IntakeWorks

March 28, 2017

Marina Coast Water District
11 Reservation Road
Marina, California 93933

Attn: Mr. Keith Van Der Maaten
General Manager

Dear Mr. Van Der Maaten:

Subject: Monterey Peninsula Water Supply Project
Draft Environmental Impact Report/Environmental Impact Statement

Intake Works LLC has reviewed the Draft Environmental Impact Report/Environmental Impact Statement for the Monterey Peninsula Water Supply Project prepared for California Public Utilities Commission and the Monterey Bay National Marine Sanctuary (dated January 2017) and provides these comments regarding potential alternatives to the proposed MPWSP slant well intake system and desalination plant, as requested. As we previously informed you, our review of the DEIR/EIS was initially hampered by delays in receiving references cited in the DEIR/EIS and ultimately the lack of any references for most of the DEIR/EIS's conclusions regarding alternative intake technologies. Based on information provided in the DEIR/EIS and the limited reference materials cited in the document and appendices, the DEIR/EIS's conclusion that slant wells are the only potentially feasible subsurface intake system for the MPWSP is unsupportable. While we generally agree with the DEIR/EIS's conclusions regarding the unacceptable impacts of open water intakes, there are several alternative subsurface intake technologies that are likely feasible (based on available information) and would avoid or reduce the MPWSP's significant impacts as discussed below.

Comments on MPWSP DEIR/EIS

In preparing these comments, we have reviewed the relevant portions of (1) the DEIR/EIS (2) the DEIR/EIS appendices; (3) references cited in the DEIR/EIS and DEIR/EIS appendices (where available); and (4) publicly available information referenced in these comments. We have also conducted independent research regarding intake technologies based on work in this area and our experience in seawater desalination.

I. Comments on Open-Water and Subsurface Intakes (Appendix I1)

As requested, our comments focus on whether there are potentially feasible intake technologies for the MPWSP that could reduce the project's environmental impacts. Therefore, our review was primarily focused on Appendix I1 (and the limited reference materials cited in the appendix). We provide the following comments on Appendix I1, which are identified under section headings for ease of reference:

A. ***Comments on Operations and Maintenance Considerations for Open-Water Intakes (I1-3)***

The Open-Water Intake section's statement that maintenance would occur every 3 to 5 years is not supported by any research and appears unrealistic (See p. I1-3). Based on reports from existing seawater intakes in the Monterey Bay National Marine Sanctuary and other intakes along the Monterey Bay, it is more likely that Intake Screens would need to be cleaned every 3 to 5 months.[1] The Intake pipelines would also need to be "pigged" at least annually.[2]

B. ***Comments on Subsurface Intakes (I1-3 through I1-7):***

The General Comments section of Subsurface Intakes states: "*the magnitude of potential entrainment of marine species into the bottom sediments caused by continuous subsurface intake operations has not been systematically and scientifically studied to date*" citing WateReuse 2011 (See p. I1-3). While a full citation of the reference was not provided in the DEIR/EIS reference materials, we assume the citation referred to in Appendix I1 is the white paper entitled "Desalination Plant Intakes Impingement and Entrainment Impact and Solutions" from the WateReuse Foundation which states, "to date there are no studies that document the actual level of entrainment reduction that can be achieved by these types of intakes." (WateReuse 2011, p. 9).[3,4] This nonsensical statement appears to repeat comments from proponents of open-ocean intakes. If there was impingement of marine species on the surface of the seabed, especially marine fish larvae, there would be an accompanying biological response which would be noteworthy. To our knowledge, there is no field observation of increase biomass, increase primary production, increase in fish density (or diversity) or other marine invertebrates' population increase in zones of subsurface infiltration. Studying a non-significant biological event is extremely difficult (i.e. expensive) and, therefore, it is not surprising that no agencies have funded a study of entrainment for intakes that draw water through several feet of natural sediment or artificial media.

The appendix, next addresses the advantages of subsurface intakes compared with open ocean intake (See p. I1-3). This discussion is based on work done for a regional desalination project in Santa Cruz involving the adjacent Soquel Creek Water District and the City of Santa

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[1] Eric Quanmen, Facilities Systems Manager, Monterey Bay Aquarium, e-mail February 15, 2017.

[2] As per Wikipedia, "Pigging in the context of pipelines refers to the practice of using devices known as "pigs" to perform various maintenance operations. A "pig" in the pipeline industry is a tool that is sent down a pipeline and propelled by the pressure of the product flow in the pipeline itself."

