Water Board Authority

1. Monitoring reports are required pursuant to section 13267 of the California Water Code. Pursuant to section 13268 of the Water Code, a violation of a request made pursuant to section 13267 may subject you to civil liability of up to $1000 per day.

2. The Water Board needs the required information to determine compliance with Order No.R3-2017-0002. The evidence supporting these requirements is included in the findings of Order No.R3-2017-0002.

____
John M. Robertson
Executive Officer

____
Date

Table 1. Major Waterbodies in Agricultural Areas[1]

Hydrologic SubArea	Waterbody Name	Hydrologic SubArea	Waterbody Name
30510	Pajaro River	30920	Quail Creek
30510	Salsipuedes Creek	30920	Salinas Reclamation Canal
30510	Watsonville Slough	31022	Chorro Creek
30510	Watsonville Creek[2]	31023	Los Osos Creek
30510	Beach Road Ditch[2]	31023	Warden Creek
30530	Carnadero Creek	31024	San Luis Obispo Creek
30530	Furlong Creek[2]	31024	Prefumo Creek
30530	Llagas Creek	31031	Arroyo Grande Creek
30530	Miller's Canal	31031	Los Berros Creek
30530	San Juan Creek	31210	Bradley Canyon Creek
30530	Tesquisquita Slough	31210	Bradley Channel
30600	Moro Cojo Slough	31210	Green Valley Creek
30910	Alisal Slough	31210	Main Street Canal
30910	Blanco Drain	31210	Orcutt Solomon Creek
30910	Old Salinas River	31210	Oso Flaco Creek
30910	Salinas River (below Gonzales Rd.)	31210	Little Oso Flaco Creek
30920	Salinas River (above Gonzales Rd. and below Nacimiento R.)	31210	Santa Maria River
30910	Santa Rita Creek[2]	31310	San Antonio Creek[2]
30910	Tembladero Slough	31410	Santa Ynez River
30920	Alisal Creek	31531	Bell Creek
30920	Chualar Creek	31531	Glenn Annie Creek
30920	Espinosa Slough	31531	Los Carneros Creek[2]
30920	Gabilan Creek	31534	Arroyo Paredon Creek
30920	Natividad Creek	31534	Franklin Creek

[1] At a minimum, monitoring sites must be included for these waterbodies in agricultural areas, unless otherwise approved by the Executive Officer. Monitoring sites may be proposed for addition or modification to better assess the impacts of waste discharges from irrigated lands to surface water. Dischargers choosing to comply with surface receiving water quality monitoring, individually (not part of a cooperative monitoring program) must only monitor sites for waterbodies receiving the discharge.

[2] These creeks are included because they are newly listed waterbodies on the 2010 303(d) list of Impaired Waters that are associated with areas of agricultural discharge.

Table 2. Surface Receiving Water Quality Monitoring Parameters

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Photo Monitoring		
Upstream and downstream photographs at monitoring location		With every monitoring event
WATER COLUMN SAMPLING **Physical Parameters and General Chemistry**		
Flow (field measure) (CFS) following SWAMP field SOP[9]	.25	Monthly, including 2 stormwater events
pH (field measure)	0.1	”
Electrical Conductivity (field measure) (µS/cm)	2.5	”
Dissolved Oxygen (field measure) (mg/L)	0.1	”
Temperature (field measure) (^{o}C)	0.1	”
Turbidity (NTU)	0.5	”
Total Dissolved Solids (mg/L)	10	”
Total Suspended Solids (mg/L)	0.5	”
Nutrients		
Total Nitrogen (mg/L)	0.5	Monthly, including 2 stormwater events
Nitrate + Nitrite (as N) (mg/L)	0.1	”
Total Ammonia (mg/L)	0.1	”
Unionized Ammonia (calculated value, mg/L))		”
Total Phosphorus (as P) (mg/L)	0.02	
Soluble Orthophosphate (mg/L)	0.01	”
Water column chlorophyll a (µg/L)	1.0	“
Algae cover, Floating Mats, % coverage	-	“
Algae cover, Attached, % coverage	-	“
Water Column Toxicity Test		
Algae - *Selenastrum capricornutum (*96-hour chronic; Method1003.0 in EPA/821/R-02/013)	-	4 times each year, twice in dry season, twice in wet season
Water Flea – *Ceriodaphnia dubia* (7-day chronic; Method 1002.0 in EPA/821/R-02/013)	-	”
Midge - *Chironomus spp.* (96-hour acute; Alternate test species in EPA 821-R-02-012)	-	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Toxicity Identification Evaluation (TIE)	-	As directed by Executive Officer
Pesticides[2] /Herbicides (µg/L)		
Organophosphate Pesticides		
Azinphos-methyl	0.02	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Chlorpyrifos	0.005	”
Diazinon	0.005	”
Dichlorvos	0.01	”
Dimethoate	0.01	”
Dimeton-s	0.005	”
Disulfoton (Disyton)	0.005	”
Malathion	0.005	”
Methamidophos	0.02	”
Methidathion	0.02	“
Parathion-methyl	0.02	“
Phorate	0.01	“
Phosmet	0.02	“
Neonicotinoids		
Thiamethoxam	.002	“
Imidacloprid	.002	“
Thiacloprid	.002	“
Dinotefuran	.006	“
Acetamiprid	.01	“
Clothianidin	.02	
Herbicides		
Atrazine	0.05	“
Cyanazine	0.20	“
Diuron	0.05	“
Glyphosate	2.0	“
Linuron	0.1	“
Paraquat	0.20	“
Simazine	0.05	“
Trifluralin	0.05	“
Metals (µg/L)		
Arsenic (total) [5,7]	0.3	2 times in both 2017 and 2018, once in dry season and once in wet season of each year, concurrent with water toxicity monitoring
Boron (total) [6,7]	10	“
Cadmium (total & dissolved) [4.5,7]	0.01	“

Parameters and Tests	RL[3]	Monitoring Frequency[1]
Copper (total and dissolved) [4,7]	0.01	"
Lead (total and dissolved) [4,7]	0.01	"
Nickel (total and dissolved) [4,7]	0.02	"
Molybdenum (total) [7]	1	"
Selenium (total)[7]	0.30	"
Zinc (total and dissolved) [4.5,7]	0.10	"
Other (µg/L)		
Total Phenolic Compounds[8]	5	2 times in 2017, once in spring (April-May) and once in fall (August-September)
Hardness (mg/L as CaCO3)	1	"
Total Organic Carbon (ug/L)	0.6	"
SEDIMENT SAMPLING		
Sediment Toxicity - *Hyalella azteca* 10-day static renewal (EPA, 2000)		2 times each year, once in spring (April-May) and once in fall (August-September)
Pyrethroid Pesticides in Sediment (µg/kg)		
Gamma-cyhalothrin	2	2 times in both 2017 and 2018, once in spring (April-May) and once in fall (August-September) of each year, concurrent with sediment toxicity sampling
Lambda-cyhalothrin	2	"
Bifenthrin	2	"
Beta-cyfluthrin	2	"
Cyfluthrin	2	"
Esfenvalerate	2	"
Permethrin	2	"
Cypermethrin	2	"
Danitol	2	"
Fenvalerate	2	"
Fluvalinate	2	"
Other Monitoring in Sediment		
Chlorpyrifos (µg/kg)	2	"
Total Organic Carbon	0.01%	"
		"
Sediment Grain Size Analysis	1%	"

[1]Monitoring is ongoing through all five years of the Order, unless otherwise specified. Monitoring frequency may be used as a guide for developing alternative Sampling and Analysis Plan.
[2]Pesticide list may be modified based on specific pesticide use in Central Coast Region. Analytes on this list must be reported, at a minimum.
[3] Reporting Limit, taken from SWAMP where applicable.

[4] Holmgren, Meyer, Cheney and Daniels. 1993. Cadmium, Lead, Zinc, Copper and Nickel in Agricultural Soils of the United States. J. of Environ. Quality 22:335-348.
[5] Sax and Lewis, ed. 1987. Hawley's Condensed Chemical Dictionary. 11th ed. New York: Van Nostrand Reinhold Co., 1987. Zinc arsenate is an insecticide.
[6] Http://www.coastalagro.com/products/labels/9%25BORON.pdf; Boron is applied directly or as a component of fertilizers as a plant nutrient.
[7] Madramootoo, Johnston, Willardson, eds. 1997. Management of Agricultural Drainage Water Quality. International Commission on Irrigation and Drainage. U.N. FAO. SBN 92-6-104058.3.
[8] http://cat.inist.fr/?aModele=afficheN&cpsidt=14074525; Phenols are breakdown products of herbicides and pesticides. Phenols can be directly toxic and cause endocrine disruption.
[9] See SWAMP field measures SOP, p. 17
mg/L – milligrams per liter; ug/L – micrograms per liter; ug/kg – micrograms per kilogram;
NTU – Nephelometric Turbidity Units; CFS – cubic feet per second;

Table 3. Groundwater Monitoring Parameters

Parameter	RL	Analytical Method[3]	Units
pH	0.1	Field or Laboratory Measurement EPA General Methods	pH Units
Specific Conductance	2.5		µS/cm
Total Dissolved Solids	10		mg/L
Total Alkalinity as $CaCO_3$	1	EPA Method 310.1 or 310.2	
Calcium	0.05	General Cations[1] EPA 200.7, 200.8, 200.9	
Magnesium	0.02		
Sodium	0.1		
Potassium	0.1		
Sulfate (SO_4)	1.0	General Anions EPA Method 300 or EPA Method 353.2	
Chloride	0.1		
Nitrate + Nitrite (as N)[2] *or* Nitrate as N	0.1		

[1] General chemistry parameters (major cations and anions) represent geochemistry of water bearing zone and assist in evaluating quality assurance/quality control of groundwater monitoring and laboratory analysis.
[2] The MRP allows analysis of "nitrate plus nitrite" to represent nitrate concentrations (as N). The "nitrate plus nitrite" analysis allows for extended laboratory holding times and relieves the Discharger of meeting the short holding time required for nitrate.
[3] Dischargers may use alternative analytical methods approved by EPA.
RL – Reporting Limit; µS/cm – micro siemens per centimeter

Table 4A. Individual Discharge Monitoring for Tailwater, Tile drain, and Stormwater Discharges

Parameter	Analytical Method[1]	Maximum PQL	Units	Min Monitoring Frequency
Discharge Flow or Volume	Field Measure	---	CFS	(a) (d)
Approximate Duration of Flow	Calculation	---	hours/month	
Temperature (water)	Field Measure	0.1	°Celsius	
pH	Field Measure	0.1	pH units	

Electrical Conductivity	Field Measure	100	µS/cm	
Turbidity	SM 2130B, EPA 180.1	1	NTUs	
Nitrate + Nitrite (as N)	EPA 300.1, EPA 353.2	0.1	mg/L	
Ammonia	SM 4500 NH3, EPA 350.3	0.1	mg/L	
Chlorpyrifos[2]	EPA 8141A, EPA 614	0.02	ug/L	(b) (c) (d)
Diazinon[2]				
Ceriodaphnia Toxicity (96-hr acute)	EPA-821-R-02-012	NA	% Survival	
Hyalella Toxicity in Water (96-hr acute)	EPA-821-R-02-012	NA	% Survival	

[1] In-field water testing instruments/equipment as a substitute for laboratory analysis if the method is approved by EPA, meets RL/PQL specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.
[2]If chlorpyrifos or diazinon is used at the farm/ranch, otherwise does not apply. The Executive Officer may require monitoring of other pesticides based on results of downstream receiving water monitoring.
(a) Two times per year during primary irrigation season for farms/ranches less than or equal to 500 acres, and four times per year during primary irrigation season for farms/ranches greater than 500 acres. Executive Officer may reduce sampling frequency based on water quality improvements.
(b) Once per year during primary irrigation season for farms/ranches less than or equal to 500 acres, and two times per year during primary irrigation season for farms/ranches greater than 500 acres.
(c) Sample must be collected within one week of chemical application, if chemical is applied on farm/ranch;
(d) Once per year during wet season (October – March) for farms/ranches less than or equal to 500 acres, and two times per year during wet season for farms/ranches greater than 500 acres, within 18 hours of major storm events;
CFS – Cubic feet per second; NTU – Nephelometric turbidity unit; PQL – Practical Quantitation Limit;
NA – Not applicable

Table 4B. Individual Discharge Monitoring for Tailwater Ponds and other Surface Containment Features

Parameter	Analytical Method[1]	Maximum PQL	Units	Minimum Monitoring Frequency
Volume of Pond	Field Measure	1	Gallons	(a) (d)
Nitrate + Nitrite (as N)	EPA 300.1, EPA 353.2	50	mg/L	

[1] In-field water testing instruments/equipment as a substitute for laboratory analysis if the method is approved by EPA, meets RL/PQL specifications in the MRP, and appropriate sampling methodology and quality assurance checks can be applied to ensure that QAPP standards are met to ensure accuracy of the test.
(a) Four times per year during primary irrigation season; Executive Officer may reduce monitoring frequency based on water quality improvements.
(d) Two times per year during wet season (October – March, within 18 hours of major storm events)

Table 5. Tier 3 - Time Schedule for Key Monitoring and Reporting Requirements (MRPs)

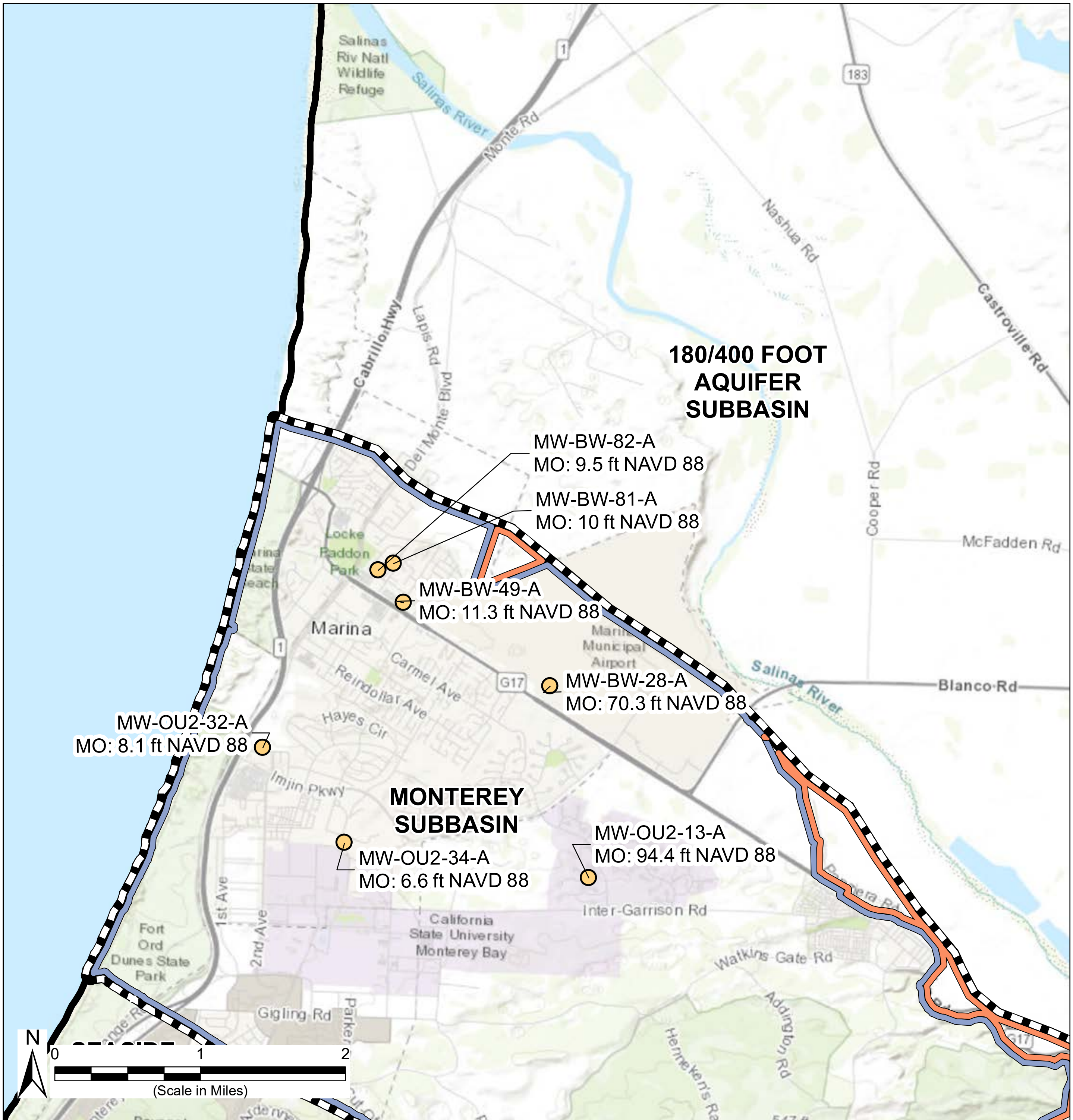
REQUIREMENT	TIME SCHEDULE[1]
Submit Sampling And Analysis Plan and Quality Assurance Project Plan (SAAP/QAPP) for Surface Receiving Water Quality Monitoring (*individually or*	By March 1, 2018, or as directed by the Executive Officer; satisfied if an approved SAAP/QAPP has been submitted pursuant

through cooperative monitoring program)	to Order No. R3-2012-0011 and associated MRPs
Initiate surface receiving water quality monitoring (*individually or through cooperative monitoring program*)	Per an approved SAAP and QAPP
Submit surface receiving water quality monitoring data (*individually or through cooperative monitoring program*)	Each January 1, April 1, July 1, and October 1
Submit surface receiving water quality Annual Monitoring Report (*individually or through cooperative monitoring program*)	By July 1 2017; annually thereafter by July 1
Initiate monitoring of groundwater wells	First sample from March-June 2017, second sample from September-December 2017
Submit individual surface water discharge SAAP and QAPP	By March 1, 2018 or as directed by the Executive Officer; waived if an approved SAAP and QAPP has been submitted and being implemented pursuant to Order No. R3-2012-0011.
Initiate individual surface water discharge monitoring	As described in an approved SAAP and QAPP
Submit individual surface water discharge monitoring data	March 1, 2018, and every March 1 annually thereafter
Submit electronic Annual Compliance Form	March 1, 2018 and every March 1 annually thereafter
Submit groundwater monitoring results	Within 60 days of the sample collection
Submit Water Quality Buffer Plan or alternative	Within 18 months of enrolling new Tier 3 farm/ranch in Order
Submit Status Report on Water Quality Buffer Plan or alternative	March 1, 2019
Tier 3 Dischargers with farms/ranches growing high risk crops:	
Report total nitrogen applied on the Total Nitrogen Applied form	March 1, 2018 and every March 1 annually thereafter
Submit INMP Effectiveness Report	March 1, 2019

[1] Dates are relative to adoption of this Order, unless otherwise specified.

Appendix 8-A

Groundwater Elevation SMCs



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

Management Areas

Marina-Ord Area

Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MO = Measurable Objectives

Notes

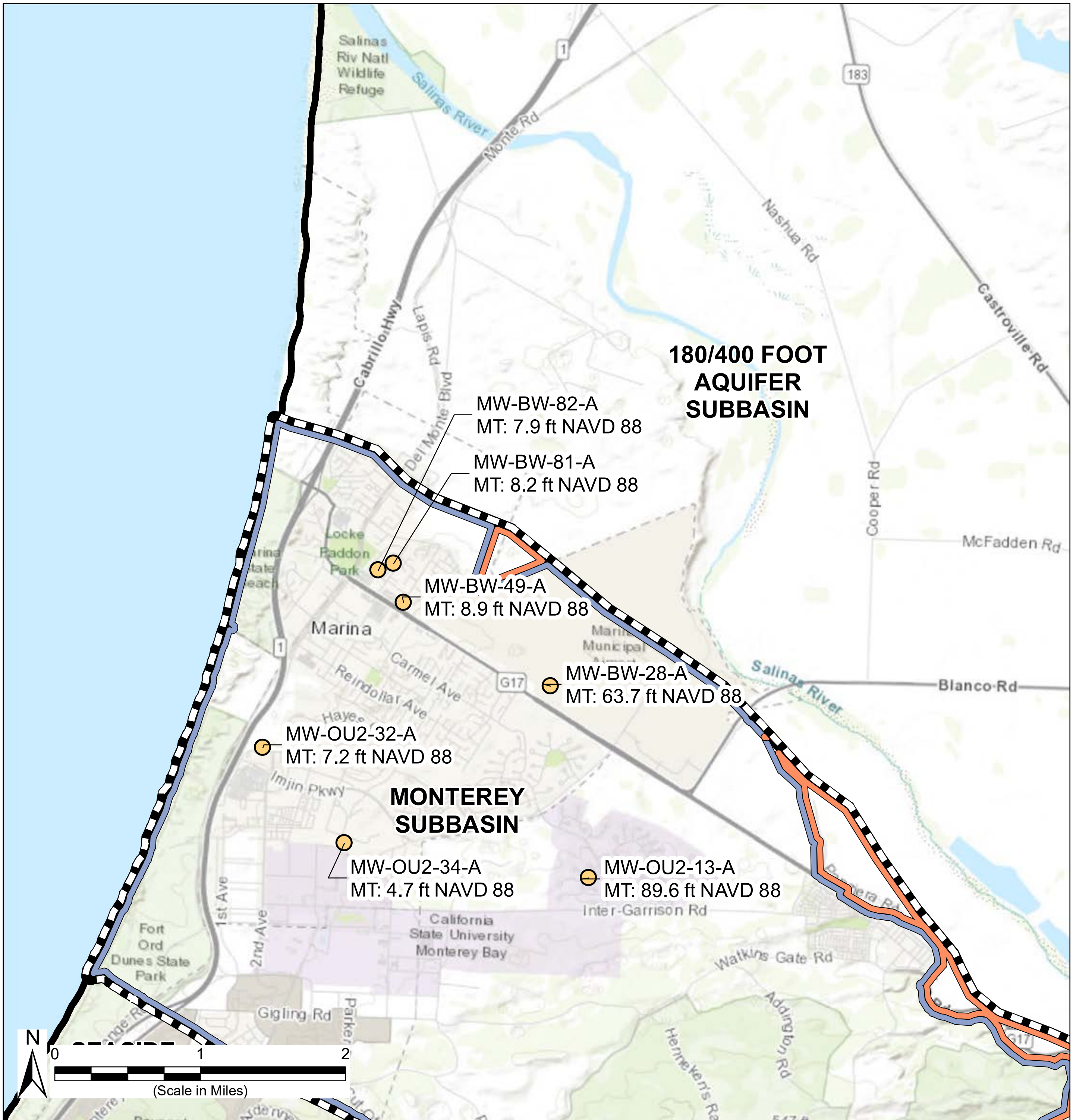
1. All locations are approximate.

Groundwater Elevation Measurable Objectives Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-1

Path: X:\B60094\Maps\2021\04\Fig8B-1_DuneSand_MO.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MT = Minimum Thresholds

Notes

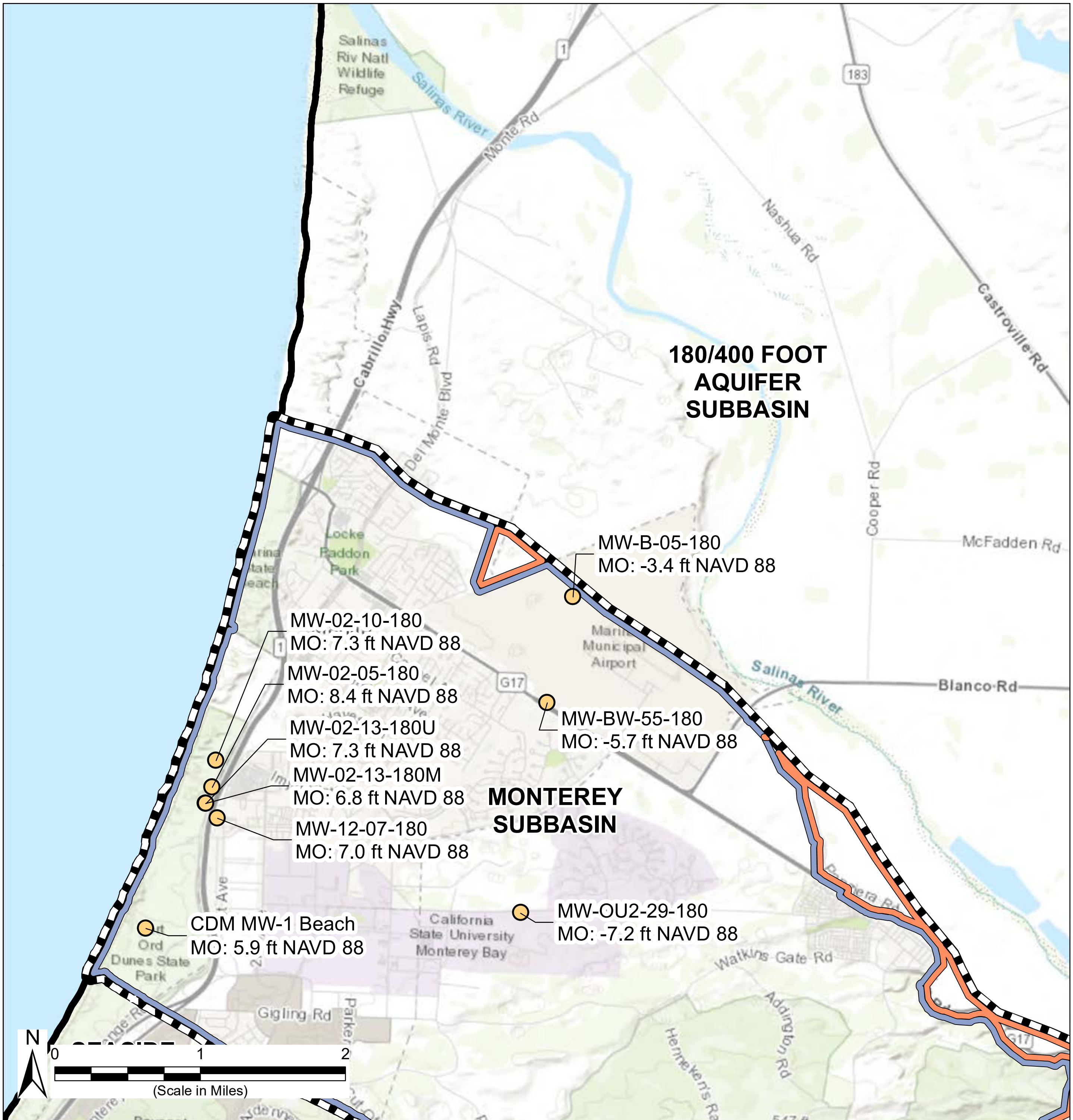
1. All locations are approximate.

Groundwater Elevation Minimum Thresholds Dune Sand Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-2

Path: X:\B60094\Maps\2021\04\Fig8B-2_DuneSand_MT.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

MO = Measurable Objectives

Notes

1. All locations are approximate.

Sources

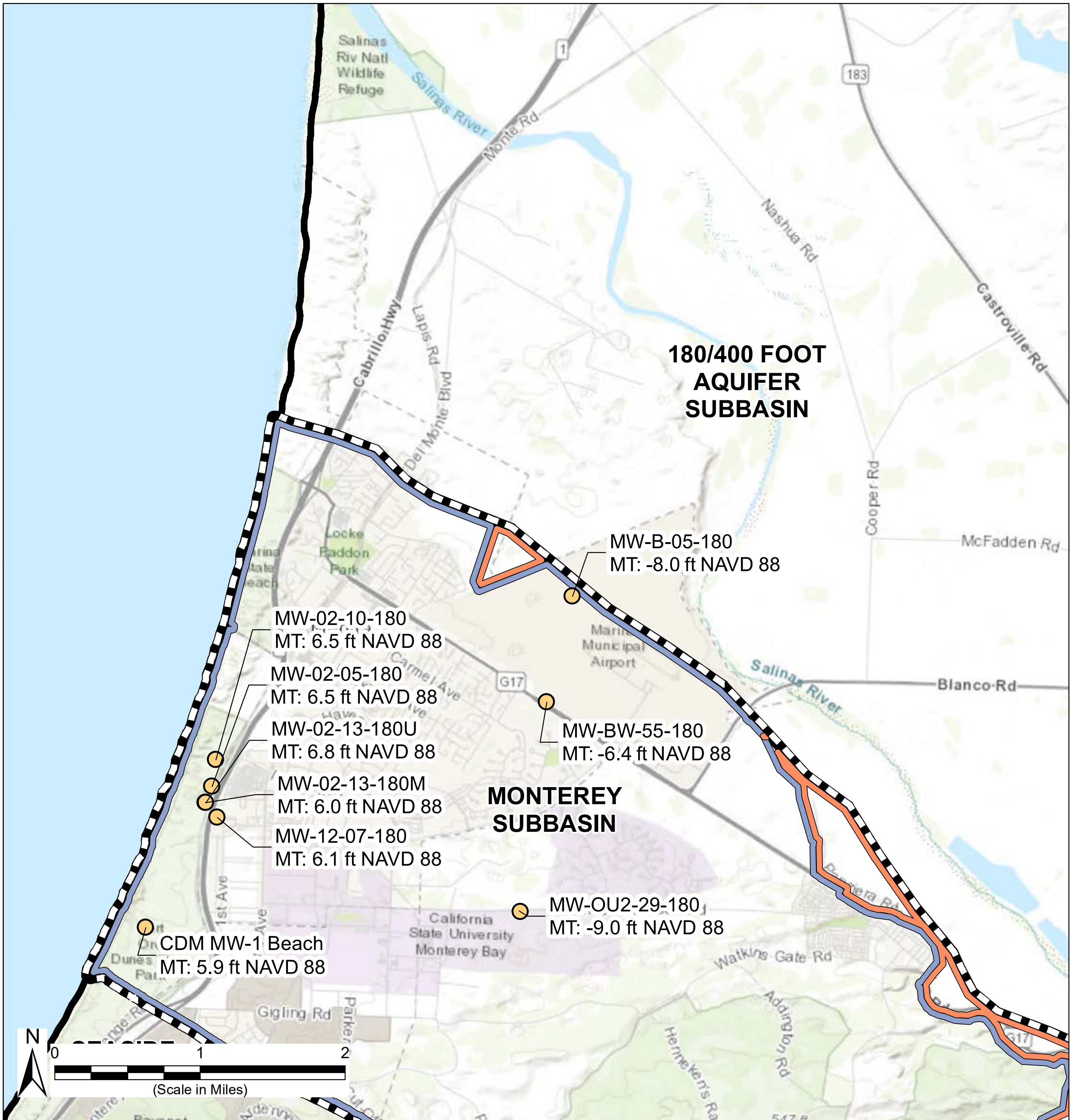
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Groundwater Elevation Measurable Objectives Upper 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-3

Path: X:\B60094\Maps\2021\04\Fig8B-3_Upper180-ft_MO.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MT = Minimum Thresholds

Notes

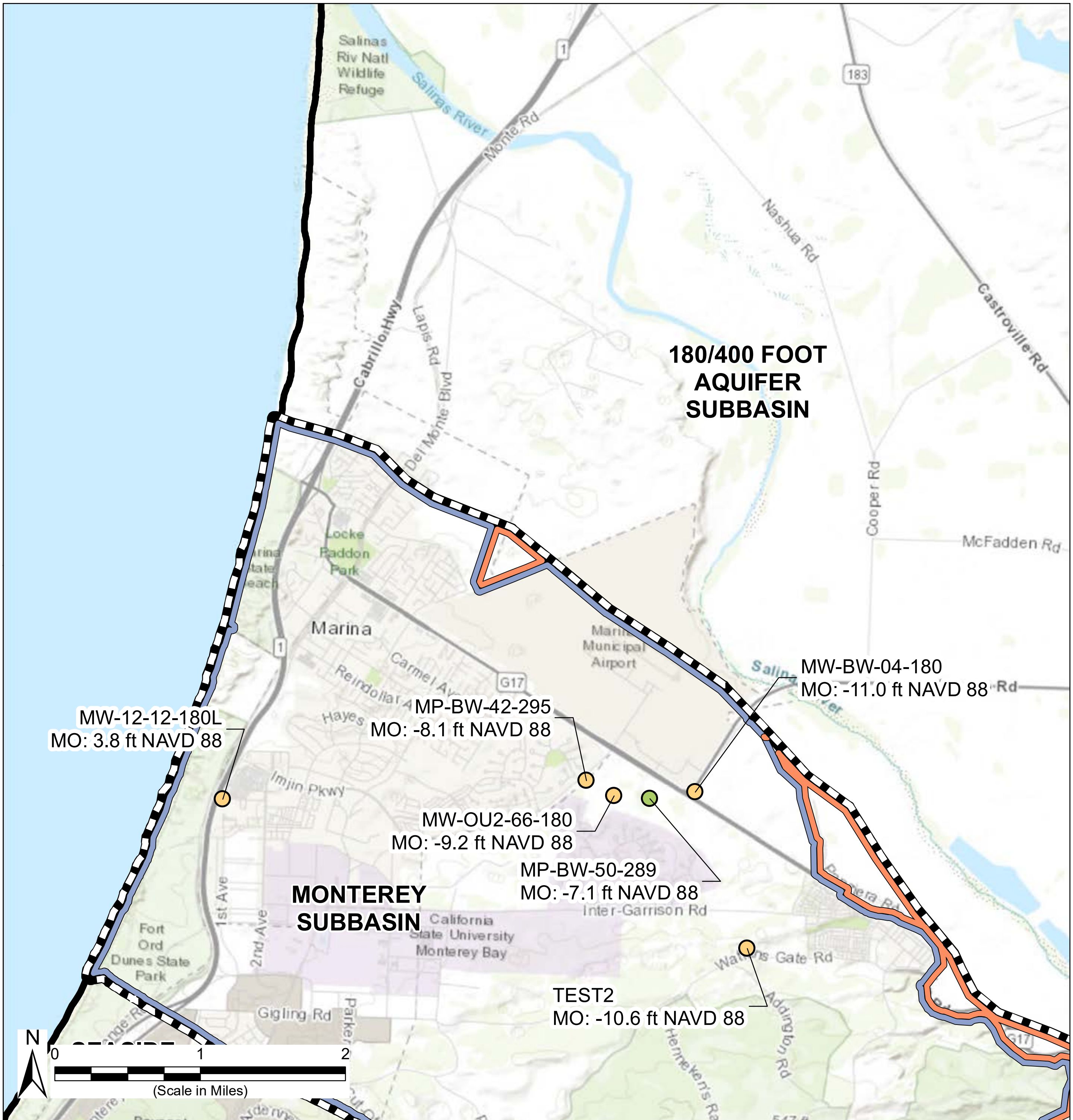
1. All locations are approximate.

Path: X:\B60094\Maps\2021\04\Fig8B-4_Upper180-ft_MT.mxd

Groundwater Elevation Minimum Thresholds Upper 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-4



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

Lower 180-Foot Aquifer

Lower 180-Foot, 400-Foot Aquifer

Management Areas

Marina-Ord Area

Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MO = Measurable Objectives

Notes

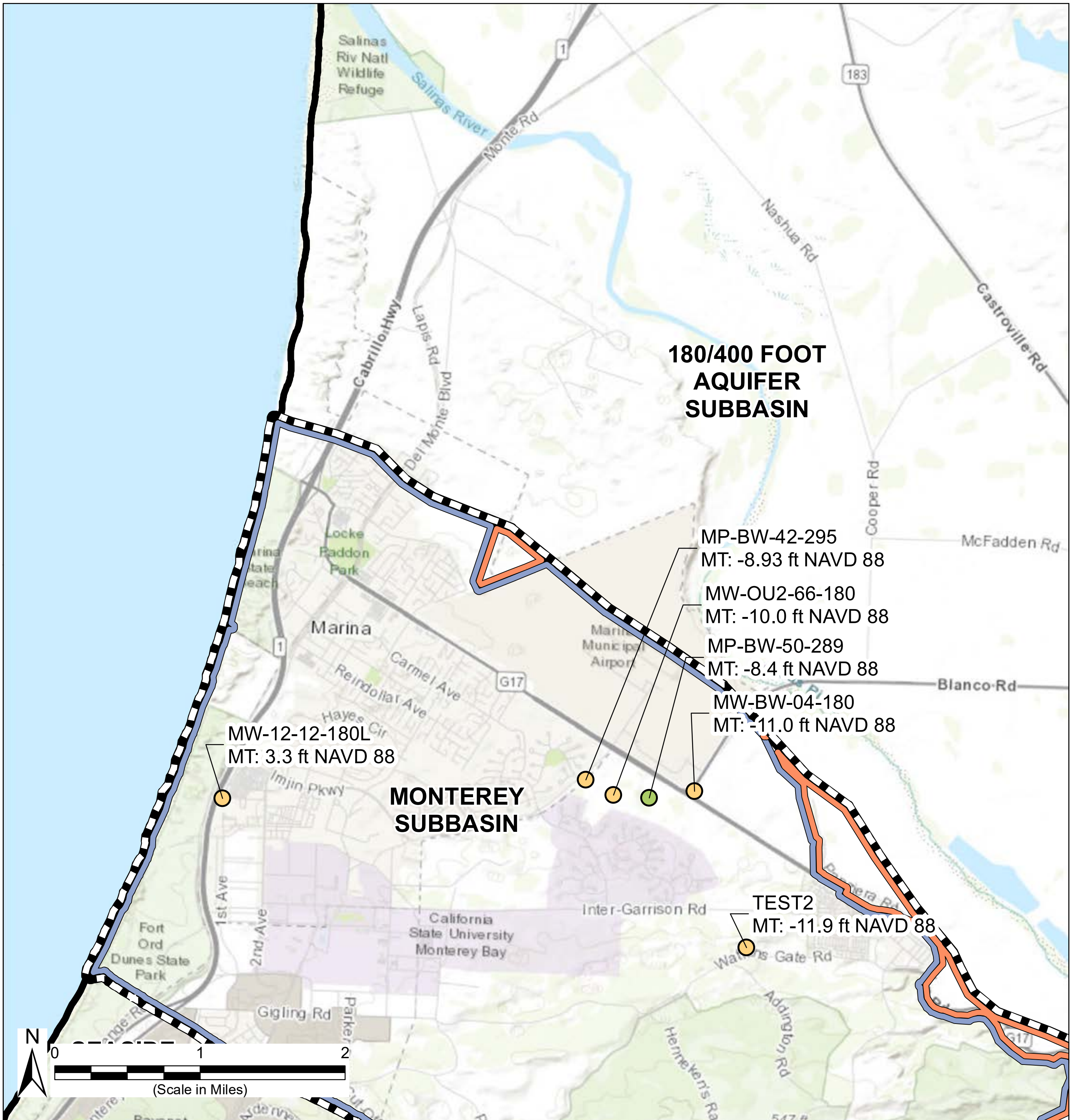
1. All locations are approximate.

Groundwater Elevation Measurable Objectives Lower 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-5

Path: X:\B60094\Maps\2021\04\Fig8B-5_Lower180-ft_MO.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- Lower 180-Foot Aquifer
- Lower 180-Foot, 400-Foot Aquifer

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

MT = Minimum Thresholds

Notes

1. All locations are approximate.

Sources

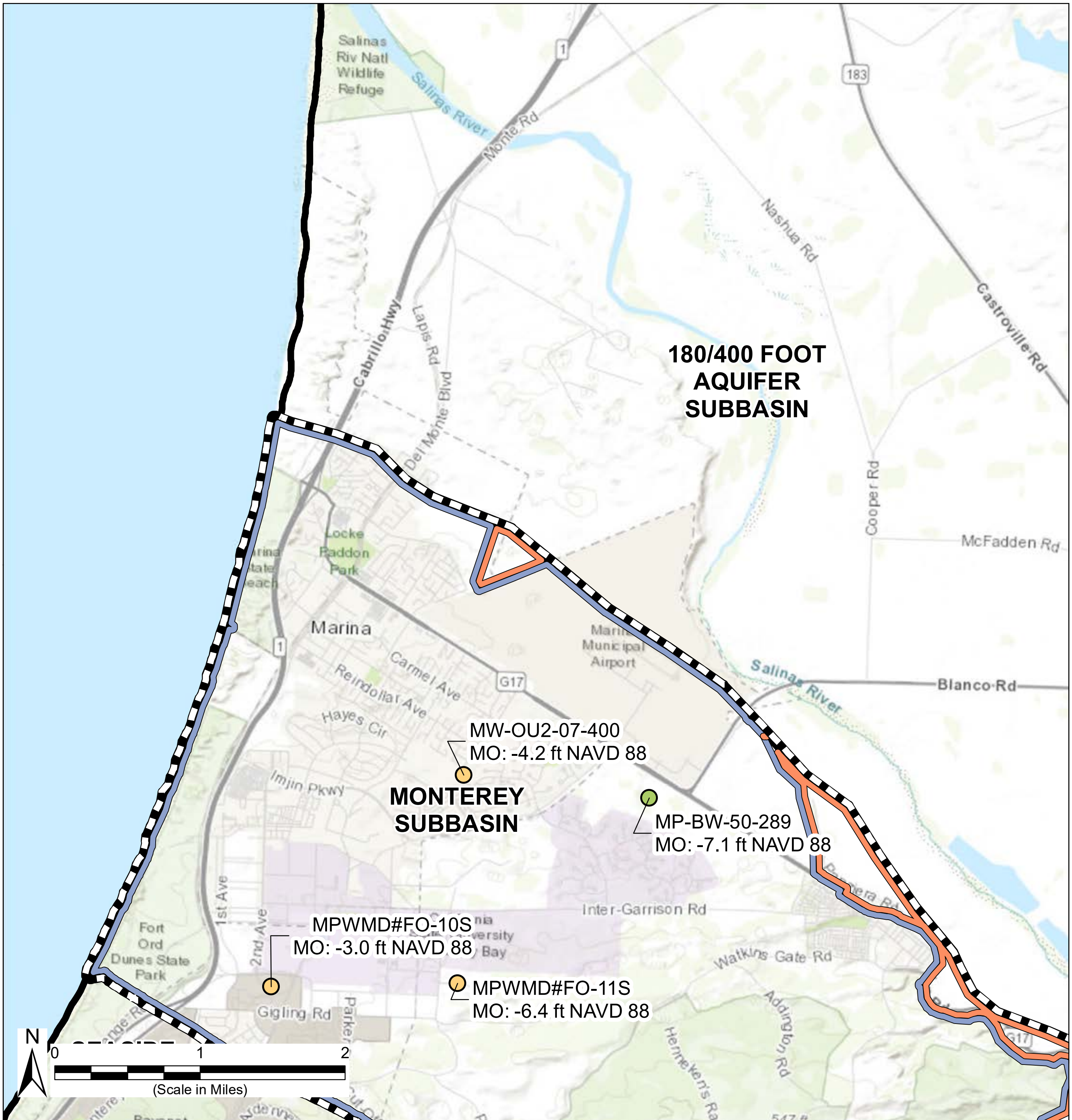
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Groundwater Elevation Minimum Thresholds Lower 180-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8A-6

Path: X:\B60094\Maps\2021\11\Fig8B-6_Lower180-ft_MT.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

- 400-Foot Aquifer (Paso Robles Aquifer)
- Lower 180-Foot, 400-Foot Aquifer

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

MO = Measurable Objectives

Notes

1. All locations are approximate.

Sources

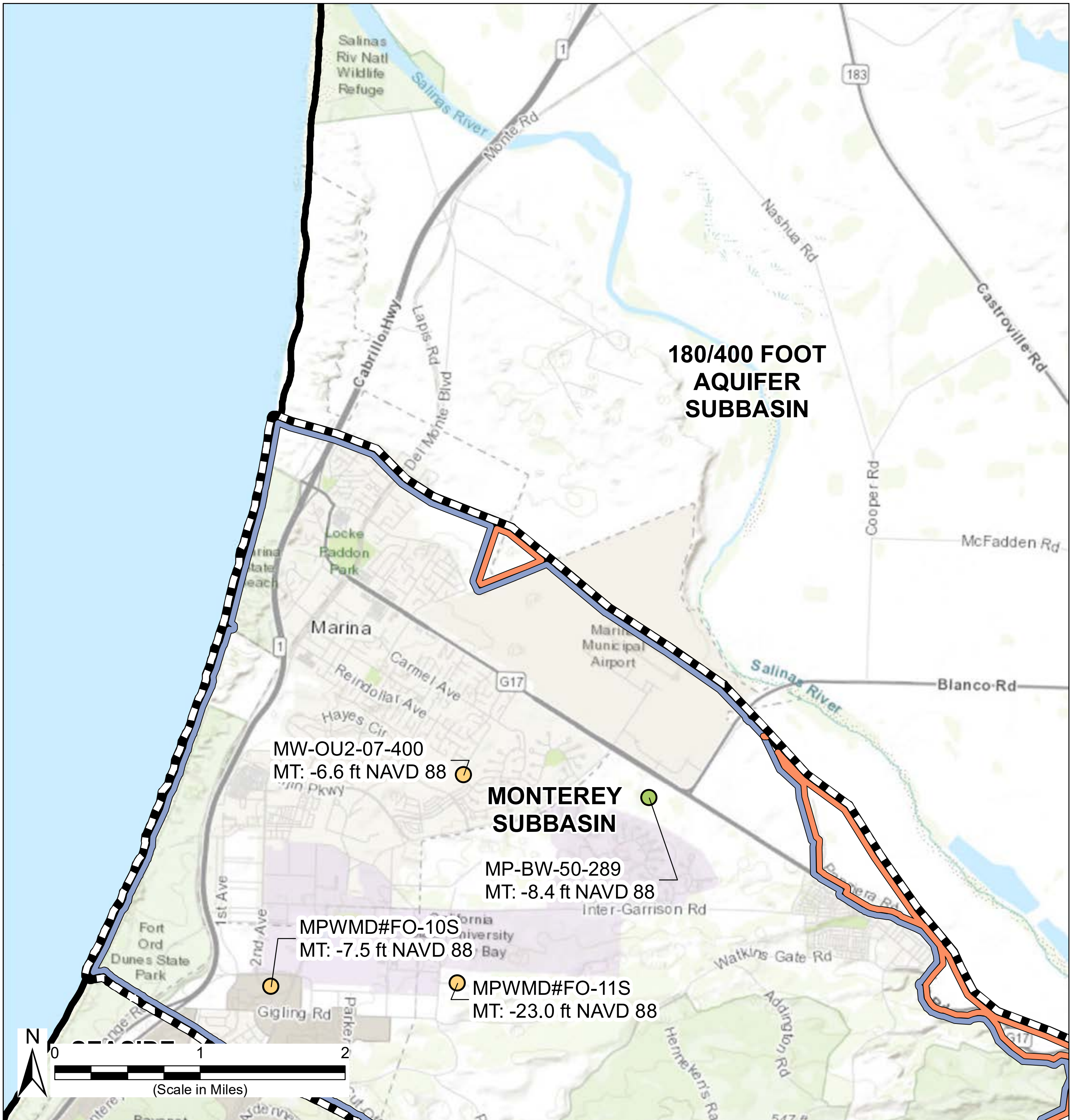
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Groundwater Elevation Measurable Objectives 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8-8

Path: X:\B60094\Maps\2021\11\Fig8B-7_400-ft_MO.mxd



Legend

Monterey Subbasin

Other Groundwater Subbasins within Salinas Valley Basin

Representative Monitoring Sites for Groundwater Elevations

400-Foot Aquifer (Paso Robles Aquifer)

Lower 180-Foot, 400-Foot

Management Areas

Marina-Ord

Corral de Tierra

Abbreviations

MT = Minimum Thresholds

Notes

1. All locations are approximate.

Sources

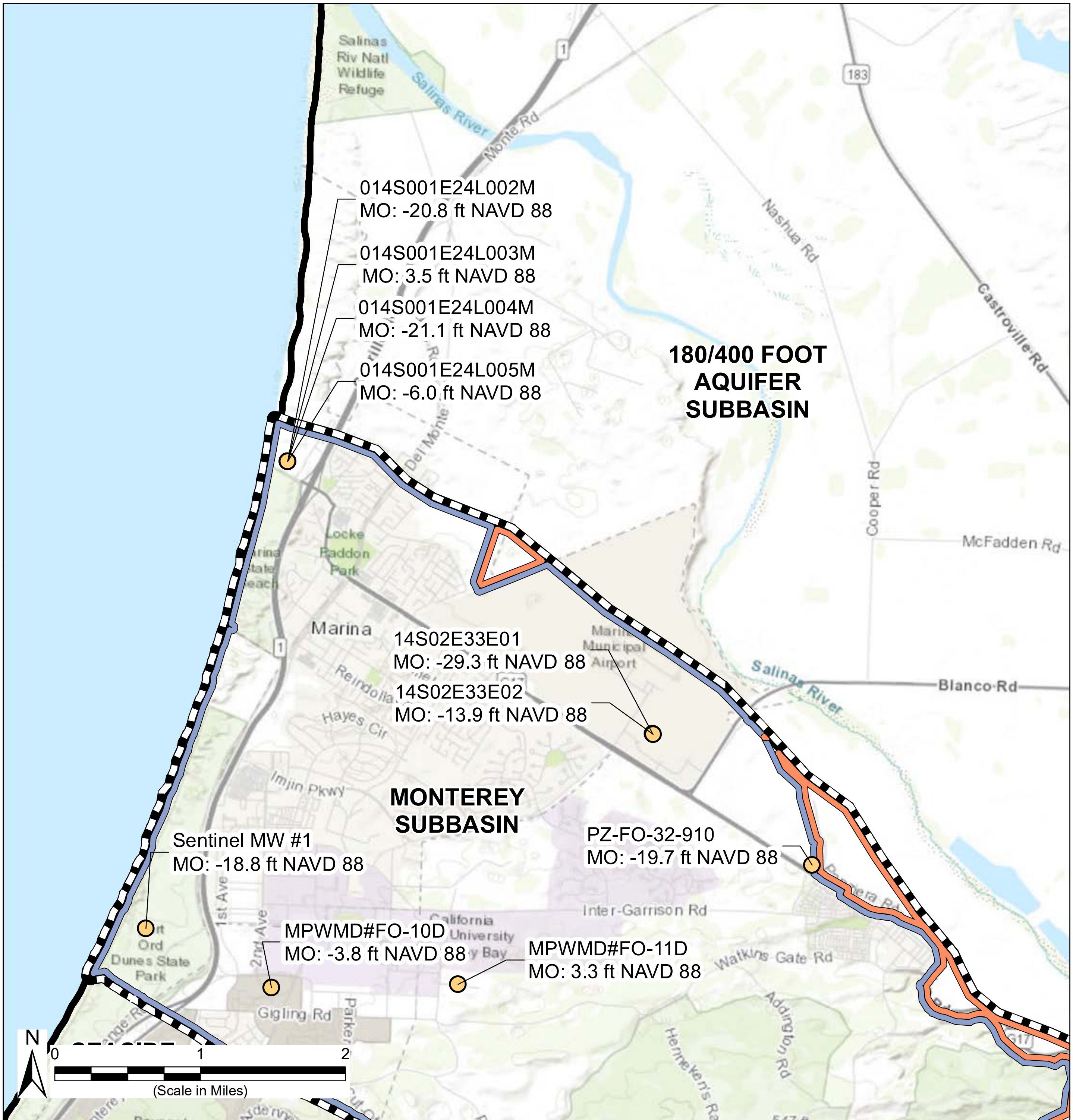
1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Groundwater Elevation Minimum Thresholds 400-Foot Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-8

Path: X:\B60094\Maps\2021\04\Fig8B-8_400-ft_MT.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 16 November 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MO = Measurable Objectives

Notes

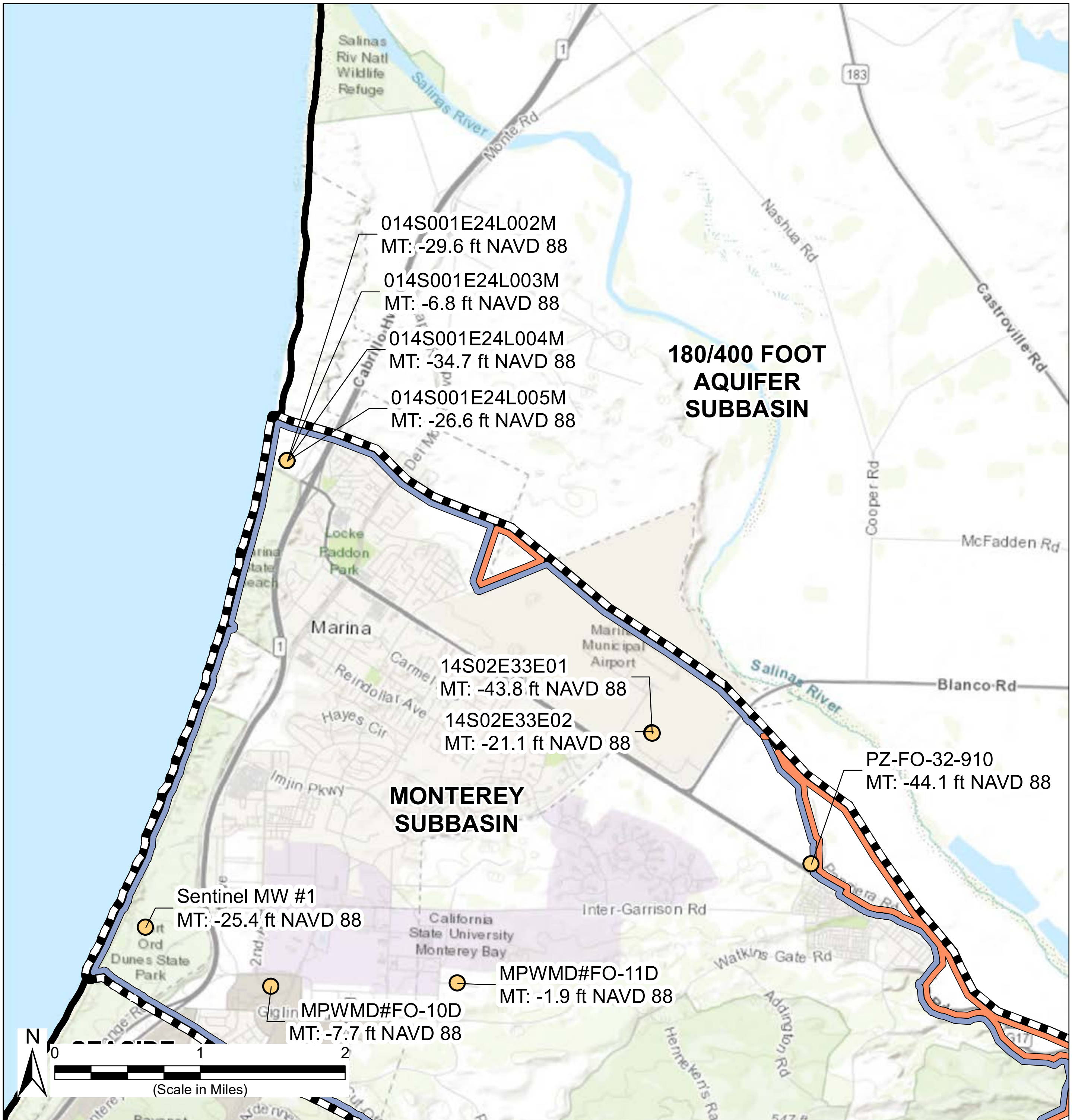
1. All locations are approximate.