[3] WateReuse Association, 2011. Desalination Plant Intakes: Impingement and Entrainment Impacts and Solutions. *WateReuse Association White Paper*.

[4] Similar to comments by Daniel P. Cartamil, Marine Biologist from Scripps Institution of Oceanography in his opinion piece "Evidence to Support an 'Eco-Friendly' Desalination Technology Lacking when comparing subsurface infiltration galleries with open-ocean intakes systems" that appeared in The Scientist (http://www.the-scientist.com/?articles.view/articleNo/47085/title/Opinion--Evidence-to-Support-an--Eco-Friendly--Desalination-Technology-Lacking/).

Cruz Water Department that advocated for a direct intake system.[5] While reference is not on point, we agree there are significant advantages of using *appropriate* subsurface intakes for seawater desalination.

First, the elimination of impingement and entrainment of marine organisms through subsurface intakes is a serious issue and provides many benefits. Not only from a regulatory perspective (Desalination Amendment to the Ocean Plan encourages indirect or subsurface intake technologies), but also from an operational perspective, removal of organic material prior to reverse osmosis membrane is beneficial to the desalination plant operation. The RO membranes are designed to separate water from salt in an aqueous solution. The reverse osmosis membranes are not designed to deal with fluctuating biological (organic) loads, which require additional pretreatment systems. Employing subsurface intakes, there is a substantial reduction in pretreatment equipment, smaller footprint, lower chemical usage (including costs for training of personnel and storage of chemical supplies), and reduced energy consumption – which all add up to real cost savings over the lifecycle of the plant.[6]

The second advantage listed in the appendix is that "*natural water filtration and pretreatment provided by ocean floor sediments, which in some cases can reduce the need for some treatment chemical during the desalination process.*" Again, we concur with this statement.

For example, data from Neodren systems[7] show that Neodren filtrate, the source water delivered through the under-the-sea intake conveyance, has reduced range or variation in temperature[8] that allow for more stable operations. The data also show the filtrate has reduced turbidity compared with ambient natural seawater conditions.[9] This is an important attribute because RO membrane manufactures require low turbidity waters for processing. Manufacturers

[5] Kennedy/Jenks Consultants. 2011. scwd2 Seawater Desalination Intake Technical Feasibility Study (ITFS). September 21.

[6] To illustrate this point, a proposal for a nearby open ocean desalination plant with approximately 12 MGD production includes an engineer's estimate of the amount of waste derived from the pretreatment process. The estimate of dry sludge is 27.6 tons per day requiring 20 dump trucks per week to haul waste offsite. Draft Process Design Report for the People's Moss Landing Water Desal Plant prepared by Watek Engineering, February 27, 2015. see http://thepeopleswater.com/Draft_Process_Design_Report_and_Cost_Information.pdf

[7] Neodren systems (discussed in more detail in section on Horizontal Wells below) are seawater intake subsystems in which filter pipes are installed in boreholes executed from the back of the beach by drilling subsoil and boring into geological formation offshore (see Figure 1 below)

[8] Peters, Thomas and Pintó, Domènec. 2006. Sub-seabed drains provide intake plus pretreatment. Desalination & Water Reuse, Volume 16. 2006

[9] Typically, turbidity values for a Neodren system are much less than 2.0 NTU. Nephelometric Turbidity Unit (NTU) refer to EPA Method 180.1. Peters, Thomas and Pintó, Domènec. 2006. Sub-seabed drains provide intake plus pretreatment. Desalination & Water Reuse, Volume 16. 2006

of the seawater reverse osmosis membranes recommend a silt density index (SDI[10]) of 5 or lower for seawater reverse osmosis membrane systems.[11] In our experience, when using the Neodren systems, particle concentrations are lower than ambient natural seawater conditions;[12] total suspended solids – a measure of the dry weight of particles trapped by a filter – are lower;[13] and total organic carbon, a measure of the amount of Carbon bound in organic compounds is reduced.[14,15]

The third benefit listed in the appendix is that "*minimal growth of marine organisms that occurs inside the intake pipeline*." Again, we agree this is an important consideration as biological fouling prevention is important for overall operational efficiency. The more biological material that is prevented from entering the desalination subsystem, the better the system will perform over a longer period before diminished yield, failure, repair or other faults.