Groundwater Elevation Measurable Objectives Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
November 2021

Figure 8A-9

Path: X:\B60094\Maps\2021\11\Fig8B-9_Deep_MO.mxd



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management

- Marina-Ord
- Corral de Tierra

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 30 April 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MT = Minimum Thresholds

Notes

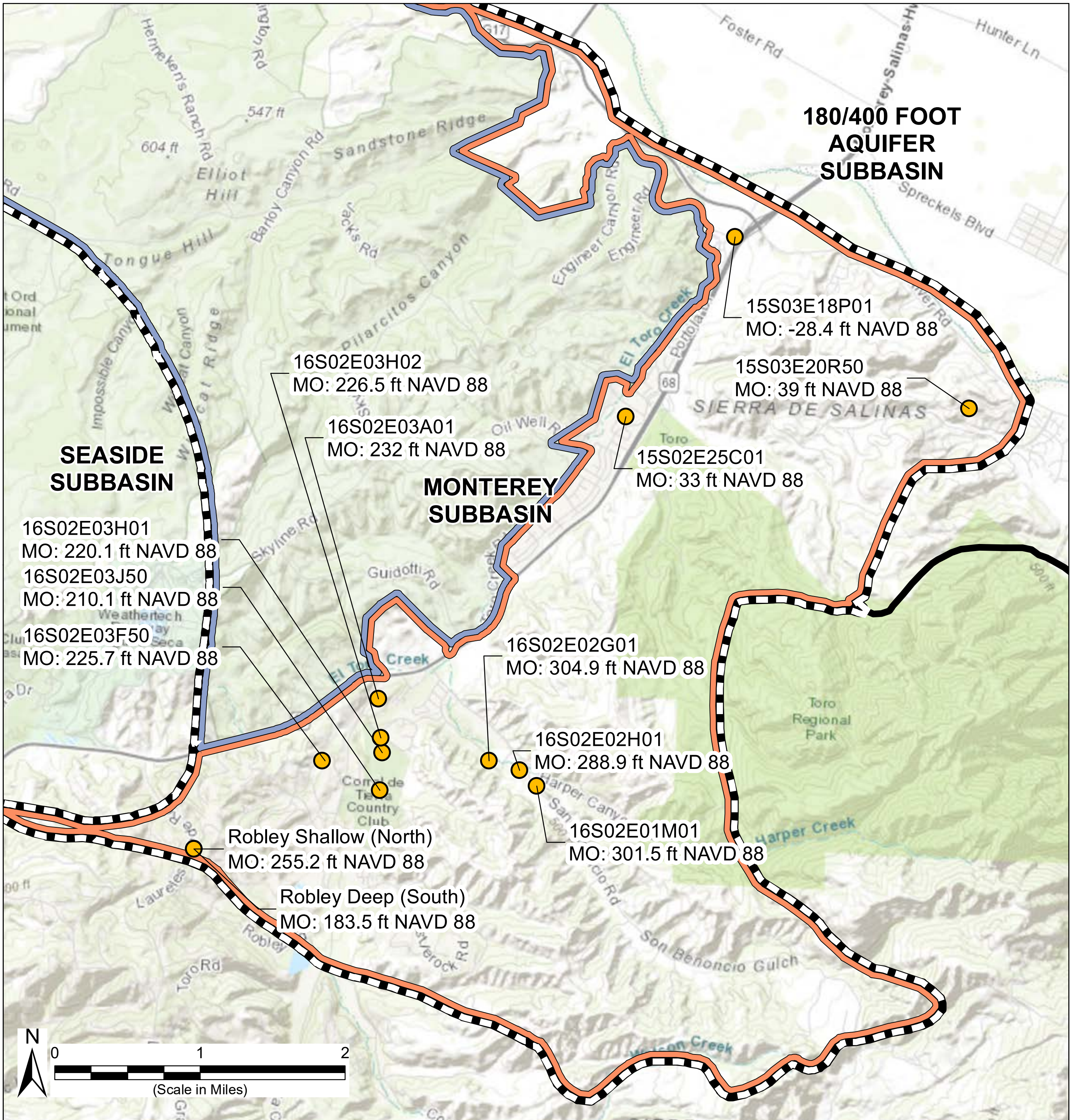
1. All locations are approximate.

Path: X:\B60094\Maps\2021\04\Fig8B-10_Deep_MT.mxd

Groundwater Elevation Minimum Thresholds Deep Aquifers

Monterey Subbasin
Groundwater Sustainability Plan
April 2021

Figure 8A-10



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 June 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Abbreviations

MO = Measurable Objectives

Notes

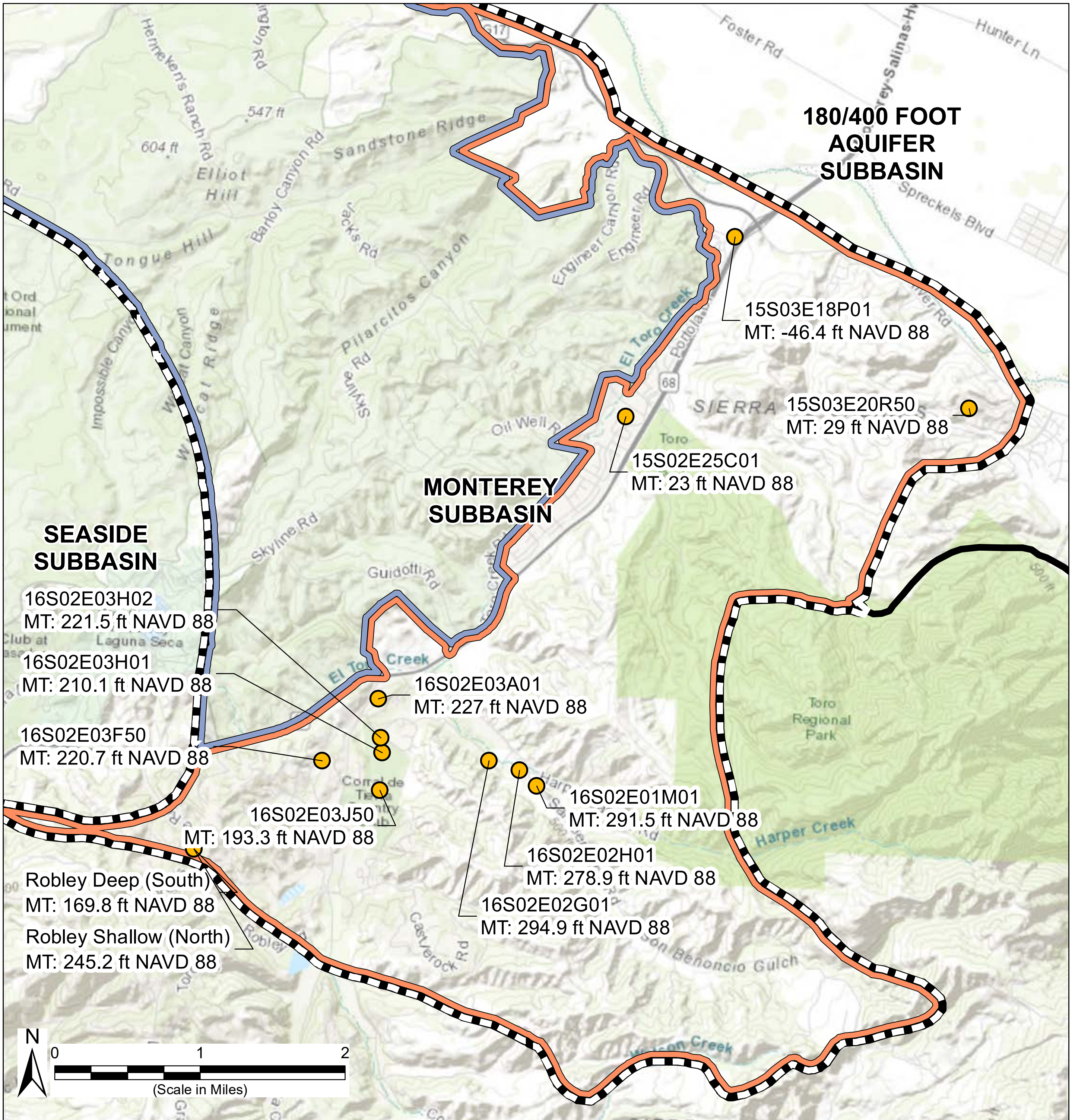
1. All locations are approximate.

Path: X:\B60094\Maps\2021\06\Fig8B-11_El_Toro_MO.mxd

Groundwater Elevation Measurable Objectives El Toro Primary Aquifer

Monterey Subbasin
Groundwater Sustainability Plan
June 2021

Figure 8A-11



Legend

- Monterey Subbasin
- Other Groundwater Subbasins within Salinas Valley Basin
- Representative Monitoring Sites for Groundwater Elevations

Management Areas

- Marina-Ord Area
- Corral de Tierra Area

Abbreviations

MT = Minimum Thresholds

Notes

1. All locations are approximate.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 24 June 2021.
2. DWR groundwater basins are based on the boundaries defined in California's Groundwater, Bulletin 118 - 2018 Update.

Groundwater Elevation Minimum Thresholds El Toro Primary Aquifer

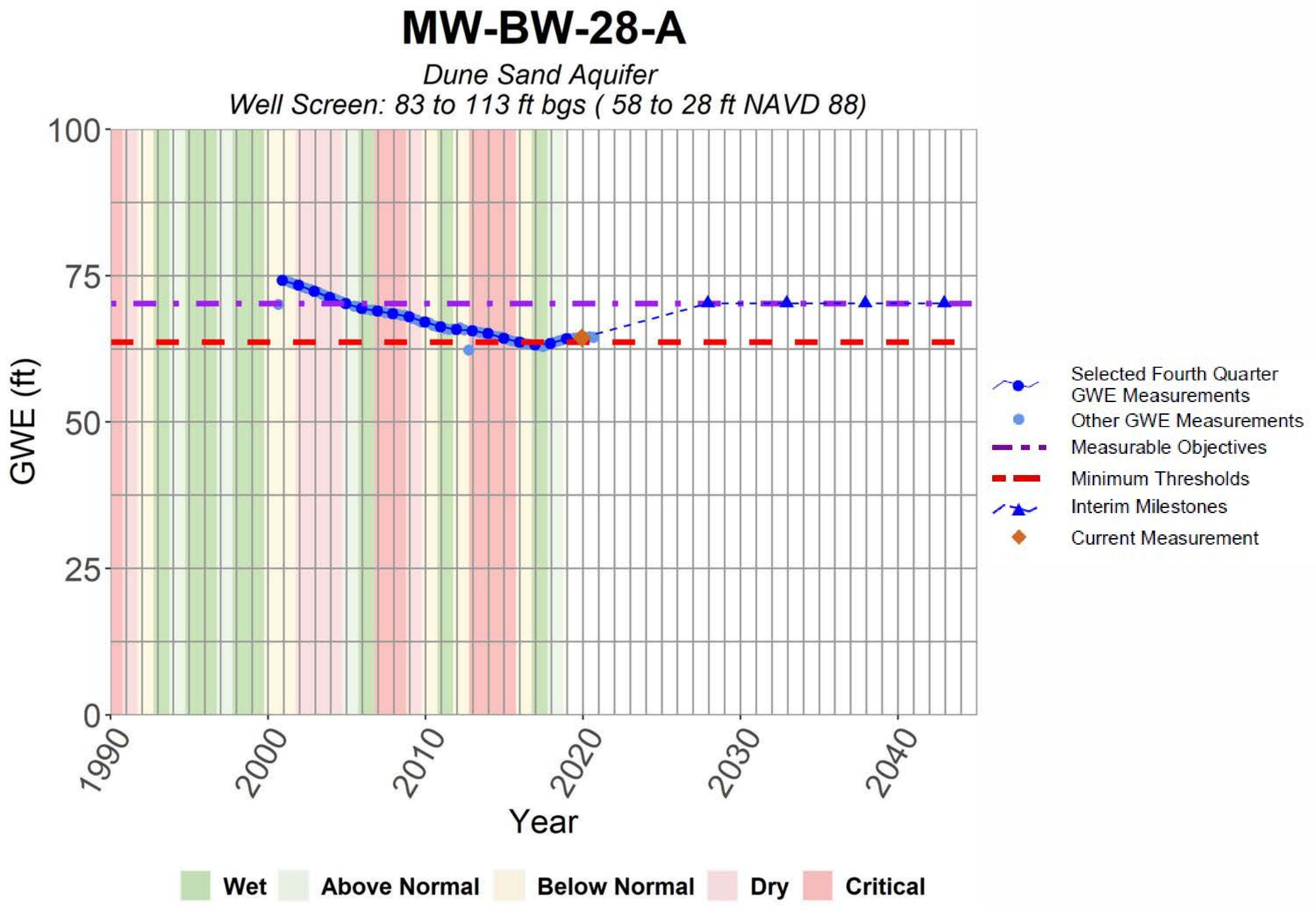
Monterey Subbasin
Groundwater Sustainability Plan
June 2021

Figure 8A-12

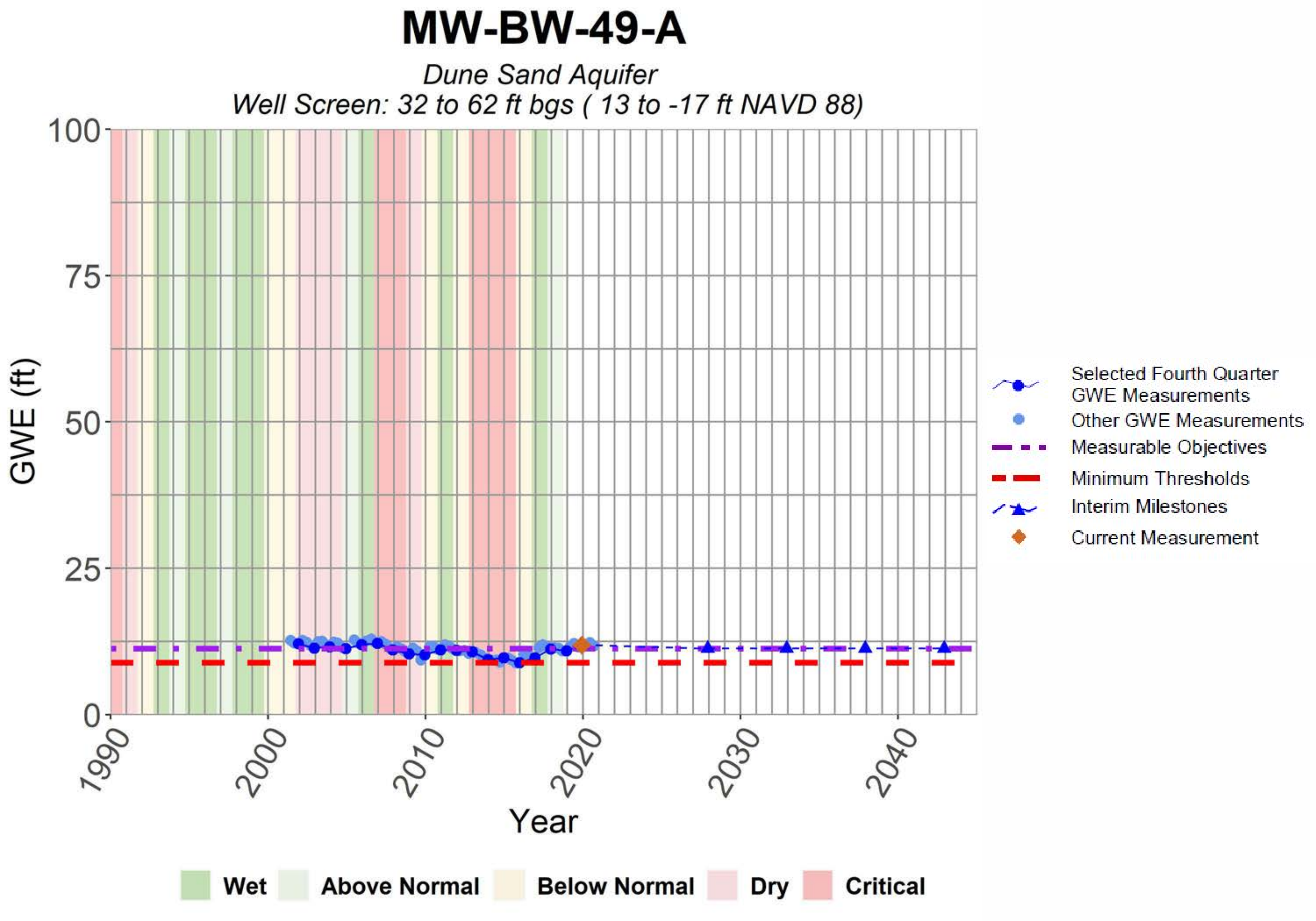
Path: X:\B60094\Maps\2021\06\Fig8B-12_El_Toro_MT.mxd

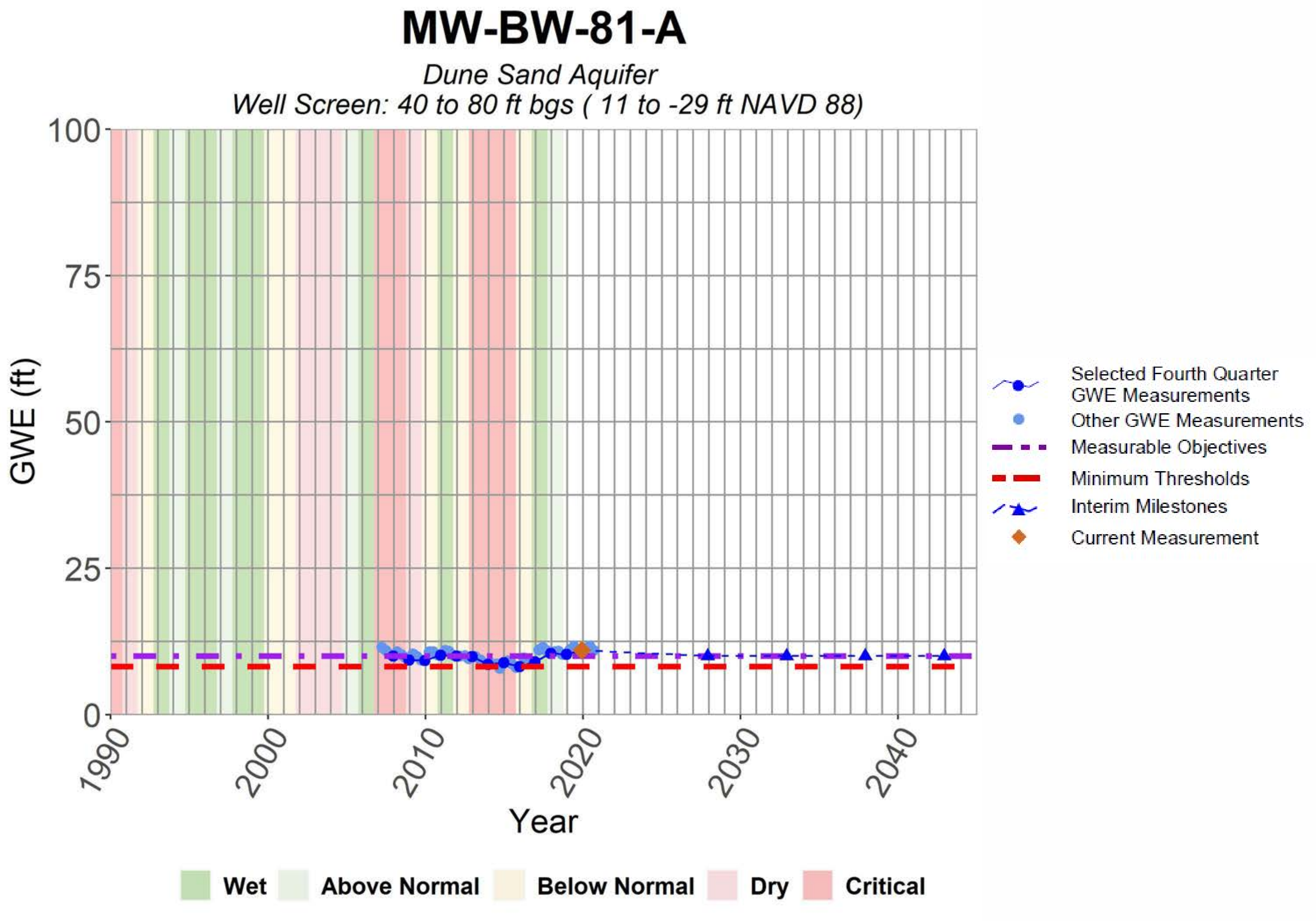
Appendix 8-B

Groundwater Elevation Interim Milestones



MW-BW-28-A
Dune Sand Aquifer
Well Screen: 83 to 113 ft bgs (58 to 28 ft NAVD 88)
GWE (ft)
100
75
50
25
0
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

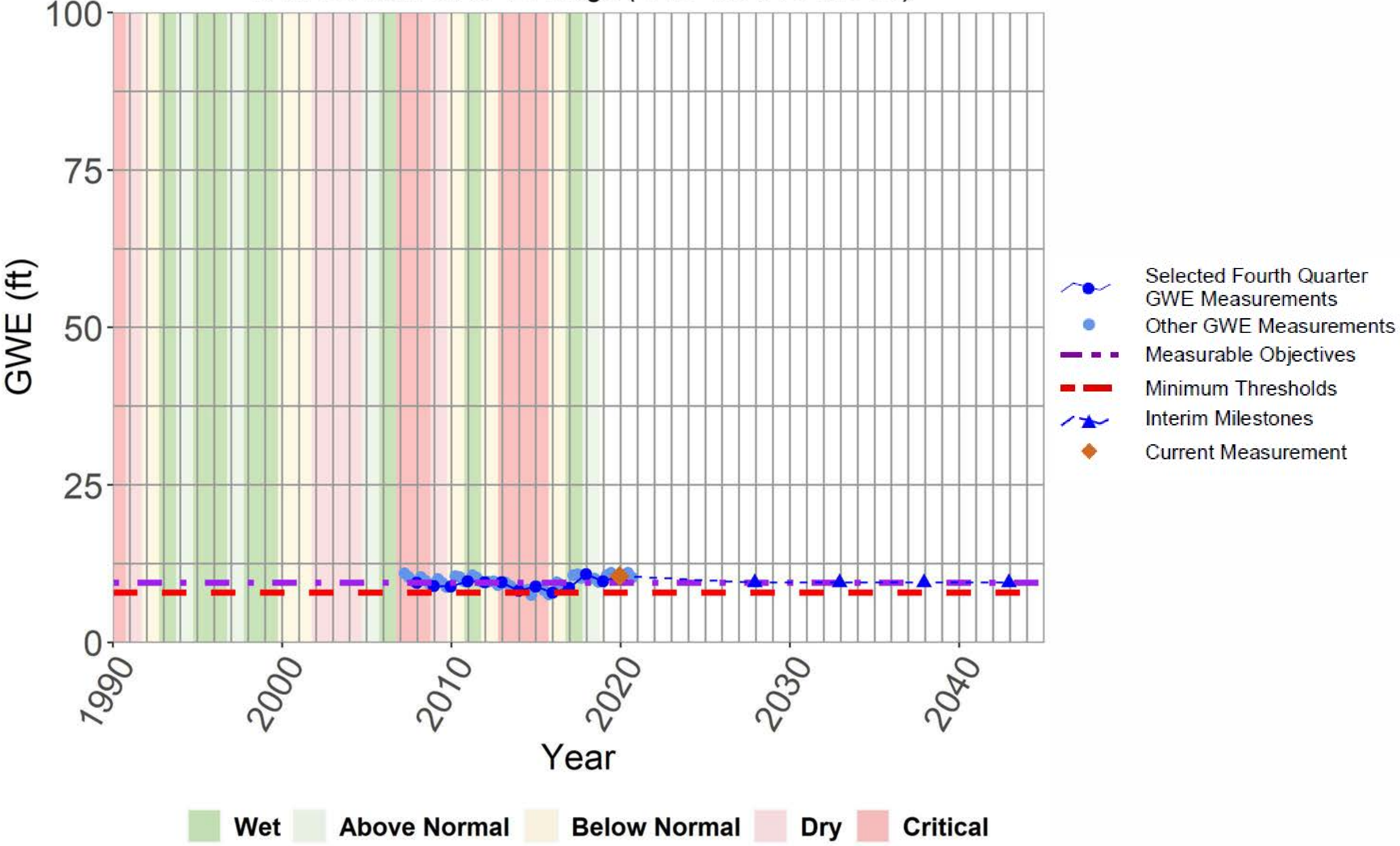

MW-BW-49-A
Dune Sand Aquifer
Well Screen: 32 to 62 ft bgs (13 to -17 ft NAVD 88)
GWE (ft)
100
75
50
25
0
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

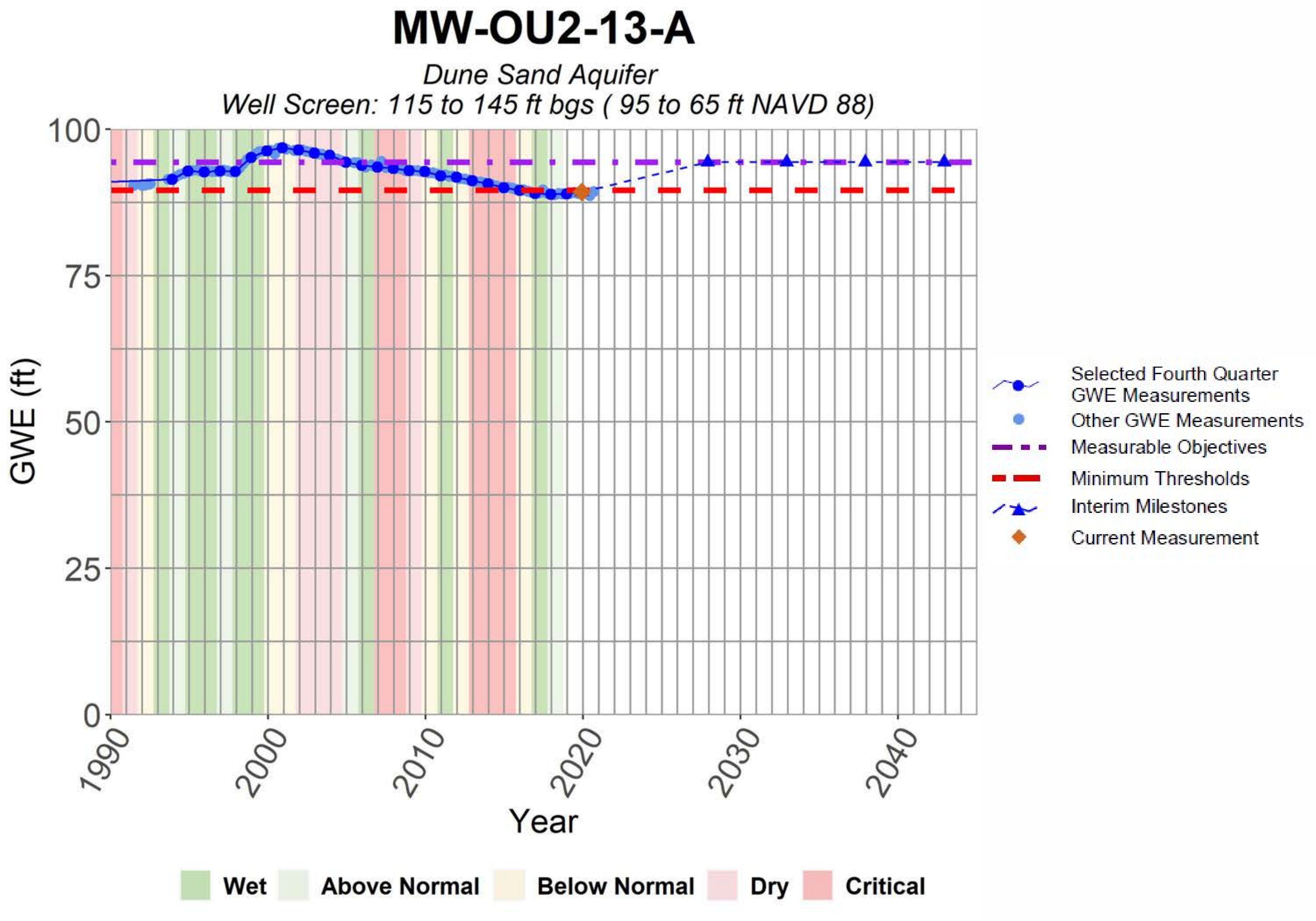


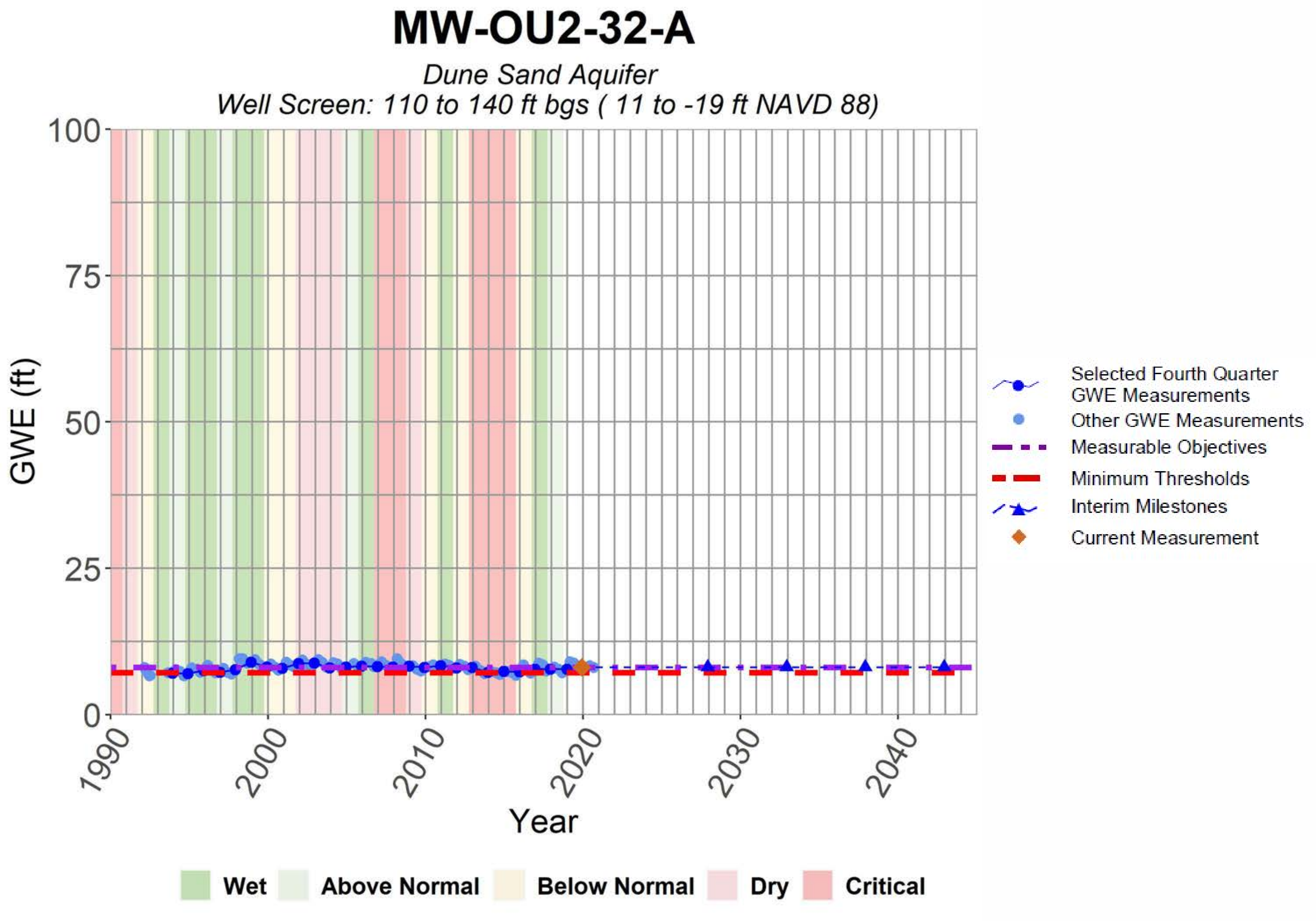
MW-BW-81-A
Dune Sand Aquifer
Well Screen: 40 to 80 ft bgs (11 to -29 ft NAVD 88)
GWE (ft)
100
75
50
25
0
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

MW-BW-82-A

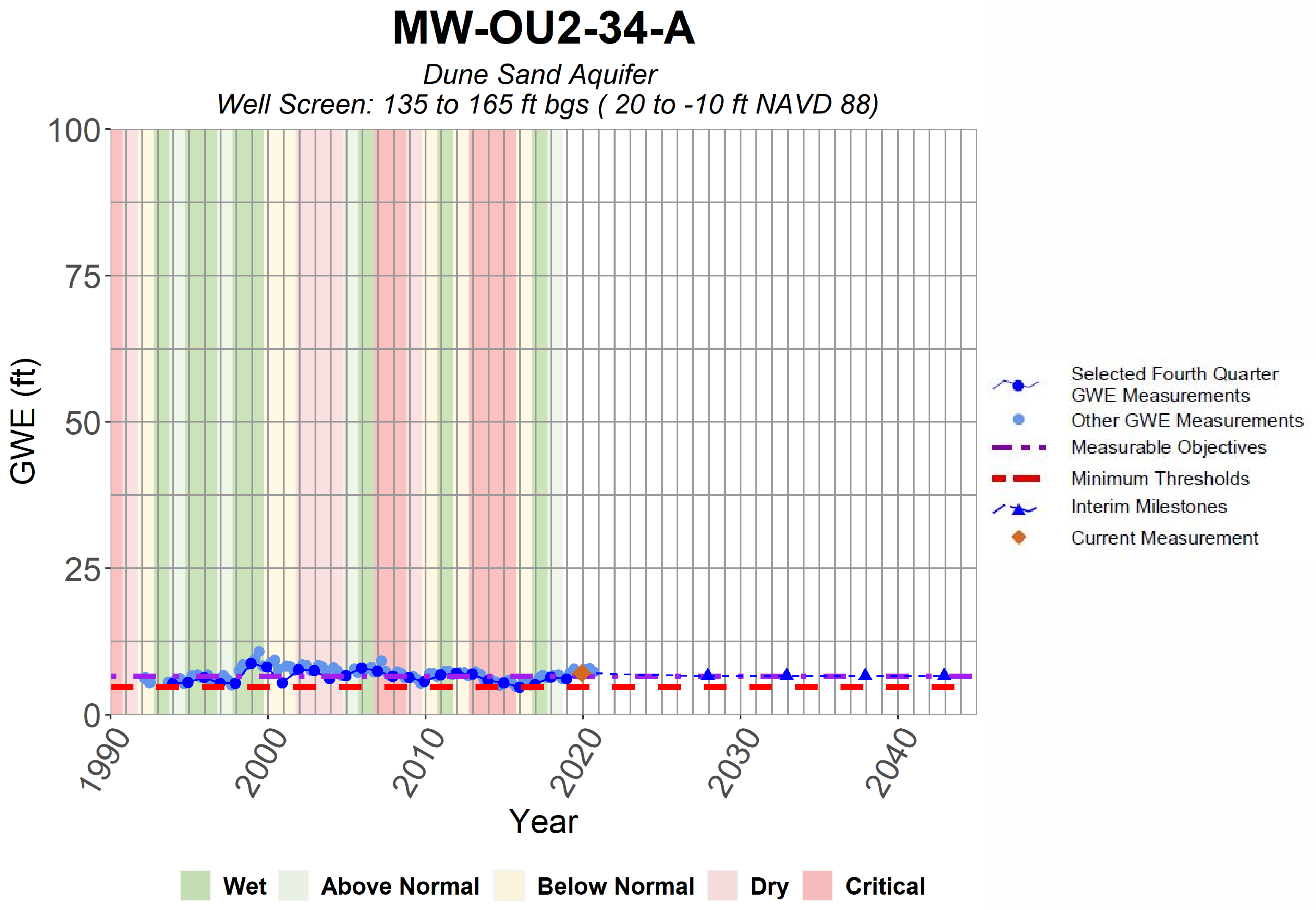
Dune Sand Aquifer
Well Screen: 32 to 72 ft bgs (7 to -33 ft NAVD 88)



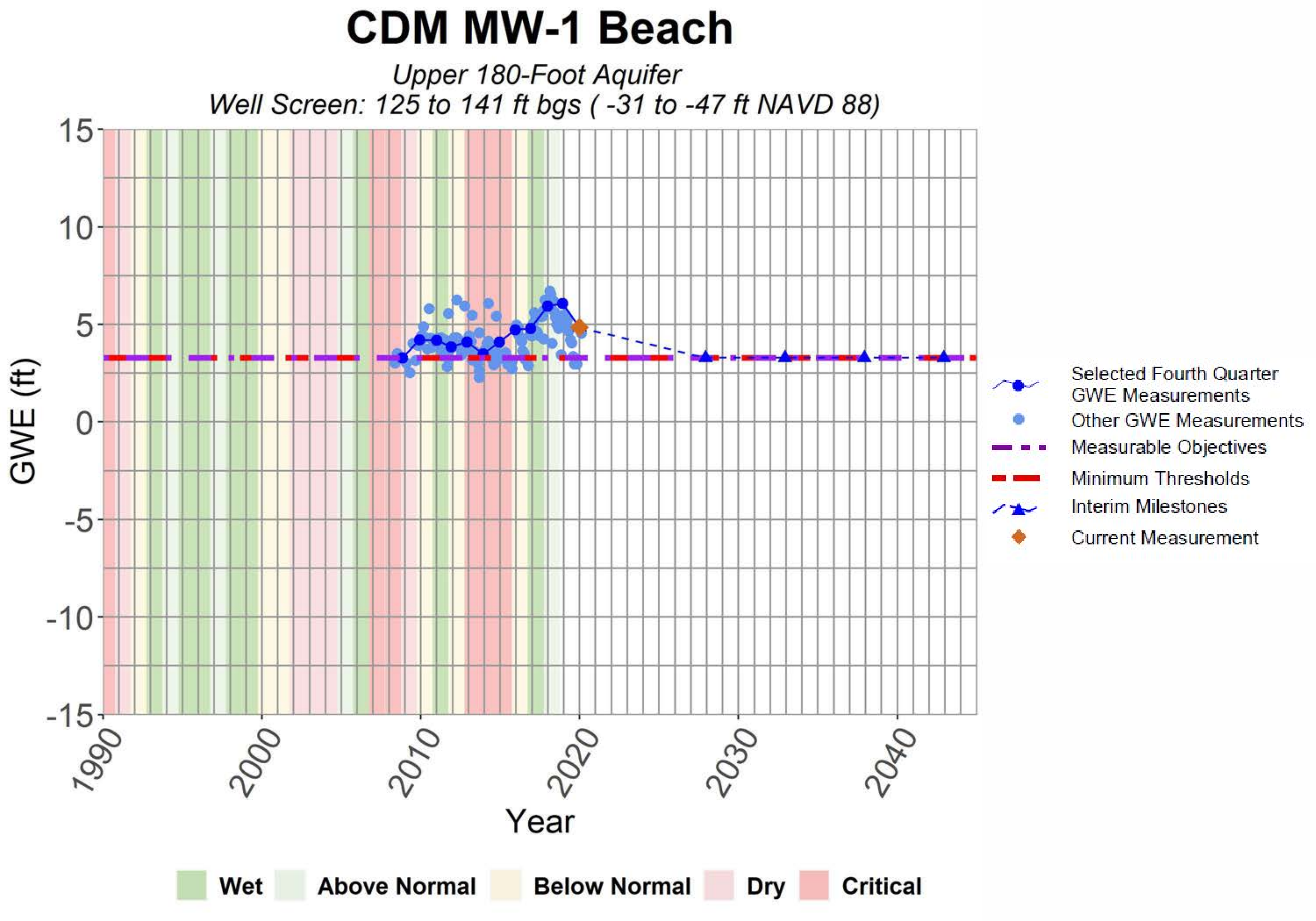

MW-OU2-13-A
Dune Sand Aquifer
Well Screen: 115 to 145 ft bgs (95 to 65 ft NAVD 88)
GWE (ft)
100
75
50
25
0
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



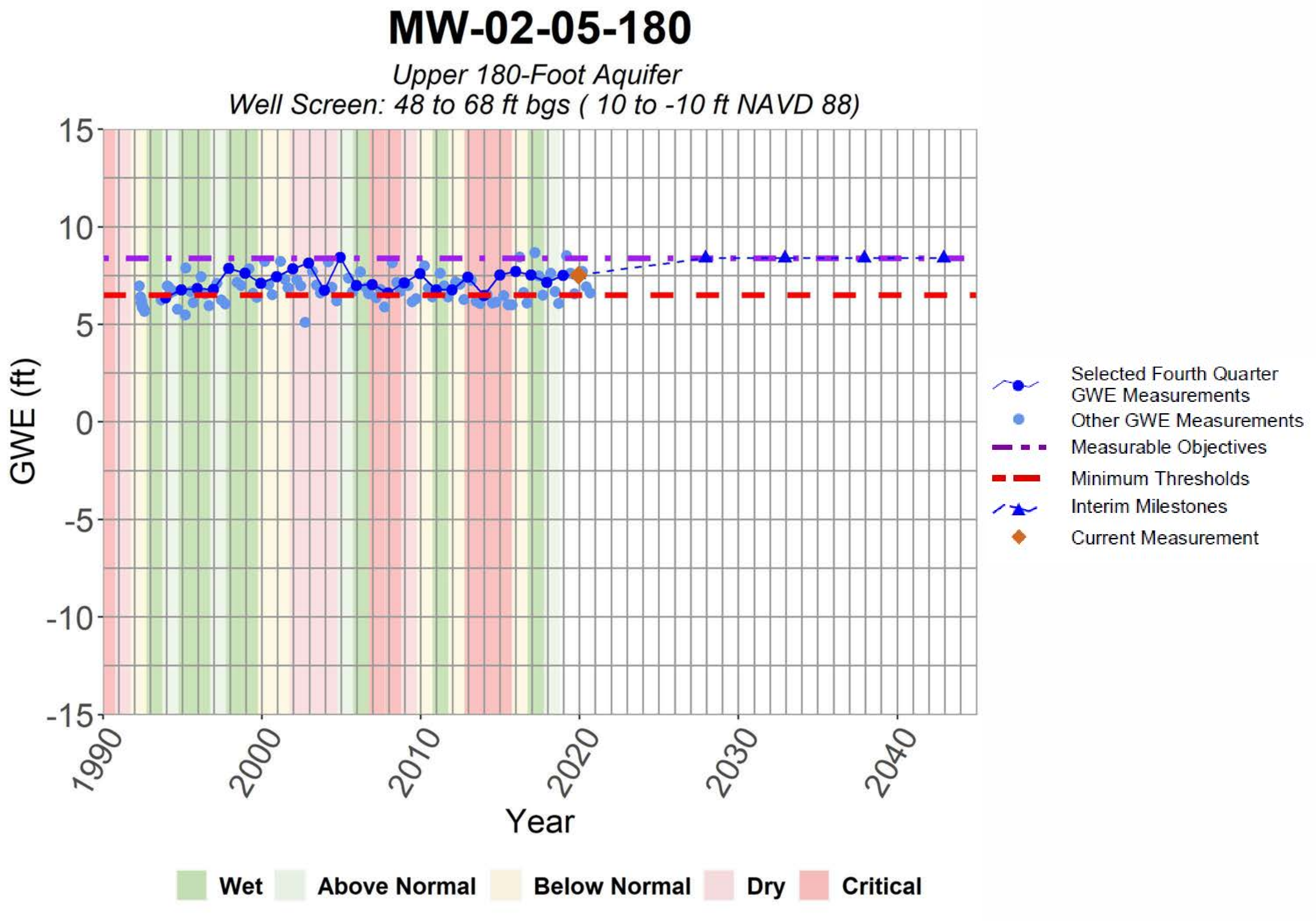
MW-OU2-32-A
Dune Sand Aquifer
Well Screen: 110 to 140 ft bgs (11 to -19 ft NAVD 88)
100
75
50
25
0
GWE (ft)
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

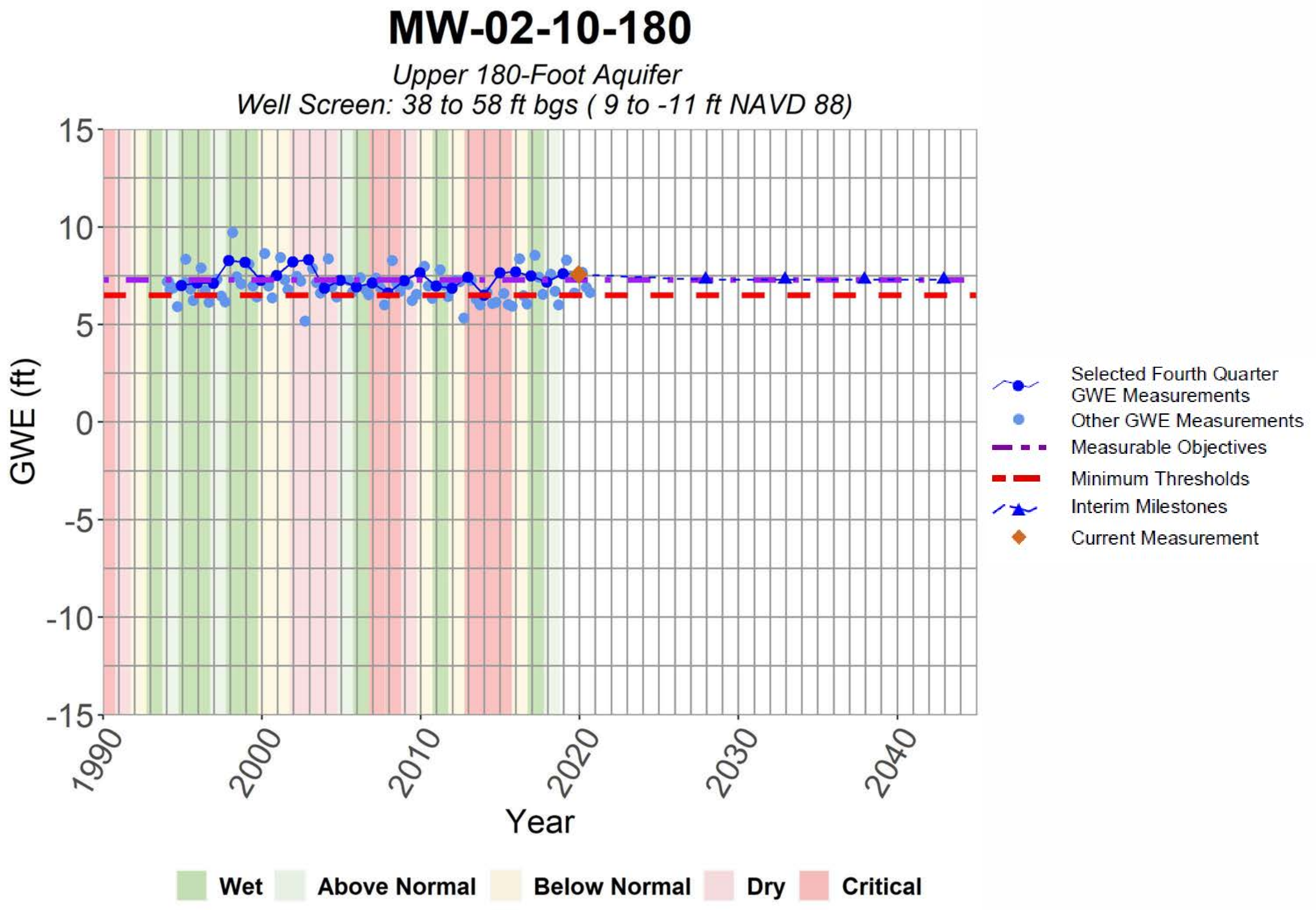


MW-OU2-34-A
Dune Sand Aquifer
Well Screen: 135 to 165 ft bgs (20 to -10 ft NAVD 88)
GWE (ft)
100
75
50
25
0
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

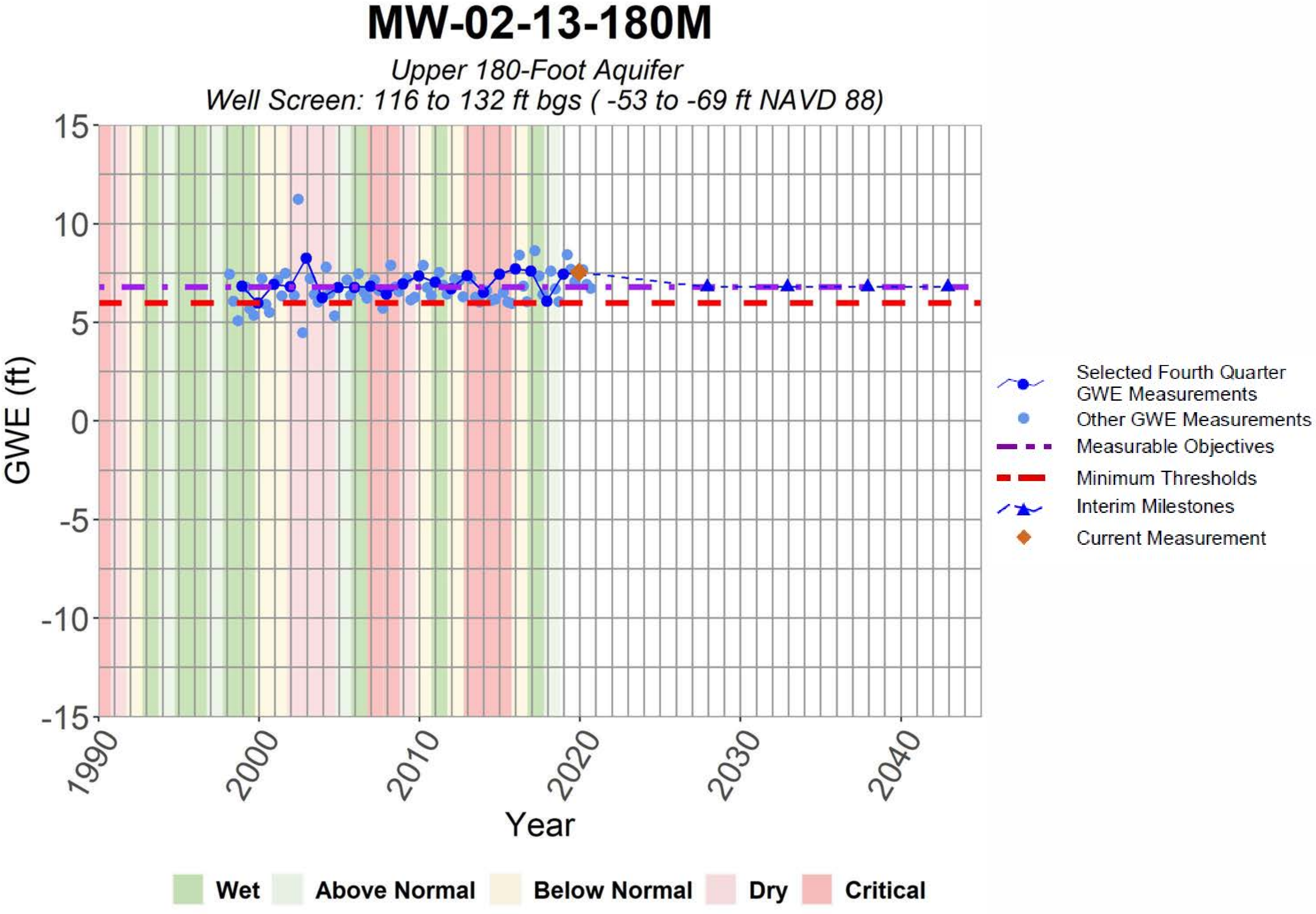


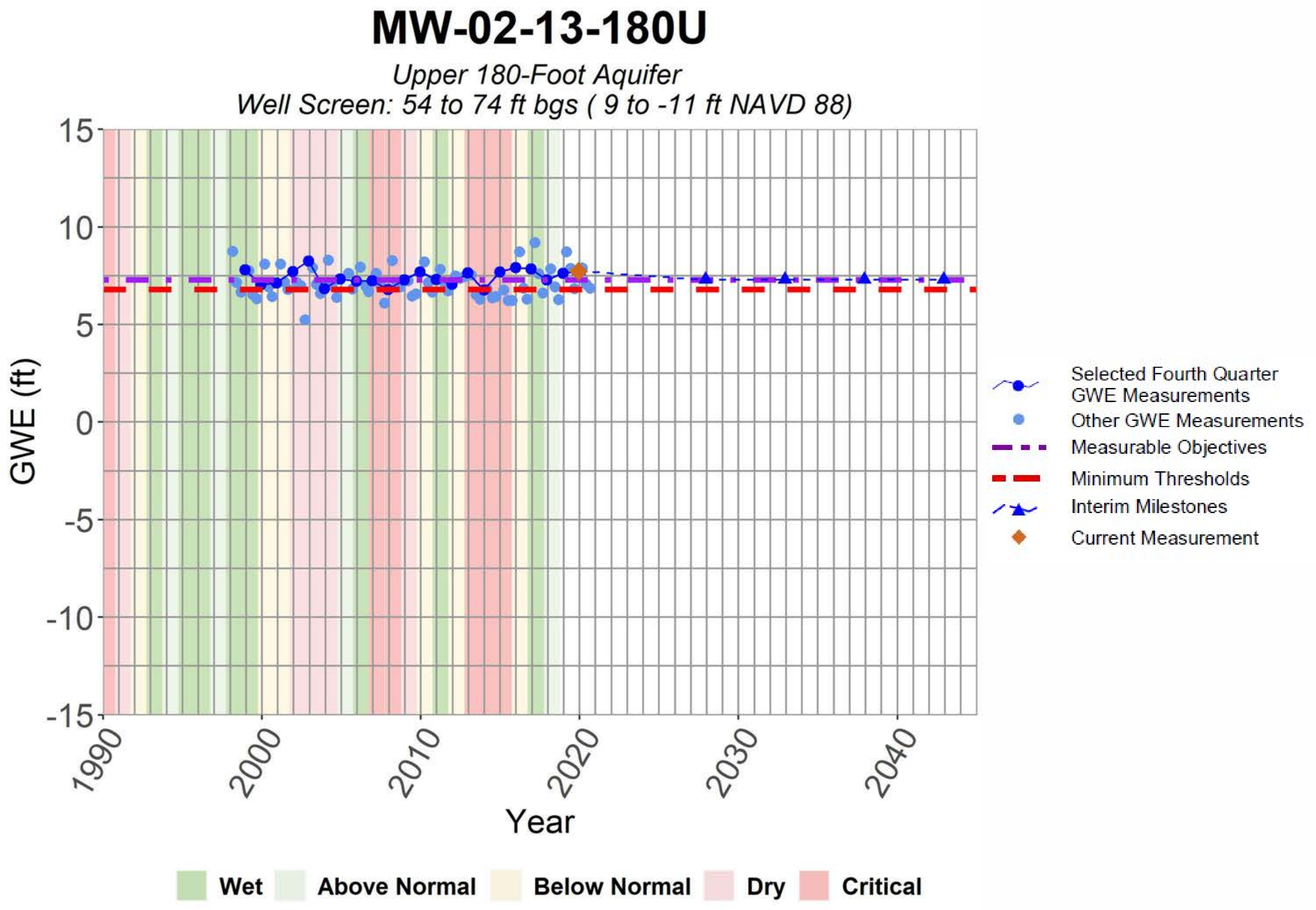
CDM MW-1 Beach
Upper 180-Foot Aquifer
Well Screen: 125 to 141 ft bgs (-31 to -47 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

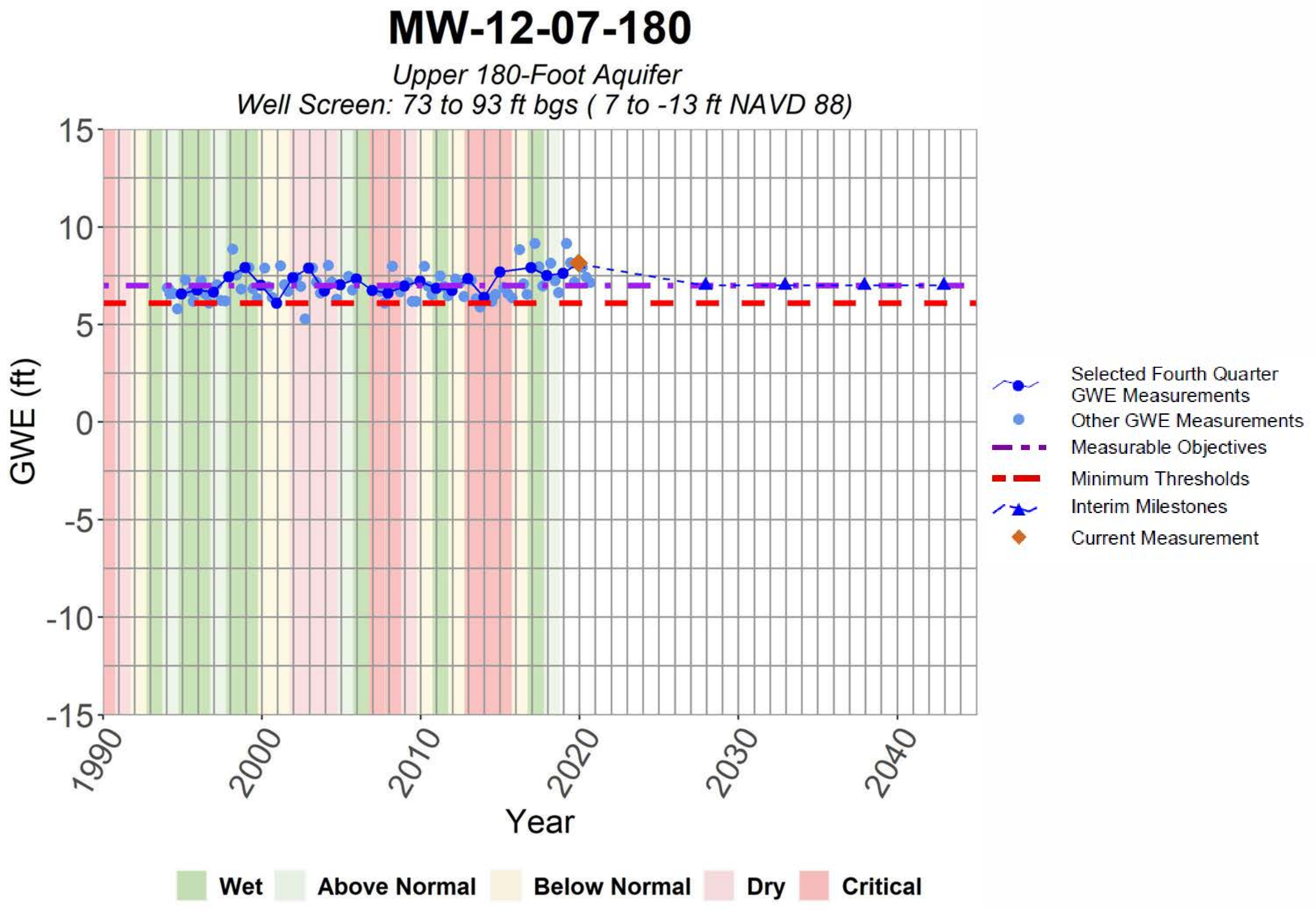

MW-02-05-180
Upper 180-Foot Aquifer
Well Screen: 48 to 68 ft bgs (10 to -10 ft NAVD 88)
15
10
5
0
-5
-10
-15
GWE (ft)
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



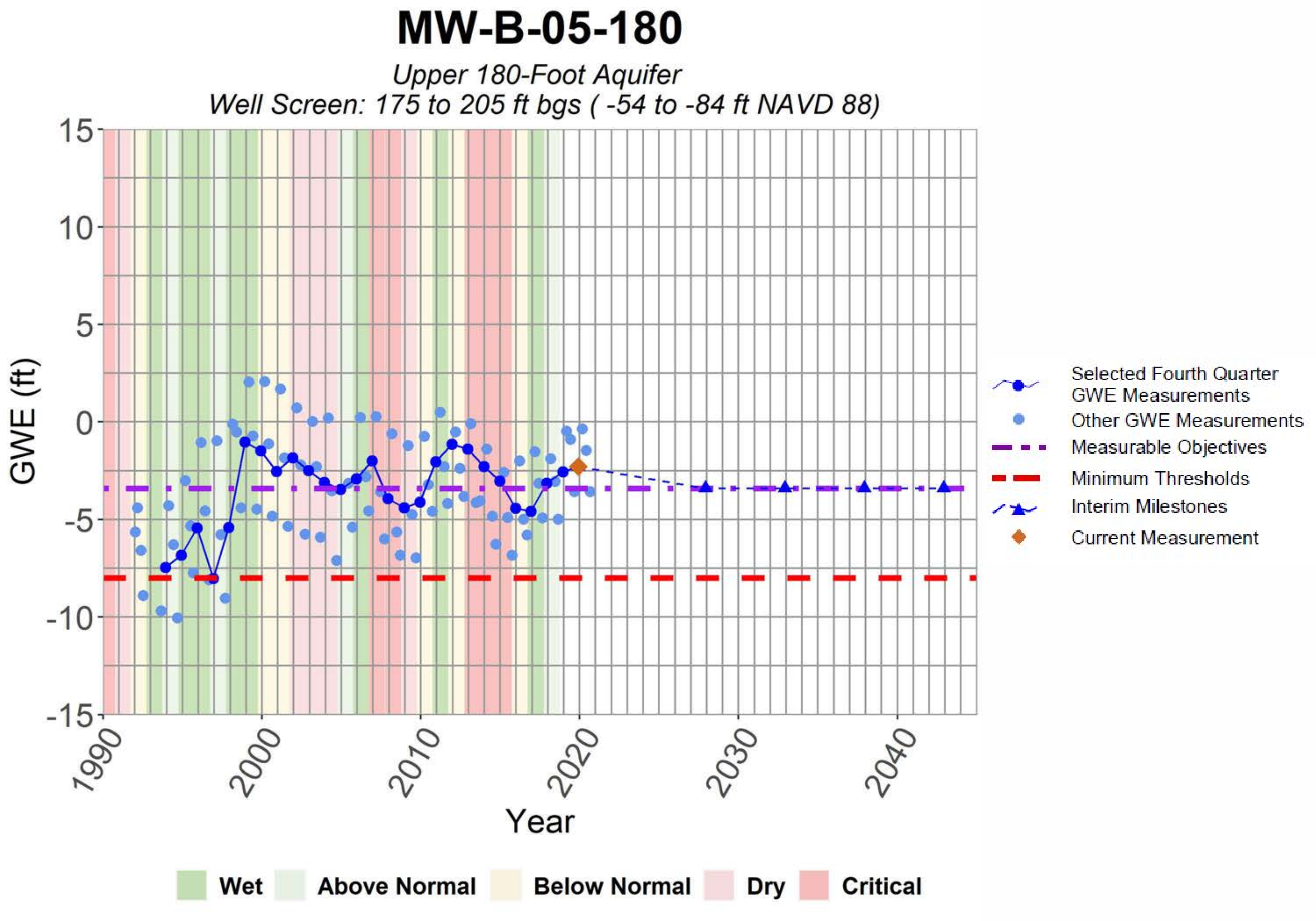
MW-02-10-180
Upper 180-Foot Aquifer
Well Screen: 38 to 58 ft bgs (9 to -11 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


MW-02-13-180M
Upper 180-Foot Aquifer
Well Screen: 116 to 132 ft bgs (-53 to -69 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

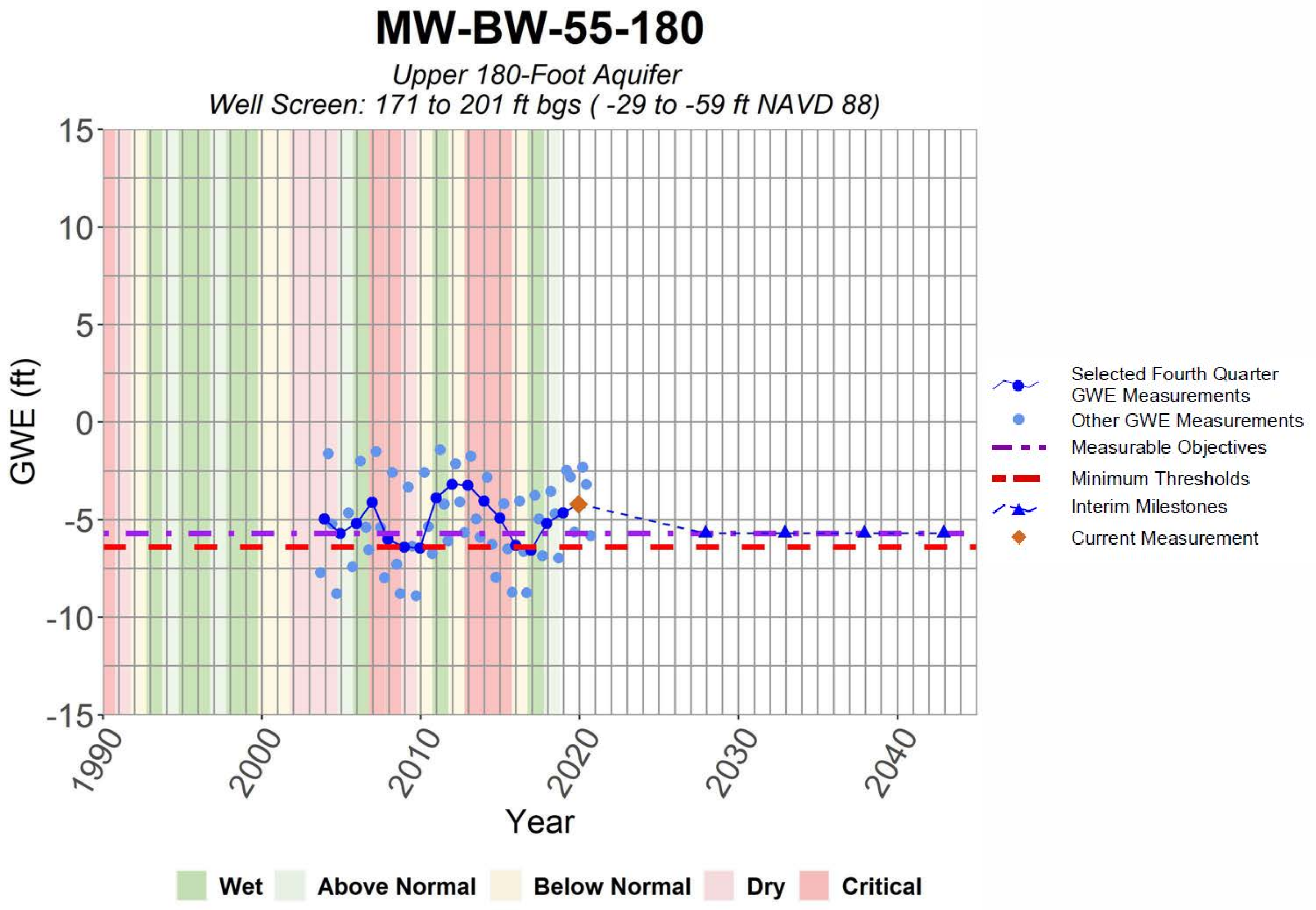

MW-02-13-180U
Upper 180-Foot Aquifer
Well Screen: 54 to 74 ft bgs (9 to -11 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

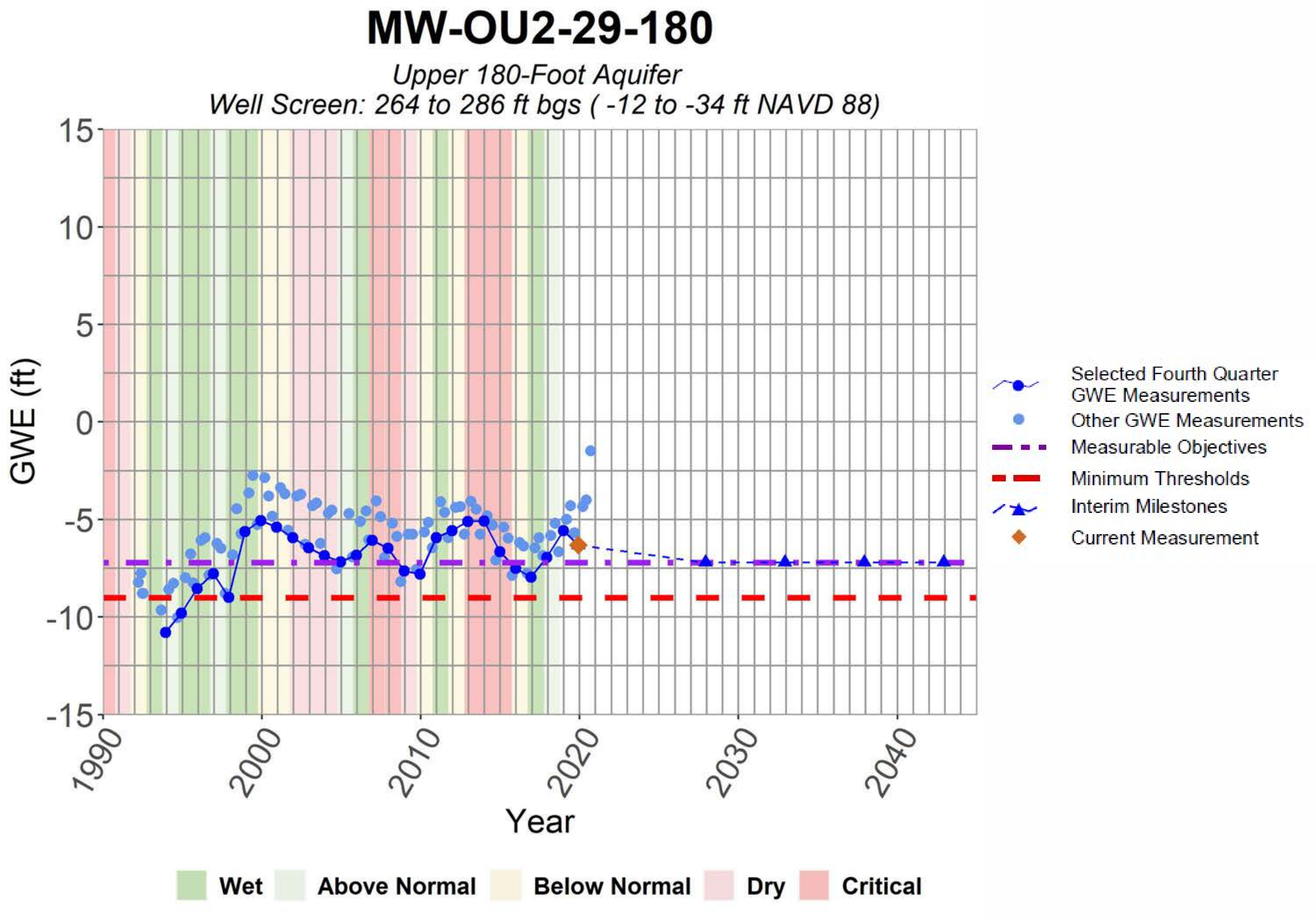


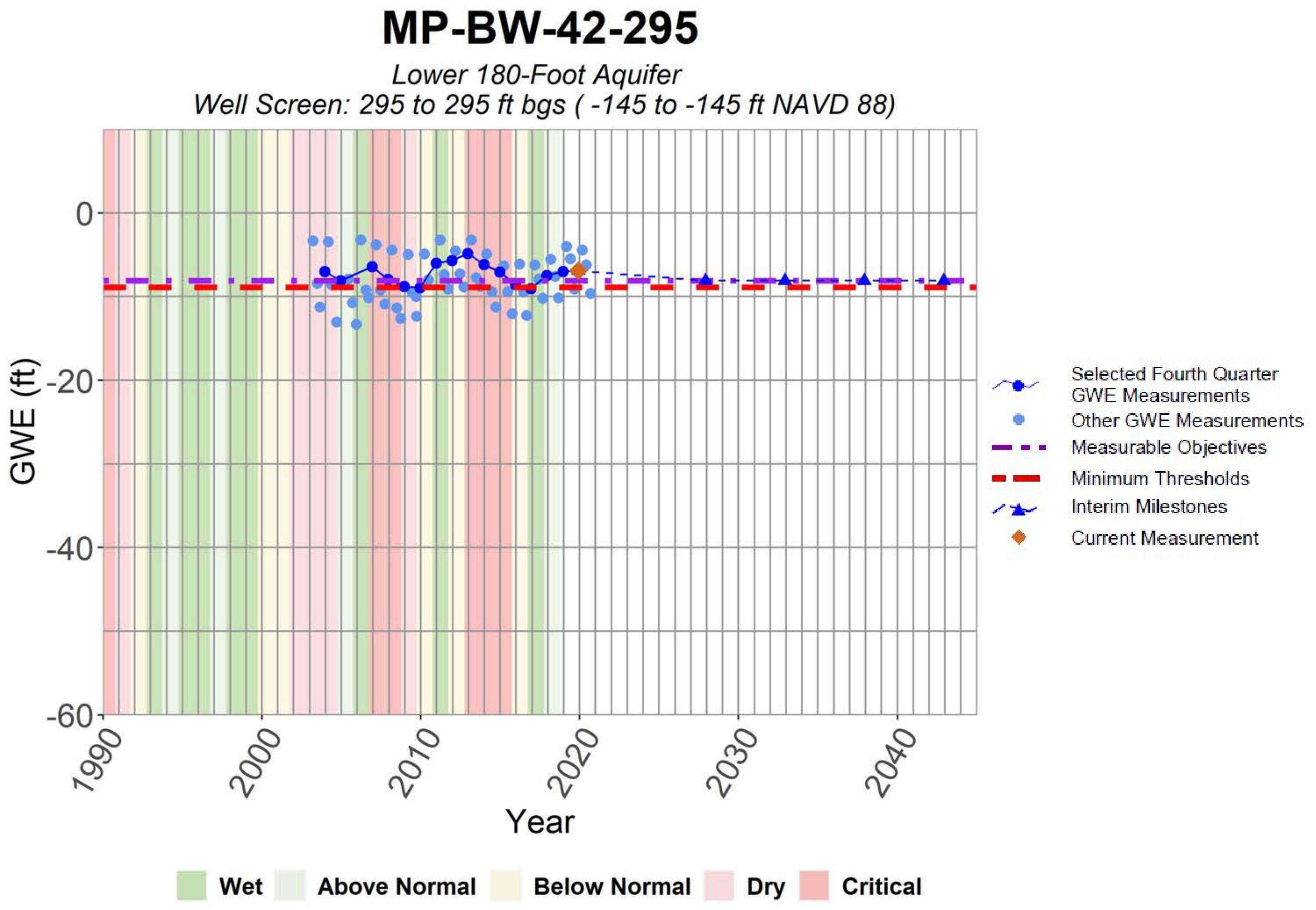
MW-12-07-180
Upper 180-Foot Aquifer
Well Screen: 73 to 93 ft bgs (7 to -13 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



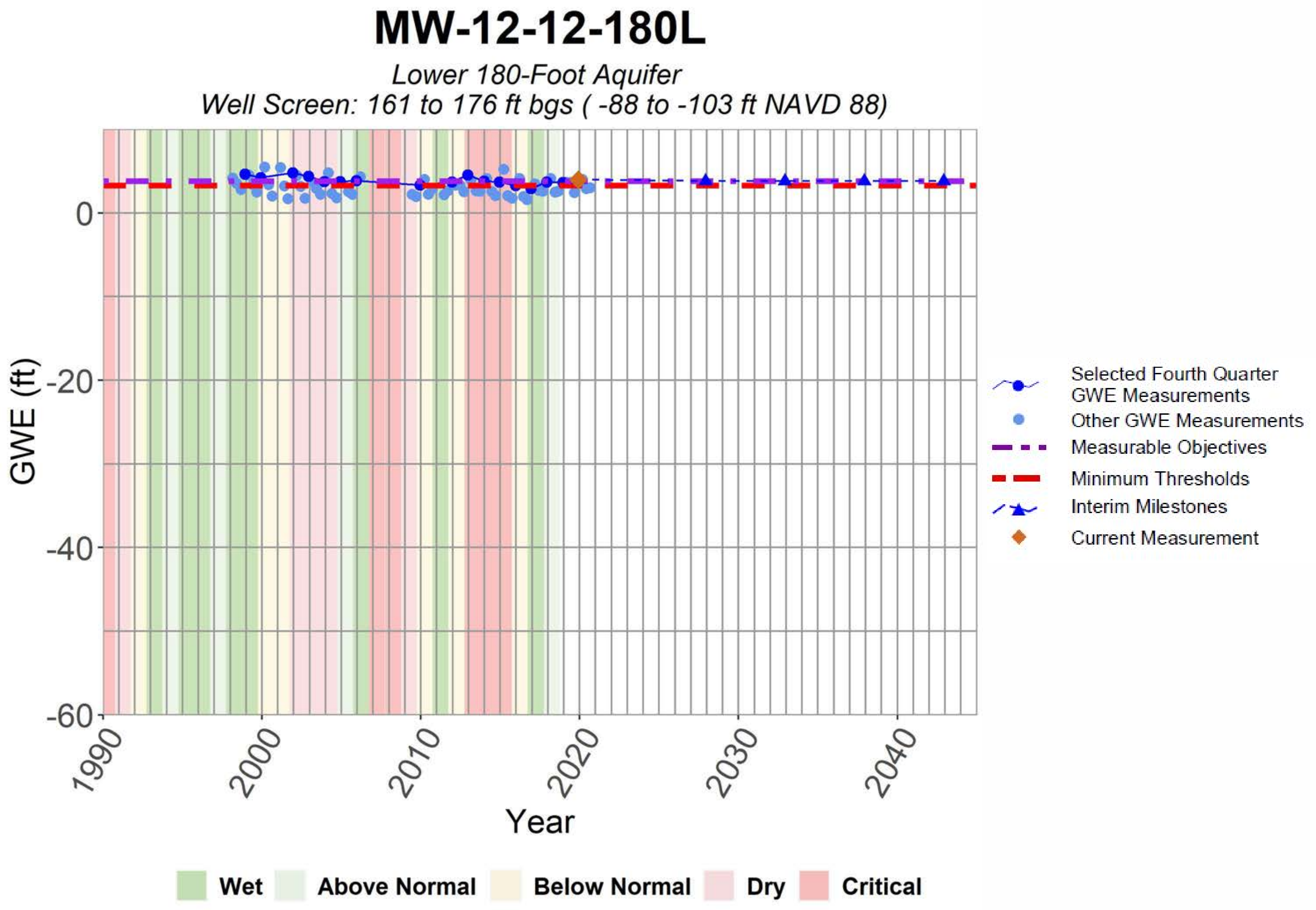
MW-B-05-180
Upper 180-Foot Aquifer
Well Screen: 175 to 205 ft bgs (-54 to -84 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


MW-BW-55-180
Upper 180-Foot Aquifer
Well Screen: 171 to 201 ft bgs (-29 to -59 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

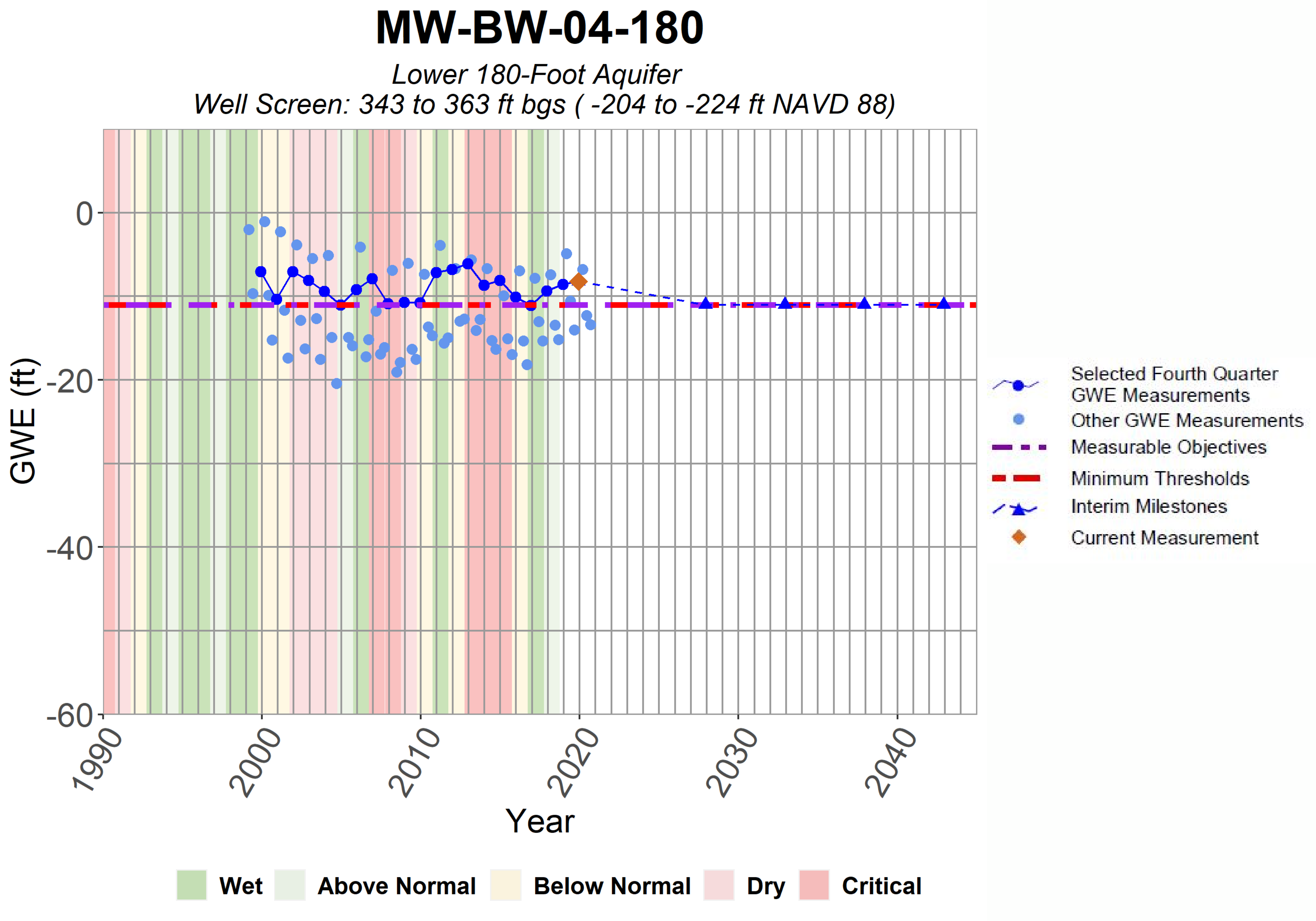

MW-OU2-29-180
Upper 180-Foot Aquifer
Well Screen: 264 to 286 ft bgs (-12 to -34 ft NAVD 88)
GWE (ft)
15
10
5
0
-5
-10
-15
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

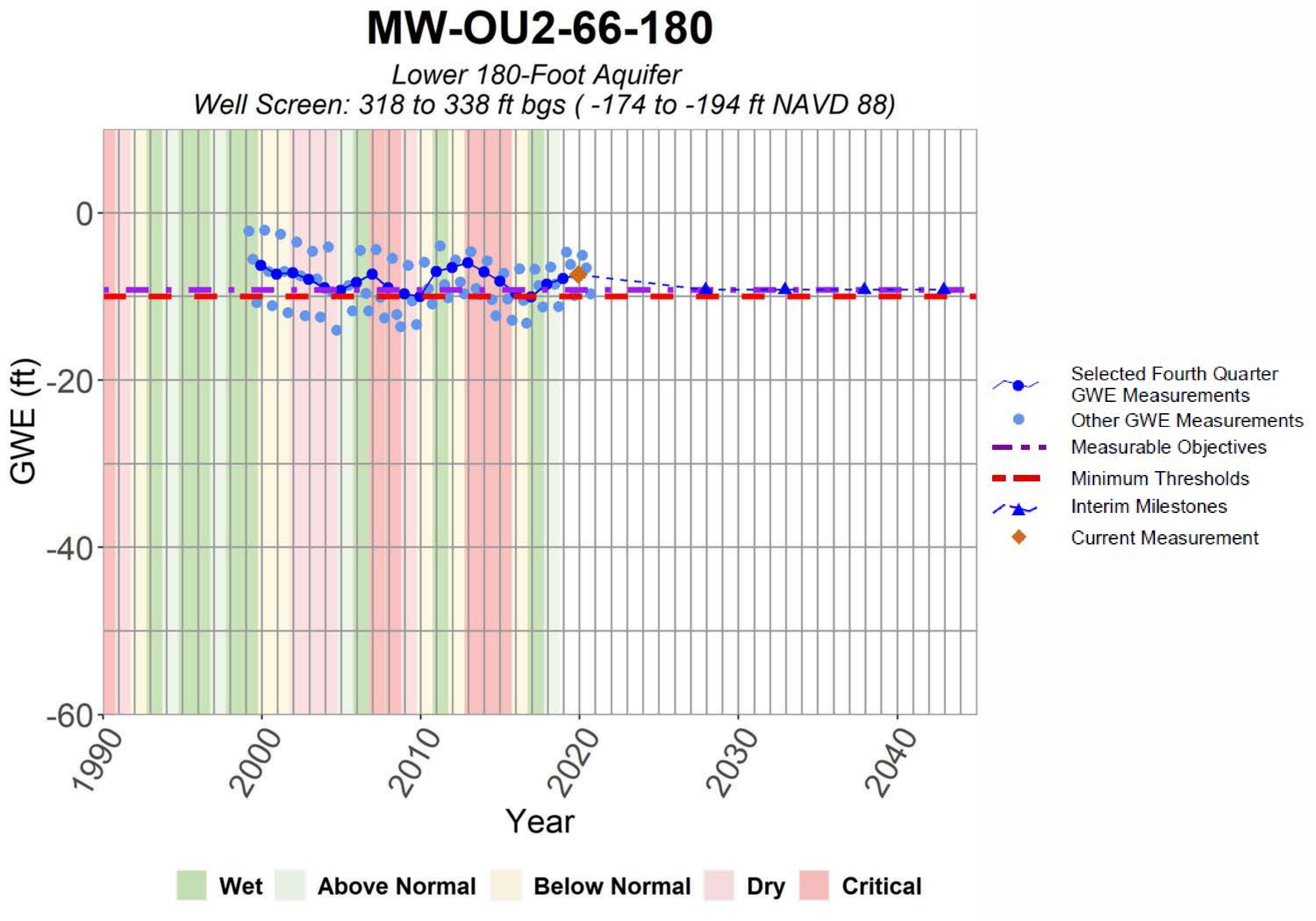


MP-BW-42-295
Lower 180-Foot Aquifer
Well Screen: 295 to 295 ft bgs (-145 to -145 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

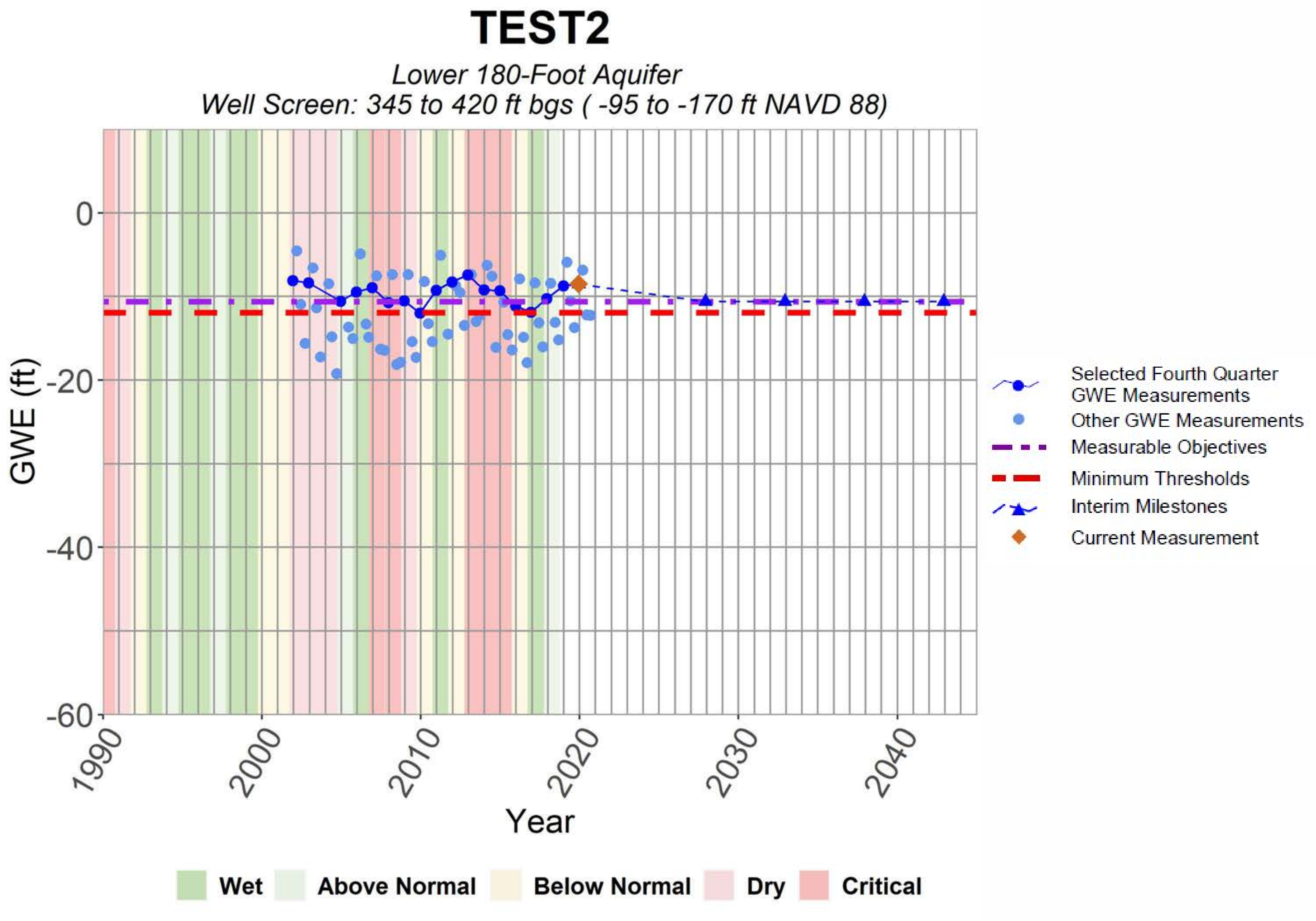


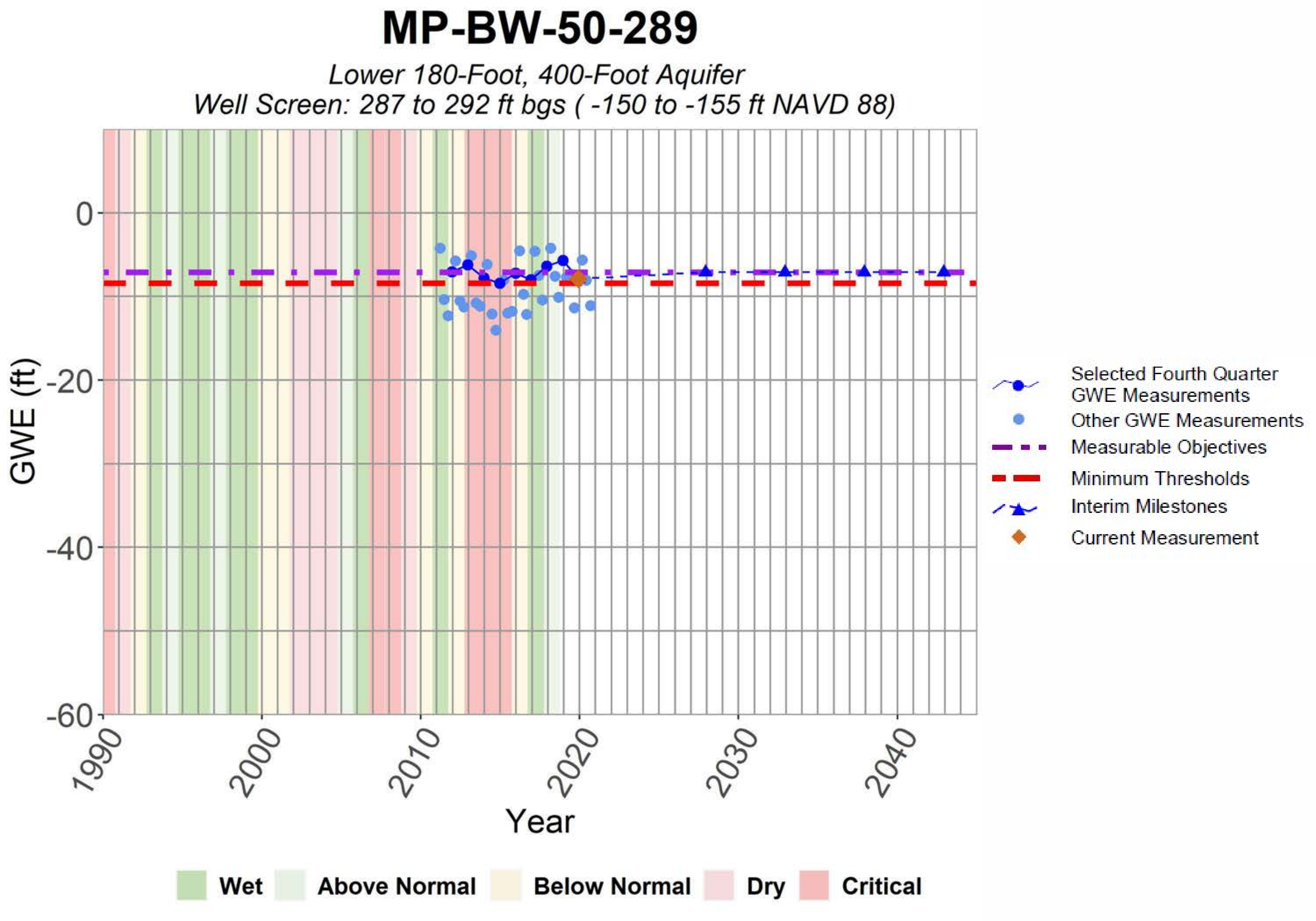
MW-12-12-180L
Lower 180-Foot Aquifer
Well Screen: 161 to 176 ft bgs (-88 to -103 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


MW-BW-04-180
Lower 180-Foot Aquifer
Well Screen: 343 to 363 ft bgs (-204 to -224 ft NAVD 88)
0
-20
-40
-60
GWE (ft)
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

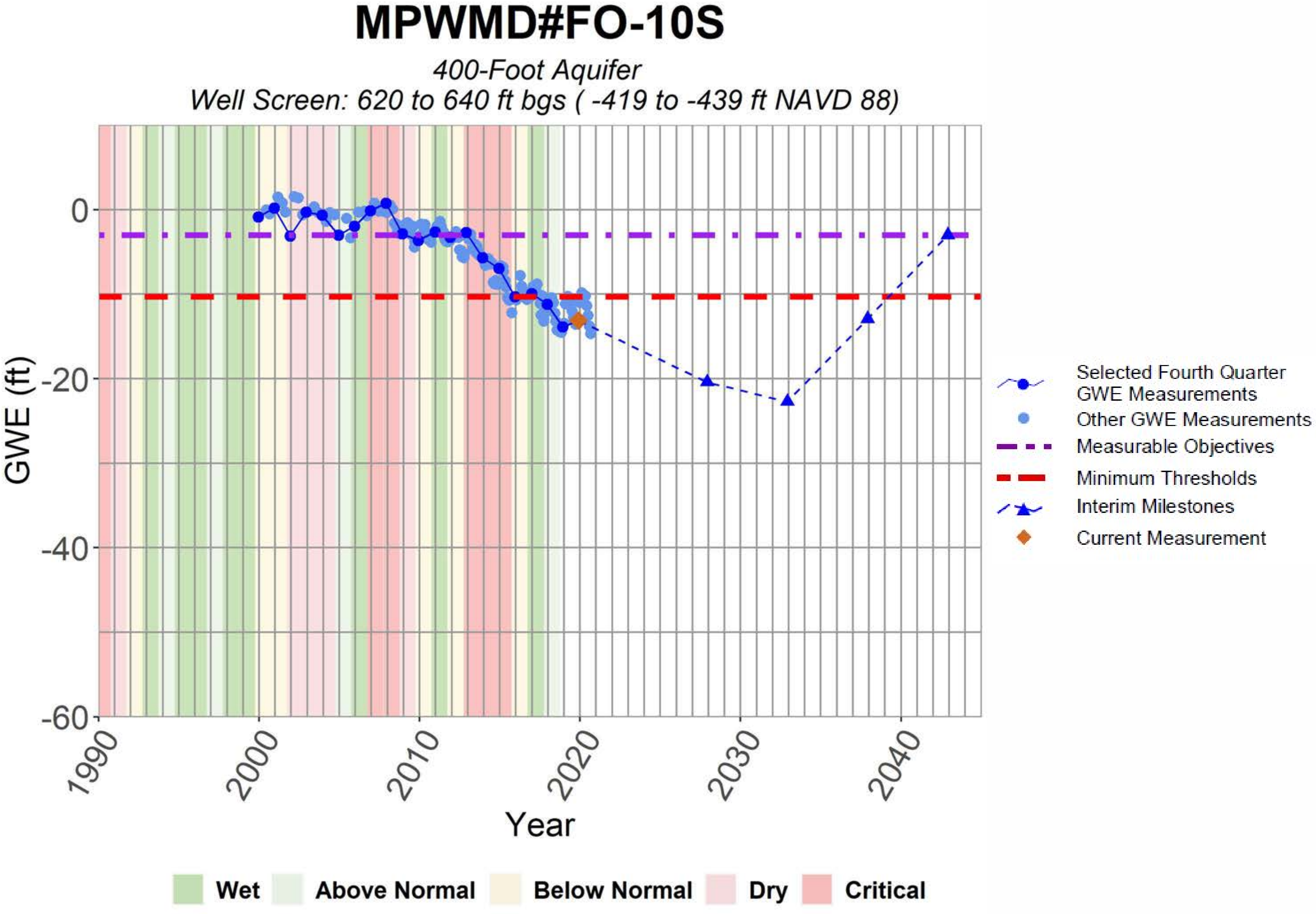


MW-OU2-66-180
Lower 180-Foot Aquifer
Well Screen: 318 to 338 ft bgs (-174 to -194 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