And finally, we generally agree with the statement that if intake technologies are not appropriately sited, subsurface intakes can adversely affect coastal aquifers and increase the risk of saltwater intrusion in freshwater aquifers (see p. I1-4). We note, however, that the vertical and slant wells are far and away the most likely to impact *adversely* affect coastal aquifers and *increase* the risk of saltwater intrusion in freshwater aquifers as explained more fully below.

1. Comments on Vertical Wells conclusions (I1-4 through I1-5):

While the DEIR/EIS's overall description of vertical wells as applied to the MPWSP appear to be generally accurate, its conclusion that they are not a potentially feasible alternative intake source for the MPWSP lacks any supporting factual information. Vertical wells have been in use for a long time, have a good track record, and are used in seawater desalination internationally. The celebrated case is in Malta where the Pembrooke desalination plant has a capacity of 9.5 MGD from a field of vertical wells in a sandstone formation is of similar size the proposed MPWSP. Notably, for smaller systems on the order of 5 MGD, there is documented life cycle costs saving approaching 17% when vertical wells at the beach are installed.[16] As the appendix notes, the primary limitation for vertical wells is logistics of dealing with multiple well heads spread out over some expanse. We also agree it is preferable to locate beach wells as close to the coastline as possible to minimize impacts on inland aquifers, because the influence over groundwater supplies inland of the sea are a concern as noted. That said, vertical wells can be

[10]Silt Density Index – a measure of fouling capacity of RO membranes systems – is greatly reduced to less than 5.0 (SDI_{15}) SDI_{15} is notation used for ASTM Standard D4189 Standard Test Method for Silt Density Index (SDI) of Water at 15-minute interval.

[11] Membrane Manufacturers will not guarantee their products if SDI is above 5.

[12] Peters, T., Schuster, O., von Harten, B., Ulbricht, M. Schmidt, E. Pintó, D. and Pintó, E. (2008) Comparison of options for seawater pre-treatment for SWRO plants. 10th World Filtration Congress, proceedings volume II, Leipzig/Germany, April 14-18, 2008

[13] Peters, T. (2009) personal communication (email), 1/17/2009

[14] Münk, F. (2008) Ecological and economic analysis of seawater desalination plants. Diploma Thesis, University of Karlsruhe, Institute for Hydromechanics, Karlsruhe

[15] Peters, Thomas and Pintó, Domènec. 2006. Sub-seabed drains provide intake plus pretreatment. Desalination & Water Reuse, Volume 16. 2006

[16] Schwarcz, J. (2000) Beach wells intake for small seawater reverse osmosis plants, Middle East Desalination Research Center Project 7-BS-015.

located outside of or inland of environmentally sensitive habitat areas. They can also be sited in areas where studies show the greatest amount of seawater has intruded (or areas indicating a preferential seawater inflow) to reduce groundwater impacts. Neither the appendix nor the DEIR/EIS provides any information regarding these possibilities.

We further note that expansion of the current Sand City desalination system or similar system may meet the water requirements of the MPWSP with a smaller overall ecological and environmental impact. Therefore, we would recommend DEIR/EIS address the capacity for expanding the existing Sand City Desalination facility. If this is not feasible, we would recommend the DEIR/EIS examine the use of pre-engineered, so called "packaged" desalination systems which could result in avoiding or substantially lessening the proposed project's significant impacts. Smaller desalinations systems (even if two are required) can be accomplished with significantly less environmental impacts and can be more economical because package solutions are available for desalination plants that are up to 5 MGD. To illustrate, IDE Technologies Ltd. has a modular RO which can be bought, leased or contracted for water purchase (see http://www.ide-tech.com/solutions/ide-progreen/). Modular systems also reduce site work, come pre-assembled, and reduce installation time. In the case of the IDE Technologies system, no chemicals are required as the systems uses the brine concentrate to purge the membranes. The system also has a relatively low electrical consumption (10 – 12 kWhr/1000 gal), and consequently lower OPEX. Several other firms that have similar offerings. (See Exhibit 1 - Summary of City of Santa Barbara Desalination Plant Reactivation Project choice of a modular approach in 2016). We also note that packaged or modular systems reduce consulting engineers custom design work, foster concurrent civil site work and fabrication of SWRO modules, allow consistency between multiple desalination sites, similar parts, similar training and can be controlled remotely and thus reduce operational costs.