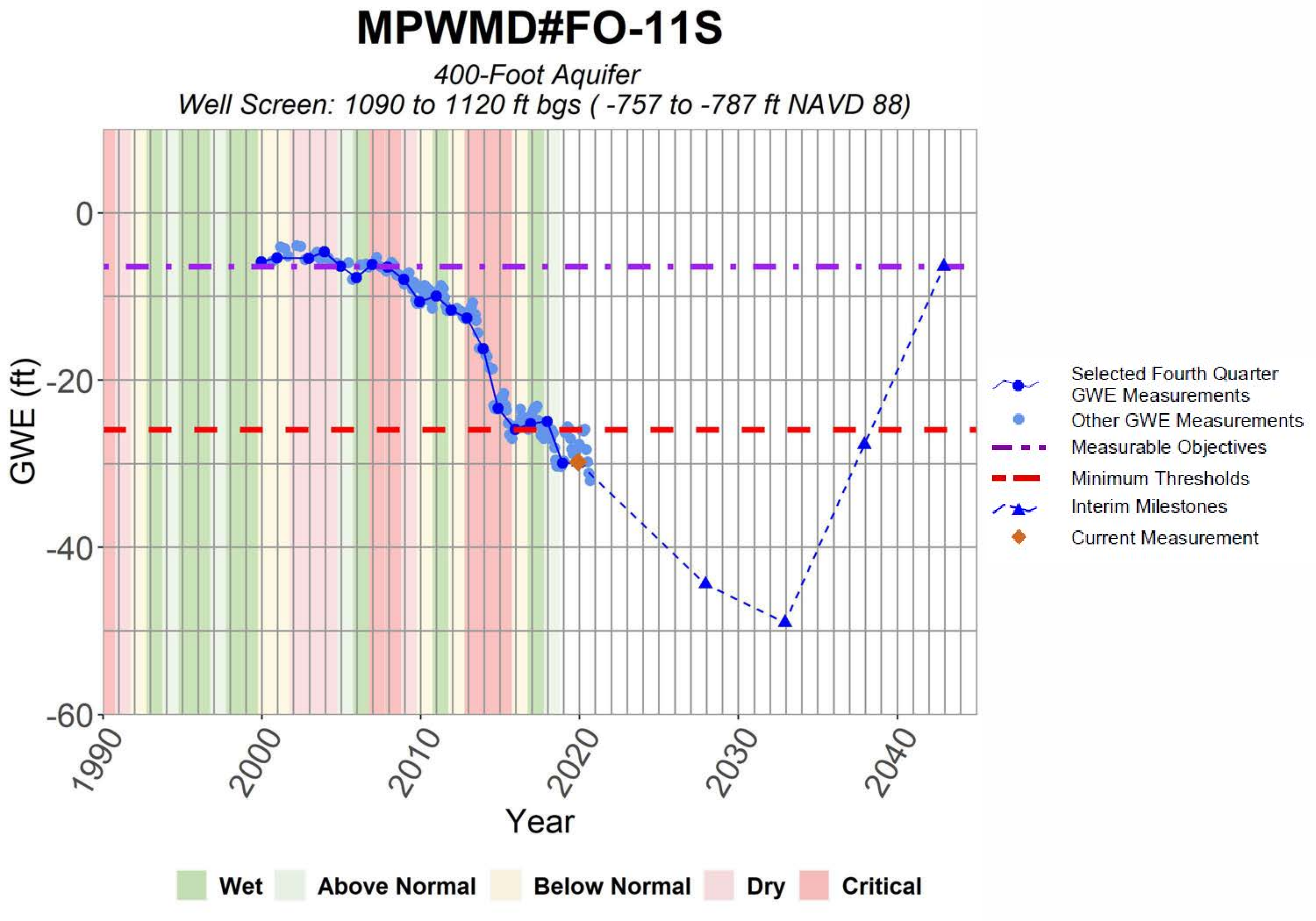

TEST2
Lower 180-Foot Aquifer
Well Screen: 345 to 420 ft bgs (-95 to -170 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

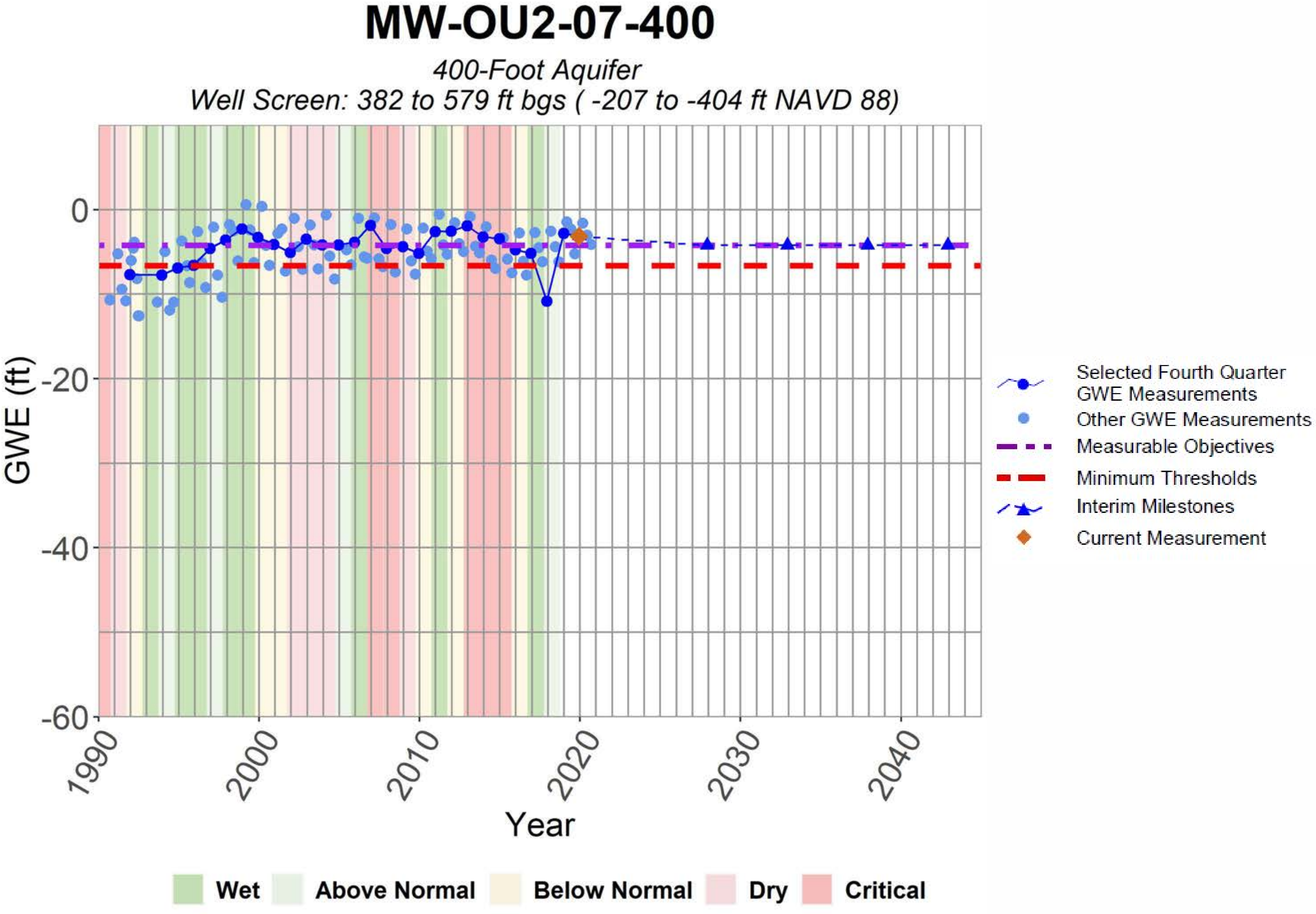


MP-BW-50-289
Lower 180-Foot, 400-Foot Aquifer
Well Screen: 287 to 292 ft bgs (-150 to -155 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



MPWMD#FO-10S
400-Foot Aquifer
Well Screen: 620 to 640 ft bgs (-419 to -439 ft NAVD 88)
0
-20
-40
-60
GWE (ft)
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

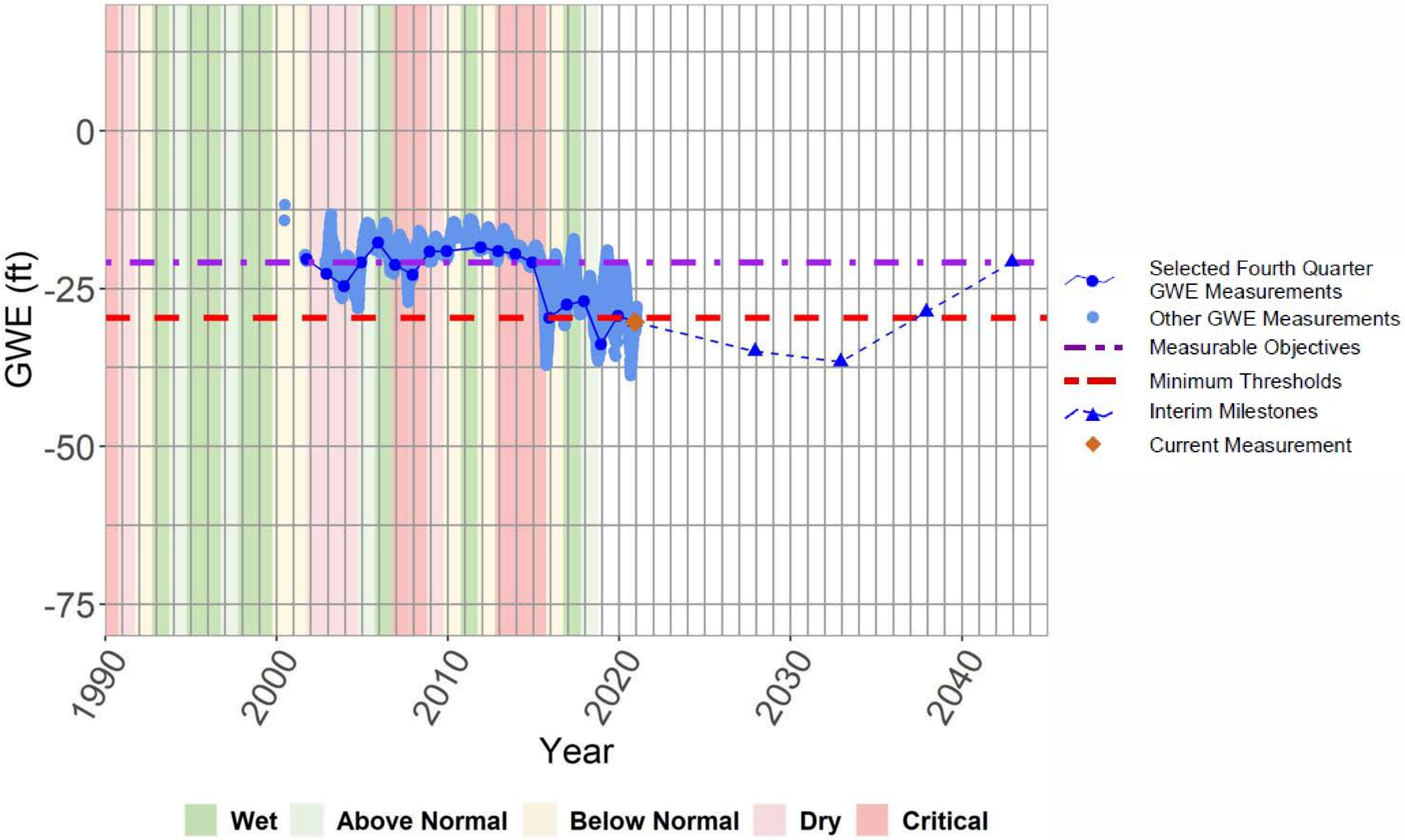

MPWMD#FO-11S
400-Foot Aquifer
Well Screen: 1090 to 1120 ft bgs (-757 to -787 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
Year
1990
2000
2010
2020
2030
2040
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

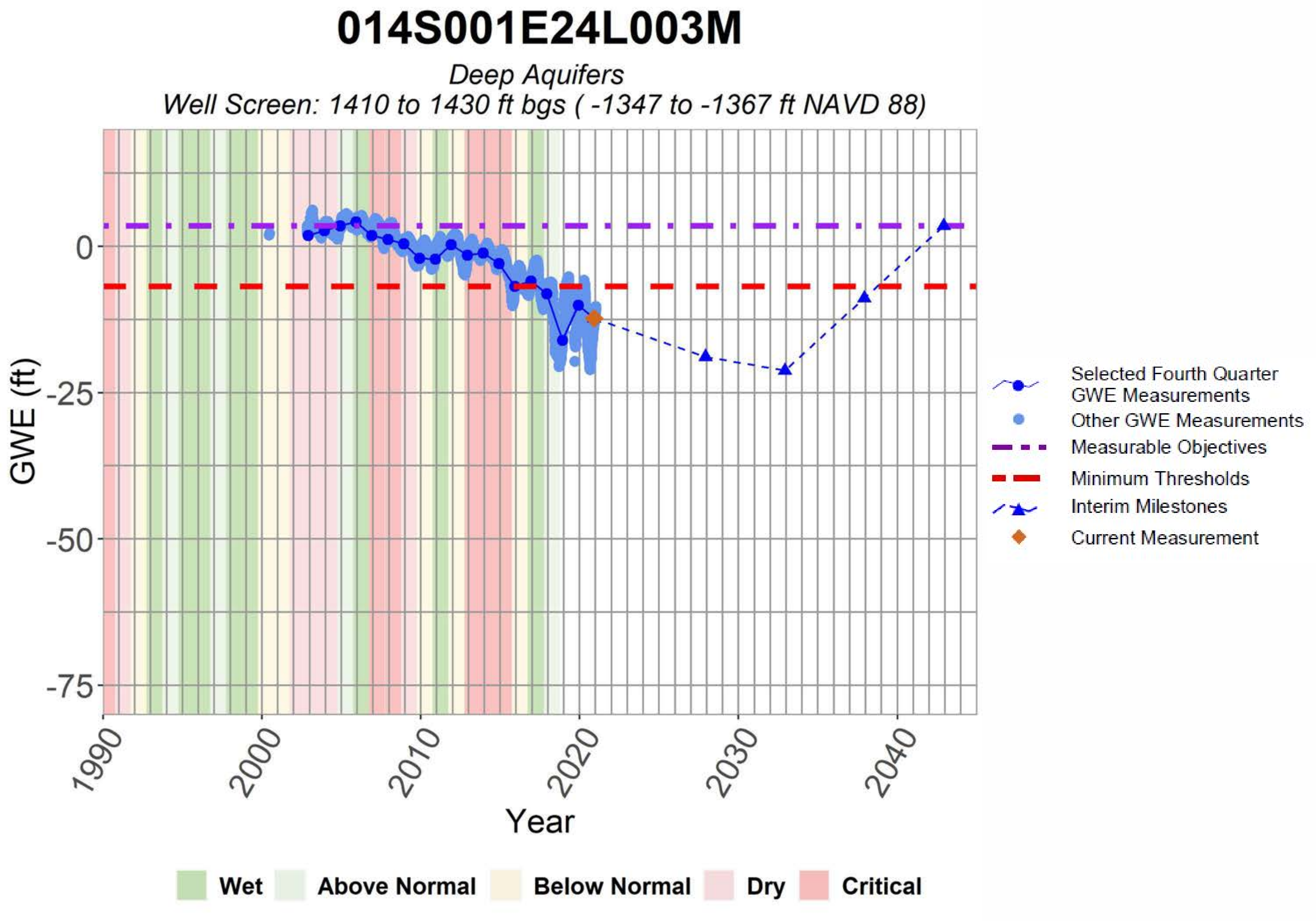


MW-OU2-07-400
400-Foot Aquifer
Well Screen: 382 to 579 ft bgs (-207 to -404 ft NAVD 88)
GWE (ft)
0
-20
-40
-60
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

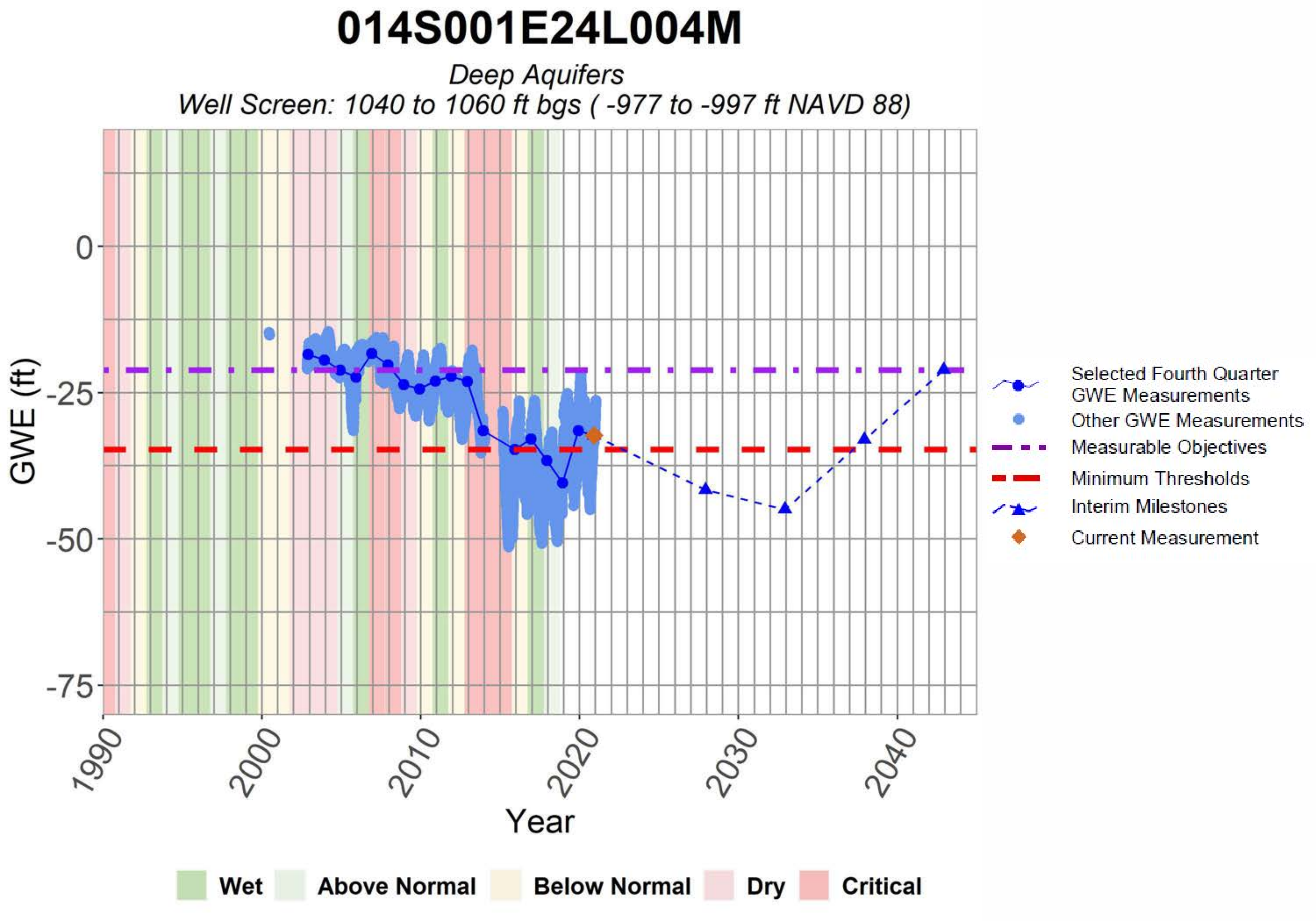
014S001E24L002M

Deep Aquifers
Well Screen: 1820 to 1860 ft bgs (-1757 to -1797 ft NAVD 88)

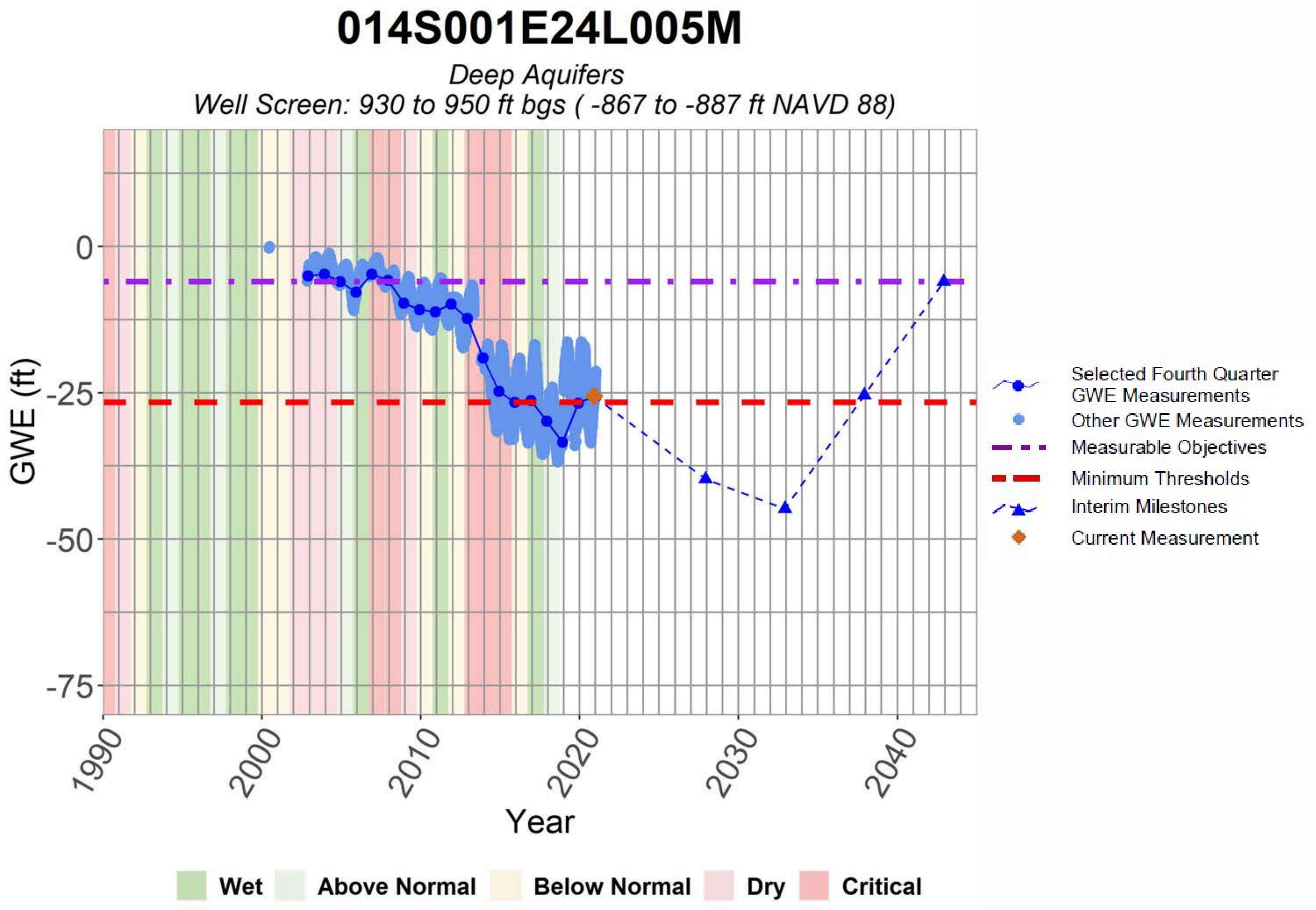


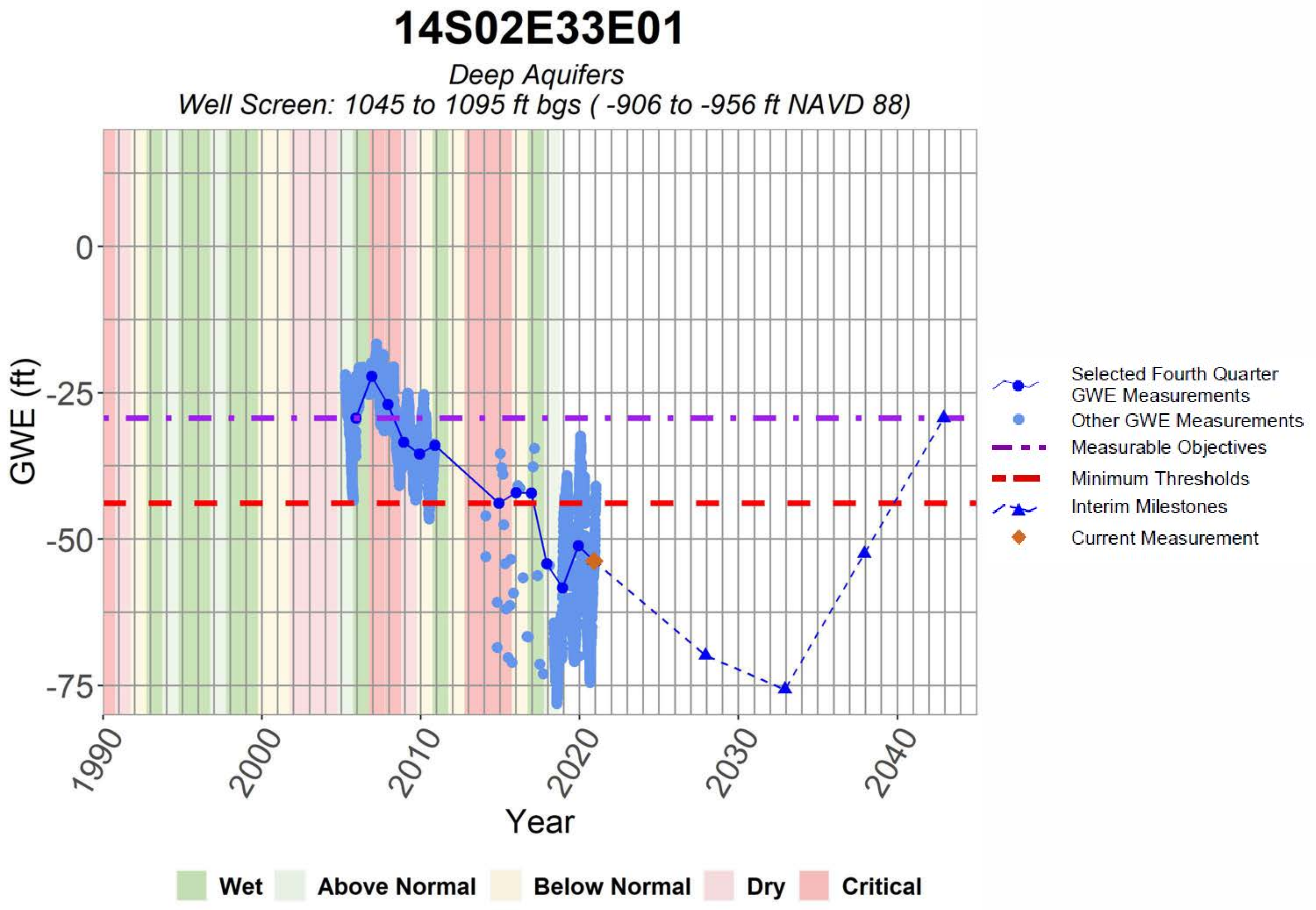


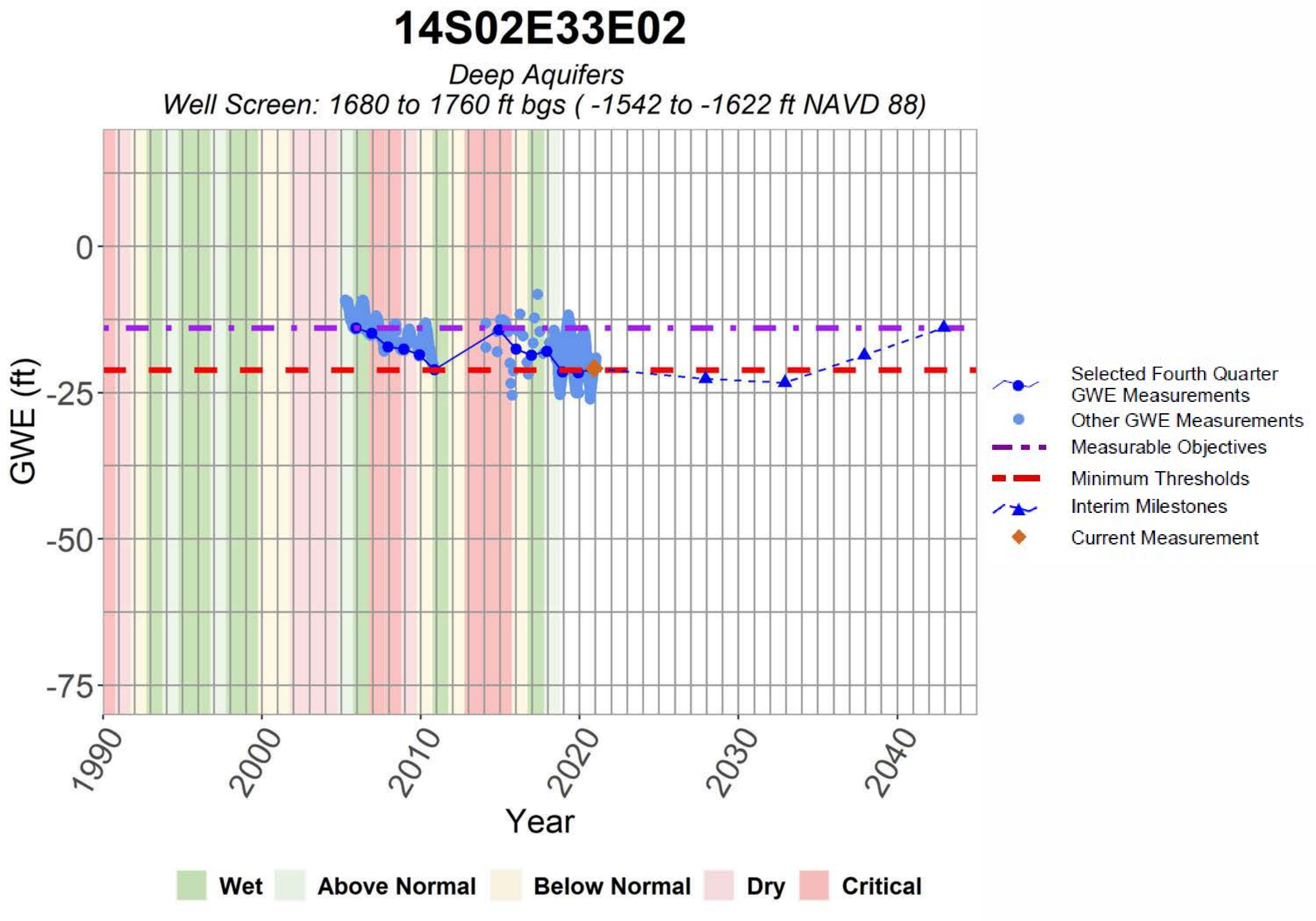
014S001E24L003M
Deep Aquifers
Well Screen: 1410 to 1430 ft bgs (-1347 to -1367 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

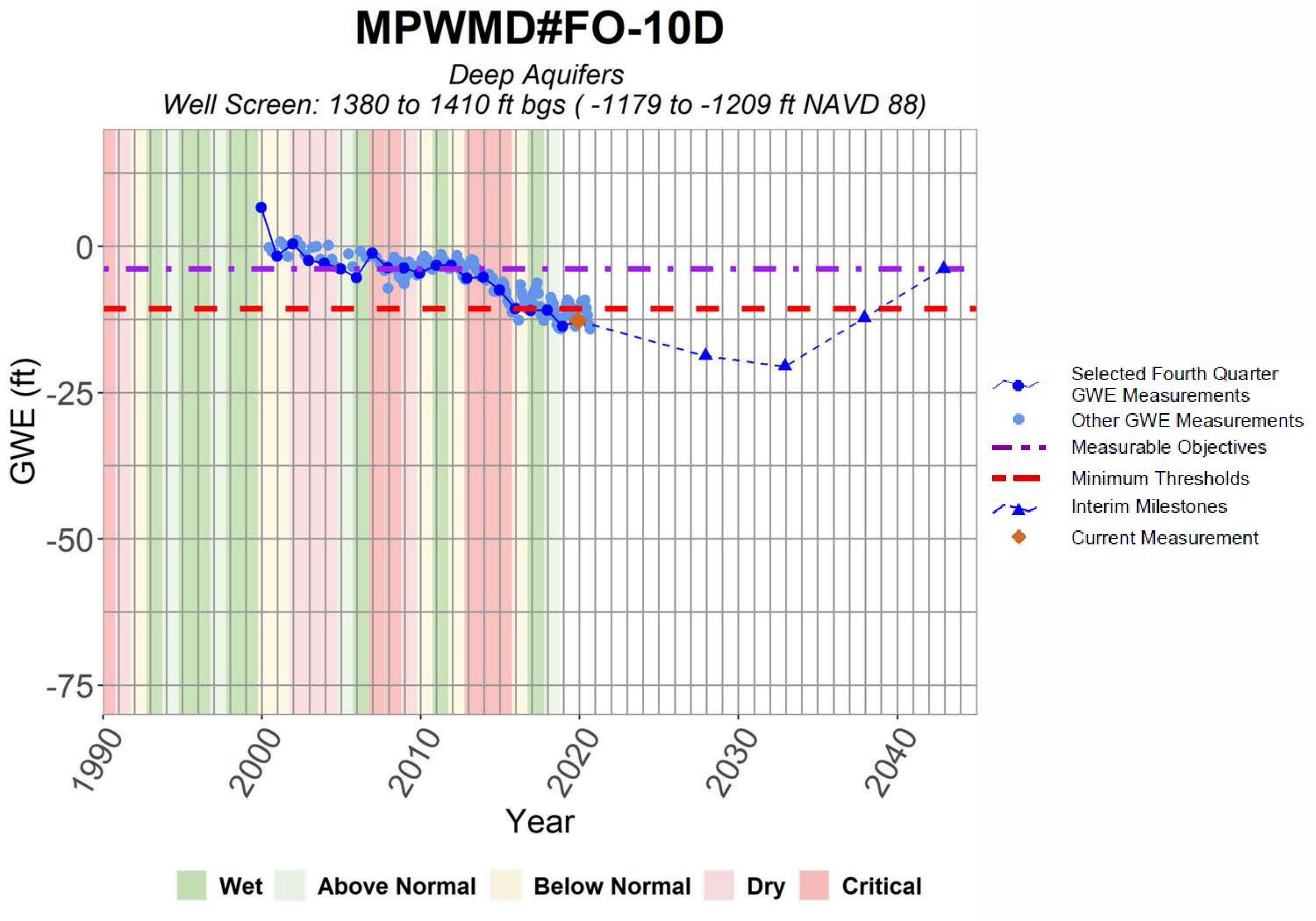


014S001E24L004M
Deep Aquifers
Well Screen: 1040 to 1060 ft bgs (-977 to -997 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

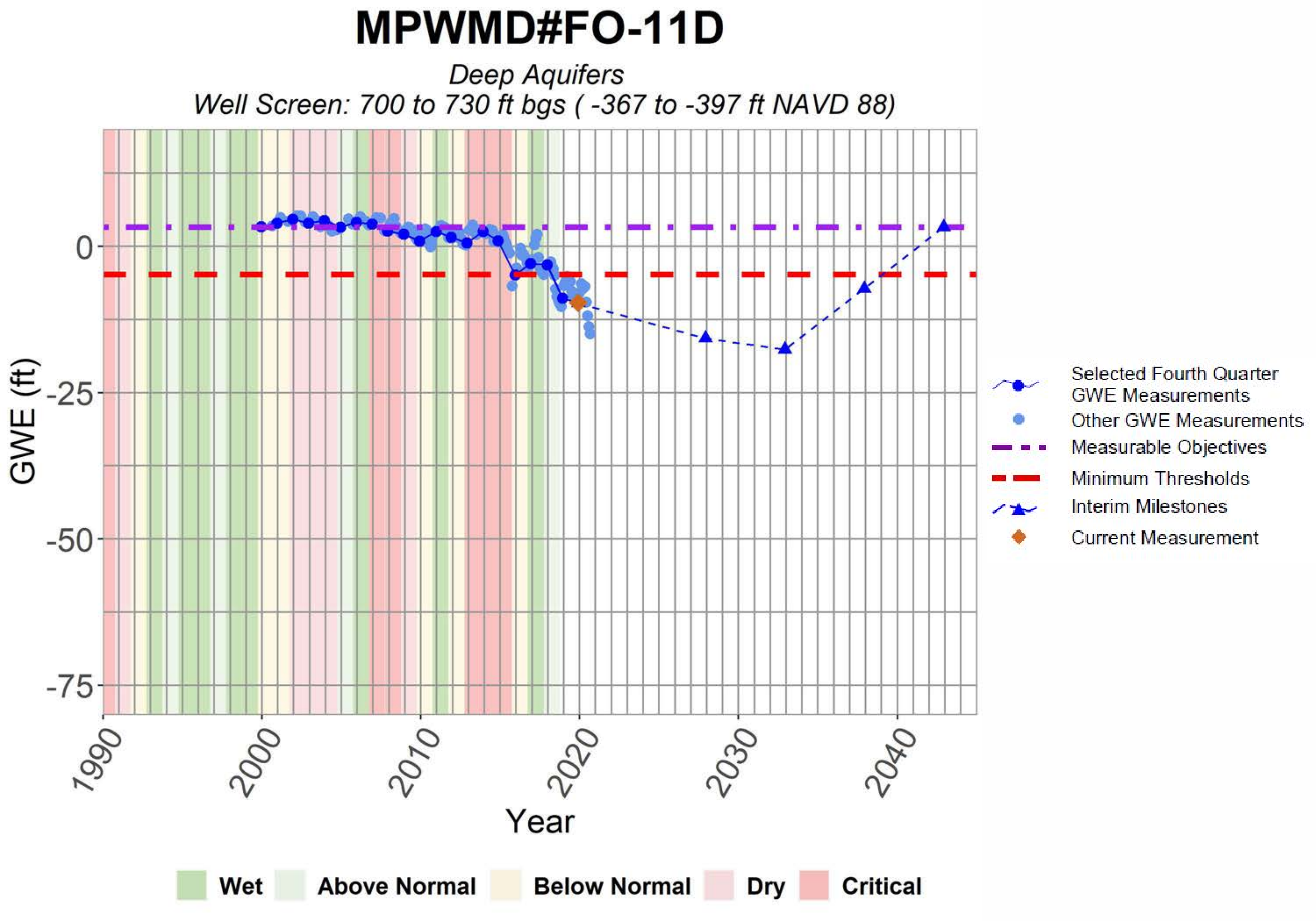

014S001E24L005M
Deep Aquifers
Well Screen: 930 to 950 ft bgs (-867 to -887 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

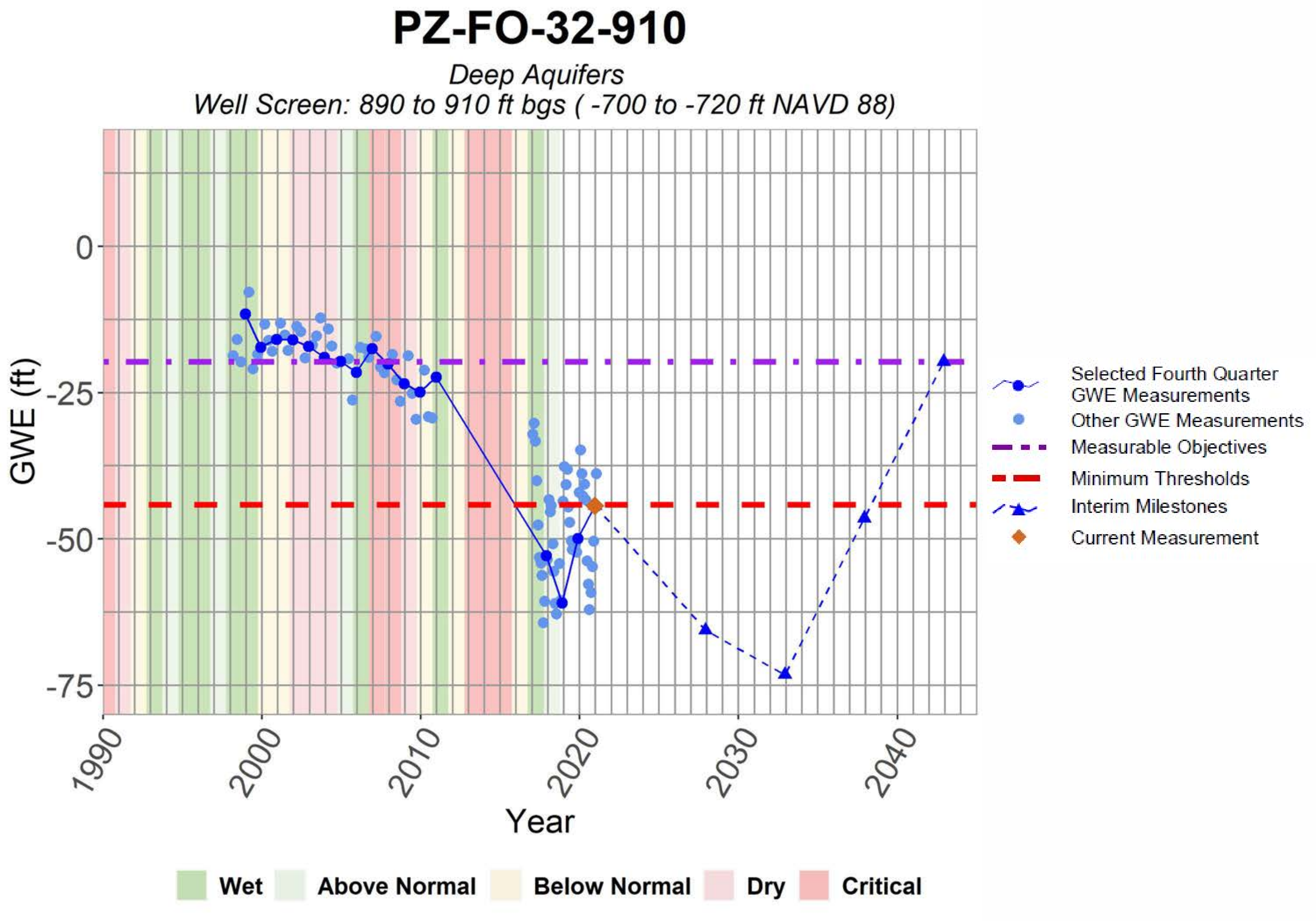

14S02E33E01
Deep Aquifers
Well Screen: 1045 to 1095 ft bgs (-906 to -956 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

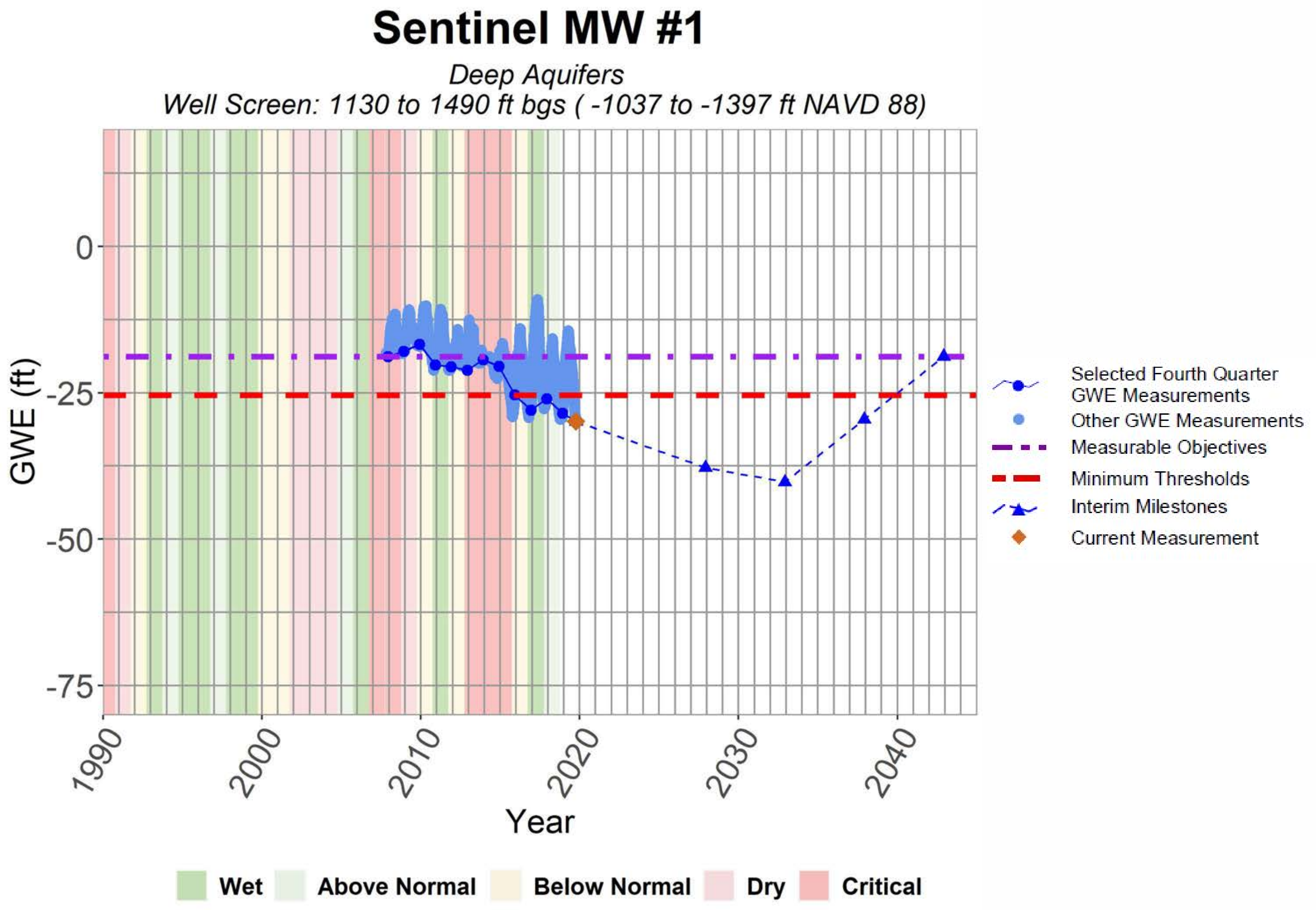

14S02E33E02
Deep Aquifers
Well Screen: 1680 to 1760 ft bgs (-1542 to -1622 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



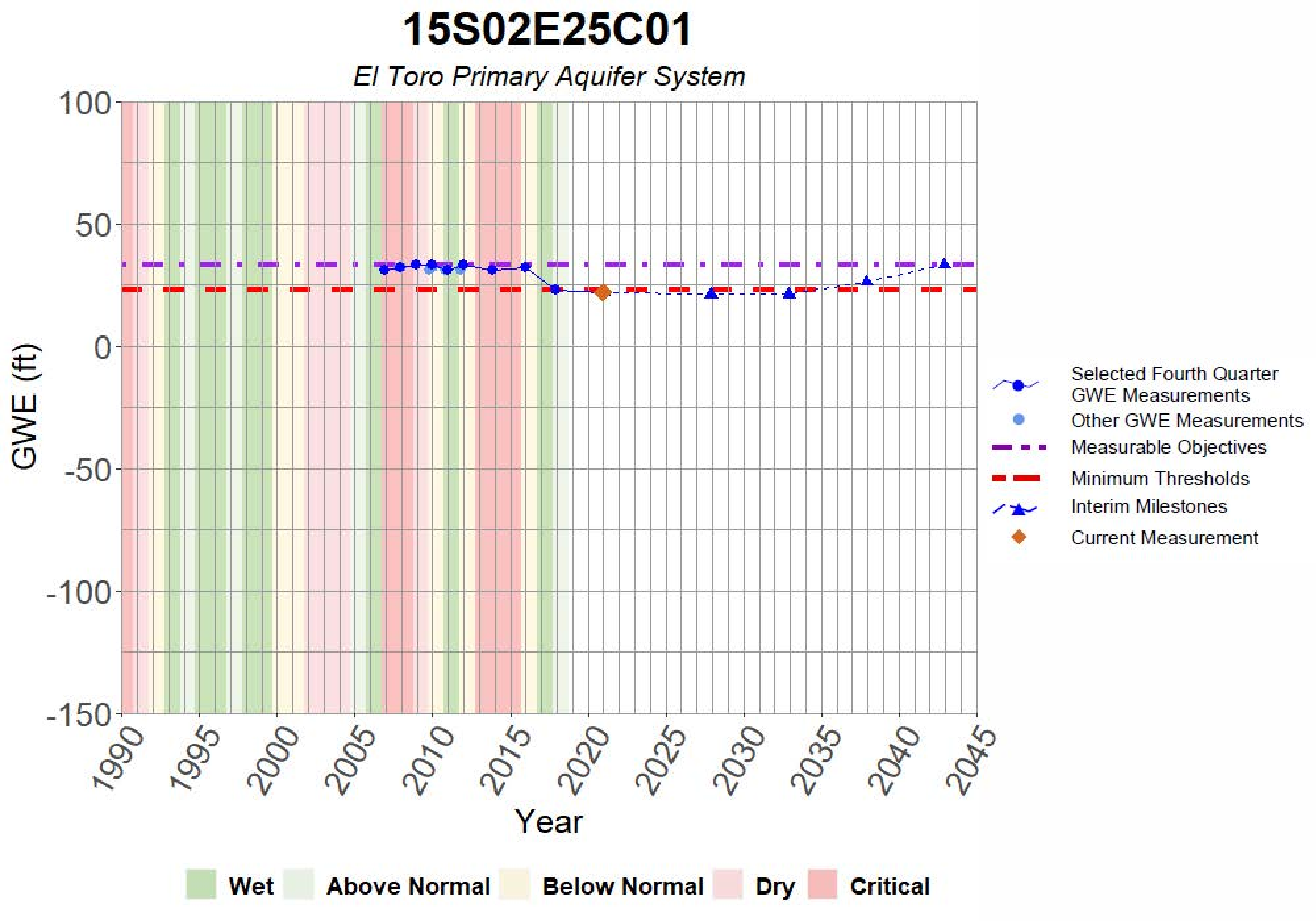
MPWMD#FO-10D
Deep Aquifers
Well Screen: 1380 to 1410 ft bgs (-1179 to -1209 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

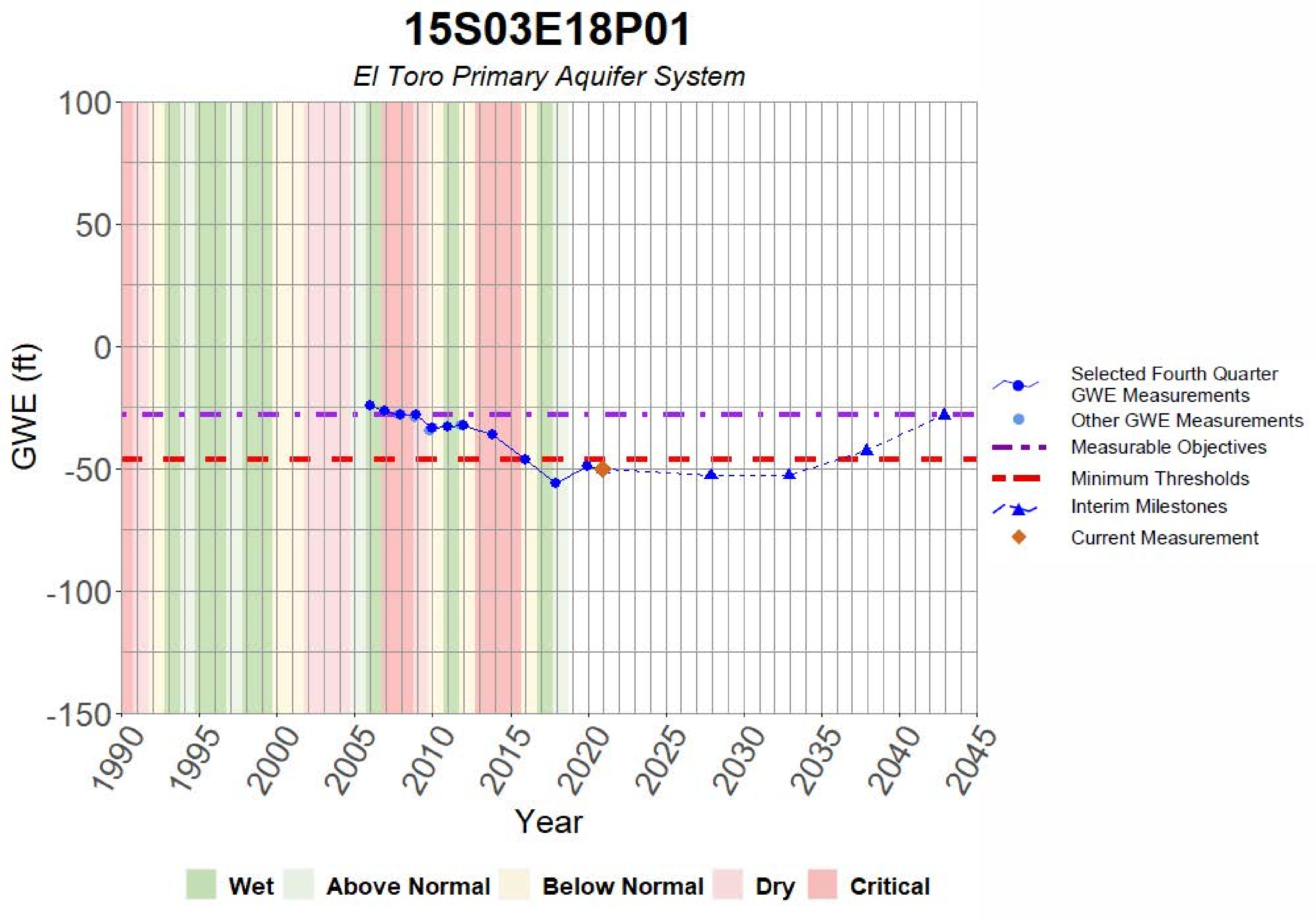

MPWMD#FO-11D
Deep Aquifers
Well Screen: 700 to 730 ft bgs (-367 to -397 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


PZ-FO-32-910
Deep Aquifers
Well Screen: 890 to 910 ft bgs (-700 to -720 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
Year
1990
2000
2010
2020
2030
2040
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

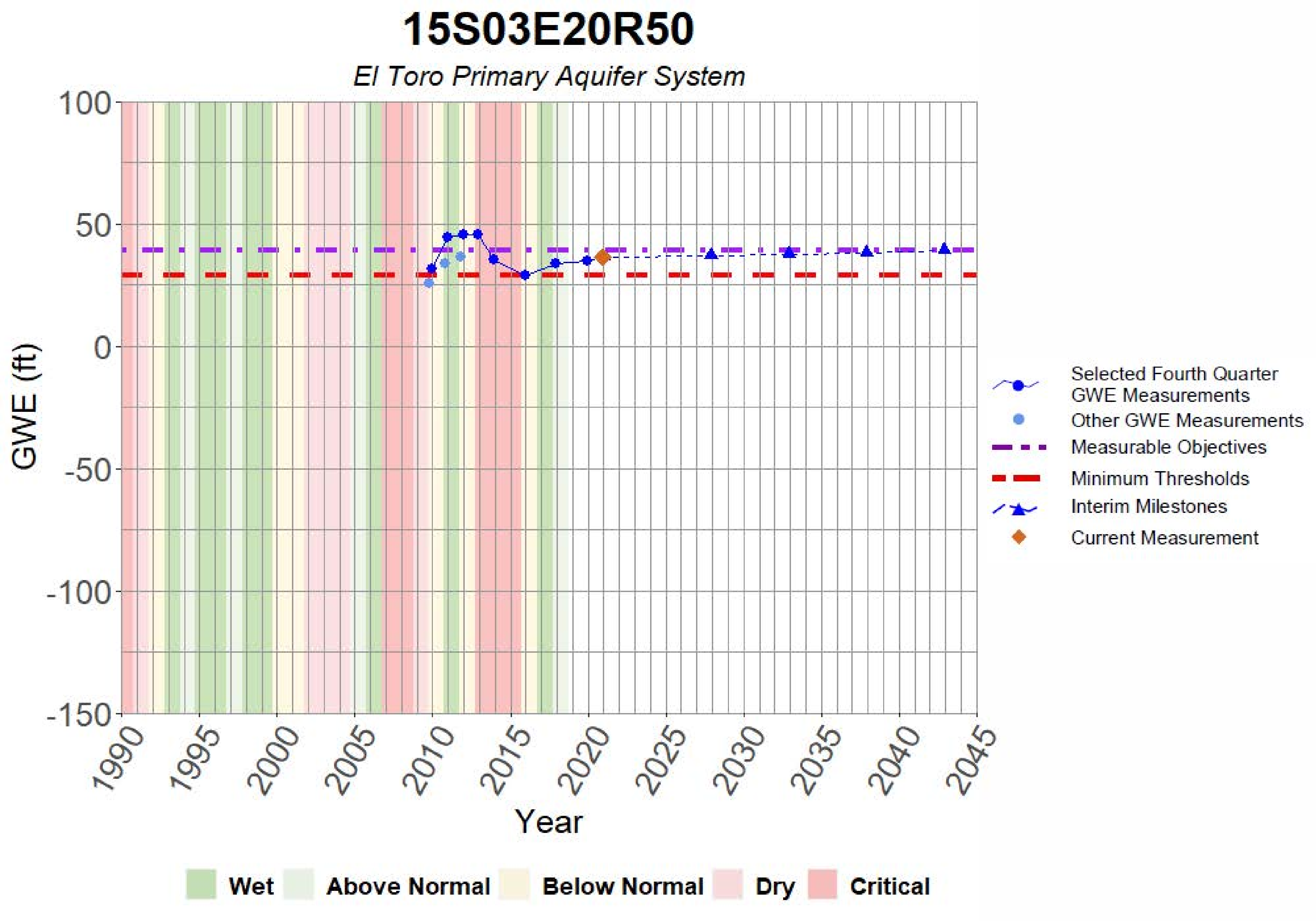


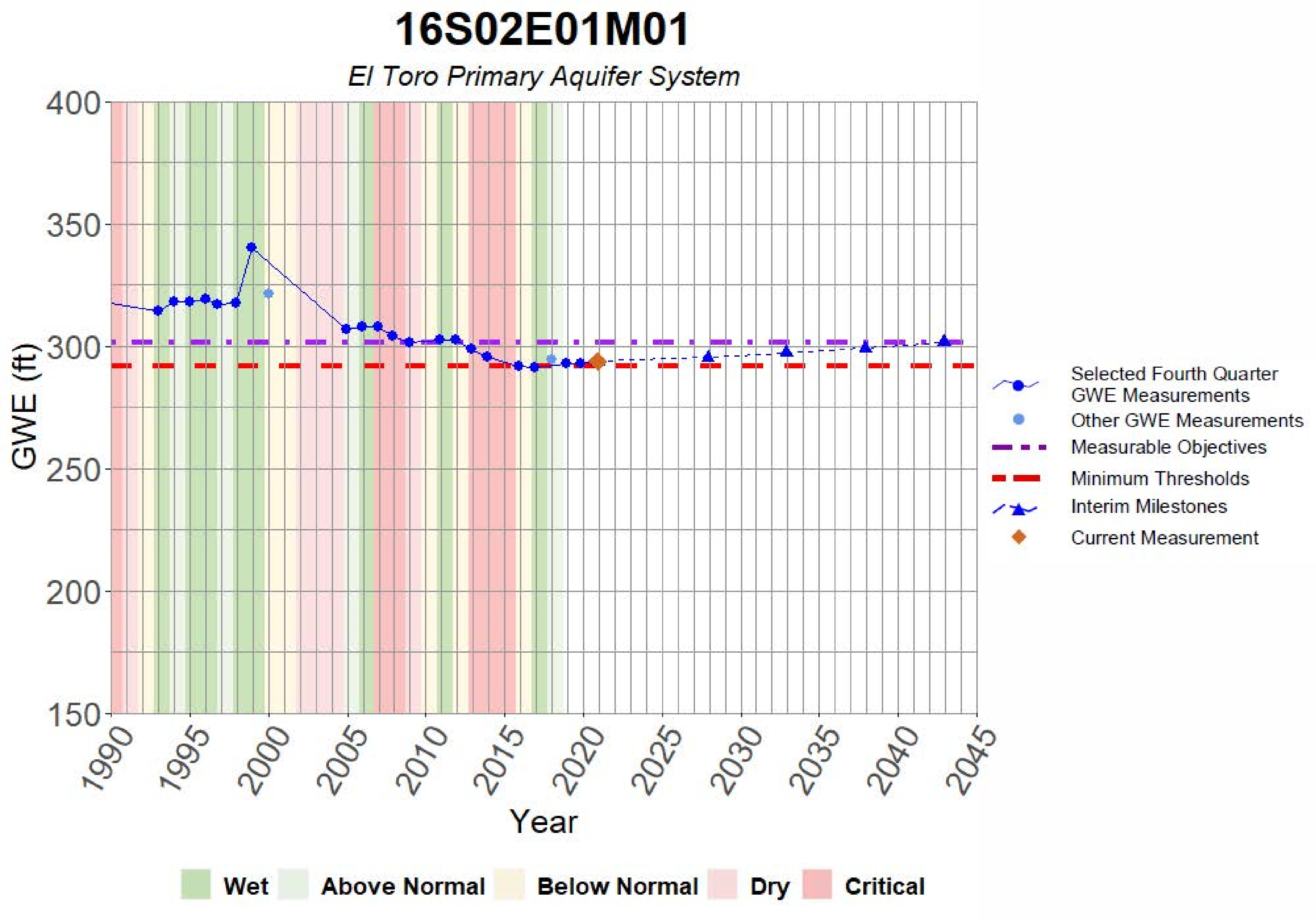
Sentinel MW #1
Deep Aquifers
Well Screen: 1130 to 1490 ft bgs (-1037 to -1397 ft NAVD 88)
GWE (ft)
0
-25
-50
-75
1990
2000
2010
2020
2030
2040
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


15S02E25C01
El Toro Primary Aquifer System
GWE (ft)
100
50
0
-50
-100
-150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

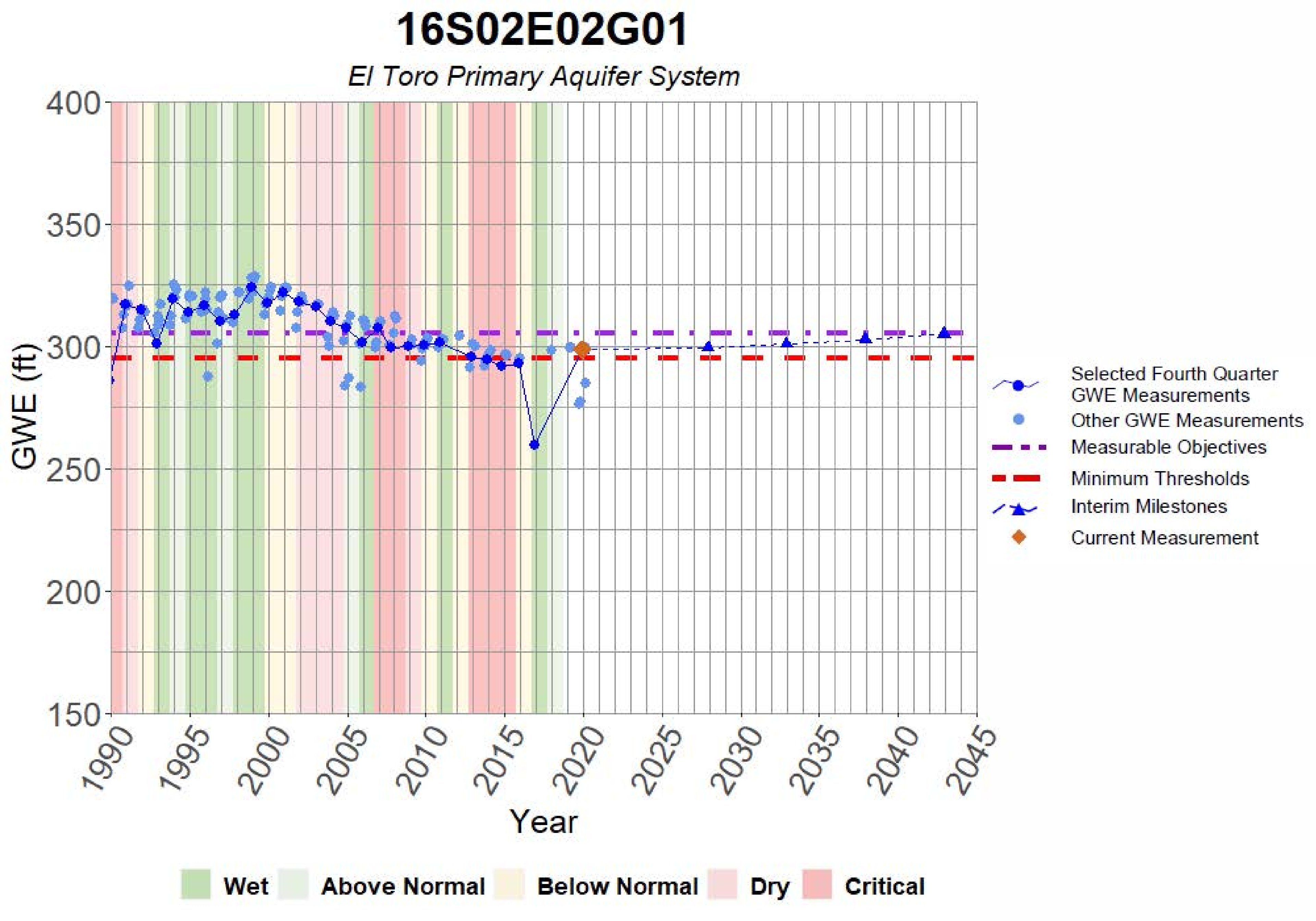


15S03E18P01
El Toro Primary Aquifer System
100
50
0
-50
-100
-150
GWE (ft)
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

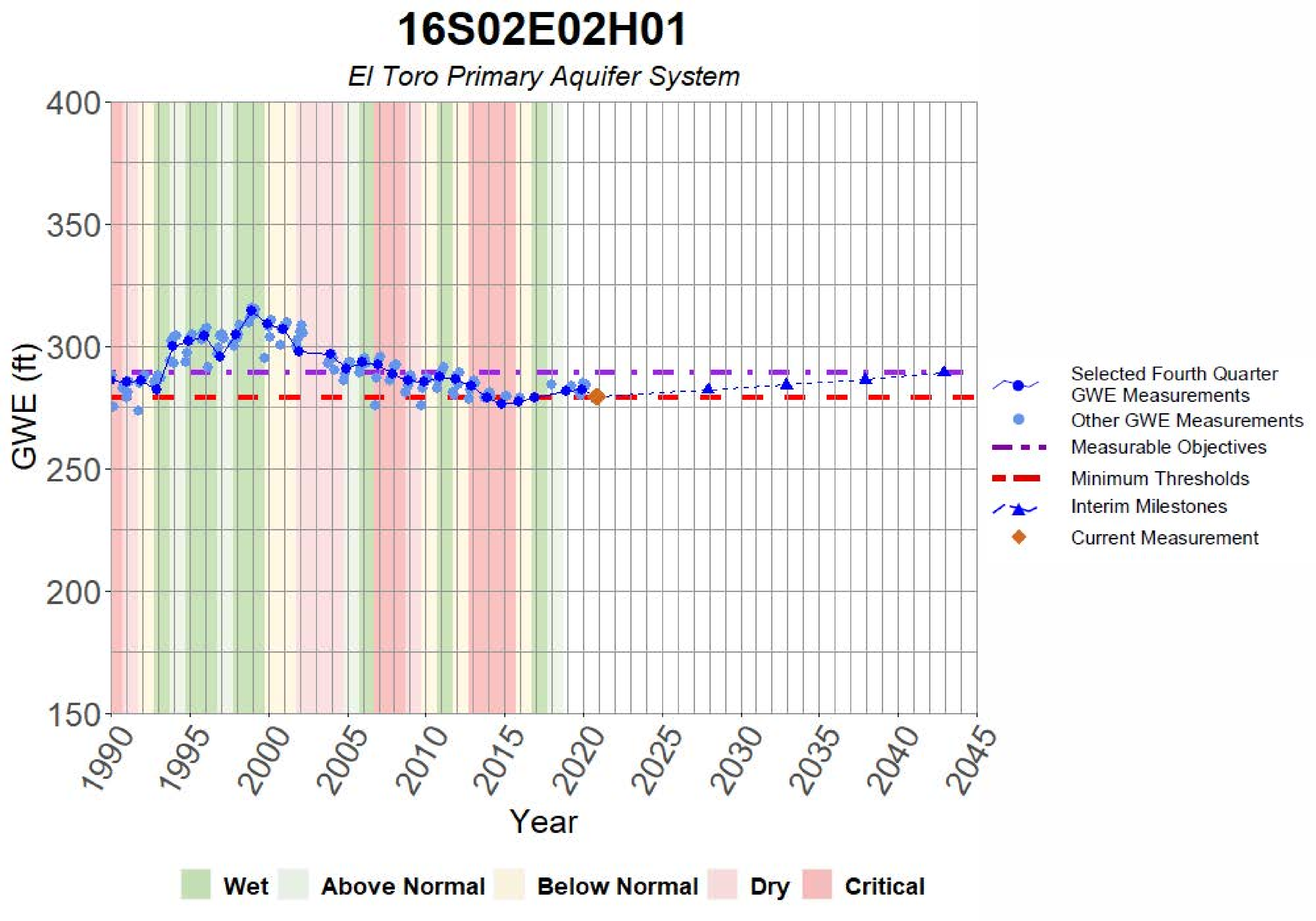

15S03E20R50
El Toro Primary Aquifer System
100
50
0
-50
-100
-150
GWE (ft)
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

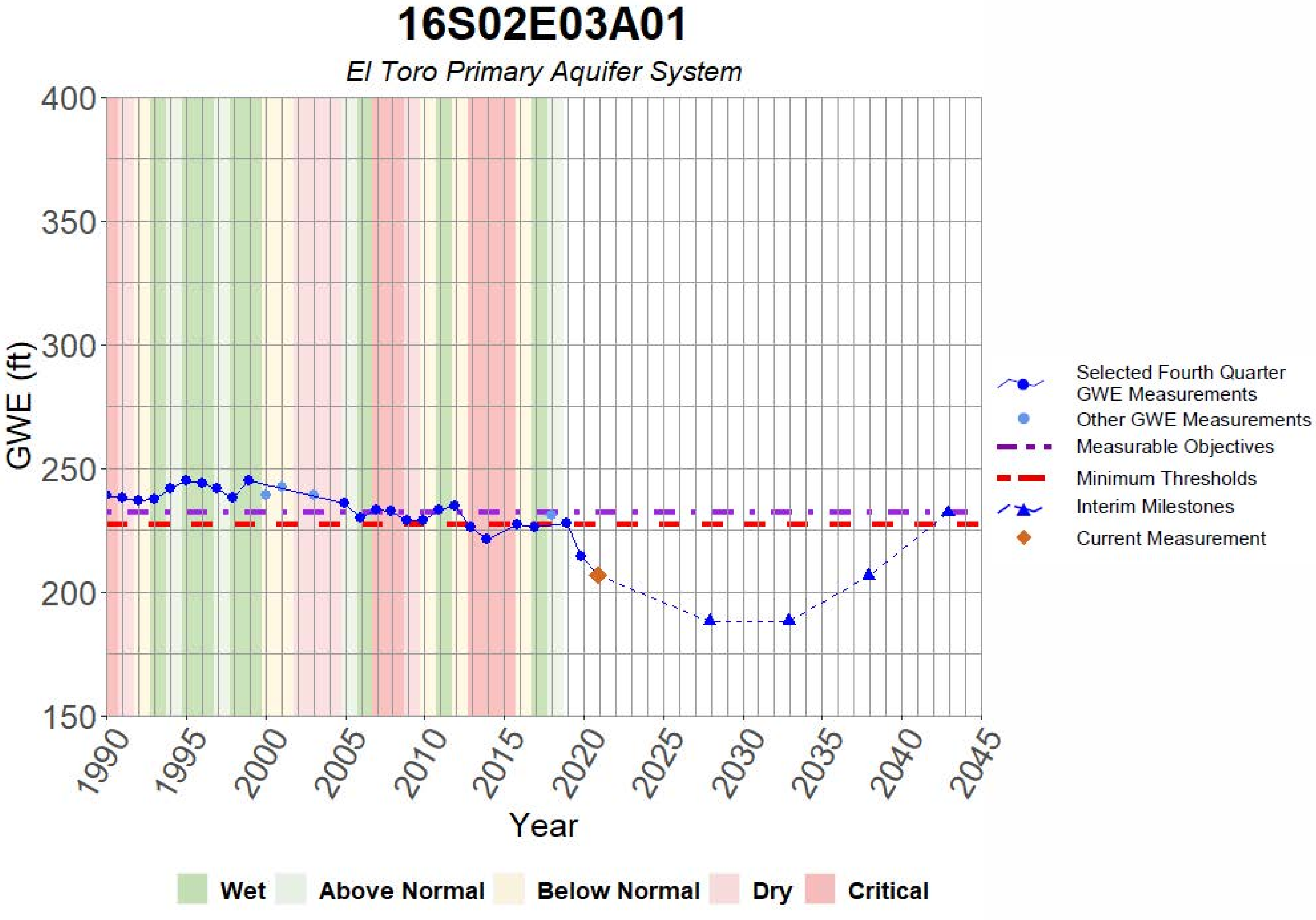


16S02E01M01
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

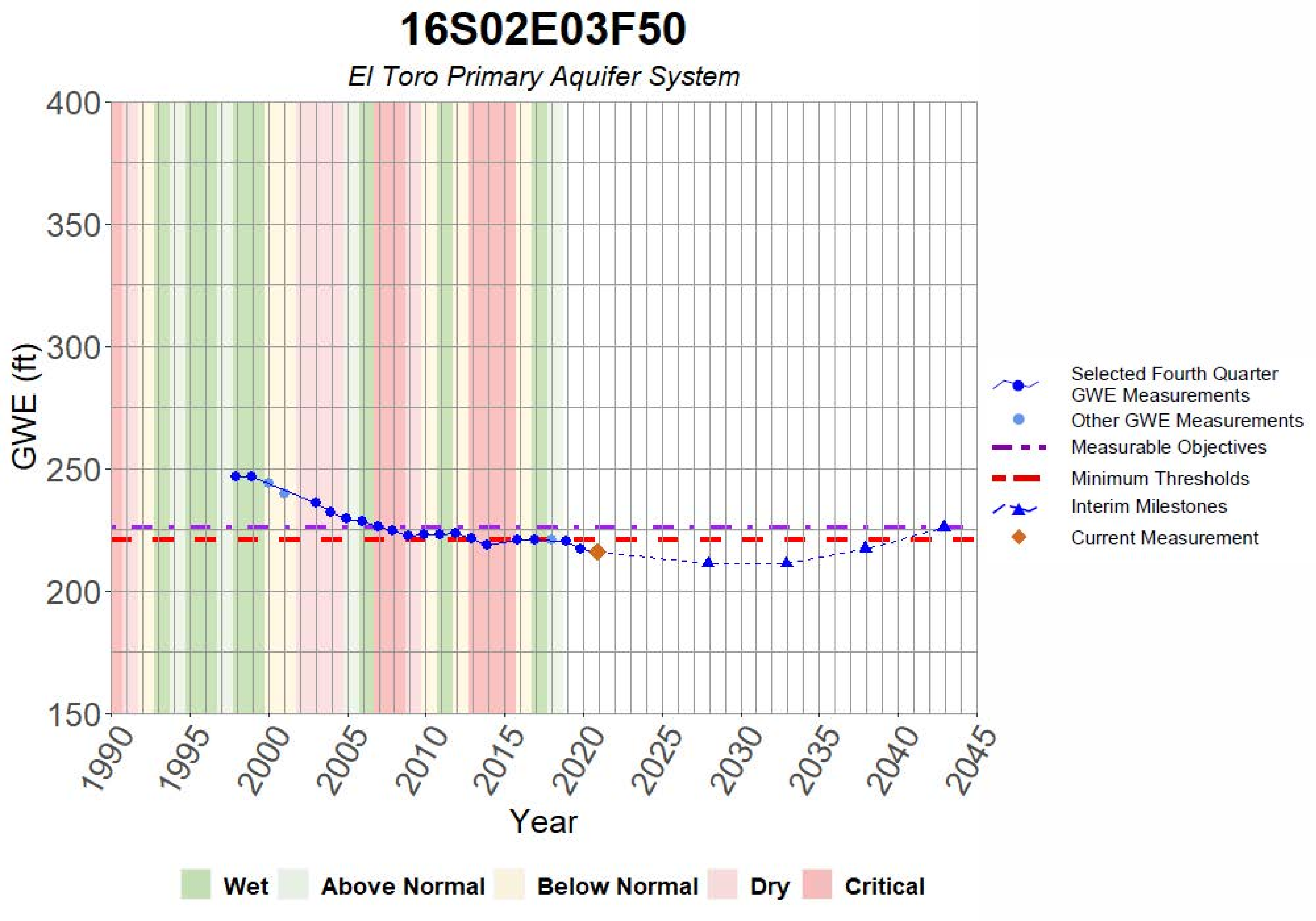


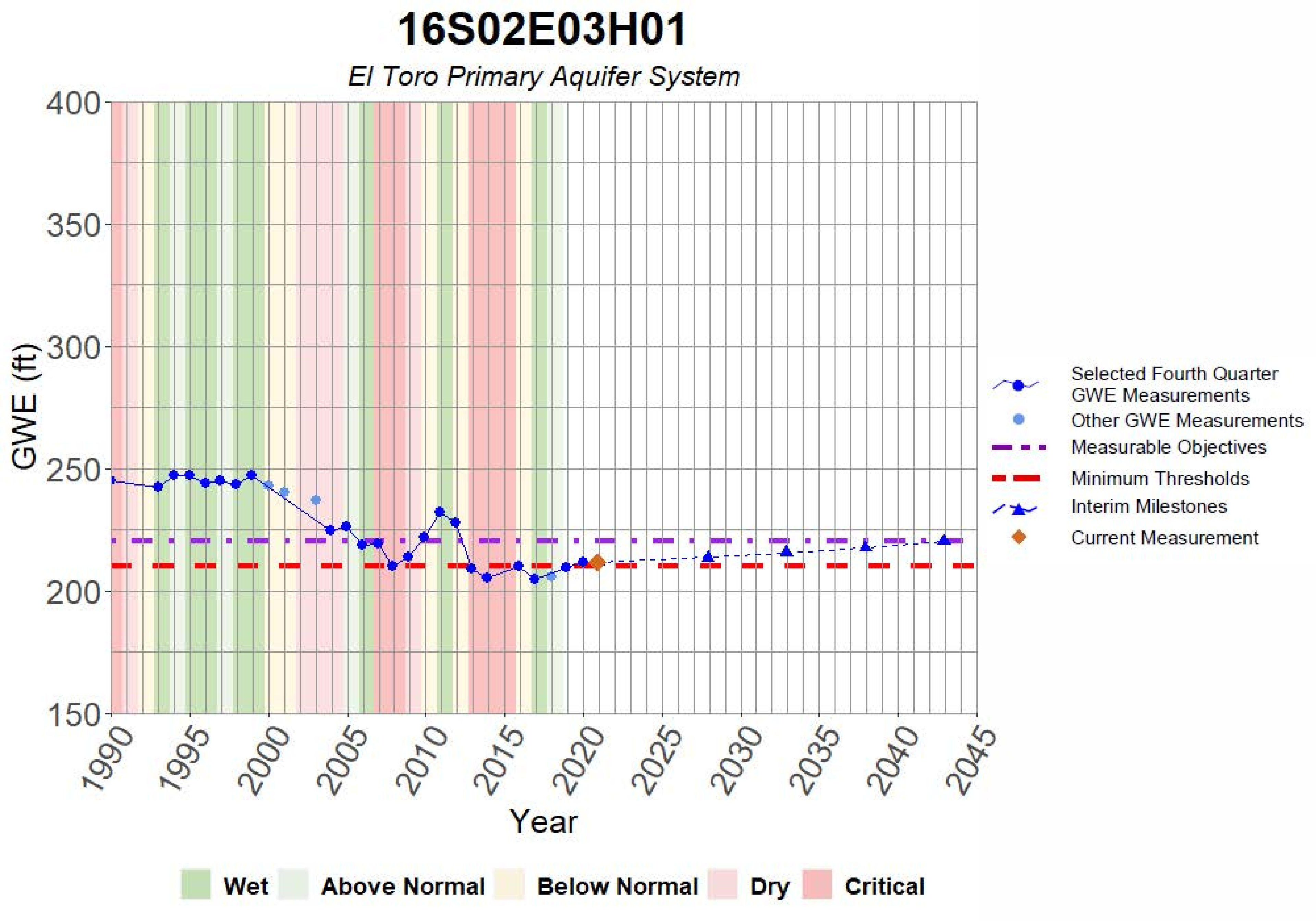
16S02E02G01
El Toro Primary Aquifer System
GWE (ft)
Year
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

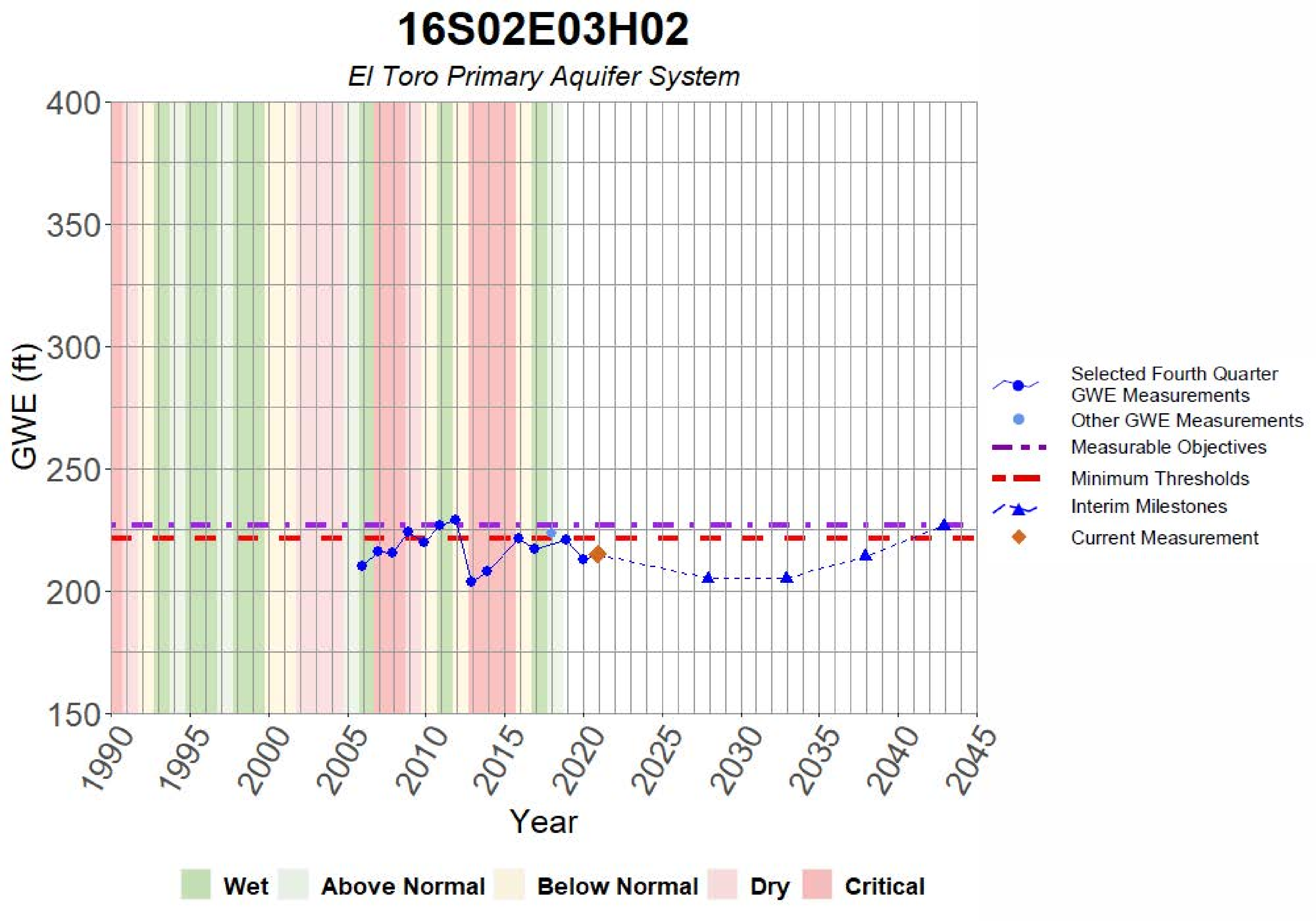

16S02E02H01
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

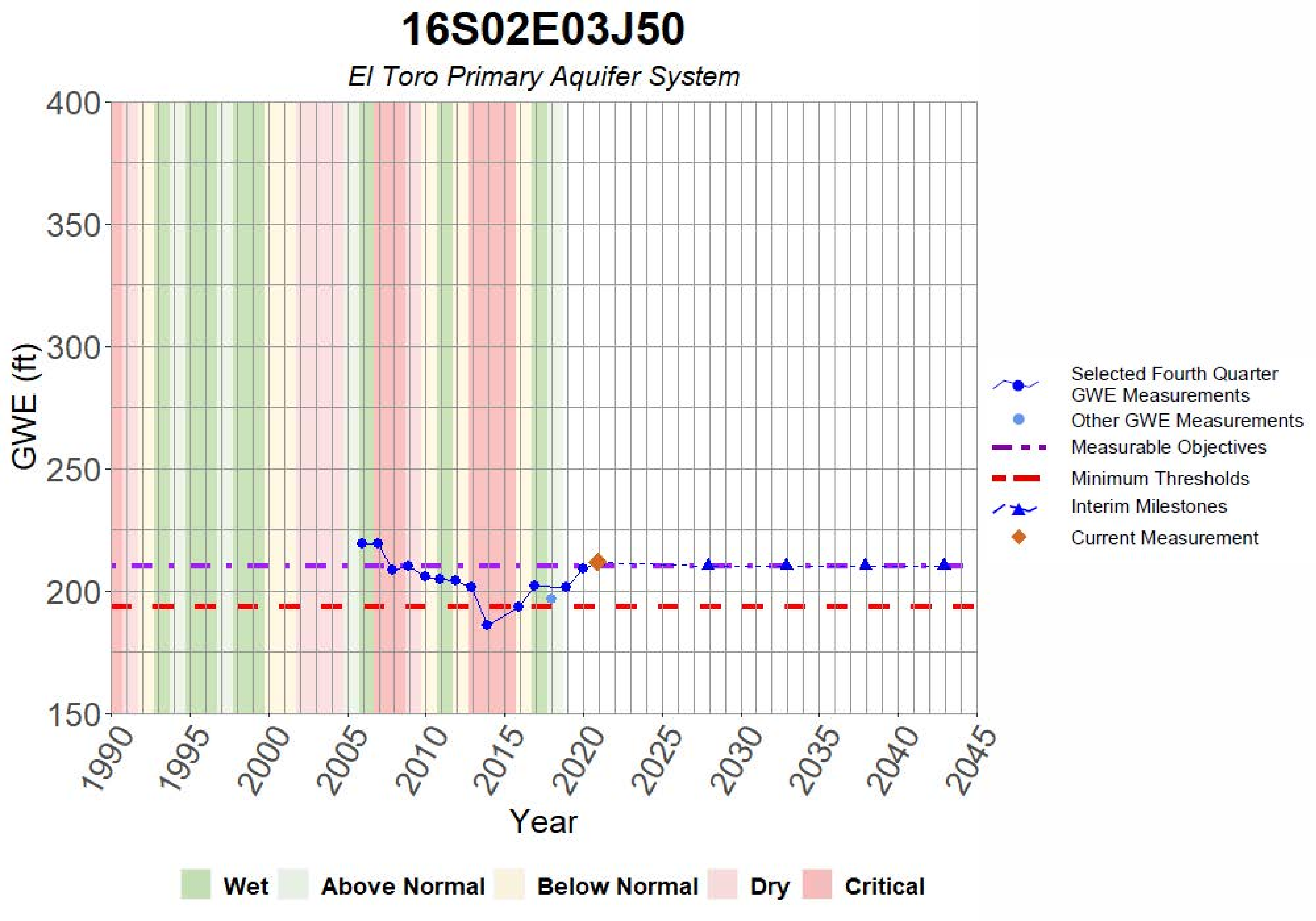


16S02E03A01
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

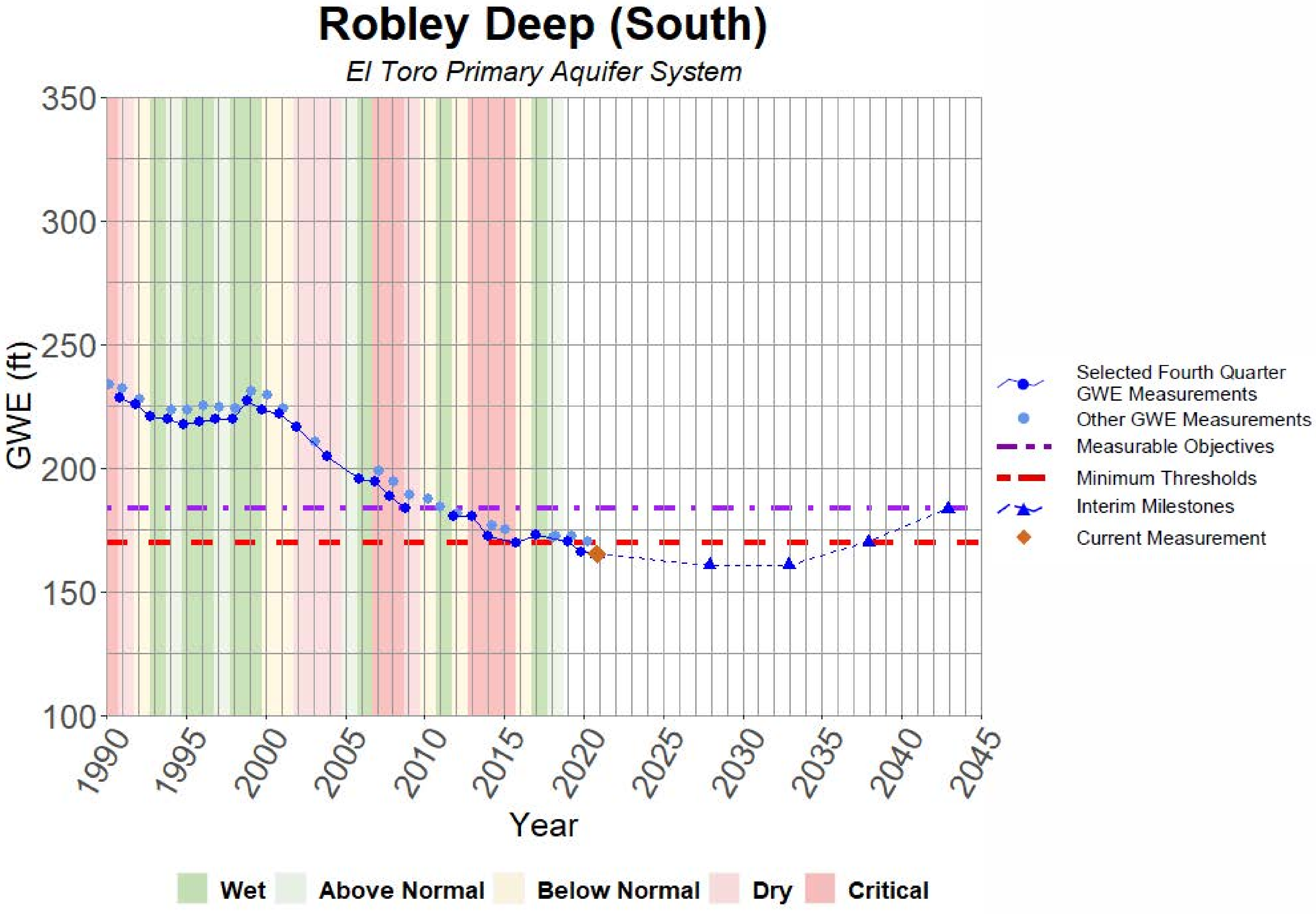

16S02E03F50
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical


16S02E03H01
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

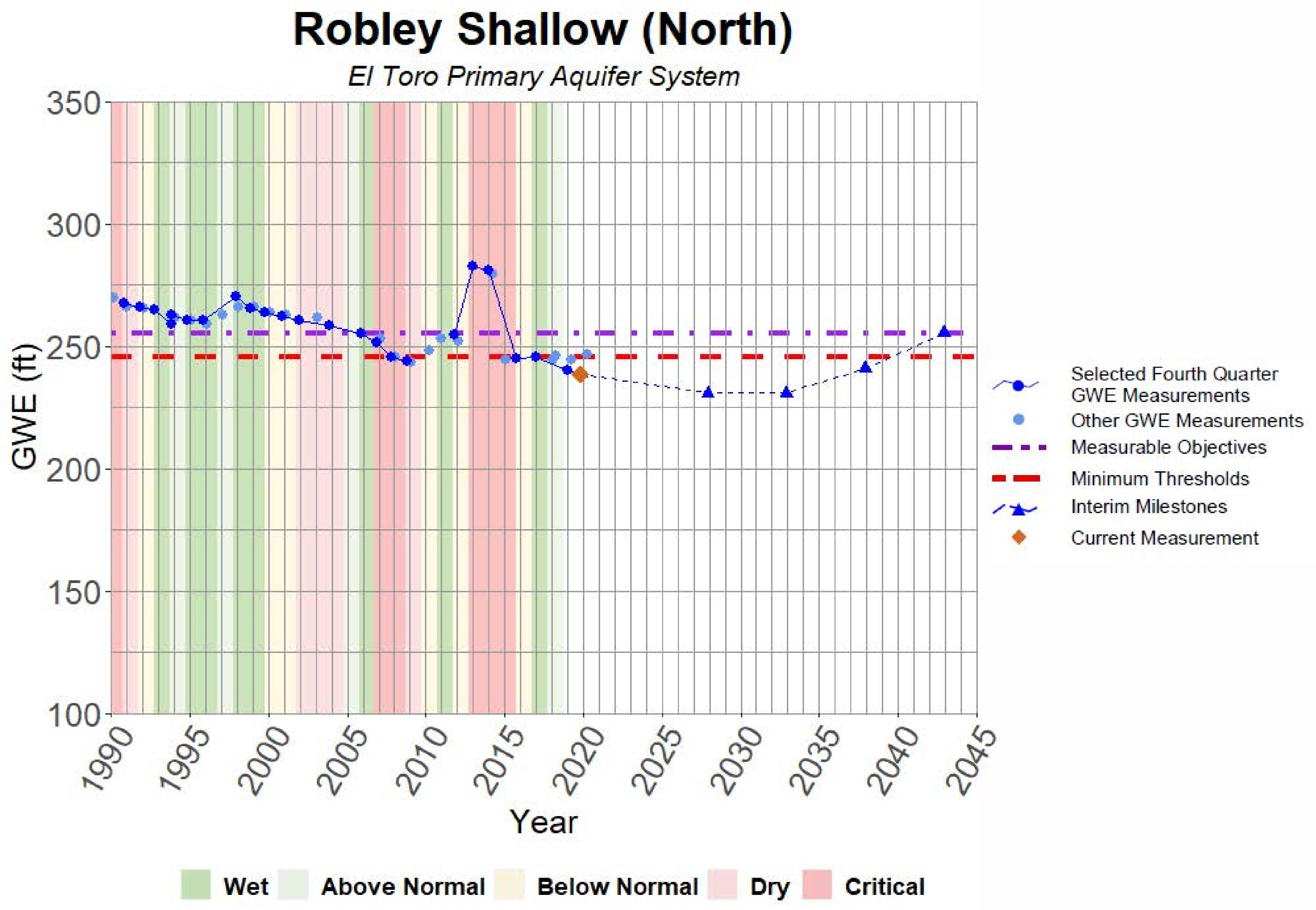

16S02E03H02
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
Year
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



16S02E03J50
El Toro Primary Aquifer System
GWE (ft)
400
350
300
250
200
150
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



Robley Deep (South)
El Toro Primary Aquifer System
GWE (ft)
350
300
250
200
150
100
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical



Robley Shallow (North)
El Toro Primary Aquifer System
350
300
250
200
150
100
GWE (ft)
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
Year
Selected Fourth Quarter GWE Measurements
Other GWE Measurements
Measurable Objectives
Minimum Thresholds
Interim Milestones
Current Measurement
Wet
Above Normal
Below Normal
Dry
Critical

Appendix 9-A

Detailed Cost Estimates

R1 - Winter Release with ASR and Direct Delivery

Capital and Annualized Costs
Winter Release with ASR
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		12,900
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$181,134,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$14,170,000
7	Annual O&M Cost		$		$5,223,000
8	Total Annualized Cost		$		$19,393,000
9	**Unit Cost**		$/AF		**$1,500**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	180' Aquifer ASR Well Construction	8	EA	$765,000	$6,120,000
11	400' Aquifer ASR Well Construction	8	EA	$1,530,000	$12,240,000
12	Well Pumps, Motors, & Wellhead Infrastructure	16	EA	$440,000	$7,040,000
13	Electrical and Instrumentation	1	LS	$1,056,000	$1,056,000
14	Percolation Basins, Site Civil Work	16	25%	$191,300	$3,060,800
15	Land Access	21	AC	$45,000	$945,000
16	Distribution Pipeline (4 mile)	21,120	LF	$650	$13,728,000
17	Filtration and Disinfection System	1	LS	$70,000,000	$70,000,000
18	***SubTotal***				$114,189,800
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	General Conditions			15%	$17,128,500
20	Contractor Overhead and Profit			18%	$20,554,200
21	Sales Tax			8.75%	$2,997,500
22	Engineering, Legal, Admininstrative, Contingencies			20%	$22,838,000
23	Bonds and Insurance			3%	$3,425,700
24	***Total Capital Cost***				$181,134,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
25	Power	1	LS	$1,607,300	$1,607,300
26	Treatment	1	LS	$548,000	$548,000
27	Equipment Repair & Replacement	1	LS	$864,000	$864,000
28	Operations Labor	1	LS	$729,600	$729,600
29	Miscellaneous	1	LS	$603,900	$603,900
30	Contingency			20%	$870,600
31	***Total O&M Annual Cost***				$5,223,000

NOTES:
1. "Project Yield" based on: 49 CFS (22,000 GPM) and 36% facility up time, reflecting winter operation.
2. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: construction of 8 ASR wells in the180-Foot Aquifer, 8 ASR wells in the 400-Foot Aquifer. Constrcution of a 23 MGD filtration/disinfection system for treating winter surface water flows prior to injection.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annual O&M Cost" includes well and treatment facilities.