In summary, using a package system with vertical wells may provide sufficient supplies to meet CalAm's water demand in conjunction with the Pure Water Monterey Groundwater Replenishment (GWR) Project noted in the DEIR/EIS. Obviously with the implementation of the GWR Project, the number of vertical wells required for feed water supplies would be substantially lower than the 24 estimated in Apppendix I1. (see p. I1-4.) This reduction could address the unspecified economic, legal (permitting) and environmental factors noted in the Appendix. However, without any information regarding these factors, we cannot assess this conclusion is accurate. We only note that given the *potential* reductions in environmental impacts and costs, we were surprised the DEIR/EIS did not evaluate vertical wells in its alternatives analysis.

2. Comments on Infiltration Galleries conclusions (I1-5):

The DEIR/EIS's limited and conclusory discussion of infiltration galleries as applied to the MPWSP seems wholly inadequate. The DEIR/EIS dismisses this alternative intake option stating because of the extent of temporary and permanent disturbance that an infiltration gallery would have on the sand dunes and sensitive marine habitat, it is considered infeasible based upon environmental, social and legal factors. Again, no analysis or information is provided regarding the environmental, social and legal factors that would make this infiltration galleries infeasible.

We note that beach infiltrations galleries were examined in the CCC's "Final Report: Technical Feasibility of Subsurface Intake Designs for the Proposed Poseidon Water Desalination Facility at Huntington Beach".[17] Their conclusion that infiltration galleries located closer to the beach were potentially a feasible options for subsurface intakes for the proposed Poseidon Water Desalination Facility, which proposes producing 50 Million Gallons per Day (MGD) of potable water, five times as much as the current project. The CCC's Report notes that:

> ***A key aspect of a beach gallery system is that it underlies the surf zone of the beach, fully or in part. This means that the active infiltration face of the filter is continuously cleaned by the mechanical energy of the breaking waves and is therefore self-cleaning*** (Maliva and Missimer, 2010). ***Also, the location within the intertidal zone allows the gallery to be continuously recharged with no impact on the inland shallow aquifer system. The vertical flow of water from the sea assures that the inorganic chemistry is not significantly altered over time***… The gallery system is unaffected by variations in the deeper groundwater, which could be fresh or brackish in nature at the shoreline. The uppermost natural sand layer is the primary treatment zone within the filter and will likely allow the removal of all algae and a high percentage of bacteria and naturally occurring organic compounds (e.g., natural organic matter). The long-term data collected at the seabed gallery in Japan shows that the SDI was reduced below two, which is at the approximate level produced by conventional SWRO pretreatment systems (Shimokawa, 2012).
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> ***The beach gallery would reduce or eliminate the impingement and entrainment of marine fauna. Also, upon completion of construction, the gallery would be located below the surface and could not be observed by beach users.***

(Id. at p. 40.)

The DEIR/EIS does not address why the same would not hold true for the MPWSP. Notably, the DEIR/EIS's apparent conclusion that infiltration galleries result in permanent disturbance to habitat does not appear to be consistent with the CCC's report. (*Ibid.*; see also *id.*, Figure 3.6 on p. 41.) Moreover, the DEIR/EIS, does not address whether an infiltration gallery could be designed in such a way that would not require the massive excavation and artificial prescribed fill used in the existing infiltration case in Fukuora, Japan cited in the CCC Report. Unlike the Fukuora location (on the semi-protected coast of the Sea of Genkai),[18] it may be possible to lay out sections of filter pipe on the sandy seabed and allow natural forces to bury the system over time. The sandy bottom biological community in Monterey is adapted to moving sands and may not be significantly impacted. Regardless, without any discussion or information

[17] http://www.coastal.ca.gov/pdf/ISTAP_Final_Phase1_Report_10-9-14.pdf.

[18] The infiltration gallery in Fukuora, Japan has a capacity of 27.2 MGD operating since 2005 (Missimer et al 2013).

regarding the potential impacts at the CEMEX site (or elsewhere) it is impossible to comment further on this issue.

Importantly, beach infiltration gallery would not adversely impact the coastal aquifers as they do not pump groundwater. Therefore, because infiltration galleries are at least potentially feasible and could eliminate some of project's significant impacts, the DEIR/EIS's failure to address the potential options for infiltration galleries or its environmental impacts is not supported by the any available information.