Conceptual Cost Estimate
Project R1 Winter Release from Reservoirs - Direct Delivery

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Capital Costs					
Surface Water Treatment Plant	1	LS	$19,480,000	$ 19,480,000	For this project, MCWD would fund a portion of the overall infrastructure costs according to their share of the overall flow through a regional treatment plant. The overall infrastructure costs for a 23 MGD treatment plant was assumed under the ASR component for $70 million. MCWD's share of such a facility is assumed to be 6.4 MGD to produce 3,600 AFY of treated water, so the overall cost was converted to a $/AF unit cost and was used to estimate MCWD's portion of the cost. Rounded up to the nearest $10,000.
Piping from Salinas River Diversion to SWTP at Armstrong Ranch	6,000	LF	$310	$ 1,860,000	20-inch diameter pipeline at $12/in-diameter foot plus 30% for various appurtenances ($310/LF). Rounded up to the nearest $10,000.
Piping from SWTP to MCWD Distribution System	10,000	LF	$310	$ 3,100,000	20-inch diameter pipeline at $12/in-diameter foot plus 30% for various appurtenances ($310/LF). Rounded up to the nearest $10,000.
			Total Direct Costs	*$ 24,440,000*	
Contingency on Infrastructure Costs	30	%	$24,440,000	$ 7,332,000	Based on a Class 5 level estimate for conceptual cost estimates (AACEI, 2019).
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, Mitigation, etc.	30	%	$31,772,000	$ 9,531,600	Assumes 30% of capital costs
Contingency for Regional Coordination	5	%	$31,772,000	$ 1,588,600	An additional 5% contigency was added to account for coordination with regional stakeholders that would be involved in this project.
			Capital Costs Subtotal (rounded up to nearest $100,000)	**$ 42,900,000**	
			Annualized over 25 year period at 6% interest	**$ 3,355,926**	
Operating Costs					
Annual Operating Costs for SWTP	1	LS	$ 500,000	$ 500,000	For this project, MCWD would fund a portion of the operating costs according to their share of the overall flow through a regional treatment plant. Operating costs for a 23 MGD treatment plant was assumed under the ASR component. MCWD's share of such a facility is assumed to be 6.4 MGD to produce 3,600 AFY of treated water, so the overall cost was converted to a $/AF unit cost and was used to estimate MCWD's portion of the cost. Rounded up to the nearest $10,000.
			Annual Operating and Overhead Cost Subtotal	**$ 500,000**	

Total Costs		
Total Annualized Cost	**$ 3,860,000**	**per year over 25 years. Rounded up to nearest $10,000**
Total 25-Year Average Cost Per Acre-Foot (3,600 AFY)	**$ 1,100**	**per acre-foot. Rounded up to nearest $100**

Abbreviations:
AFY: acre feet per year
ASR: Aquifer Storage and Recovery
EA: each
LF: lineal foot
LS: lump sum
MCWD: Marina Coast Water District
SWTP: surface water treatment plant

References
AACEI, 2019. *Recommended Practices and Standards* , Association for the Advancement of Cost Engineering International, March 2019 Update.

R2 - Regional Municipal Supply

Capital and Annualized Costs
Regional Alternative Water Supply Project
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$309,387,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$24,203,300
7	Annual O&M Cost		$		$11,874,000
8	Total Annualized Cost		$		$36,077,300
9	**Unit Cost**		$/AFY		**$2,405**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	SWRO Facility	13	MGD	$14,000,000	$182,000,000
11	Source Water Pipeline	58,080	LF	$400	$23,232,000
12	***Subtotal***				$205,232,000
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
13	General Conditions			15%	$30,784,800
14	Contractor Overhead and Profit			18%	$36,941,800
15	Sales Tax			8.75%	$17,957,800
16	Engineering, Legal, Admininstrative, Contingencies			20%	$12,313,900
17	Bonds and Insurance			3%	$6,157,000
18	***Total Capital Cost***				$309,387,000
OPERATIONS AND MAINTENANCE					
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	Desalination O&M	13	MGD	$913,400	$11,874,200
1	***Total O&M Annual Cost***				$11,874,000

NOTES:
1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.
3. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.

Capital and Annualized Costs
Regional Alternative Water Supply Project
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$65,257,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$5,105,100
7	Annual O&M Cost		$		$1,318,000
8	Total Annualized Cost		$		$6,423,100
9	**Unit Cost**		$/AFY		**$428**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$2,061,345	$2,061,345
11	Environmental and Stormwater	1	LS	$3,747,900	$3,747,900
12	Pipeline to Salinas	52,700	LF	$400	$21,080,000
13	Pipeline to Salinas Hils	39,100	LF	$300	$11,730,000
14	Distribution Pump Station	11.6	MGD	$350,000	$4,060,000
15	Electrical, I&C	1	LS	$609,000	$609,000
16	***Subtotal***				$43,288,245
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
17	General Conditions			15%	$6,493,200
18	Contractor Overhead and Profit			18%	$7,791,900
19	Sales Tax			8.75%	$3,787,700
20	Engineering, Legal, Admininstrative, Contingencies			20%	$2,597,300
21	Bonds and Insurance			3%	$1,298,600
22	***Total Capital Cost***				$65,257,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
23	Power	1	LS	$664,780.25	$664,780
24	Labor	1	LS	$180,000	$180,000
25	Equipment Repair & Replacement	1	LS	$168,956	$168,956
26	Contingency			30%	$304,100
27	***Total O&M Annual Cost***				$1,318,000

NOTES:
1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.

Capital and Annualized Costs
Regional Alternative Water Supply Project
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$70,623,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$5,524,800
7	Annual O&M Cost		$		$1,458,000
8	Total Annualized Cost		$		$6,982,800
9	**Unit Cost**		$/AFY		**$466**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$2,090,124	$2,090,124
11	Environmental and Stormwater	1	LS	$3,800,225	$3,800,225
12	Pipeline to Salinas	52,700	LF	$400	$21,080,000
13	Pipeline to Salinas Hils	39,100	LF	$300	$11,730,000
14	Pipeline to Marina	9,850	LF	$300	$2,955,000
15	Distribution Pump Station	12.9	MGD	$350,000	$4,515,000
16	Electrical, I&C	1	LS	$677,250	$677,250
17	***Subtotal***				$46,847,599
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
18	General Conditions			15%	$7,027,100
19	Contractor Overhead and Profit			18%	$8,432,600
20	Sales Tax			8.75%	$4,099,200
21	Engineering, Legal, Admininstrative, Contingencies			20%	$2,810,900
22	Bonds and Insurance			3%	$1,405,400
23	***Total Capital Cost***				$70,623,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
24	Power	1	LS	$742,310.45	$742,310
25	Labor	1	LS	$192,000	$192,000
26	Equipment Repair & Replacement	1	LS	$186,862	$186,862
27	Contingency			30%	$336,400
28	***Total O&M Annual Cost***				$1,458,000

NOTES:
1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.

Capital and Annualized Costs
Regional Alternative Water Supply Project
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		15,000
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$84,315,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$6,596,000
7	Annual O&M Cost		$		$1,515,000
8	Total Annualized Cost		$		$8,111,000
9	**Unit Cost**		$/AFY		**$541**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$2,101,193	$2,101,193
11	Environmental and Stormwater	1	LS	$3,820,350	$3,820,350
12	Pipeline to Salinas	52,700	LF	$400	$21,080,000
13	Pipeline to Salinas Hils	39,100	LF	$300	$11,730,000
14	Pipeline to Marina	9,850	LF	$300	$2,955,000
15	Pipeline to Castroville	29,500	LF	$300	$8,850,000
16	Distribution Pump Station	13.4	MGD	$350,000	$4,690,000
17	Electrical, I&C	1	LS	$703,500	$703,500
18	***Subtotal***				$55,930,043
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	General Conditions			15%	$8,389,500
20	Contractor Overhead and Profit			18%	$10,067,400
21	Sales Tax			8.75%	$4,893,900
22	Engineering, Legal, Admininstrative, Contingencies			20%	$3,355,800
23	Bonds and Insurance			3%	$1,677,900
24	***Total Capital Cost***				$84,315,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
25	Power	1	LS	$767,054.14	$767,054
26	Labor	1	LS	$204,000	$204,000
27	Equipment Repair & Replacement	1	LS	$194,211	$194,211
28	Contingency			30%	$349,600
29	***Total O&M Annual Cost***				$1,515,000

NOTES:
1. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
2. "Interest Rate" selected within expected range for public-financing options.
3. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.

R3 - Multi-benefit Stream Channel Improvements

Multi-benefit stream channel improvements

Component 2

RCD Arundo Eradication Cost Estimate

Five-year cost for treating arundo (includes three herbicide treatments and mowing or hand-cutting if applicable)								
Work activity	Cost/acre for arundo control contractor	Cost/acre for biomonitoring	Cost/acre for biological surveys	Cost/acre for RCD program administration	Total Cost/acre	Estimated acres remaining	Total Cost (Low Estimate	Total Cost (High Estimate)
Mowed arundo	$ 10,350.00	$ 356.04	$ 2,127.50	$ 2,495.50	$ 15,329.04	700	$ 10,730,328.00	$ 13,949,426.40
Unmowed arundo	$ 7,475.00	$ 349.60	$ 1,322.50	$ 1,759.50	$ 10,906.60	150	$ 1,635,990.00	$ 2,126,787.00
Hand-cut arundo	$ 34,500.00	$ 2,300.00	$ 2,875.00	$ 3,737.50	$ 43,412.50	50	$ 2,170,625.00	$ 2,821,812.50
						Est. cost of initial + retreatment	**$ 14,536,943.00**	**$ 18,898,025.90**

Cost of O&M	
WCS completed treatment on approximately 21 river miles in 2020	$151,599.00
Cost per river mile of 2020 treatment	$7,219.00
Cost per river mile rounded up	$7,500.00
*Cost includes biological surveys and monitoring	
*90 miles of river in Monterey County	
Cost for retreating whole river 1 time	$675,000.00
Cost to re-treat equivalent of whole river five times over 25 years	$3,375,000.00
Cost of helicopter survey to re-map arundo over whole river	$400,000.00
RCD admin costs @ 20% of contractor cost	$755,000.00
Total cost for O&M	**$4,130,000.00**
Average annual cost (total cost/25 years)	**$165,200.00**

Capital and Annualized Costs

Multi-Benefit Stream Channel Improvement - Component 2 - Low Estimate

(Preliminary Cost Estimate)

SUMMARY					
Line No.	**Description**		**Units**		**Total**
1	Project Yield (high estimate)		acre-feet per year		20,880
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$14,536,943
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$1,100,000
7	Annual O&M Cost		$		$165,200
8	Total Annualized Cost		$		$1,265,200
9	Unit Cost		$/AFY		$60
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mowed arundo	700	Acres	$15,329	$10,730,328
11	Unmowed arundo	150	Acres	$10,907	$1,635,990
12	Hand-cut arundo	50	Acres	$43,413	$2,170,625
13	***Subtotal***				$14,536,943
OPERATIONS AND MAINTENANCE					
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
16	O&M Estmate	1	LS	$165,200	$165,200
17	***Total O&M Cost***				$165,200

NOTES:
1. "Project Yield" based on: Range of 6,000 to 36,000 AF, assumed an average of 20,000 AF
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: Phase I and Phase II.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.
7. "Annual O&M Cost" estimate based on average annual needs for on going monitoring and maintenance (checmical treatment every 3 to 5 years).

Capital and Annualized Costs

Multi-Benefit Stream Channel Improvement - Component 2 - High Estimate

(Preliminary Cost Estimate)

SUMMARY					
Line No.	**Description**		**Units**		**Total**
1	Project Yield (low estimate)		acre-feet per year		2,790
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$18,898,026
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$1,500,000
7	Annual O&M Cost		$		$165,200
8	Total Annualized Cost		$		$1,665,200
9	Unit Cost		$/AFY		$600
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mowed arundo	700	Acres	$19,928	$13,949,426
11	Unmowed arundo	150	Acres	$14,179	$2,126,787
12	Hand-cut arundo	50	Acres	$56,436	$2,821,813
13	***Subtotal***				$18,898,026
OPERATIONS AND MAINTENANCE					
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
16	O&M Estmate	1	LS	$165,200	$165,200
17	***Total O&M Cost***				$165,200

NOTES:
1. "Project Yield" based on: Range of 6,000 to 36,000 AF, assumed an average of 20,000 AF
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: Phase I and Phase II.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.
7. "Annual O&M Cost" estimate based on average annual needs for on going monitoring and maintenance (checmical treatment every 3 to 5 years).

Component 3

Capital and Annualized Costs
Multi-Benefit Stream Channel Improvements - Component 3
(Preliminary Opinion of Probable Cost)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		100
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$1,116,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$87,300
7	Annual O&M Cost		$		$6,000
8	Total Annualized Cost		$		$93,300
9	**Unit Cost**		$/AF		**$930**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$52,000	$52,000
11	Environmental and Stormwater	1	LS	$103,000	$103,000
12	Off-Stream Recharge Basin	8.5	AC	$48,500	$412,250
13	Land Acquisition	1	AC	$45,000	$45,000
14	*Subtotal*				$612,250
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
15	Construction Contingency			30%	$124,000
16	General Conditions			15%	$92,000
17	Contractor Overhead and Profit			15%	$92,000
18	Sales Tax			9.25%	$11,300
19	Engineering, Legal, Admininstrative, Contingencies			30%	$184,000
20	***Total Capital Cost***				$1,116,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
21	Detention Basin Maintenance	1	LS	$4,300	$4,300
22	Contingency			30%	$1,300
23	***Total O&M Cost***				$6,000

NOTES:
1. "Project Yield" based on: Assumed 100 acre-feet per year.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" includes land acquisition costs estimated for an area equivalent to 10% of required recharge basin area. Recharge basin unit cost assumes inclusion of site civil earthwork and access road improvements. Environmental and stormwater requirements are estimate at 15% of capital base costs for off-stream basins.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

Capital and Annualized Costs
Winter Releases from Reservoirs, with Aquifer Storage and Recovery in the 180/400-Foot Aquifer Subbasin
(Preliminary Cost Estimate)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		12,900
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$172,141,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$13,467,000
7	Annual O&M Cost		$		$5,223,000
8	Total Annualized Cost		$		$18,690,000
9	**Unit Cost**		$/AFY		**$1,450**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	180' Aquifer ASR Well Construction	8	EA	$765,000	$6,120,000
11	400' Aquifer ASR Well Construction	8	EA	$1,530,000	$12,240,000
12	Well Pumps, Motors, & Wellhead Infrastructure	16	EA	$440,000	$7,040,000
13	Electrical and Instrumentation	1	LS	$1,056,000	$1,056,000
14	Percolation Basins, Site Civil Work	16	25%	$191,300	$3,060,800
15	Land Access	21	AC	$45,000	$945,000
16	Distribution Pipeline (4 mile)	21,120	LF	$650	$13,728,000
17	Filtration and Disinfection System	1	LS	$70,000,000	$70,000,000
18	***SubTotal***				$114,189,800
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	General Conditions			15%	$17,128,500
20	Contractor Overhead and Profit			18%	$20,554,200
21	Sales Tax			8.75%	$9,991,600
22	Engineering, Legal, Admininstrative, Contingencies			20%	$6,851,400
23	Bonds and Insurance			3%	$3,425,700
24	***Total Capital Cost***				$172,141,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
25	Power	1	LS	$1,607,300	$1,607,300
26	Treatment	1	LS	$548,000	$548,000
27	Equipment Repair & Replacement	1	LS	$864,000	$864,000
28	Operations Labor	1	LS	$729,600	$729,600
29	Miscellaneous	1	LS	$603,900	$603,900
30	Contingency			20%	$870,600
31	***Total O&M Annual Cost***				$5,223,000

NOTES:
1. "Project Yield" based on: 49 CFS (22,000 GPM) and 36% facility up time, reflecting winter operation.
2. "Facility Life" selected based on 25-yr anticipated life of extraction wells.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" based on: construction of 8 ASR wells in the180-Foot Aquifer, 8 ASR wells in the 400-Foot Aquifer. Constrcution of a 23 MGD filtration/disinfection system for treating winter surface water flows prior to injection.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annual O&M Cost" includes well and treatment facilities.

M3 - Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse

Conceptual Cost Estimate
Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse
2,400 AFY 180/400 Foot Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Capital Costs (a)					
AWPF Facility Expansion					
AWPF Expansion Construction Cost	1	LS	$10,930,000	$ 10,930,000	Costs for a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018) based on a 30% design that was prepared. Costs were revised based on the increase in ENR CCI for San Francisco from February 2018 to October 2019 (approximately 2.9%) and then converted to a $/AF unit cost. This unit cost was used to estimate the cost of a 2,745 AFY expansion. Rounded up to the nearest $10,000.
Well Injection Facilities					
Mobilization and Demobilization	5	%	$16,983,216	$ 849,161	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assumed same as M1W project.
General Site Work and Piping	1	LS	$1,891,000	$ 1,891,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes shoring, SWPPP, and traffic control. Costs for items such as paving and site preparation are assumed to be the same as the M1W project, but pipelines are assumed to be smaller as described in Section 3.2 of TM 3.
Injection Well Installation and Testing	5	EA	$960,000	$ 4,800,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 560-foot borehole and 550-foot deep well. 130-feet of screen.
Production Well Installation and Testing	2	EA	$620,000	$ 1,240,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018) and similar recent projects. Assumes 560-foot borehole and 550-foot deep well. 130-feet of screen.
Site Work at Each Well Site	7	EA	$860,000	$ 6,020,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes site improvements, well pads and pedestals, well pumps, and site piping. For budgeting purposes, assume same sizes as M1W project
Monitoring Wells	4	EA	$100,000	$ 400,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 550-foot deep 4-inch monitoring well.
Backflush Basin and Associated Appurtenances	1	LS	$15,000	$ 15,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project (125-ft x 125-ft x 5-ft), and cut/fill can be balanced.
Electrical Building and Hydropneumatic Tank	1	LS	$77,216	$ 77,216	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
Electrical, Instrumentation, and Controls for Wells	1	LS	$2,360,000	$ 2,360,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project.
Other Site Work (i.e. landscaping, road maintenance during construction, etc.)	1	LS	$180,000	$ 180,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
Purified Recycled Water Pipeline					
Purified Recycled Water Pipeline from AWPF to Injection Wells	23,760	LF	$250	$ 5,940,000	Assume 4.5-mile pipeline from AWPF to injection wells. Assumed maximum flow of 2,900 GPM. 16-inch diameter pipeline at $12/in-diameter foot plus 30% for various appurtenances ($250/LF). Rounded up to the nearest $10,000.
			Total Direct Costs	*$ 34,702,377*	
Contingency on Infrastructure Costs	30	%	$34,702,377	$ 10,410,713	Based on a Class 5 level estimate for conceptual cost estimates (AACEI, 2019).
Contingecy for Electrical Connection with PG&E at Each Well Site	7	EA	$200,000	$ 1,400,000	Assumes $200,000 per well site for connection and routing power lines to site.
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, mitigation, etc.	30	%	$45,113,090	$ 13,533,927	Assumes 30% of capital costs
			Capital Costs Subtotal (rounded up to nearest $100,000)	**$ 60,100,000**	
			Annualized over 25 year period at 6% interest	**$ 4,701,426**	

Conceptual Cost Estimate
Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse
2,400 AFY 180/400 Foot Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Operating Costs					
Annual Operating Costs for AWPF, Injection wells, and Production Wells	1	LS	$ 2,400,000	$ 2,400,000	Costs for operation of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a $/AF unit cost and used to estimate the cost of a 2,745 AFY expansion. An additional 5% was also added to account for the operational cost of each new production well. Rounded up to the nearest $10,000.
Annual Overhead costs for AWPF, Injection wells, and Production Wells	1	LS	$ 410,000	$ 410,000	Costs for overhead of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a $/AF unit cost and used to estimate the cost of a 2,745 AFY expansion. An additional 5% was also added to account for the overhead cost of each new production well. Rounded up to the nearest $10,000.
Annual Energy Costs for Production Wells	1	LS	$ 300,000	$ 300,000	Energy costs are based on 200 HP pumps and an electricity price of $0.185/KWH. Energy costs for AWPF and injection wells are included in operating costs listed above. Rounded up to the nearest $10,000.
Annual Operating and Overhead Cost Subtotal				**$ 3,110,000**	

Total Costs		
Total Annualized Cost	**$ 7,820,000**	**per year over 25 years. Rounded up to nearest $10,000**
Total 30-Year Average Cost Per Acre-Foot (2,400 AFY)	**$ 3,300**	**per acre-foot. Rounded up to nearest $100**

Abbreviations:
AFY: acre feet per year
AWPF: advanced water purification facility
EA: each
ENR CCI: Engineering News-Record Construction Cost Index
gpm: gallons per minute
LF: lineal foot
LS: lump sum
M1W: Monterey One Water
MCWD: Marina Coast Water District

Notes
(a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

References
AACEI, 2019. *Recommended Practices and Standards* , Association for the Advancement of Cost Engineering International, March 2019 Update.
M1W, 2018, *Progress Report on Pure Water Monterey Expansion,* Monterey One Water, 10 May 2018.
Nellor et al, 2019, *Final Engineering Report, Pure Water Monterey Groundwater Replenishment Project* , Nellor Environmental Associates, Trussell Technologies, and Todd Groundwater, April 2019
SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2* , SCI Specialty Construction, May 2018.

Conceptual Cost Estimate
Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse
2,400 AFY Deep Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Capital Costs (a)					
AWPF Facility Expansion					
AWPF Expansion Construction Cost	1	LS	$10,930,000	$ 10,930,000	Costs for a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018) based on a 30% design that was prepared. Costs were revised based on the increase in ENR CCI for San Francisco from February 2018 to October 2019 (approximately 2.9%) and then converted to a $/AF unit cost. This unit cost was used to estimate the cost of a 2,745 AFY expansion. Rounded up to the nearest $10,000.
Well Injection Facilities					
Mobilization and Demobilization	5	%	$21,933,216	$ 1,096,661	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assumed same as M1W project.
General Site Work and Piping	1	LS	$1,421,000	$ 1,421,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes shoring, SWPPP, and traffic control.
Injection Well Installation and Testing	5	EA	$2,130,000	$ 10,650,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,510-foot borehole and 1,500-foot deep well. 270-feet of screen.
Production Well Installation and Testing	1	EA	$1,270,000	$ 1,270,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018) and similar recent projects. Assumes 1,510-foot borehole and 1,500-foot deep well. 130-feet of screen.
Site Work at Each Well Site	6	EA	$860,000	$ 5,160,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Includes site improvements, well pads and pedestals, well pumps, and site piping. For budgeting purposes, assume same sizes as M1W project
Monitoring Wells	4	EA	$200,000	$ 800,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,500-foot deep 4-inch monitoring well.
Backflush Basin and Associated Appurtenances	1	LS	$15,000	$ 15,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project (125-ft x 125-ft x 5-ft), and cut/fill can be balanced.
Electrical Building and Hydropneumatic Tank	1	LS	$77,216	$ 77,216	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
Electrical, Instrumentation, and Controls for Wells	1	LS	$2,360,000	$ 2,360,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Reduced by 40% due to half as many wells and one-quarter as many monitoring wells.
Other Site Work (i.e. landscaping, road maintenance during construction, etc.)	1	LS	$180,000	$ 180,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). For budgeting purposes, assume same size as M1W project
Purified Recycled Water Pipeline					
Purified Recycled Water Pipeline from AWPF to Injection Wells	18480	LF	$250	$ 4,620,000	Assume 3.5-mile pipeline from AWPF to injection wells. Assumed maximum flow of 2,900 GPM. 16-inch diameter pipeline at $12/in-diameter foot plus 30% for various appurtenances ($250/LF). Rounded up to the nearest $10,000.
			Total Direct Costs	*$ 38,579,877*	
Contingency on Infrastructure Costs	30	%	$38,579,877	$ 11,573,963	Based on a Class 5 level estimate for conceptual cost estimates (AACEI, 2019).
Contingecy for Electrical Connection with PG&E at Each Well Site	6	EA	$200,000	$ 1,200,000	Assumes $200,000 per well site for connection and routing power lines to site.
Soft Costs: Planning, Environmental, Permitting, Engineering, Legal, mitigation, etc.	30	%	$50,153,840	$ 15,046,152	Assumes 30% of capital costs
			Capital Costs Subtotal (rounded up to nearest $100,000)	**$ 66,400,000**	
			Annualized over 25 year period at 6% interest	**$ 5,194,254**	

Conceptual Cost Estimate
Project M3: Recycled Water Reuse Through Landscape Irrigation and Indirect Potable Reuse
2,400 AFY Deep Aquifer Injection Alternative

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Operating Costs					
Annual Operating Costs for AWPF, Injection wells, and Production Wells	1	LS	$ 2,400,000	$ 2,400,000	Costs for operation of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a $/AF unit cost and used to estimate the cost of a 2,145 AFY expansion. An additional 5% was also added to account for the operational cost of each new production well. Rounded up to the nearest $10,000.
Annual Overhead costs for AWPF, Injection wells, and Production Wells	1	LS	$ 410,000	$ 410,000	Costs for overhead of a 2,250 AFY expansion were presented in M1W Expansion Memo (M1W, 2018). Operating costs were converted to a $/AF unit cost and used to estimate the cost of a 2,145 AFY expansion. An additional 5% was also added to account for the overhead cost of each new production well. Rounded up to the nearest $10,000.
Annual Energy Costs for Production Wells	1	LS	$ 370,000	$ 370,000	Energy costs are based on 250 HP pumps and an electricity price of $0.185/KWH. Energy costs for AWPF and injection wells are included in operating costs listed above.
			Annual Operating and Overhead Cost Subtotal	**$ 3,180,000**	

Total Costs		
Total Annualized Cost	**$ 8,380,000**	**per year over 25 years. Rounded up to nearest $10,000**
Total 30-Year Average Cost Per Acre-Foot (2,400 AFY)	**$ 3,500**	**per acre-foot. Rounded up to nearest $100**

Abbreviations:
AFY: acre feet per year
AWPF: advanced water purification facility
EA: each
ENR CCI: Engineering News-Record Construction Cost Index
gpm: gallons per minute
LF: lineal foot
LS: lump sum
M1W: Monterey One Water
MCWD: Marina Coast Water District

Notes
(a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

References
AACEI, 2019. *Recommended Practices and Standards* , Association for the Advancement of Cost Engineering International, March 2019 Update.
M1W, 2018, *Progress Report on Pure Water Monterey Expansion,* Monterey One Water, 10 May 2018.
Nellor et al, 2019, *Final Engineering Report, Pure Water Monterey Groundwater Replenishment Project* , Nellor Environmental Associates, Trussell Technologies, and Todd Groundwater, April 2019
SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2* , SCI Specialty Construction, May 2018.

M4 - Monitoring Well(s)

Conceptual Cost Estimate
Project M4: Drill and Construct Monitoring Wells

Description	Quantity	Units	Unit Cost	Total	Basis for Cost
Capital Costs (a)					
400-Foot Aquifer Monitoring Wells	2	EA	$100,000	$ 200,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 550-foot deep 4-inch monitoring well.
Deep Aquifer Monitoring Wells	1	EA	$200,000	$ 200,000	Based on Pure Water Monterey Winning Bid Schedule (SCI, 2018). Assumes 1,500-foot deep 4-inch monitoring well.
			Total Direct Costs	*$ 400,000*	
Contingency on Infrastructure Costs	30	%	$400,000	$ 120,000	Based on a Class 5 level estimate for conceptual cost estimates (AACEI, 2019).
Geochemical Analysis of the Deep Aquifers	1	LS	$250,000	$ 250,000	Based on cost estimates for similar projects
Soft Costs: Planning, Permitting, Engineering, Legal, mitigation, etc.	30	%	$770,000	$ 231,000	Assumes 30% of capital costs
Capital Costs Subtotal (rounded up to nearest $100,000)				**$ 1,100,000**	

Abbreviations:
AFY: acre feet per year
EA: each
LS: lump sum
MCWD: Marina Coast Water District

Notes
(a) Increase for general conditions, contractor overhead and profit, and sales tax are included in capital unit costs and thus are not added separately.

References
AACEI, 2019. *Recommended Practices and Standards* , Association for the Advancement of Cost Engineering International, March 2019 Update.
SCI, 2018. *Schedule of Values for Pure Water Monterey, Injection Wells Ph2* , SCI Specialty Construction, May 2018.

C2 - Check Dams

Capital and Annualized Costs
Corral de Tierra - Project 3, Check Dams Along Streams
(Preliminary Opinion of Probable Cost)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		150
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$5,143,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$402,300
7	Annual O&M Cost		$		$22,000
8	Total Annualized Cost		$		$424,300
9	**Unit Cost**		$/AFY		**$2,830**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$110,000	$110,000
11	Environmental and Stormwater	1	LS	$319,000	$319,000
11	Earthwork/Site Preparation	1	LS	$379,000	$379,000
12	Channel Erosion Control Lining	1	LS	$57,000	$57,000
13	Rubber Dam	1	LS	$1,060,000	$1,060,000
14	Check Dam Support Building	625	SF	$150	$93,750
15	Electrical, I&C	1	LS	$288,000	$288,000
16	Land Acquisiton	10	AC	$64,000	$640,000
17	*Subtotal*				$2,946,750
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
18	Plumbing Appurtenance Contingency			30%	$346,000
19	General Conditions			15%	$442,000
20	Contractor Overhead and Profit			15%	$442,000
21	Sales Tax			9.25%	$81,800
22	Engineering, Legal, Admininstrative, Contingencies			30%	$884,000
23	***Total Capital Cost***				$5,143,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
24	Power	1	LS	$600	$600
25	Labor	1	LS	$9,600	$9,600
26	Equipment Repair & Replacement	1	LS	$5,200	$5,200
27	Miscellaneous Allowance	1	LS	$1,100	$1,100
28	Contingency			30%	$5,000
29	***Total O&M Cost***				$22,000

NOTES:
1. "Project Yield" based on: Assumed recharge of 150 AFY equivalent to 60% of the runoff volume from a 2-year, 24-hour event.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

C3 - Recharge from Surface Water DiversionS

Capital and Annualized Costs
Corral de Tierra - Project 1, Creek Diversion and Recharge
(Preliminary Opinion of Probable Cost)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		160
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$5,950,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$465,500
7	Annual O&M Cost		$		$26,000
8	Total Annualized Cost		$		$491,500
9	**Unit Cost**		$/AF		**$3,070**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$113,000	$113,000
11	Environmental and Stormwater	1	LS	$327,000	$327,000
11	Earthwork/Site Preparation	1	LS	$59,000	$59,000
12	Diversion Structure	1	LS	$140,000	$140,000
13	Pipeline	3200	LF	$250	$800,000
14	Storage Basin (10 AF)	0	LS	$177,000	$0
15	Pump Station	1	LS	$648,000	$648,000
16	Equipment and Control Building	625	SF	$150	$93,750
17	Injection and Monitoring Wells	0	LS	$2,051,000	$0
18	Electrical, I&C	1	LS	$185,000	$185,000
19	Land Acquisiton	15.7	AC	$64,000	$1,004,800
20	*Subtotal*				$3,370,550
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
21	Plumbing Appurtenance Contingency			30%	$463,000
22	General Conditions			15%	$506,000
23	Contractor Overhead and Profit			15%	$506,000
24	Sales Tax			9.25%	$93,500
25	Engineering, Legal, Admininstrative, Contingencies			30%	$1,011,000
26	***Total Capital Cost***				$5,950,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
27	Power	1	LS	$6,700	$6,700
28	Labor (Diversion Facilities, Basin)	1	LS	$3,200	$3,200
29	Equipment Repair & Replacement	1	LS	$4,000	$4,000
30	Miscellaneous Allowance	1	LS	$6,100	$6,100
31	Contingency			30%	$6,000
32	***Total O&M Cost***				$26,000

NOTES:
1. "Project Yield" based on: Analysis of USGS Gage Station 11152540 using the CA SWRCB's 90th Percentile/20% Method and applying a 0.67 reduciton factor for the assumed, upstream diversion site.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

C4 - Wastewater Recycling for Reuse

Capital and Annualized Costs
Monterey Basin - Project No. 8, Toro Park Water Reclamation
(Preliminary Opinion of Probable Cost)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		232
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$28,635,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$2,240,100
7	Annual O&M Cost		$		$486,000
8	Total Annualized Cost		$		$2,726,100
9	**Unit Cost**		$/AF		**$11,750**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$719,000	$719,000
11	Environmental and Stormwater	1	LS	$1,307,000	$1,307,000
12	Tertiary Treatment Plant	1	LS	$4,351,000	$4,351,000
13	Reclaimed Water Lift Station	1	LS	$345,000	$345,000
14	Treated Water Storage Tank	1	EA	$450,000	$450,000
15	Pipeline	30,900	LF	$250	$7,725,000
16	Electrical, I&C	1	LS	$199,000	$199,000
17	Land Acquisiton/Easements	1	LS	$211,000	$211,000
18	*Subtotal*				$15,307,000
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	Plumbing Appurtenance Contingency			30%	$3,861,000
20	General Conditions			15%	$2,296,000
21	Contractor Overhead and Profit			15%	$2,296,000
22	Sales Tax			9.25%	$283,200
23	Engineering, Legal, Admininstrative, Contingencies			30%	$4,592,000
24	***Total Capital Cost***				$28,635,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
25	Power	1	LS	$21,400	$21,400
26	Tertiary Plant Operations	1	LS	$30,300	$30,300
27	Labor (Tank, Pipeline, Pump Stations)	1	LS	$288,000	$288,000
28	Equipment Repair & Replacement	1	LS	$34,000	$34,000
29	Contingency			30%	$112,100
30	***Total O&M Cost***				$486,000

NOTES:
1. "Project Yield" based on: Beneficial reuse of treated wastwater flows to Toro Park WWTP, estimated at 232 AFY in Wallace Group memorandum, *Corral De Tierra Subarea Water and Wastewater Usage Analysis* (March 2021).
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

C7 - Increase Groundwater Production in the Upper Corral de Tierra Valley for Distribution to Lower Corral de Tierra Valley (Artesian Well)

Capital and Annualized Costs
Corral de Tierra - Project 2, Upper Corral de Tierra Artesian Well and Lower Corral de Tierra Recharge
(Preliminary Opinion of Probable Cost)

Line No.	Description		Units		Total
1	Project Yield		acre-feet per year		160
2	Facility Life		years		25
3	Interest Rate		%		6
4	Capital Cost		$		$13,275,000
5	Cost Recovery Factor		--		0.078
6	Annualized Capital Cost		$		$1,038,500
7	Annual O&M Cost		$		$9,000
8	Total Annualized Cost		$		$1,047,500
9	**Unit Cost**		$/AFY		**$6,550**
CAPITAL COSTS					
Line No.	**Capital**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
10	Mobilization/Demobilization	1	LS	$297,000	$297,000
11	Environmental and Stormwater	1	LS	$863,000	$863,000
11	Earthwork/Site Preparation	1	LS	$19,000	$19,000
12	Recharge Basin Inlet Structure	1	LS	$16,000	$16,000
13	Pipeline	20500	LF	$225	$4,612,500
14	Extraction Well	1	LS	$207,000	$207,000
15	Surge Tank	1	LS	$137,000	$137,000
16	Electrical, I&C	1	LS	$86,000	$86,000
17	Land Acquisiton	15.7	AC	$64,000	$1,004,800
18	*Subtotal*				$7,242,300
Line No.	**Markups**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
19	Plumbing Appurtenance Contingency			30%	$1,487,000
20	General Conditions			15%	$1,086,000
21	Contractor Overhead and Profit			15%	$1,086,000
22	Sales Tax			9.25%	$201,000
23	Engineering, Legal, Admininstrative, Contingencies			30%	$2,173,000
24	***Total Capital Cost***				$13,275,000
OPERATIONS AND MAINTENANCE					
Line No.	**Description**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
25	Power	1	LS	$0	$0
26	Labor (Well Facility, Recharege Basin)	1	LS	$4,000	$4,000
27	Equipment Repair & Replacement	1	LS	$2,500	$2,500
28	Miscellaneous Allowance	1	LS	$500	$500
29	Contingency			30%	$2,100
30	***Total O&M Cost***				$9,000

NOTES:
1. "Project Yield" based on: 100 gpm well capacity producing a mean of 160 AFY.
2. "Facility Life" selected based on 25-yr anticipated life of facilities.
3. "Interest Rate" selected within expected range for public-financing options.
4. "Capital Cost" excludes additional treatment costs.
5. "Cost Recovery Factor" based on anticipated Facility Life and Interest Rate.
6. "Annualized Capital Cost" based on facility life and interest rate.

Appendix 9-B

The 2016 Pure Water Delivery and Supply Project Agreement and the 2017 Amendment

Pure Water Delivery and Supply Project Agreement Between Monterey Regional Water Pollution Control Agency and Marina Coast Water District

MRWPCA

MARINA COAST WATER DISTRICT

Table of Contents

THIS **PURE WATER DELIVERY AND SUPPLY PROJECT** [hereinafter referred to as "Agreement"] is made this 8th day of April, 2016 ("Effective Date"), by and between Monterey Regional Water Pollution Control Agency ("PCA") and Marina Coast Water District ("MCWD"), hereinafter "Parties."

The PCA was formed as a California Joint Powers Agency by a Joint Exercise of Powers Agreement for the Monterey Regional Water Pollution Control Agency, effective June 29, 1979. The MCWD is a County Water District and political subdivision of the State of California, organized under Division 12, sections 30000 and following, of the California Water Code.

WITNESSETH

WHEREAS, the 1997 Fort Ord Base Reuse Plan (BRP) identifies the availability of water as a resource constraint and the BRP estimates that an additional 2,400 AFY of water is needed to augment the existing groundwater supply to achieve the permitted development level as reflected in the BRP (Volume 3, figure PFIP 2-7); and,

WHEREAS, the Fort Ord Reuse Authority ("FORA") transferred ownership of all of the then existing Fort Ord water and sewer facilities to the Marina Coast Water District ("MCWD") under the 1998 Water/Wastewater Facilities Agreement; title was transferred in 2001; and,

WHEREAS, under Section 3.2.2 of the 1998 Water/Wastewater Facilities Agreement, FORA has the responsibility to determine, in consultation with MCWD, what additional water and sewer facilities are necessary for MCWD's Ord Community service area in order to meet the BRP requirements, and that, once FORA determines that additional water supply and/or sewer conveyance capacity is needed, under Section 3.2.1, it is MCWD's responsibility to plan, design, and construct such additional water and sewer facilities. Section 7.1.2 requires FORA to insure that MCWD recovers all of its costs for the new facilities and their operation; and,

WHEREAS, in 2002, MCWD, in cooperation with FORA, initiated the Regional Urban Water Augmentation Project (RUWAP) to explore water supply alternatives to provide the additional 2,400 AFY of water supply needed under the BRP; and

WHEREAS, as a result of an extensive environmental review, FORA and MCWD agreed to adopt a modified Hybrid Alternative, which would provide 1,427 AFY of recycled water to the Ord Community without the need for seasonal storage, and this in turn resulted in the FORA Board adopting Resolution 07-10 (May 2007), which allocated that 1,427 AFY of RUWAP recycled water to its member agencies having land use jurisdiction; and

WHEREAS, in June 2009, PCA and MCWD entered into a 50-year RUWAP Memorandum of Understanding, in which, subject to certain conditions specified therein, (a) PCA committed 650 AFY of summer recycled water to MCWD for the Ord Community; (b) MCWD affirmed its separate commitment of 300 AFY of summer recycled water to the Ord Community; and (c) PCA and MCWD committed to supply 477 AFY of recycled water during other months to the Ord Community - for a total of 1,427 AFY; and

WHEREAS, MCWD has been and continues to work collaboratively with FORA and with the PCA to carry out MCWD's obligation to provide the 1,427 AFY of recycled water for the Ord Community; and

WHEREAS, on May 31, 2013, PCA commenced environmental review of its Pure Water Monterey Groundwater Replenishment Project ("Pure Water Monterey Project"). The Pure Water Monterey Project is a water supply project that would serve northern Monterey County by providing: (1) purified recycled water for recharge of a groundwater basin that serves as drinking water supply; and (2) recycled water to augment the existing Castroville Seawater Intrusion Project's agricultural irrigation supply. The Pure Water Monterey Project includes a pipeline to transport purified recycled water from a new Advanced Water Treatment Plant ("AWT") at PCA's Regional Treatment Plant to new Injection Well Facilities overlying the Seaside Groundwater Basin ("Product Water Conveyance Pipeline"). The Environmental Impact Report ("EIR") for the Pure Water Monterey Project evaluated two alternative alignments for the Product Water Conveyance Pipeline, a Coastal Alignment and an alignment that follows the right-of-way for the existing and future RUWAP pipeline ("RUWAP Alignment"). The Pure Water Monterey Project EIR identified the environmental effects of constructing the Product Water Conveyance Pipeline along the RUWAP Alignment, and operating the Product Water Conveyance Pipeline for the Pure Water Monterey Project; however the EIR recognized that shared use of a single Product Water Conveyance Pipeline for both the Pure Water Monterey Project and to supply recycled water to MCWD for the RUWAP would necessitate further review under the California Environmental Quality Act ("CEQA"). Shared use of a single Product Water Conveyance Pipeline would necessitate expansion of the Advanced Water Treatment Plant in order to purify the recycled water destined for the RUWAP because all water flowing in the shared pipeline must be purified; by contrast if water to serve the RUWAP were conveyed in its own separate pipeline only tertiary treatment would be needed; and

WHEREAS, on September 8, 2015, MWCD and PCA tentatively agreed to work together on the Pure Water Monterey Project; and

WHEREAS, on October 8, 2015, the PCA Board unanimously voted to certify the EIR for the Pure Water Monterey Project and to approve the Pure Water Monterey Project. The PCA Board selected the RUWAP Alignment for the Product Water Conveyance Pipeline.

WHEREAS, on October 9, 2015, the FORA Board unanimously voted to adopt a resolution to endorse the Pure Water Monterey Project as an acceptable option as the recycled component of the RUWAP and, as part of the Pure Water Monterey Project implementation, the FORA Board will review and consider project component costs and scheduling through annual consideration of the FORA CIP and Ord Community Budgets.

NOW, THEREFORE, for and in reliance of the foregoing, the Parties hereby agree as follows:

DEFINITIONS

For the purposes of this Agreement, the following definitions are provided:

A. The term "Annexation Agreements" refers to the Annexation Agreement between MCWD and PCA dated April 25, 1989, and the Annexation Agreement between MCWD and WRA dated March 26, 1996. The individual Annexation Agreements are referenced herein by their respective dates.

B. The term "AWT" or "AWT Facilities" or "Advanced Water Treatment Facilities" means the Advanced Water Treatment facilities as shown in Exhibit B at the PCA Regional Treatment Plant for the Pure Water Monterey Project and includes the AWT-PCA, AWT Phase 1, and the AWT Phase 2. The AWT Facilities includes that segment of new pipeline shown on Exhibit B and located within the existing property lines of the Regional Treatment Plant property.

C. The term "AWT Capacity Entitlement" shall mean the entitlement to the plant treatment capacity of the AWT which a Party has the right to use under this Agreement.

D. The term "AWT-PCA" shall mean construction and operation of an advanced water treatment plant sized to produce 3,700 AFY of purified recycled water to deliver to the Seaside Groundwater Basin for the Pure Water Monterey Project as approved by the PCA Board in its Resolution Number 2015-24 on October 8, 2015 as part of the "Pure Water Monterey Project".

E. The term "AWT Phase 1" shall mean construction and operation of an expansion to the AWT-PCA to produce an additional 600 AFY of purified recycled water to deliver to the FORA land use jurisdiction members in addition to the 3,700 AFY of purified recycled water from the AWT-PCA to deliver to the Seaside Groundwater Basin, for a total production of purified recycled water of from the AWT Phase 1 of 4,300 AFY.

F. The term "AWT Phase 2" shall mean construction and operation of an expansion to the AWT-PCA to produce an additional 827 AFY for a total of 1,427 AFY of purified recycled water to deliver to the FORA land use jurisdiction members in addition to the 3,700 AFY of purified recycled water from the AWT-PCA to deliver to the Seaside Groundwater Basin, for a total production of purified recycled water from the AWT Phase 2 of 5,127 AFY.

G. The term "Drought Reserve" shall refer to storage of up to 1,000 acre-feet of water for potential use during a drought. During wet or normal water years, about 50% of the years, an additional 200 AFY may be conveyed through the Pipeline Facilities and injected in the winter months to develop the Drought Reserve, thereby increasing PCA's use of the Pipeline Facilities to 3,700 AFY.

H. The term "Existing Pipeline Facilities" shall be the existing recycled water pipeline (and appurtenances) constructed by MCWD and rights-of-ways, which will become part of the Product Water Conveyance Facilities as shown in Exhibit C.

I. The term "Injection Well Facilities" shall mean collectively the Injection Well Facilities, turnouts, diversions and lateral pipelines connected to and beyond the Product Water Conveyance Facilities as shown in Exhibit C.

J. The term "New Pipeline Facilities" shall mean the new recycled water pipeline sections (and appurtenances), booster plant, and rights-of-ways to convey purified recycled water as shown in Exhibit C which will become a part of the Product Water Conveyance Facilities. The beginning and ending points of the "New Pipeline Facilities" are shown in Exhibits A and C, respectively.

K. The term "Parties" or "Both Parties" shall mean MCWD and PCA and their respective Boards.

L. The term "Pipeline Facilities Entitlement" shall mean the entitlement to the capacity of the Pipeline Facilities which a Party has the right to use under this Agreement.

M. The term "Product Water Conveyance Facilities", "Pipeline Facilities", and "RUWAP Conveyance Facilities" shall mean collectively the New Pipeline Facilities and the Existing Pipeline Facilities as shown in Exhibits C.

N. The term "Pure Water Monterey Project" shall mean the full project that the PCA Board approved in its Resolution Number 2015-24 on October 8, 2015 including construction and operation of all source water facilities, Product Water Conveyance Facilities, AWT-PCA and other improvements to the Regional Treatment Plant, and Cal Am Distribution System Improvements described in such resolution and in the EIR for the Pure Water Monterey Project.

O. The term "Pure Water Delivery and Supply Project Facilities" or "Project Facilities" shall mean collectively the AWT and the Product Water Conveyance Pipeline Facilities, as generally shown in Exhibit A. The term "Project Facilities components" shall refer severally to the AWT Facilities and the Pipeline Facilities. The Pure Water Delivery and Supply Project Facilities, as defined by this Agreement is a subset of certain components of the Pure Water Monterey Project and RUWAP Recycled Water Project including expansion of the AWT to implement this Agreement.

P. The terms "reclaimed water", "reclaimed wastewater", and "recycled water" shall mean purified recycled water.

Q. The term "RUWAP Distribution Facilities" shall mean those facilities connected to the Product Water Conveyance Facilities, which will be used to distribute MCWD's recycled water to MCWD's customers. The RUWAP Distribution Facilities are not a Project Facilities component.

R. The term "RUWAP Recycled Project" shall mean the urban recycled water portion of the Regional Urban Water Augmentation Project (RUWAP) approved by the MCWD and FORA Boards. In 2002, MCWD, in cooperation with FORA, initiated the Regional Urban Water Augmentation Project (RUWAP) to explore water supply alternatives to provide an additional 2,400 AFY of water supply needed under the Base Reuse Plan. As a result of an extensive environmental review, FORA and MCWD agreed to adopt a modified Hybrid Alternative, which would provide 1,427 AFY of recycled water to the Ord Community without the need for seasonal storage, and this in turn resulted in the FORA Board adopting Resolution 07-10 (May 2007), which allocated that 1,427 AFY to its member agencies having land use jurisdiction. As a result of the Pure Water Monterey Project, the RUWAP Recycled Project includes MCWD's Pipeline Facilities Entitlement, the RUWAP Distribution Facilities, and MCWD's AWT Capacity Entitlement under this Agreement.

S. The term "Source Water Facilities" shall mean the diversion facilities as approved in the "Pure Water Monterey Project" by the PCA Board in its Resolution Number 2015-24 on October 8, 2015.

T. The term "summer months" shall mean the months of May, June, July, August, and September.

I. DESIGN, ENVIRONMENTAL, RIGHT-OF-WAY, AND CONSTRUCTION

1.01 California Environmental Quality Act Compliance and Other Conditions

(a) Conditions Precedent and Drop Dead Dates: Nothing in this Agreement, except Section 1.01 (b), shall be deemed to constitute a binding obligation on either Party unless and until all of the following have occurred first:

i. New Pipeline Facilities: MCWD must complete any necessary CEQA review for any change in the location of the New Pipeline Facilities as compared to the location of the pipeline facilities as shown the EIR for the Pure Water Monterey Project by October 31, 2016. Further, upon completion of any such CEQA review, before this Agreement can take effect, MCWD and PCA must approve the change in location of the New Pipeline Facilities. In conducting the CEQA review, MCWD reserves all of its rights, powers and discretion with regard to any such change in location in pipeline facilities. This includes the authority to adopt mitigation measures and/or an alternative project design, configuration, capacity or location in order to reduce any identified significant environmental impacts; the authority to deny the change in location of pipeline facilities based on any significant environmental impact that cannot be mitigated (in which case this Agreement shall not take effect); and the authority to approve the change in location of pipeline facilities notwithstanding any significant environmental impact that cannot be mitigated, if MCWD determines that these impacts are outweighed by the project's social, economic or other benefits. PCA similarly reserves all of its rights, powers and discretion under CEQA with regard to any decision by PCA on whether and how to approve any change in location in pipeline facilities.

ii. AWT: PCA must complete any necessary CEQA review for AWT Phase 1 and AWT Phase 2 by October 31, 2016. In conducting the CEQA review, PCA reserves all of its rights, powers and discretion with regard to the expansion of the AWT. This includes the authority to adopt mitigation measures and/or an alternative project design, configuration, capacity or location in order to reduce any identified significant environmental impacts; the authority to deny the expansion of the AWT based on any significant environmental impact that cannot be mitigated (in which case this Agreement shall not take effect); and the authority to approve the expansion of the AWT notwithstanding any significant environmental impact that cannot be mitigated, if PCA determines that these impacts are outweighed by the project's social, economic or other benefits. MCWD similarly reserves all of its rights, powers and discretion under CEQA with regard to any decision by MCWD on whether and how to approve any expansion of the AWT.

iii. There must be no CEQA lawsuits challenging any of the Parties' approvals with respect to any change in the location of the New Pipeline Facilities or with respect to the AWT Phase 1 or AWT Phase 2; if any such lawsuits are filed, all such lawsuits must be favorably resolved to the satisfaction of both PCA and MCWD.

iv. All necessary regulatory approvals must be obtained for the Pure Water Monterey Project, AWT, and the New Pipeline Facilities including regulatory approvals required for any change in the location of the New Pipeline Facilities as compared to the location evaluated in the EIR for the Pure Water Monterey Project by October 31, 2016.

v. Funding must be secured by December 31, 2016 for the Pure Water Monterey Project and the RUWAP Distribution Facilities, including for any change in the location of the New Pipeline Facilities as compared to the location evaluated in the EIR for the Pure Water Monterey Project, for AWT Phase 1, and for the CEQA work for AWT Phase 2; provided, however, that this funding is not required for the completed design and construction of AWT Phase 2 for the provisions of this Agreement to take effect with regard to implementation of Phase 1.

vi. All source water must be approved for the Pure Water Monterey Project, except for Lake El Estero and Tembladero Slough by October 31, 2016.

vii. All approvals must be obtained from the California Public Utilities Commission for the water purchase agreement under which Cal Am agrees to buy 3,500 acre-feet of water per year from the Pure Water Monterey Project by October 31, 2016.

(b) Key Dates and Conditions for Future Negotiations.

i. If the Division of Financial Services of the State Water Resource Control Board fails to approve PCA's SRF loan Initial Funding Agreement by October 31, 2016, then MCWD and PCA agree to negotiate in good faith alternatives for providing recycled water (tertiary or purified) for potential customers.

ii. If the Division of Financial Services of the State Water Resource Control Board approves PCA's initial funding agreement, then if the Division of Financial Services of the State Water Resource Control Board fails to approve MCWD's State Revolving Fund (SRF) loan Initial Funding Agreement and/or MCWD passes a Board resolution to discontinue work on the project by October 31, 2016, then MCWD shall transfer all work product (e.g. right-of-way, design, survey, environmental, bid documents, etc.) to PCA so PCA can continue progressing with the project. If the Division of Financial Services of the State Water Resource Control Board approves PCA's State Revolving Fund (SRF) Loan Final Funding Agreement but denies MCWD's State Revolving Fund (SRF) Loan Final Funding Agreement and MCWD does not identify alternate financing by December 31, 2016, MCWD shall transfer all work product to PCA for financing and constructing the New Pipeline Facilities.

a. PCA will pay MCWD for all project expenditures on any work products transferred (e.g. right-of-way, design, survey, environmental, and bid document development).

b. In the event that PCA assumes responsibility for the financing and construction of the product water conveyance facilities, MCWD would continue to maintain ownership of the Product Water Conveyance Facilities per 2.06 of this agreement, and would assume ownership upon satisfactory demonstration of no additional financial impact to PCA for providing the financing to construct the Product Water Conveyance Facilities.

iii. If the Division of Financial Services awards PCA an interest rate that is lower than the interest rate awarded to MCWD and MCWD does not receive grant or other funds that could be applied to the New Pipeline Facilities that would reduce PCA's share of the New Pipeline Facilities cost by approximately the same amount as the difference in cost from MCWD's higher interest rate, then MCWD and PCA agree to negotiate in good faith alternatives for financing and constructing the New Pipeline Facilities.

1.02 MCWD's Obligations.

MCWD will fulfill the following obligations relating to the New Pipeline Facilities:

(a) MCWD will be responsible for acquiring all rights-of-way needed for the New Pipeline Facilities.

(b) MCWD will conduct any necessary CEQA review for the New Pipeline Facilities.

(c) MCWD will complete the design and contract documents for the construction of the New Pipeline Facilities.

(d) MCWD will finance, construct, and install the New Pipeline Facilities in substantial conformity with designs and plans approved by the Parties in writing. MCWD will put the New Pipeline Facilities out to bid and administer the construction contract.

1.03. PCA's Obligations.

PCA will fulfill the following obligations relating to the AWT Facilities:

(a) PCA will conduct any necessary CEQA review for the AWT including Phase 1 and Phase 2.

(b) PCA will finance, construct, and install the AWT Phase 1, in substantial conformity with designs and plans approved by the Parties in writing. PCA will put the AWT Phase 1 out to bid, and administer the construction contract(s).

(c) PCA will complete the design and contract documents for the AWT Phase 1.

(d) PCA will provide, and MCWD shall have, an AWT Capacity Entitlement of 600 AFY of purified recycled water from the AWT Phase 1 facilities.

(e) PCA will provide, and MCWD shall have, an AWT Capacity Entitlement of an additional 827 AFY of purified recycled water from the AWT Phase 2 for a total AWT Capacity Entitlement in the AWT facilities of 1,427 AFY.

(f) Up until MCWD exercises its option for the AWT Phase 2 facilities, MCWD shall have the continuing right to 827 AFY of tertiary water as set forth in the Annexation Agreements and the 2009 RUWAP MOU (1,427 AFY less the 600 AFY of recycled water provided in the AWT Phase 1 facility). It is not intended or implied that this water would be used in the same pipeline as the advanced treated water.

1.04. Change Orders.

(a) Change orders must be approved in writing.

(b) Any change order or related set of change orders that increases the Pure Water Delivery and Supply Project Facilities cost by $100,000 or more shall require the written consent of both parties within 30 days of presentation.

(c) Any change order or related set of change orders that increases the Pure Water Delivery and Supply Project Facilities cost by less than $100,000 or that lowers the Pure Water Delivery and Supply Project Facilities cost may be approved by the party designated herein to administer the contract, without the consent of the other party, except that a copy of any proposed or executed change order shall promptly be provided to the other party as soon as it is available. The contract administrator party shall not split up change order work so that approval of the combined change order work by the other party is not required.

(d) Each party's contract administrator shall be authorized to give consent to change orders for that party. Neither party's consent to a change order will be unreasonably withheld or delayed.

(e) This Change Orders section shall apply separately to the AWT and Product Water Conveyance Facilities. This section shall no longer apply to a component of the Pure Water Delivery and Supply Project Facilities on the date that the parties agree in writing that that such component has been completed and is ready to be used.

1.05. Project Schedule Cooperation between agencies.

(a) Subject to the terms and conditions of this Agreement, PCA and MCWD shall work cooperatively and with diligence to obtain all permits, approvals, and financing to construct the Pure Water Delivery and Supply Project Facilities.

(b) Both parties will develop an implementation schedule. Representatives of the parties will meet on a monthly basis, or more often if necessary, in order to ensure that the Pure Water Delivery and Supply Project Facilities are proceeding according to the schedule and in conformity with this contract and the approved plans and designs. Each party will make every reasonable effort to fulfill its obligations in a timely manner to meet the projects milestones and deadlines.

1.06. Right to inspect.

(a) Each party shall have the right to inspect the Pure Water Delivery and Supply Project Facilities, while under construction and at any time thereafter during the term of this contract, upon the giving of reasonable advance notice to the party administering the construction contract. Such inspections may take place at any time during the day or night; however, night time inspections will not take place without at least one week's notice, except in case of emergency or by agreement between the parties.

(b) Each party shall have the sole right to direct the construction work that such party is responsible to implement and the work of each party's own employees. Each party's right to inspect is for the purpose of observation only and not for the purpose of supervision of the work observed.

1.07. Ocean Outfall.

Nothing in this Agreement changes past agreements between the Parties to meet and confer in good faith to evaluate the environmental, technical, managerial, and financial feasibility of a project to use the Regional Treatment Plant outfall to transport and discharge brine byproduct from a future water desalination facility.

II. PURE WATER DELIVERY AND SUPPLY PROJECT FACILITIES DESCRIPTION, OWNERSHIP, OPERATIONS, AND MAINTENANCE

2.01. Location and Description of the Pure Water Delivery and Supply Project Facilities.

The Pure Water Delivery and Supply Project Facilities are shown generally in Exhibit A, attached hereto and made a part hereof and consist of the following sections:

- AWT (Exhibit B)
- New Pipeline Facilities (Exhibit C)
- Existing Pipeline Facilities (Exhibit C)

2.02. AWT Phase 1

The AWT Phase 1 shall be sized to produce a minimum of 600 AFY of purified recycled water with the ability to produce a maximum day demand of 1.37 MGD for MCWD and in addition to produce a minimum of 3,700 AFY of purified recycled water with the ability to produce a maximum day demand of 4.0 MGD for the Pure Water Monterey Project.

2.03. Product Water Conveyance Facilities

(a) The New and Existing Pipeline Facilities will have a minimum total conveyance capacity of

5,127 AFY.

(b) PCA is prohibited from providing water to any customer within any MCWD service area through the use of any Pure Water Monterey Project Facility, either directly or through a third party, unless approved and authorized in writing by the MCWD Board of Directors. PCA agrees that it shall not authorize any third party to use any Pure Water Monterey Project Facility to serve water to any customer within any MCWD service area unless approved and authorized in writing by the MCWD Board of Directors.

2.04. Reserved

2.05. Future Expansion of Facilities (AWT Phase 2)

(a) Subject to Section 1.01 (a) conditions, PCA will provide upon a written request from MCWD an additional AWT Capacity Entitlement for MCWD of up to and including 827 AFY of purified recycled water under AWT Phase 2 for a total AWT Capacity Entitlement of 1,427 AFY. PCA will not unreasonably delay implementing the request.

(b) PCA will reserve physical space at the plant site and facilities for expanding the AWT should subsection (a) be triggered from time to time in the future.

(c) Should MCWD request expanding the AWT beyond the AWT Phase 1 while there is sufficient time and funding capacity to include the further expansion in the Clean Water State Revolving Fund loan for the Pure Water Monterey Project, the costs for the AWT Phase 2 will be subject to the cost sharing section of this Agreement.

(d) Subject to Section 2.05(b) above, PCA may expand the AWT and may construct additional reclamation facilities, at its sole cost and expense and without receiving the consent of MCWD, unless the Product Water Conveyance Facilities are disrupted or delivery of AWT water to MCWD is affected, then consent is required by MCWD in writing. Any increases in capacity and any additional reclamation facilities so constructed shall be used at PCA's discretion.

2.06. Ownership, Operation, and Maintenance of the Pure Water Delivery and Supply Project Facilities

(a) PCA will own, operate, and maintain the AWT.

(b) MCWD will own, operate and maintain the Product Water Conveyance Facilities. In addition, MCWD shall own a Pipeline Facilities Capacity Entitlement equal to 27.833% of the capacity of the Product Water Conveyance Facilities with a maximum annual use of 1,427 AFY during the initial term and any extended term of this Agreement. If and when the AWT Phase 2 is commercially operational and as shown on the table accompanying Section 3.02(b), the Parties recognize and agree that, during the summer months, MCWD's use of the Pipeline Facilities' capacity may exceed 27.833% of the instantaneous capacity and that MCWD is hereby authorized to exceed 27.833% during the summer months.

(c) PCA shall own a Pipeline Facilities Capacity Entitlement equal to 72.167% of the capacity of the Product Water Conveyance Facilities with a maximum annual use of 3,700 AFY during initial term and any extended term of this Agreement. Parties recognize and agree that, during the months of November through February, PCA's use of the Pipeline Facilities' capacity may exceed 72.167% of the instantaneous capacity and that PCA is hereby authorized to exceed 72.167% during those specific months.

(d) For the term of this Agreement, PCA shall maintain the AWT in good condition and repair and MCWD shall maintain the Product Water Conveyance Facilities in good condition and repair.

(e) Both parties agree to coordinate operations and to share/integrate SCADA and other operational tools as necessary to facilitate efficient and effective operations of the Pure Water Delivery and Supply Project Facilities.

2.07. Decision-making authority.

In order to provide for the smooth and efficient operation of the Pure Water Delivery and Supply Project Facilities, MCWD and PCA will have the full authority to make and implement decisions with regard to activities and expenditures for the operations, and maintenance of their respective Project Facilities component without prior approval of the other party. All such activities shall be within the scope of services for operations and maintenance. All such expenditures shall be funded with the respective parties operational and maintenance budgets and/or the replacement reserves.

2.08. Outside Contracts.

When either Party deems it more appropriate for an outside contractor to make repairs or perform maintenance, bids may be solicited for contracts to perform this work.

2.09. Permits and approvals.

Each Party shall be responsible for obtaining and complying with all permits and approvals for the Project Facilities component that such Party owns that are necessary to perform its work under this Agreement.

2.10. Safety and loss prevention program.

MCWD and PCA will jointly develop, maintain, and implement a safety and loss prevention program for the Pure Water Delivery and Supply Project Facilities, and will provide appropriate training for its employees working on the facilities. This program will conform to all requirements set forth in CAL OSHA's Process Safety Management Program and US EPA's Risk Management Program, and will be revised and updated as new regulations are promulgated. All costs associated with the program will be included in the annual budget process.

2.11. Access to facilities.

Both MCWD and PCA personnel shall be provided access rights to all Pure Water Delivery and Supply Project Facilities with adequate notice and staff availability/chaperone.

2.12. Pure Water Coordinating Committee.

(a) Within sixty days of the Effective Date of this Agreement, the parties shall establish and maintain a Pure Water Coordinating Committee which membership shall consist of at least one representative from each Party. A representative from each Party shall be the person who will be or who is responsible for the daily operations of a Pure Water Delivery and Supply Project Facilities component. The committee shall have access to and shall share all pertinent information in order to discuss and make recommendations for sustaining or improving the operations (including water quality), maintenance, and capital replacement efforts of the project.

(b) Any financial changes approved by the Pure Water Coordinating Committee at a Committee meeting that require a budget modification will be submitted to both Boards of Directors for approval of the necessary budget modifications.

2.13. Unanticipated events/Emergency situations

(a) Non-emergency circumstances or events may arise which were not anticipated in either the scopes of services or the budgets for the Pure Water Delivery and Supply Project Facilities. In this case, plans for addressing such circumstances or events, including justification and estimated amount of expenditures, will be submitted to the Pure Water Coordinating Committee for its review and recommendations. Before proceeding with those plans, each party must first give its written approval to incur any additional costs associated therewith consistent with the procurement policy of each agency.

(b) If the event or circumstance constitutes an emergency situation which threatens health and safety, damage to property, or injury to persons, the Party having operational control of the affected Pure Water Delivery and Supply Project Facilities component will act as promptly and as efficiently as possible to mitigate the situation without waiting for approval by the Pure Water Coordinating Committee. The Pure Water Coordinating Committee will be advised as soon as possible thereafter of the mitigating actions taken and of any further action that may be necessary.

III. DELIVERY OF PURIFIED RECYCLED WATER

3.01. Existing Allocations

(a) Subject to the terms and conditions described in this Agreement, PCA agrees to treat and provide an annual amount of purified recycled water from PCA's and MCWD's entitlements to assure delivery of the agreed water commitments to the RUWAP Recycled Project approved by the FORA Board of Directors and allocated to FORA land use jurisdiction members. Up to 1,762 AFY of source water would be made available from PCA to provide a net 1,427 AFY of purified recycled water taking into account the assumption of a 19% loss resulting from the advanced water treatment processes with the following limitations unless the FORA Board of Directors agrees to an allocation of less than 1,427 AFY of net purified recycled water:

i. As stated in the 1996 Annexation Agreement, up to a maximum of 300 AFY of source water will be treated for MCWD's use between the months of April and September.

ii. As stated in the 2009 RUWAP MOU, up to a maximum of 650 AFY of source water will be made available from PCA entitlements between the months of May and August for recycled water use.

iii. As per the 2009 RUWAP MOU, Section 3.1, the Parties agreed to meet and confer in good faith to evaluate the environmental, technical, managerial, and financial feasibility of a groundwater recovery replenishment project to inject and store recycled water.

iv. As stated in Section IV 1(d) of the Amended and Restated Water Recycling Agreement between PCA and Monterey County Water Resources Agency which was approved in November 2015, PCA is allocated 650 AF of water by Water Resources Agency during the months of May through August.

(b) The parties agree to commit to a process to determine the amount of MCWD's Fort Ord Water Rights. The process shall include MCWD, PCA, FORA, U.S. Army, and MCWRA meeting and discussing the various agreements, obtaining legal opinions as necessary, and drafting documentation to clarify each agency's opinion, agreement, or disagreement and next steps on this issue by January 31, 2017.

3.02 Demand Schedule.

(a) According to Section 3.01 and subject to Section 2.03 of this Agreement, PCA will provide MCWD with purified recycled water according to the following typical nonbinding Schedule for AWT Phase 1 (~600 AFY of product water):

Approximate Demand Schedule (Phase 1):

Month	Demand (AF)			Needed Supply (AF)
	Others	Golf Course	Total	
January	7	16	23	28
February	5	11	16	19
March	8	19	27	33
April	16	40	56	70
May	26	62	88	108
June	26	63	89	110
July	27	65	92	113
August	22	54	76	94
September	20	49	69	85
October	12	29	41	51
November	5	12	17	21
December	2	5	7	9
Total	175	425	600	741

(b) According to Section 3.01 and subject to Section 2.03 of this Agreement, PCA will provide MCWD with purified recycled water according to the following typical nonbinding Schedule for AWT Phase 2 project (ultimate build out of the AWT to the amount approved by the FORA Board of Directors pursuant to Resolution No. 07-10):

Approximate Demand Schedule (Phase 2):

Month	Demand (AF)			Needed Supply (AF)
	Others	Golf Course	Total	
January	38	16	54	66
February	26	11	37	46
March	45	19	64	79
April	94	40	134	166
May	146	62	208	257
June	149	63	212	261
July	153	65	218	269
August	127	54	181	224
Septembe	116	49	165	203
October	68	29	97	120
Novembe	28	12	40	50
Decembe	12	5	17	21
Total	1002	425	1427	1762

3.03 Water Quality.

All water produced and delivered to MCWD shall meet all applicable standards of quality prescribed by the State of California (including, but not limited to, the regulations promulgated by the State Health Department and set forth in the California Code of Regulations, Title 22), or by separate agreement of the parties, so that the water may be used for the purposes specified herein. The parties clarify their intent with regard to the required water quality and further agree that the AWT Facilities have been designed to produce purified recycled water for the injection and landscape irrigation and other authorized purposes. The Parties agree that the purified recycled water to be used for landscape irrigation and other authorized purposes shall be of the same water quality as the water used for injection.

3.04. Warranties.

PCA warrants that all water committed to MCWD pursuant to this Agreement shall be transferred to MCWD free and clear of all claims by any person or entity, except as otherwise specified.

3.05. Duty to monitor water quality; cessation in deliveries.

PCA will monitor the quality of water produced, in accordance with the Indirect Potable Reuse guidelines per the California Department of Drinking Water Title 22 Article 5.2 of the CCR.

3.06. Regulations to protect water quality.

PCA will, to the extent feasible, enact reasonable and appropriate regulations governing the kinds of wastes and other materials that may be discharged into the sewerage system, in order to protect the quality of water ultimately produced by the AWT.

3.07. Daily Operation.

The AWT will be in operation and will supply water to MCWD on a daily basis except for temporary periods of shut-down authorized by this Agreement or made necessary by circumstances beyond the control of PCA or MCWD.

3.08. Incidental Uses.

PCA may use such amounts of purified recycled water from the Pure Water Delivery and Supply Project Facilities as may be needed for the normal operation and maintenance of PCA's facilities, including, but not limited to, the backwash of injection wells.

3.09. Notice of temporary cessation of water deliveries.

PCA will give immediate notice to MCWD, by telephone and/or electronic communication to MCWD's General Manager, or to the person designated by the General Manager to receive such notices, with a prompt follow-up notice in writing, as soon as PCA becomes aware of the need to cease deliveries. In addition, whenever a cessation of deliveries occurs, PCA shall use every reasonable effort to restore service as soon as possible.

3.10. Interruptions of service.

(a) No work of construction, remodeling, renovation, replacement, repairs, addition, or expansion authorized under this Agreement and performed on the AWT or Injection Well Facilities shall, either before, during, or after such work, interfere with, interrupt, or reduce the delivery of advanced treated water to MCWD under this Agreement, except that minor interferences, interruptions, or reductions shall be allowed when necessary, unavoidable, or beyond the control of PCA.

(b) PCA shall schedule its planned maintenance activities on the AWT and the Injection Well Facilities to minimize interruption of distribution of purified recycled water. Unscheduled work to perform repairs or maintenance will be performed in the manner deemed by PCA to have the least impact on the supply of advanced treated water. In case of any interruption of service, PCA shall give notice in the same manner as required by this Agreement.

(c) MCWD shall schedule its planned capital replacement, maintenance activities, and lateral tie-in's to the Product Water Conveyance Facilities to minimize interruption of distribution of purified recycled water. Unscheduled work to perform repairs or maintenance will be performed in the manner deemed by MCWD to have the least impact on the distribution of purified recycled water. In case of any interruption of service on the Product Water Conveyance Facilities, MCWD shall give notice in the same manner as required by this Agreement.

IV. ESTIMATED COSTS, COST SHARING, FINANCING, AND BUDGETING

4.01. Estimated Costs of the Project

(a) The PCA submitted an SRF loan package in the amount of $113,000,000 of which $41,190,000 is for the Advanced Water Treatment Facilities. It is anticipated that project costs will be below this amount. MCWD submitted an SRF loan package in the amount of $35,000,000 which includes $22,600,000 for the RUWAP New Pipeline Facilities. It is also anticipated that project costs will be below this amount.

(b) The estimated construction costs and proportional share of the New Pipeline Facilities and AWT Phase 1 are presented below. The cost allocations for the Pipeline Facilities are based upon a MCWD maximum use of 1,427 AFY per year and a PCA maximum use of 3,700 AFY. If any maximum use amount is exceeded, then the Parties agree to recalculate the allocations for the Pipeline Facilities, to true up those capital costs back to the date of this Agreement, and to agree on a true up amount and payment schedule. The estimated annual debt service cost share is located in Exhibit E:

ESTIMATED CAPITAL COSTS	Total Amount	PCA Share	MCWD Share
New Pipeline Facilities	$ 22,600,000	$ 16,309,742 72.167%	$ 6,290,258 27.833%
AWT Phase 1	$ 41,184,636	$ 35,438,144 86.047%	$ 5,746,492 13.953%
Existing Pipeline Facilities	$ 1,389,000	$ 1,002,400 72.167%	$ 386,600 27.833%
TOTAL	$ 65,173,636	$ 52,185,008 80.071%	$ 12,988,628 19.929%

(c) Except for the $1,389,000 in Section 4.02 (a) (iii) for the Existing Pipeline Facilities, the Parties agree that all dollar amounts in this Agreement, including exhibits, are estimates and that this Agreement shall be amended from time to time to reflect the actual dollar amounts when known.

(d) Both Parties commit grant funds to the Project Facilities by the ratio of the costs of the Project Facilities to the total costs to each party for Project Facilities, Injection Facilities, RUWAP Distribution Facilities, and Source Water Facilities. Both Parties agrees to apply those grant funds towards the total capital costs of a Project Facilities component, to be allocated to each parties share of capital costs as defined in Section 4.02 (a). The following is an example:

PRODUCT CONVEYANCE FACILITIES AND RUWAP DISTRIBUTION FACILITIES

Total Project Cost	$35 Million
Transmission Line PCA 71% MCWD 29%	$23 Million $16.33 Million $ 6.67 Million
Distribution (ALL MCWD)	$12 Million
Capital Cost Split (Grant Distribution %)	PCA $16.33 Million (46.7%) MCWD $18.67 Million (53.3%)
Assume $17M in Grants	PCA $7,939,000 MCWD $9,061,000

AWT, DIVERSION, INJECTION FACILITIES

AWTF PCA 72.17% MCWD 27.83%	$40,000,000 $28,866,783 $11,133,216
Diversion PCA 100%	$947,765 + 5,649,339 ≈ $6,600,000
Injection PCA 100%	$10,668,000
Capital Distribution (Grant Distribution %)	
MCWD -AWTF	$11,133,216 (19.44%)
PCA AWTF+DIV+IND	$46,134,783 (80.56%)
TOTAL	$57,267,999
Assume $15M in Grants	PCA $12,084,000 MCWD $2,916,000

Total Project Costs	$92,267,999
Total Capital Cost Split PCA MCWD	 $62,464,783 $29,803,216
Total Assured Grants	$32,000,000
Grant Amounts PCA MCWD	 $20,023,000 $11,977,000

4.02. Cost Sharing: Capital and Replacement Costs

(a) Both parties will pay their share of all capital and replacement costs for the Project Facilities based on its percentage share of AWT Capacity Entitlement and/or Pipeline Facilities Capacity Entitlement as follows:

i. AWT Facilities: % of a party's AWT Capacity Entitlement in AFY to the total AWT Capacity Entitlement in AFY from both parties. For AWT Phase 1, PCA = 86.047% and MCWD = 13.953%. For AWT Phase 2, PCA = 72.167% and MCWD = 27.833%.

ii. New Pipeline Facilities: PCA = 72.167% and MCWD = 27.833%.

iii. Existing Pipeline Facilities: PCA = 72.167% and MCWD = 27.833%. The parties agree that the total value of MCWD's Existing Pipeline Facilities for purposes of this Agreement is $1,390,000. The parties agree that the annual payment to MCWD shall be equal to this total value amortized over a 30 year period.

4.03. Cost Sharing: Operations and Maintenance Costs

(a) Both parties will pay their share of all operations and maintenance costs for the Pure Water Delivery and Supply Project Facilities based on actual use of the facilities based on the following:

i. AWT Facilities: % of AFY produced vs total from both parties

ii. Product Water Conveyance Facilities: % AFY through pipeline vs total from both parties

iii. Operations and Maintenance costs include, but are not limited to, the following: Power, chemicals, a Party's own or contracted labor and services, parts, materials, supplies, insurance, engineering, financial, and legal services, and such other cost categories agreed to by the Parties.

4.04. Project Funding: Capital Costs

(a) PCA applied for a Clean Water SRF loan to pay for the entire capital costs of AWT which shall include all of the design, contract documents, rights-of-way acquisition, and all work to construct the AWT.

(b) MCWD applied for a Clean Water SRF loan to pay for the entire capital costs of the New Pipeline Facilities which shall include all of the design, contract document, rights-of-way acquisition, and CEQA work necessary, and all work to construct the New Pipeline Facilities.

4.05. Project Funding: Replacement and Renewal Reserves

(a) Each Agency shall establish a Replacement and Renewal Reserve Fund for the purpose of funding capital outlay projects on the Pure Water Delivery and Supply Project Facilities; assist in meeting any fiscal sustainability plan requirements for the Clean Water State Revolving Fund loans; and maintaining a proportional share of the State Revolving Fund loan's debt reserve requirement.

(b) Each agency shall allocate sufficient funds in their annual budget to contribute to each Replacement and Renewal Reserve Fund in accordance with the capital cost sharing section of this Agreement. PCA will retain the replacement funds for those facilities in which they own and operate. MCWD will retain the replacement funds for those facilities in which they own and operate. Unless otherwise stated in Clean Water State Revolving Fund agreements, the following depreciation schedule related to operational equipment shall be used as a basis to establish annual funding of replacement reserves:

Equipment Type	Useful Life (Years)
Replacement Electrical	30
Replacement Instrumentation	15
Replacement Pumps & Motors	20
Motorized sluice gates	30
Replacement Wells & Ozonators	20

(c) Two years prior to the completion of the thirty-year loan cycle, MCWD and PCA will develop a long-term Capital Improvement Plan, which includes establishing an appropriate level of Renewal and Replacement reserves. Any funds that are held in Reserves in excess of the Capital Improvement Plan will be refunded within ninety (90) days of the Plan's establishment.

4.06. Project Funding: Operations and Maintenance Costs

Each party shall place in their annual operating budget sufficient funds to pay for operations and maintenance according to the operations and maintenance cost sharing section of this Agreement.

Each party shall follow the recommended operation and maintenance schedules as suggested by the manufacturers throughout the initial term of this agreement.

4.07. Annual Budget Process.

Each year, in accordance with its normal budgeting schedule, both parties will adopt budgets sufficient to cover the capital, renewal, operation, and maintenance costs of their proportional share of the Pure Water Delivery and Supply Project Facilities.

4.08 Financial Obligations

Both Parties agree to pledge sufficient funds to meet their respective financial obligations under this Agreement by Board action.

V. PAYMENTS AND ACCOUNTING

5.01 Payment Schedule and Procedures.

(a) MCWD will make payments to PCA each year as follows:

i. Thirty (30) days before the date the PCA's annual payment on the Clean Water State Revolving Fund loan for the Pure Water Monterey Project is due, MCWD will pay an amount equal to MCWD's proportional share of capital costs (debt service) as provided in Exhibit E.

ii. By March 1 of each year, MCWD shall pay PCA the proportional share of the amortized replacement/renewal costs as identified in Exhibit E.

iii. On a monthly basis, PCA will bill MCWD for Operation and Maintenance costs on an acre foot rate basis and actual demand.

(a) PCA will make payments to MCWD each year as follows:

i. Thirty (30) days before the date the MCWD's annual payment on the Clean Water State Revolving Fund loan for the New Pipeline Facilities is due, PCA will pay an amount equal to PCA's proportional share of capital costs (debt service) as provided in Exhibit E.

ii. By March 1 of each year, PCA shall pay MCWD the proportional share of the amortized replacement/renewal costs of the New Pipeline Facilities as identified in Exhibit E.

iii. By June 30 of each year, PCA will pay an amount equal to PCA's proportional share of capital costs (debt service) for the construction of the Existing Pipeline Facilities funded by MCWD as provided in Exhibit E.

iv. By June 30 of each year, PCA will pay MCWD the proportional share of the amortized replacement/renewal costs of the Existing Pipeline Facilities as identified in Exhibit E.

v. On a monthly basis, MCWD will bill PCA for the Operation and Maintenance costs for the Product Water Conveyance Facilities on an acre foot rate basis and actual demand.

(b) At least thirty (30) days before capital or replacement payments are due, a request for payment shall be sent indicating the amount due, the date payment is due, and the nature of the payment.

(c) Payment requests for operation and maintenance costs will be billed monthly. The resulting payments will be due within thirty days of billing.

(d) Notwithstanding anything to the contrary contained herein, obligations to make payments shall be prioritized as follows, and the obligations in each category shall be subordinate to the obligations in each prior category, shall be on a parity with all other obligations in such category, and shall be senior to the obligations in each subsequent category:

i. Operation and maintenance

ii. Debt service on obligations incurred to finance the Pure Water Delivery and Supply Project Facilities and payments to any provider of credit enhancement for such obligations

iii. Replacement/renewal costs

(e) All requests for payment shall be promptly reviewed, approved for payment where such requests or portion thereof that are in conformity with this Agreement, and promptly submitted for payment. Disputed payment shall be resolved according to the Dispute Resolution Process in this Agreement.

5.02. Application of loan payments by PCA.

(a) All payments made by MCWD to PCA for the repayment of the Clean Water SRF loan shall be used for such repayment. Upon termination of any loan agreement, any unused funds retained by PCA shall be returned to MCWD within 60 days from the date of the approved PCA audit for the fiscal year in which the agreement was terminated.

(b) All payments made by PCA to MCWD for the repayment of the Clean Water SRF loan shall be used for such repayment. Upon termination of any loan agreement, any unused funds retained by MCWD shall be returned to PCA within 60 days from the date of the approved MCWD audit for the fiscal year in which the agreement was terminated.

5.03. Remedies for Delinquent Payments.

(a) If either party should fail to make any payment required under this Agreement for a period of ninety (90) days or more after the due date, then upon fifteen (15) days' written notice, the party that is owed may act to proportionally reduce the activities for which payment is due; provided that no such reduction shall take effect if Dispute Resolution has been invoked and the full amount of the payment has been paid under protest.

(b) In addition, if either party should fail to make any payment required under this Agreement for a period of ninety (90) days or more after the due date and Dispute Resolution has not been invoked, the party that is owed shall have the right to seek any appropriate judicial relief, at law or in equity, for such default. Such relief may include, but need not be limited to, damages and injunctive relief.

5.04 Allocations: Operations and Maintenance Rates

(a) Operations and Maintenance Rates: Based on electronic timesheets and indirectly through each Agency's Cost Allocation Plan, all costs associated with the new AWT Facilities will be allocated directly to PCA's Pure Water Monterey Fund and all costs associated with the Product Water Conveyance Facilities will be allocated directly to MCWD's RUWAP Conveyance Facilities Fund. Indirect costs and direct costs will be used in the development of PCA's and MCWD's Operation and Maintenance Rates. Each Agency's Operation and Maintenance rate will be subject to review and/or development of a third party consultant of the respective Agency's selection. PCA's Operation and Maintenance component of the rate will be consistent with rates provided to entities who utilize Advanced Treated Water.

(b) PCA and MCWD retain the right to transition from any cost allocation plan identified in 5.04 of this Agreement to a cost allocation model that is compliant with the Office of Management and Budget (OMB) Circular A-87 – Cost Principles for State, Local, and Indian Tribe Governments or a subsequent revision. Any cost allocation subject to this provision shall be accompanied by a Certificate of Cost Allocation Plan and be in compliance with Title 2 CFR, Part 200. All indirect costs charged to the Pure Water Monterey Fund and the RUWAP Conveyance Facilities Fund will be applied consistently with the results of this plan to ensure equity between costs centers and conformance with OMB standards.

5.05. Accounting system.

Both parties will maintain an accounting system that is in conformity with generally accepted accounting principles (GAAP) and will allow for the segregation and tracking of all Replacement/Renewal reserves associated with the Project Facilities. Indirect costs shall not be applied to Replacement/Renewal Reserve contributions.

5.06. Financial reports.

Both parties will provide an annual report of the proportional share of reserve funds retained for the purpose of renewing the Pure Water Delivery and Supply Project Facilities. This report will be provided by September 30 of each year; and include deposits made to the Repair/Renewal Reserve, proportional interest earned, and the proportional share of any replacement/renewal costs.

5.07. Annual audit.

The accounting for the Pure Water Delivery and Supply Project Facilities will be subject to both parties Annual Audit. The Replacement/Renewal Reserve funds will be classified as Restricted on both parties Comprehensive Annual Financial Statement (CAFR). This Restricted classification will remain in effect through the term of this agreement, unless there are any new Governmental Accounting Standards Board (GASB) pronouncements or auditor comments that require a change in classification. A copy of each parties CAFR will be provided to the other by January following the close of the prior fiscal year.

5.08. Right to inspect and audit records.

Both parties shall have the right to inspect the other's records pertaining to debt service payments associated with the Pure Water Delivery and Supply Project Facilities and contributions for Renewal/Replacement Reserves, upon reasonable advance notice. Both parties shall also have the right to audit the other's records pertaining to the Project Facilities and contributions for Renewal/Replacement Reserves, or to have them audited by an auditor selected by the other party at that party's sole cost and expense. Such audit may be performed at any time during regular business hours, upon the giving of reasonable advance notice.

5.09. Reimbursement for overcharge or undercharge.

If any there is audit shows that the incorrect application of replacement/renewal reserves, each agency will have 90 days to comply with the audit findings. If an undercharge or an overcharge has occurred in monthly demand billings, each agency will have 90 days to refund or pay the identified difference.

5.10. Claims for Stranded Costs

The parties agree to commit to a process to determine the amount of each parties' claims for stranded costs. The process shall include MCWD and PCA meeting and discussing the documentation to clarify each agency's opinion, agreement, or disagreement and next steps on this issue by March 31, 2017.

VI. INDEMNIFICATION.

6.01. Indemnification.

(a) PCA shall indemnify, defend, and hold harmless MCWD , its officers, agents, and employees, from and against any and all claims, liabilities, and losses whatsoever against MCWD (including damages to property and injuries to or death of persons, court costs, and reasonable attorneys' fees) occurring or resulting to any and all persons, firms or corporations furnishing or supplying work, services, materials, or supplies in connection with the performance of this Agreement, and from any and all claims, liabilities, and losses occurring or resulting to any person, firm, or corporation for damage, injury, or death arising out of or connected with the PCA's performance or non-performance of its obligations pursuant to this Agreement caused in whole or in part by any negligent act or omission or willful misconduct of PCA, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except to the extent caused by the negligence or willful misconduct of MCWD.

(b) MCWD shall indemnify, defend, and hold harmless PCA, its officers, agents, and employees, from and against any and all claims, liabilities, and losses whatsoever against PCA (including damages to property and injuries to or death of persons, court costs, and reasonable attorneys' fees) occurring or resulting to any and all persons, firms or corporations furnishing or supplying work, services, materials, or supplies in connection with the performance of this Agreement, and from any and all claims, liabilities, and losses occurring or resulting to any person, firm, or corporation for damage, injury, or death arising out of or connected with the MCWD's performance or non-performance of its obligations pursuant to this Agreement caused in whole or in part by any negligent act or omission or willful misconduct of MCWD, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except to the extent caused by the negligence or willful misconduct of PCA.

6.02. Procedure for Indemnification.

(a) If any legal or administrative proceedings are instituted, or any claim or demand is asserted, by any third party which may give rise to any damage, liability loss or cost or expense with respect to which either party has agreed to indemnify the other party in this contract, then the indemnified party shall give the indemnifying party written notice of the institution of such proceedings, or the assertion of such claim or demand, promptly after the indemnified party first becomes aware thereof. However, any failure by the indemnified party to give such notice on such prompt basis shall not affect any of its rights to indemnification hereunder unless such failure materially and adversely affects the ability of the indemnifying party to defend such proceeding.

(b) The indemnifying party shall have the right, at its option and at its own expense, to utilize counsel of its choice in connection with such proceeding, claim or demand, subject to the approval of the indemnified party, which approval shall not be unreasonably withheld or delayed. The indemnifying party shall also have the right to defend against, negotiate with respect to, settle or otherwise deal with such proceeding, claim or demand. However, no settlement of such proceeding, claim or demand shall be made without the prior written consent of the indemnified party, which consent shall not be unreasonably withheld or delayed. The indemnified party may participate in any such proceeding with counsel of its choice at its own expense.

(c) In the event, or to the extent, the indemnifying party elects not to, or fails to, defend such proceeding, claim or demand and the indemnified party defends against, settles or otherwise deals with any such proceeding, claim or demand, any settlement thereof may be made without the consent of the indemnifying party if it is given written notice of the material terms and conditions of such settlement at least ten days before a binding agreement with respect to such settlement is executed. However, nothing herein is intended to bar either party from submitting any dispute arising from this section to Dispute Resolution.

(d) Each of the parties agrees to cooperate fully with each other in connection with the defense, negotiation or settlement or any such proceeding, claim or demand.

6.03. Payment of indemnified claims.

The indemnifying party shall forthwith pay all of the sums owing to or on behalf of the indemnified party, upon the happening of any of the following events:

(a) Upon the rendition of a final judgment or award with respect to any proceeding described in Section 6.02, above, by a court, arbitration board or administrative agency of competent jurisdiction and upon the expiration of the time in which an appeal therefrom may be made; or

(b) Upon the making of a settlement of such proceeding, claim or demand; or

(c) Upon the parties' making of a mutually binding agreement with respect to each separate matter indemnified thereunder.

6.04. Contribution in the event of shared liability.

In the event any proceeding, claim or demand described in Section 6.01 is brought, in which allegations of fault are made against both the parties, the extent of indemnification shall be determined in accordance with the agreement of the parties, or, if there is no agreement, then in accordance with the findings of the court as to the relative contribution by each of the parties to the damage suffered by the party seeking indemnity with respect to such proceedings. If the court fails to make any such findings, then the matter shall be submitted to Dispute Resolution.

6.05. Exclusion from O&M costs.

Amounts payable by either party as indemnification shall not be included in the operations and maintenance costs of the Project.

VII. INSURANCE

7.01. General insurance requirements.

Without limiting either parties duty to indemnify, both parties shall maintain in effect throughout the term of this Agreement a policy or policies of insurance meeting the requirements hereinafter set forth. All such insurance required by this article shall meet the following requirements:

(a) Each policy shall be with a company authorized by law to transact insurance business in the State of California, and shall be written on an occurrence form unless such insurance is only available at a reasonable cost if written on a claims made form.

(b) Each policy shall provide that both parties shall be given notice in writing at least thirty days in advance of any change, cancellation or non-renewal thereof.

(c) Except with respect to workers compensation insurance, each policy shall provide an endorsement naming both parties and its officers, agents and employees as additional insureds, or additional insureds, as applicable, and shall further provide that such insurance is primary to any other insurance maintained by either party.

(d) Unless otherwise agreed by MCWD and PCA, if a party awards a contract for construction work for the Pure Water Delivery and Supply Project Facilities, that party shall require the general contractor to provide commercial general liability and motor vehicle liability insurance coverage at least equal to the coverages required under this Agreement and shall name both MCWD and PCA as an additional named insureds and shall further provide that such insurance is primary to any issuance maintained by MCWD or PCA.

7.02. Commercial general liability insurance.

(a) MCWD and PCA shall maintain (and be named insured under) commercial general liability insurance covering all operations under this Agreement, with such coverages as the parties may agree upon from time to time. Each party shall be named as an additional insured on the other party's commercial general liability coverage.

(b) Each party shall pay the annual cost of such insurance for the term of this Agreement. Such insurance costs shall be treated as an annual operation and maintenance cost for the AWT Facilities and the Product Water Conveyance Facilities. In addition, should this Agreement be terminated by the parties, the obligation to pay for such insurance regarding the Project shall be accordingly reduced.

7.03. Motor vehicle insurance.

Both parties shall maintain insurance covering all motor vehicles (including owned and non-owned) used in providing services under this Agreement, with a combined single limit of not less than $2,000,000.

7.04. Property insurance.

(a) PCA shall maintain insurance covering the AWT Facilities against loss or damage due to fire and other perils to the extent that such insurance is reasonably commercially available and within available funds for the Pure Water Monterey Project. MCWD shall maintain insurance covering the Product Water Conveyance Facilities against loss or damage due to fire and other perils to the extent that such insurance is reasonably commercially available and within available funds for the Project.

(b) Subject to Subsection (a) above, the amount of the insurance shall not be less than the then-current replacement cost of the applicable Pure Water Delivery and Supply Project Facilities, without depreciation. Insurance coverage for the Pure Water Delivery and Supply Project Facilities under this section shall be reviewed and approved by both parties, which shall not unreasonably withhold or delay its approval. Both parties shall provide each other with a copy of the insurance policy and shall give the other party thirty (30) days' advance notice of any cancellation or proposed change in the insurance required by this section, and any such change shall be subject to review and approval by the other party.

7.05. Workers' compensation insurance.

Each party shall maintain a workers' compensation plan covering all of its employees as required by Labor Code Sec 3700, either (a) through workers' compensation insurance issued by an insurance company, with coverage meeting the statutory limits and with a minimum of $100,000 per accident for employer's liability, or (b) through a plan of self-insurance certified by the State Director of Industrial Relations, with equivalent coverage. If either party elects to be self-insured, the certificate of insurance otherwise required by this Agreement shall be replaced with a consent to self-insure issued by the State Director of Industrial Relations.

7.06. Certificate of insurance.

Each party shall file certificates of insurance with the other party, showing that it has in effect the insurance required by this contract. Each party shall file a new or amended certificate promptly after any change is made in any insurance policy which would alter the information on the certificate then on file.

7.07. Self-insurance up to and including the first $1 million of liability.

Each party may elect to be self-insured or to participate in the self-insurance pool for up to and including the first $1 million of liability under any insurance required to be provide by it under this Agreement, provided the other party first gives its written consent, which will not be unreasonably withheld or delayed. The parties shall enter into a separate written memorandum of understanding specifying the proportionate amount or share of such self-insurance costs to be allowed and allocated as annual operation and maintenance costs for the Pure Water Delivery and Supply Project Facilities.

7.08. Insurance costs.

Except as otherwise specifically provided for in this Agreement, the parties agree to determine as part of the annual budget process what annual insurance costs are to be allowed and allocated as annual operation and maintenance costs for the Pure Water Delivery and Supply Project Facilities.

7.09. Periodic increases in coverage requirements.

Not more frequently than every five (5) years, if in the opinion of an insurance broker or consultant retained jointly by the parties, the amount of any insurance coverage required by this Agreement is not adequate, the party responsible for providing that insurance coverage shall increase the amount of the insurance coverage as required by the insurance broker or consultant.

7.10. Duty to apply insurance proceeds.

If either party recovers any insurance proceeds on account of loss or damage to any Project Facilities component, such proceeds shall be applied to repair or replace the damaged portion of that Project Facilities component, and not otherwise. If either party is self-insured and any loss or damage occurs that would have been covered by insurance otherwise required to be maintained by such party under this Agreement, then such party shall provide the funds that would have been recovered had the party been insured and shall apply the funds to repair or replace the damaged portion of the Project Facilities component.

7.11. Losses Caused by Third Parties.

If any Project Facilities component is damaged or destroyed or any other personal injury, death, property damage or economic loss is incurred relating to any Project Facilities component (collectively, "damage or loss") during the term of this Agreement, and excluding the amount of any such damage or loss covered in Section VI, Indemnification, then the responsible third party or parties shall be responsible for paying for any such damage or loss. If the funds or other consideration paid by either party pursuant to Section VI and by the third parties are insufficient to cover the total cost of the damage or loss, then the balance necessary to cover the total cost of the damage or loss shall be paid from the applicable reserve and, then to the extent the funds in the replacement reserve are inadequate, the balance will be allocated between the parties based upon the then Capital Cost allocation for the applicable Project Facilities component.

VIII. TERM OF AGREEMENT

8.01. Term of Agreement.
This Agreement shall become effective on the date hereinabove entered and terminate on December 31, 2055 unless extended in accordance with Section 8.02.

8.02. Automatic extension.
This Agreement shall be automatically renewed for an additional 10-year period (an "extended term") unless a party is in default under this Agreement or unless one party provides the other party with written notice to terminate this Agreement upon expiration of the initial term or of any extended term. Any such notice must be provided to the other party at least three (3) full years prior to the expiration of any extended term. Unless such notice is provided, the parties agree that there shall not be a limit on the number of extended terms.

8.03. Conditions of agreement during term.
All the terms of this Agreement shall remain in effect during any term, except as otherwise provided in this Agreement or as may be amended in writing which is signed by both parties.

8.04. Rights on Termination.
(a) Unless otherwise agreed upon in writing by the parties, upon any termination of this Agreement, MCWD shall have the continuing right to tertiary water as set forth in the Annexation Agreements and the 2009 RUWAP MOU. Except as provided in the Annexation Agreements and the 2009 RUWAP MOU, PCA shall provide facilities for treating the water beyond secondary treatment level at its sole cost and expense or through a cooperative agreement with MCWD or any other entity. Upon any termination of this Agreement, MCWD shall have the continuing right to receive the same quantity of tertiary treated water as MCWD was or would have been entitled to receive during any term of this Agreement so long as MCWD provides facilities at its sole cost and expense or through a cooperative agreement with PCA or any other entity for the delivery of such tertiary treated water and purified recycled water.

(b) MCWD's and PCA's respective rights to tertiary treated water in accordance with this Agreement shall also survive termination.

IX. DISPUTE RESOLUTION

9.01. Dispute resolution procedure.
If any dispute arises between the parties as to the proper interpretation or application of this Agreement and/or the proper operation of the facilities, the parties shall resolve the dispute in accordance with this Article.

9.02. Duty to meet and confer.
If any dispute under this Agreement arises, the parties shall first meet and confer, in an attempt to resolve the matter between themselves. Each party shall make all reasonable efforts to provide to the other party all the information that the party has in its possession that is relevant to the dispute, so that both parties will have ample information with which to reach a decision.

9.03. Mediation and Binding Arbitration.

(a) If the dispute is not resolved within sixty (60) days after the first meeting under Section 9.02, then either party may notify the other party that the notifying party elects to submit the dispute to mediation. If the other party agrees to submit the dispute to mediation, then the parties will jointly select a mediator. The terms of mediation shall be set by agreement of the parties and the mediator.

(b) If the dispute is not resolved by meeting and conferring, and mediation does not occur or is unsuccessful, the parties may agree to submit the matter to binding arbitration. In that event, the parties will jointly select a single arbitrator. If the parties are unable to agree on a single arbitrator, then the parties shall request the Presiding Judge of the Monterey County Superior Court to appoint an arbitrator who has proven experience in the subject matter of the dispute. Any person selected as an arbitrator shall be a qualified professional with expertise in the area that is the subject of the dispute, unless the parties otherwise agree. The cost of the arbitrator shall be shared equally between the parties. Unless otherwise agreed by the parties, the arbitration shall be conducted in accordance with the rules of the American Arbitration Association ("Rules"); provided that the arbitration does not have to be handled through the American Arbitration Association. . The parties agree that they will faithfully observe the Rules and will abide by and perform any award rendered by the arbitrator, and that a judgment of the court having jurisdiction may be entered on the award. Notwithstanding the Rules, discovery will be permitted and the provisions of the California Code of Civil Procedure Section 1283.05 are incorporated herein unless the parties agree otherwise. The parties hereby consent to the jurisdiction of the courts of Monterey County for the confirmation, correction or vacation of any arbitration award. The arbitrator may grant any remedy or relief deemed by the arbitrator just and equitable under the circumstances, whether or not such relief could be awarded in a court of law. The arbitrator will have no power to award punitive damages or other damages not measured by the party's actual damages against any party. This limitation of the arbitrator's powers under this Agreement shall not operate as an exclusion of the issue of punitive damages from this Agreement to arbitrate sufficient to vest jurisdiction in a court with respect to that issue. The arbitrator's award will be deemed final, conclusive and binding to the fullest extent allowed by California law, and may be entered as a final judgment in court.

X. GENERAL PROVISIONS

10.01. Compliance with laws.
Both parties will comply with all permit and licensing requirements applicable to the project, and will operate the project in accordance with all requirements of law and governmental regulations.

10.02. Attorney's fees.
If either party commences an action against the other party arising out of or in connection with this Agreement, the prevailing party shall be entitled to have and recover from the losing party reasonable attorneys' fees and costs.

10.03. Amendments.
No amendment or modification shall be made to this Agreement, except in writing, approved by the respective Boards and duly signed by both parties.

10.04. Contract administrators.
(a) MCWD hereby designates its General Manager as its contract administrator for this Agreement. All matters concerning this Agreement which are within the responsibility of MCWD shall be under the direction of or shall be submitted to the General Manager or such other MCWD employee in the MCWD as the General Manager may appoint. MCWD may, in its sole discretion, change its designation of the contract administrator and shall promptly give written notice to PCA of any such change.

(b) PCA hereby designates its General Manager as its contract administrator for this Agreement. All matters concerning this Agreement which are within the responsibility of PCA shall be under the direction of or shall be submitted to the General Manager or such other PCA employee in the PCA as the General Manager may appoint. PCA may, in its sole discretion, change its designation of the contract administrator and shall promptly give written notice to MCWD of any such change.

10.05. Assignment.
Any assignment of this Agreement shall be void without the written consent of the non-assigning party, except that PCA shall have the right to assign all of its rights and obligations under this Agreement to a local governmental agency created by PCA for the sole purpose of assuming and performing all rights and obligations of PCA under the Pure Water Monterey Project and except that MCWD shall have the right to assign all of its rights and obligations under this Agreement to a local governmental agency created by MCWD for the sole purpose of assuming and performing all rights and obligations of MCWD under this Agreement; provided that in either case the local governmental agency assignee shall have adequate financial assets to insure its performance of all assigned obligations.

10.06. No Modification of MCWD Contract Entitlement.
Nothing in this Agreement is intended to, nor shall it be interpreted to, expand, limit or otherwise modify MCWD's existing contractual rights, entitlements, and obligations pursuant to either of the Annexation Agreements or the 2009 RUWAP MOU.

10.07. Negotiated Agreement.
This Agreement has been arrived at through negotiation between the parties. Neither party is to be deemed the party which prepared this Agreement within the meaning of Civil Code Sec. 1654.

10.08. Time is of essence.
Time is of the essence of this Agreement.

10.09. Headings.
The article and paragraph headings are for convenience only and shall not be used to limit or interpret the terms of this Agreement.

10.10. Entire Agreement.
This written Agreement, together with all exhibits attached hereto and incorporated by reference, is the complete and exclusive statement of the mutual understanding of the parties, except to the extent that this Agreement expressly refers to or requires the preparation of additional agreements. Any such additional agreement shall be in writing.

10.11. Notices.
All notices and demands required under this Agreement shall be deemed given by one party when delivered personally to the principal office of the other party; when faxed to the other party, to the fax number provided by the receiving party; or five days after the document is placed in the US mail, certified mail and return receipt requested, addressed to the other party as follows:

To PCA:

General Manager
MRWPCA
5 Harris Court, Building D
Monterey, CA 93940
Fax: (831) 372-6178

To MCWD:

General Manager
MCWD
11 Reservation Road
Marina, CA 93933
Fax: (831) 883-5995

10.12. Execution of documents.
(a) The parties will execute all documents necessary to complete their performance under this Agreement.

10.13. Exhibits.
(a) The following exhibits are attached to this Agreement:

Exhibit A: Pure Water Delivery and Supply Facilities

Exhibit B: AWT Facilities

Exhibit C: Product Water Conveyance Facilities

Exhibit D: Reserved

Exhibit E: Summary of Estimated Costs- Phase 1 only

Exhibit F: Financial and Construction Responsibilities of the Project Components

Exhibit G: Important Project Agreement Dates

10.14. Severability.
If any one or more of the terms, provisions, covenants or conditions of this Agreement are to any extent declared invalid, unenforceable, void or voidable for any reason whatsoever by a court of competent jurisdiction, the finding or order or decree of which becomes final, the Parties agree to amend the terms in a reasonable manner to achieve the intention of the Parties without invalidity. If the terms cannot be amended thusly, the invalidity of one or several terms will not affect the validity of the Agreement as a whole, unless the invalid terms are of such essential importance to this Agreement that it can be reasonably assumed that the Parties would not have contracted this Agreement without the invalid terms. In such case, the Party affected may terminate this Agreement by written notice to the other Party without prejudice to the affected Party's rights in law or equity.

10.15. Waiver.
(a) No waiver of any right or obligation of any of the parties shall be effective unless in writing, specifying such waiver, executed by the party against whom such waiver is sought to be

enforced. A waiver by any of the parties of any of its rights under this Agreement on any occasion shall not be a bar to the exercise of the same right on any subsequent occasion or of any other right at any time.

10.16. Written Authorization.

(a) For any action by any party which requires written authorization from the other party, the written authorization shall be signed by authorizing party's General Manager, or the General Manager's written designee.

XII. EXECUTION

In witness whereof, the parties execute this Agreement as follows:

PCA	MCWD
Dated: 4/8/2016	Dated: 4.7.16
[signature]	[signature]
Board Chair, Board of Directors	President, Board of Directors
Approved as to form:	
Dated: 4/8/2016	Dated: April 7, 2016
[signature]	Roger K. Masuda
Counsel, PCA	Legal Counsel, MCWD

Exhibit A: Pure Water Delivery and Supply Facilities

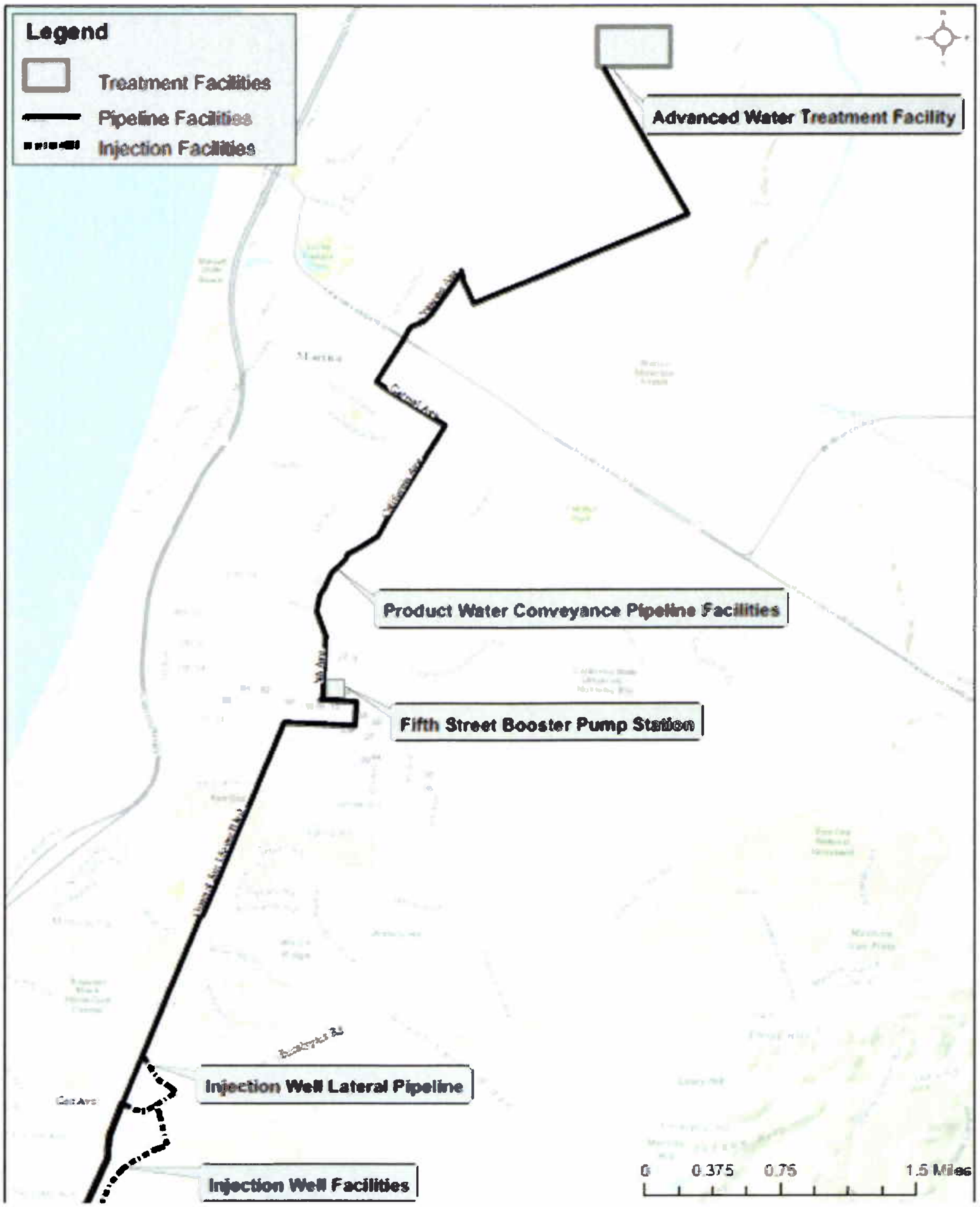
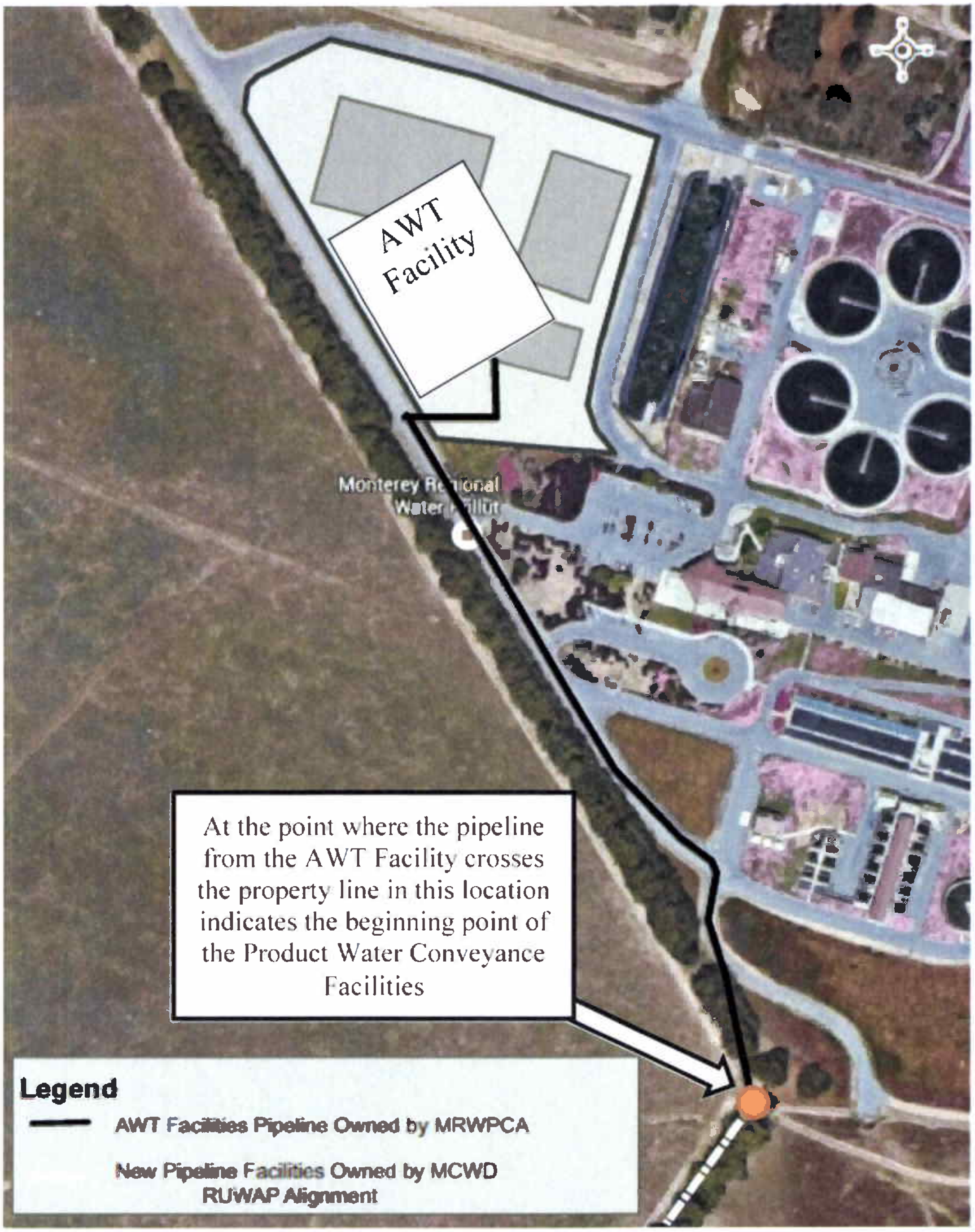


Exhibit B: AWT Facilities



Beginning of Product Water Conveyance Facilities

Exhibit C (page 1 of 2): Product Water Conveyance Facilities

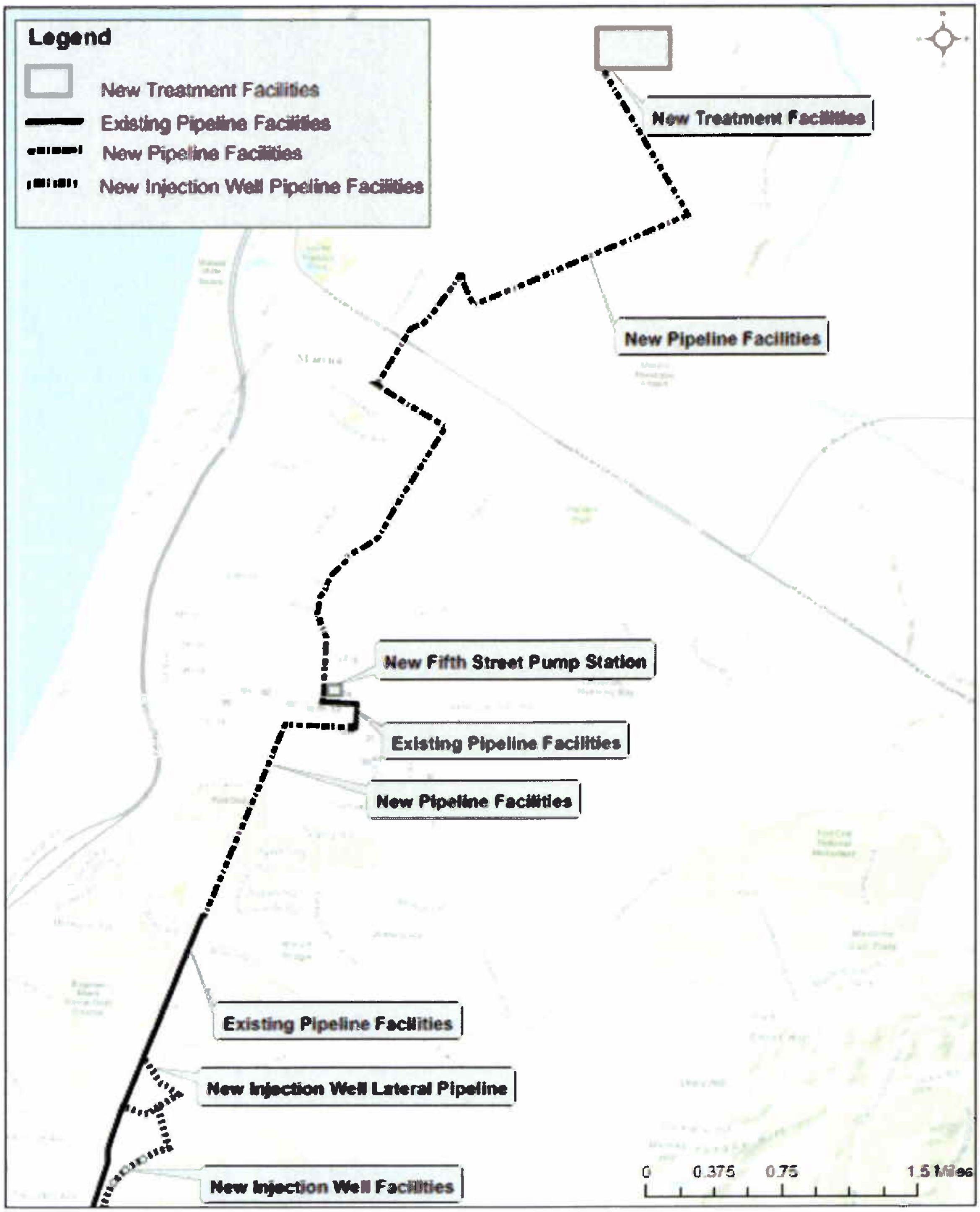
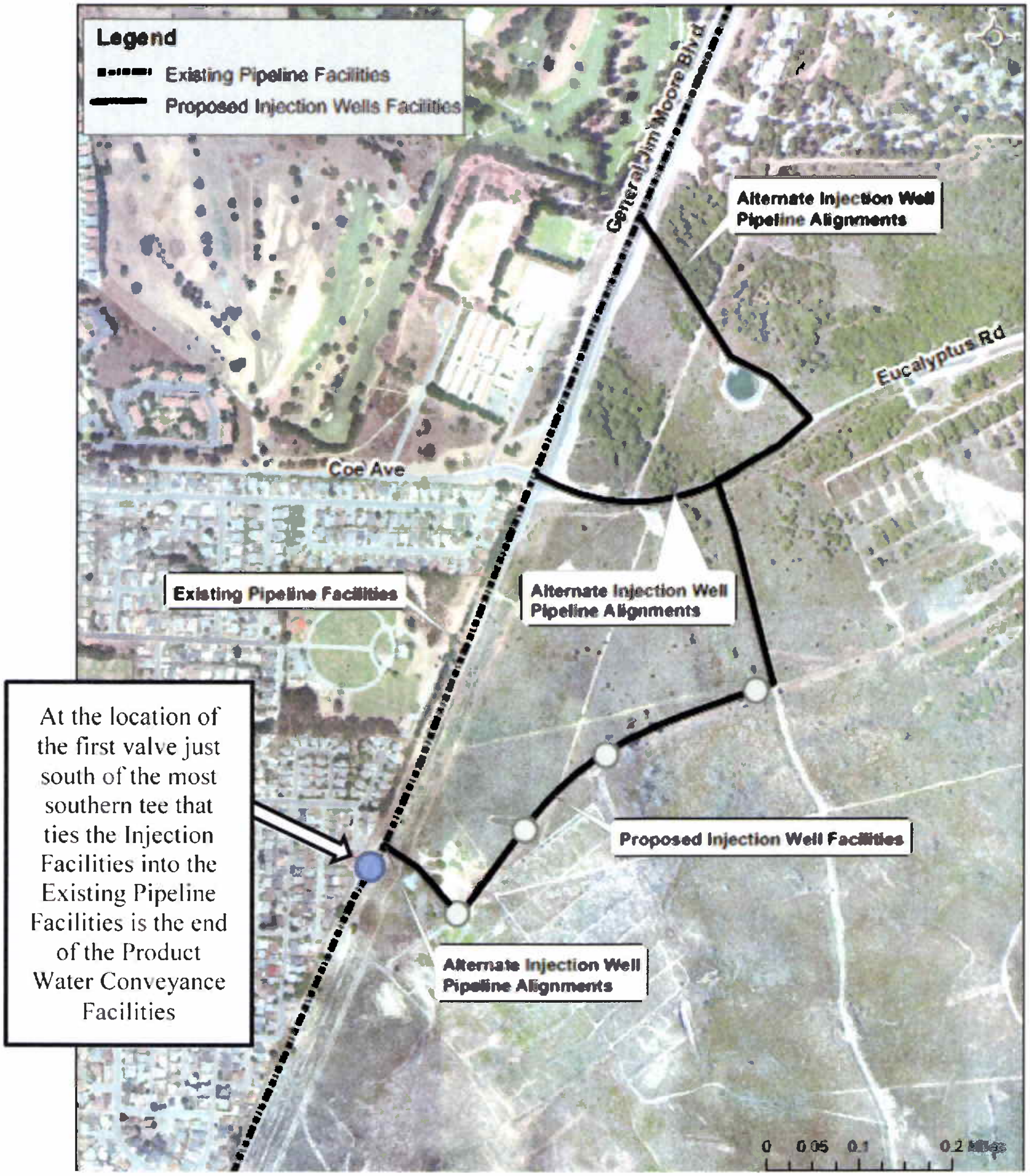


Exhibit C (page 2 of 2): Product Water Conveyance Facilities



End of Product Water Conveyance Facilities

Exhibit D: Reserved

Exhibit E: Summary of Estimated Costs-Phase 1 Only

(Note: This table does not include potential grant funds or other capital contributions that may be received and applied to the project that would reduce the overall costs for PCA and/or MCWD).

Est. Capital Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Total Amount
New Pipeline Facilities	72.167%	27.833%	$ 16,309,742	$ 6,290,258	$ 22,600,000
AWT Phase 1	86.047%	13.953%	$ 35,438,144	$ 5,746,492	$ 41,184,636
Existing Pipeline Facilities	72.167%	27.833%	$ 1,002,400	$ 386,600	$ 1,389,000
TOTAL	80.938%	19.062%	$ 52,750,285	$ 12,423,351	$ 65,173,636

Est. Annual Debt Service Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	$ 631,972	$ 243,736	$ 875,707
AWT Phase 1	86.047%	13.953%	$ 1,373,161	$ 222,666	$ 1,595,827
Existing Pipeline Facilities	72.167%	27.833%	$ 54,502	$ 21,020	$ 75,522
TOTAL	80.863%	19.137%	$ 2,059,635	$ 487,421	$ 2,547,056

Est. Annual OM Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	86.047%	13.953%	$ 146,054	$ 23,684	$ 169,738
AWT Phase 1	86.047%	13.953%	$ 2,480,409	$ 402,212	$ 2,882,621
Existing Pipeline Facilities	86.047%	13.953%	$ 4,595	$ 745	$ 5,340
TOTAL	86.047%	13.953%	$ 2,631,058	$ 426,641	$ 3,057,699

Est. Annual Renewal Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	$ 56,110	$ 21,640	$ 77,750
AWT Phase 1	86.047%	13.953%	$ 620,818	$ 100,669	$ 721,487
Existing Pipeline Facilities	72.167%	27.833%	$ 2,005	$ 773	$ 2,778
TOTAL	84.653%	15.347%	$ 678,933	$ 123,082	$ 802,015

Est Total Annual Costs		PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities		$ 834,136	$ 289,059	$ 1,123,195
AWT Phase 1		$ 4,474,388	$ 725,547	$ 5,199,935
Existing Pipeline Facilities		$ 61,102	$ 22,538	$ 83,640
TOTAL		$ 5,369,626	$ 1,037,145	$ 6,406,770

Est. Total Demands and Cost/AF	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
Phase 1 Demand	86.047%	13.953%	3,700	600	4,300
Total Cost/AF			$ 1,451	$ 1,729	$ 1,490

Note: New Pipeline Facilities includes the piping and pump station facilities.

Exhibit F: Financial and Construction Responsibilities of Project Components

Project Item	Who will perform the work and pay the initial invoices		How will costs be reconciled between MCWD and PCA
	MCWD	PCA	
New Pipeline Facilities CEQA	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Design	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Permits	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities Capital	X		PCA to reimburse MCWD based on Capital Cost Share %
New Pipeline Facilities O&M	X		PCA to reimburse MCWD based on OM Cost Share %
New Pipeline Facilities Renewal	X		PCA to reimburse MCWD based on Renewal Cost Share %
Existing Pipeline Facilities O&M	X		PCA to reimburse MCWD based on OM Cost Share %
Existing Pipeline Facilities Renewal	X		PCA to reimburse MCWD based on Renewal Cost Share %
RUWAP Distribution Facilities CEQA, Design, Permits, Capital, O&M, and Renewal	X		Not applicable.
AWT-PHASE 1 CEQA		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 Design		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 Permits		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT- PHASE 1 Capital		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 1 O&M		X	MCWD to reimburse PCA based on OM Cost Share %
AWT-PHASE 1 Renewal		X	MCWD to reimburse PCA based on Renewal Cost Share %
AWT-PHASE 2 CEQA		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Design		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Permits		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 Capital		X	MCWD to reimburse PCA based on Capital Cost Share %
AWT-PHASE 2 O&M		X	MCWD to reimburse PCA based on OM Cost Share %
AWT-PHASE 2 Renewal		X	MCWD to reimburse PCA based on Renewal Cost Share %
Injection Facilities CEQA, Design, Permits, Capital, O&M, and Renewal		X	Not applicable.

Exhibit G: Important Project Agreement Dates

Section 1.01 (a)	Milestone	Party	Key Date	Drop Dead Date
i	CEQA Approval-New Pipeline Facilities	MCWD		October 31, 2016
ii	CEQA Approval-AWT Phase 1 and AWT Phase 2	PCA		October 31, 2016
iii	No CEQA Lawsuits	BOTH		N/A
iv	Regulatory Approvals	PCA		October 31, 2016
v	SRF Funding Agreement	BOTH	October 31, 2016 Initial funding agreement	December 31, 2016 Final funding agreement
vi	Source waters approval	PCA		October 31, 2016
vii	CPUC approval	PCA		October 31, 2016

FIRST AMENDMENT TO

PURE WATER DELIVERY AND SUPPLY PROJECT AGREEMENT
BETWEEN MONTEREY REGIONAL WATER POLLUTION CONTROL AGENCY AND
MARINA COAST WATER DISTRICT

WHEREAS, on April 8, 2016, Marina Coast Water District (MCWD) and Monterey Regional Water Pollution Control Agency entered into the Pure Water Delivery and Supply Project Agreement (Agreement).

The parties agree to amend the Pure Water Delivery and Supply Project Agreement as follows:

1. Everywhere the term "Monterey Regional Water Pollution Control Agency" or "PCA" is used, substitute the term "Monterey One Water" and "M1W," respectively.

2. Delete Section 1.01 in its entirety. The Parties agree that this Amendment addresses all of the matters previously listed in Section 1.01.

3. Amend Section 1.03(a) as follows:

> M1W has already completed the necessary CEQA review for the use of AWT Phase 1 water for irrigation. MCWD intends to use its AWT Phase 1 water for irrigation; however, to the extent that any portion of MCWD's AWT Phase 1 water is to be used for injection, then any additional CEQA review necessary to address the use of that water for injection will be the responsibility of MCWD as described in Section 1.03(g) below.
>
> Because of the uncertainty resulting from the possibility that a portion of MCWD's AWT Phase 2 will be used for injection, details regarding Phase 2 implementation of MCWD's AWT Phase 2 water for injection will require a separate agreement or an amendment to this agreement based upon the existing terms of this agreement.

4. Add as a new Section 1.03(g) to read: M1W agrees that MCWD may use water delivered by this project, subject to the following conditions:

   1. The CEQA work completed and approved by the M1W Board in October, 2017 describes a MCWD project that applies this water for irrigation. Any change to that CEQA work, from irrigation to injection and sale shall be at the sole expense of MCWD and M1W shall not be responsible for any delays that any such change might cause in the timing of delivery of water for injection to MCWD.

   2. If MCWD elects to inject, it will be responsible for permitting at its injection site but M1W agrees to help by providing all of the work product it completed for its injection well project, e.g., engineering report for the drinking water permit, to MCWD for its use.

   3. M1W injection well field and infrastructure will not be used for MCWD injection unless and until there is a future separate agreement between the parties hereto.

   4. Any costs for a change from irrigation to injection, e.g. CEQA, engineering, permitting, test well construction, modeling, etc. shall be the sole responsibility of MCWD. To the extent that M1W agrees to do work to assist MCWD, MCWD agrees

to pay any such invoices to M1W within the time period for payment specified by the service provider.

5. FORA agrees to any such change in use from irrigation to injection and agrees to continue to fund the project as agreed to in 7 (d) (ii) of this amendment.

6. The portion of the 650 acre feet of summer delivery water that is not used by MCWD for AWT Phase 1 will be available for use by M1W. For AWT Phase 2, the entire amount of the 650 acre feet of summer delivery will be needed and used by MCWD and will no longer be available to M1W.

5. In Section 2.05(a), delete the words "Subject to Section 1.01(a) conditions" and substitute the following words, "Subject to Section 1.03(a)".

6. In Section 3.01(b), delete "January 31, 2017" and substitute "December 31, 2018".

7. Delete existing Section 4.01 in its entirety and replace with the following:

(a) Reserved.

(b) The estimated construction costs and proportional share of the New Pipeline Facilities and AWT Phase 1 are presented below (which also includes the Distribution, Diversion, and Injection Facilities to provide a total project cost perspective even though those are not part of the cost sharing). The cost allocations for the Pipeline Facilities are based upon a MCWD maximum use of 1,427 AFY and a M1W maximum use of 3,700 AFY. If any maximum use amount is exceeded, then the Parties agree to recalculate the allocations for the Pipeline Facilities, to true up those capital costs back to the date of this Agreement, and to agree on a true up amount and payment schedule.

	Costs (Millions)		
Capital Facility	M1W Share	MCWD Share	TOTAL
AWT Phase 1	$ 56.79	$ 9.21	$ 66.00
New Pipeline Facilities	$ 17.52	$ 10.28	$ 27.80
Existing Pipeline Facilities	$ 1.00	$ 0.39	$ 1.39
Diversion Facilities	$ 6.60	$ -	$ 6.60
Injection Facilities	$ 10.67	$ -	$ 10.67
Distribution Facilities	$ -	$ 11.50	$ 11.50
TOTAL	$ 92.58	$ 31.38	$ 123.96

(c) Except for the $1.39 million in Section 4.01(b) for the Existing Pipeline Facilities, the Parties agree that all dollar amounts in this Agreement, including exhibits, are estimates.

(d) Grants and Capital Contributions from Third Parties.

i. Unless otherwise agreed in writing by the Parties, each Party is only required to apply grant funds and capital contributions from third parties to cover that Party's cost share of the Pure Water Delivery and Supply Project Facilities.

ii. FORA Capital Contribution. FORA and MCWD entered into the Reimbursement Agreement for Advanced Water Treatment Phase 1 and Product Water Conveyance Facilities of the RUWAP Recycled Project dated September 6, 2016 (the FORA-MCWD Reimbursement Agreement"), pursuant to Sections 3.2.2 and 7.1.2 of the 1998 Water/Wastewater Facilities Agreement (the "1998 Agreement). If the FORA Board of Directors independently determines to provide $2.3 million to M1W for M1W's share of costs for the Project, then MCWD agrees to not object. M1W agrees to enter into a separate reimbursement agreement with FORA. M1W acknowledges FORA's obligations to MCWD under Section 7.1.2 of the 1998 Agreement. M1W agrees that it shall not be entitled to any additional funds allocated to MCWD by FORA for RUWAP and/or for Water Augmentation under the Base Reuse Plan; however, nothing herein is intended to prevent M1W from seeking additional funds directly from FORA.

8. Add the following new Subsections iv, v, and vi to Section 4.02(a):

iv. The transmission main turnouts, any other expense shown to be exclusively for the MCWD distribution system, and the potable water facility included in MCWD's transmission pipeline construction contract are considered to be a part of the Distribution System for cost sharing purposes (e.g. MCWD pays for 100% of the Distribution System costs).

v. The 2.0 million gallon recycled water reservoir included in MCWD's transmission pipeline construction contract is considered to be 25% for Injection Facilities (M1W) and 75% for Distribution Facilities (MCWD) and therefore the parties will split the cost of the recycled water reservoir along these percentages.

9. Substitute the following for Sections 4.04(b):

(b) MCWD applied for a Clean Water SRF loan to pay for its cost share of the Project Facilities except for its cost share of the AWT Phase 1 treatment plant facilities. MCWD AWT costs for Phase 1 will be included in the SRF loan referenced in Section 4.04(a) (included within M1W's SRF loan).

10. Section 5.01 has two subsections "(a)." The second subsection (a) should be re-lettered subsection (b) and the following subsections (b), (c), (d), and (e) shall be re-lettered (c), (d), (e), and (f), respectively. Subsection 5.01(b)(i) shall be deleted because M1W's SRF loan includes M1W's share of the New Pipeline Facilities.

11. Subsection 5.02(b) shall be deleted because M1W's SRF loan includes M1W's share of the New Pipeline Facilities.

12. In Section 5.10, Claims for Stranded Costs, delete "March 31, 2017" and substitute "December 31, 2018".

13. Delete the existing Exhibit A and substitute the attached new Exhibit A.

14. Delete the existing Exhibit B and substitute the attached new Exhibit B.

15. Delete the existing Exhibit C (2 pages) and substitute the attached new Exhibit C (2 pages).

16. Delete the existing Exhibit E and substitute the attached Exhibit E.

17. Delete the existing Exhibit G.

18. Except as set forth in this First Amendment, all the provisions of the Agreement shall remain unchanged and in full force and effect.

In witness whereof, the parties execute this First Amendment as follows:

M1W

Dated: 11/29/2017

Rudy Fischer

Board Chair, Board of Directors

MCWD

Dated: 12.18.17

[signature]

President, Board of Directors

Approved as to form:

Dated: 11/30/17

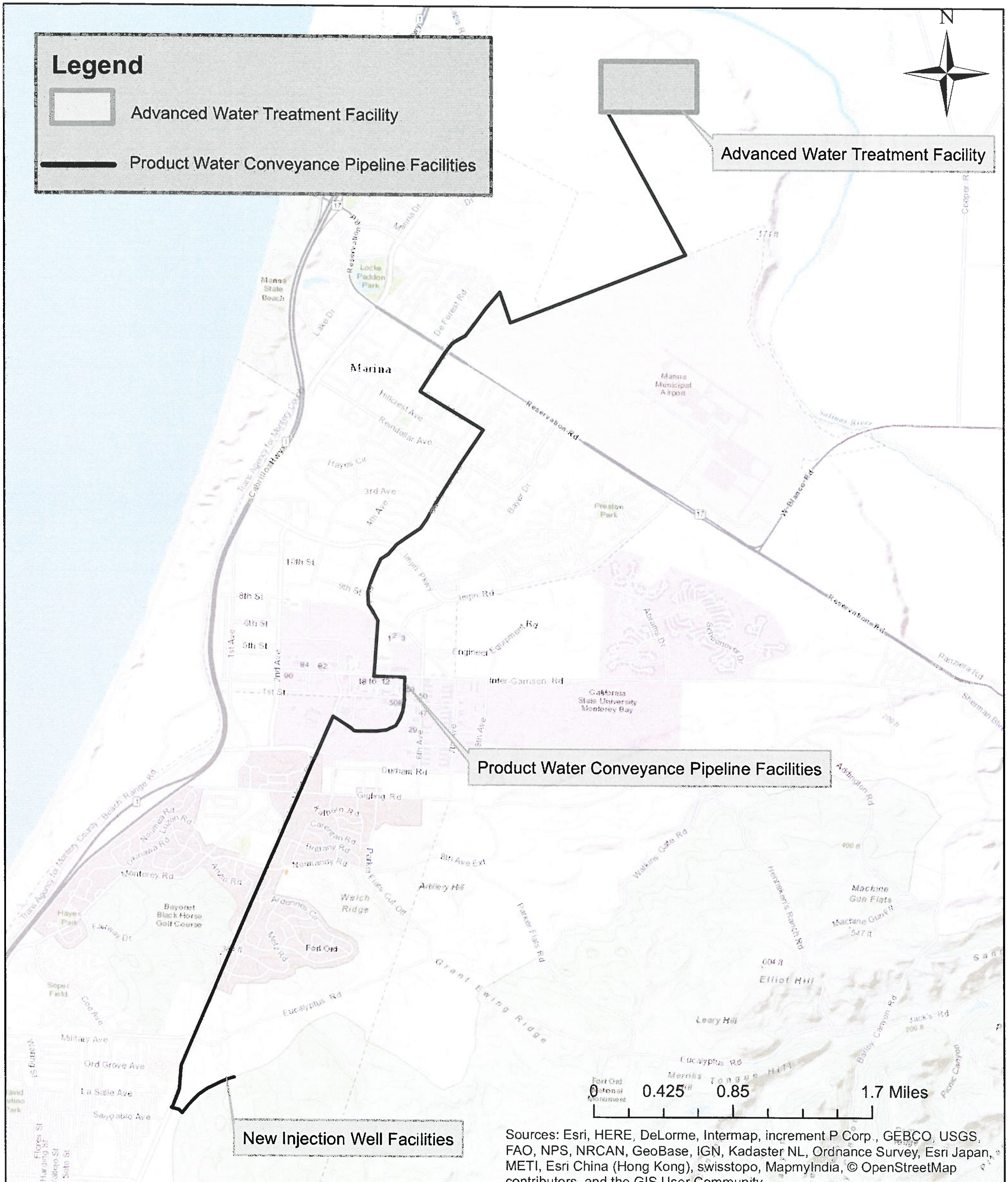
Robert R. Wellington

Counsel, M1W

Dated: 12/18/17

Roger K. Masuda

Legal Counsel, MCWD

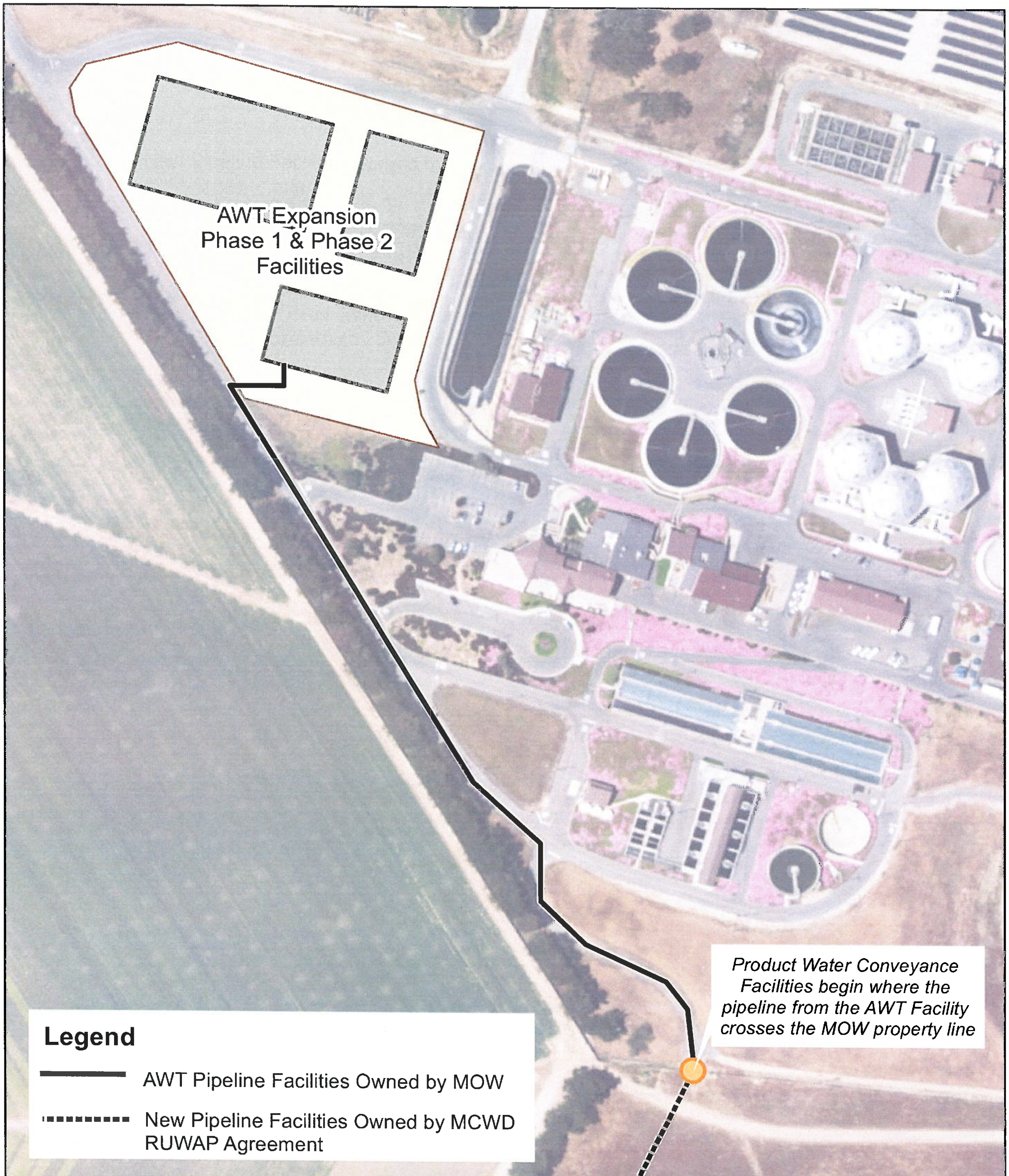


Marina Coast Water District
11 Reservation Road
Marina, CA 93933
mcwd.org

Exhibit A
Pure Water Delivery and Supply Facility

Drawn By: J.Hollida

Date: 10/16/2017



MARINA COAST WATER DISTRICT

Exhibit B

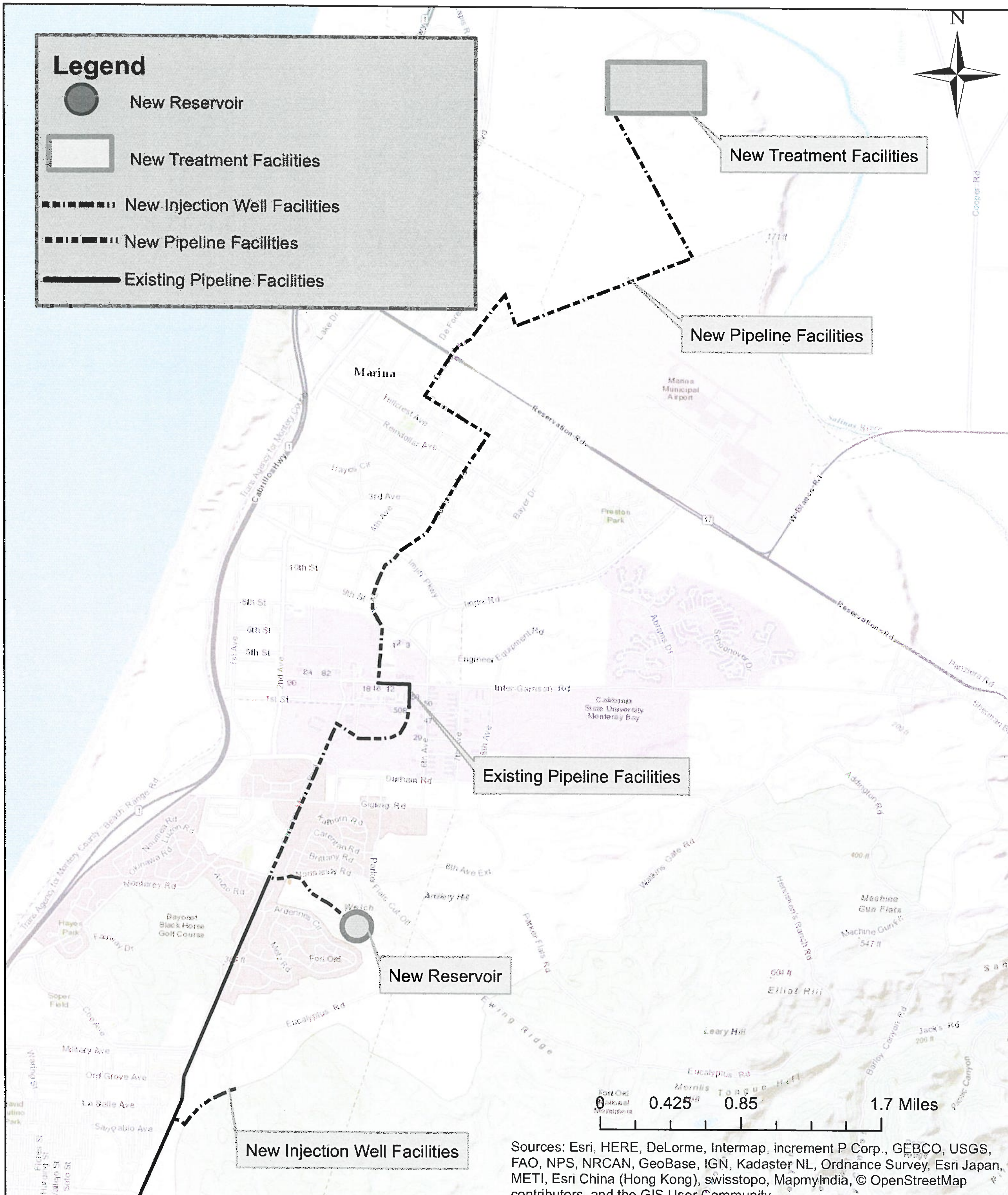
Advanced Water Treatment Facility
(Pure Water Monterey Project)
Recycled Water Delivery and Supply Project

N

0 100 200 Feet

1 inch = 200 feet

November 2017
Author: A. Racz

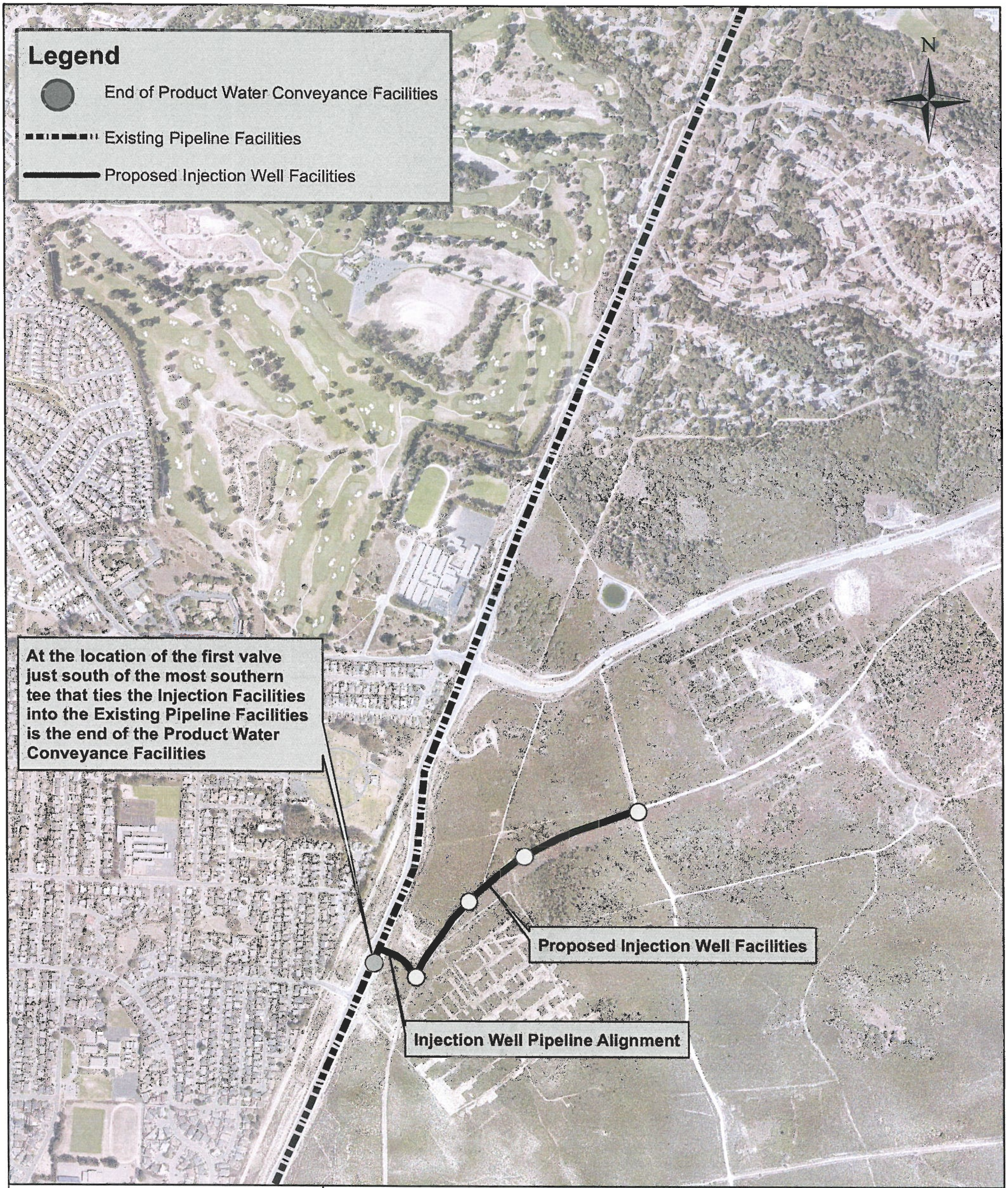


Marina Coast Water District
11 Reservation Road
Marina, CA 93933
mcwd.org

Exhibit C
Product Water Conveyance Facilities

Drawn By: J.Hollida

Date: 10/16/2017



Marina Coast Water District
11 Reservation Road
Marina, CA 93933
mcwd.org

Exhibit C
Product Water Conveyance Facilities

Drawn By:
J.Hollida

Date:
10/16/2017

Exhibit E: Summary of Estimated Costs-Phase 1 Only

Note: This table is only cost estimates, and does not include financing reductions from either grant funds or capital contributions.

Est. Capital Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Total Amount
New Pipeline Facilities	72.167%	27.833%	$ 16,537,790	$ 6,378,210	$ 22,916,000
RUWAP Distribution Facilities	0.000%	100.000%	$ -	$ 12,464,000	$ 12,464,000
Blackhorse Reservoir	25.000%	75.000%	$ 980,000	$ 2,940,000	$ 3,920,000
AWT Phase 1	86.047%	13.953%	$ 56,790,698	$ 9,209,302	$ 66,000,000
Diversion Facilities	100.000%	0.000%	$ 6,600,000	$ -	$ 6,600,000
Existing Pipeline Facilities	72.167%	27.833%	$ 1,002,400	$ 386,600	$ 1,389,000
Injection Well Facilities	100.000%	0.000%	$ 10,670,000	$ -	$ 10,670,000
TOTAL	74.687%	25.313%	$ 92,580,887	$ 31,378,113	$ 123,959,000

Est. Annual Debt Service Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	$ (640,808)	$ (277,015)	$ (917,823)
RUWAP Distribution Facilities	0.000%	100.000%	$ -	$ (541,329)	$ (541,329)
Blackhorse Reservoir	25.000%	75.000%	$ (37,973)	$ (127,688)	$ (165,662)
AWT Phase 1	86.047%	13.953%	$ (2,200,532)	$ (356,843)	$ (2,557,375)
Diversion Facilities	100.000%	0.000%	$ (255,738)	$ -	$ (255,738)
Existing Pipeline Facilities	72.167%	27.833%	$ (38,841)	$ (16,791)	$ (55,632)
Injection Well Facilities	100.000%	0.000%	$ (413,442)	$ -	$ (413,442)
TOTAL	73.106%	26.894%	$ (3,587,335)	$ (1,319,666)	$ (4,907,001)

Est. Annual OM Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	86.047%	13.953%	$ (146,054)	$ (23,684)	$ (169,738)
RUWAP Distribution Facilities	0.000%	100.000%	$ -	$ (75,000)	$ (75,000)
Blackhorse Reservoir	25.000%	75.000%	$ (6,250)	$ (18,750)	$ (25,000)
AWT Phase 1	86.047%	13.953%	$ (2,480,395)	$ (402,000)	$ (2,882,621)
Diversion Facilities	100.000%	0.000%	$ -	$ -	$ -
Existing Pipeline Facilities	86.047%	13.953%	$ (4,595)	$ (745)	$ (5,340)
Injection Well Facilities	100.000%	0.000%	$ -	$ -	$ -
TOTAL			$ (2,637,293)	$ (520,179)	$ (3,157,699)

Est. Annual Renewal Costs	PCA Share	MCWD Share	PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities	72.167%	27.833%	$ (165,378)	$ (63,782)	$ (229,160)
RUWAP Distribution Facilities	0.000%	100.000%	$ -	$ (124,640)	$ (124,640)
Blackhorse Reservoir	25.000%	75.000%	$ (9,800)	$ (29,400)	$ (39,200)
AWT Phase 1	86.047%	13.953%	$ (567,907)	$ (92,093)	$ (660,000)
Diversion Facilities	100.000%	0.000%	$ (66,000)	$ -	$ (66,000)
Existing Pipeline Facilities	72.167%	27.833%	$ (10,024)	$ (3,866)	$ (13,890)
Injection Well Facilities	100.000%	0.000%	$ (106,700)	$ -	$ (106,700)
TOTAL			$ (925,809)	$ (313,781)	$ (1,239,590)

Est Total Annual Costs		PCA Share	MCWD Share	Annual Amount
New Pipeline Facilities		$ (952,240)	$ (364,481)	$ (1,316,721)
RUWAP Distribution Facilities		$ -	$ (740,969)	$ (740,969)
Blackhorse Reservoir		$ (54,023)	$ (175,838)	$ (229,862)
AWT Phase 1		$ (5,248,834)	$ (850,936)	$ (6,099,996)
Diversion Facilities		$ (321,738)	$ -	$ (321,738)
Existing Pipeline Facilities		$ (53,460)	$ (21,402)	$ (74,862)
Injection Well Facilities		$ (520,142)	$ -	$ (520,142)
TOTAL		$ (7,150,437)	$ (2,153,627)	$ (9,304,290)

Key

Item in cost share agreement
Item not in cost share agreement