3. Comments on Horizontal Wells conclusions (I1-5)

The DEIR/EIS's limited discussion of horizontal (or HDD) wells as applied to the MPWSP wholly inadequate. The Appendix states that it describes each subsurface intake type to include "*typical suitable locations, examples of existing technology, general construction methodology, operation and maintenance, and capabilities and limitations*" (page I1-4). Given our particular expertise as it relates to Horizontal Wells, we were shocked that DEIR/EIS—in less than 200 words---dismissed this technology in an Appendix without citation to a single reference material. (See Appendix I1 Open-Water and Subsurface Intakes, p. I1-5.) Importantly, the DEIR/EIS dismisses the feasibility of horizontal wells without adequately describing the technology, its advantages over the project's proposed slant wells intakes and its appropriateness for the Monterey Bay coastal environment as the Appendix suggests.[19] Therefore, we provide the following information for your background regarding Horizontal Wells using the Neodren subsurface intake systems.[20] While our comments address Horizontal Wells using Neodren subsurface intake systems, please note there are other Horizontal Well technologies that could also be employed and could be investigated by the CPUC or Sanctuary. Following this background, we explain why none of the reasons listed for rejecting Horizontal Wells are accurate.

a) <u>Background on Horizontal Wells Not Included In the DEIR/EIS</u>

Directional boring also known as Horizontal Directional Drilling (HDD) is "a steerable trenchless method of installing underground pipes, conduits and cables in a shallow arc along a prescribed bore path by using a surface-launched drilling rig, with minimal impact on the surrounding area."[21] A key aspect is the shallow arc as shown in Figure 2 below.

Horizontal Wells have been installed using directional boring techniques at multiple locations internationally. While there is currently no installation in California, this is not

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[19] We note that in the past couple of years with the flurry of activities involving subsurface intakes and the interest in HDD, no one from the CPUC or MBNMS has contacted Catalana de Perforacions (developers of Neodren subsurface seawater intake systems) for information regarding its feasibility for the MPWSP. We find this remarkable because the technology has been discussed at various desalination conferences (including in California) on panels with Geoscience (the developers of the Slant Well technology for the MPWSP). A copy of Neodren Subsurface Intake Technology presentation at recent California Conference is attached as Exhibit 2.

[20] Attached as Exhibit 3 is a bibliography on Neodren.

[21] https://en.wikipedia.org/wiki/Directional_boring

surprising because most seawater desalination is performed outside the United States. In fact, there are only a handful operational seawater desalination plants in California, and even fewer operational seawater desalination plants in California that use subsurface intakes.

The technology of HDD, however, is well known in California having been conceived to cross rivers by Martin Cherrington in the early 1970s. When excavating or trenching is not practical, HDD is commonly used in a wide variety of environments including crossing under

Figure 1. Cross section of stylized Neodren installation.

waterways, roadways, congested areas, sensitive environmental areas and areas where other methods are more destructive or expensive.

The technology of HDD, however, is well known in California having been conceived to cross rivers by Martin Cherrington in the early 1970s. When excavating or trenching is not practical, HDD is commonly used in a wide variety of environments including crossing under waterways, roadways, congested areas, sensitive environmental areas and areas where other methods are more destructive or expensive.

The constellation or spatial pattern of lateral wells is dependent on the site and its hydrogeological properties. Note that in the existing operating intakes joined to seawater desalination plants, none of them are in 3 or 4 well clusters as advertised in the DEIR/EIS (page I1-5).

Typical Suitable Locations

In the case of Neodren subsurface seawater intake systems, coastal sites with appropriate offshore geological formation for transmission of water through the upper 15 to 30 ft of the seafloor are ideal.

Examples of Existing Technology

Neodren systems have been installed at various sites in Spain (Table 1). The Neodren drains are engineered to ensure the correct scheduling per pipe specification, pipe path positioning and punch out location. Using basic installation techniques, HDD allows multiple curves in plan and section, striving to avoid submerged structures and geological stratums with no productive yield. Drain filter pipes are installed in the excavated borehole, ensuring a long-term intake, and ensuring stability of the borehole. In total, 36 lateral drains comprising over 5 miles of pipe drawing in 63.4 MGD are operating at seawater desalination plants.

Table 1. Neodren Installations in Spain.

Year	Location and description	m^3/day	l/s/m	Status
1996	Fish farm, Sant Pere Pescador (Gerona)	4,320	0.22	Operating
2001	Fish farm, Sant Pere Pescador (addition)	8,640	0.26	Operating
2003	SWRO IDAM, San Pedro del Pinatar (MU)	172,800	0.44	Operating
2003	Fish farm, Cabo Cope (Murcia)	8,640	0.48	Operating
2004	SWRO, IDAM Águilas (Murcia)	41,472	0.48	Operating
2004	Cooling water, Albuixech (V)	47,952	2.92	Operating
2005	Investigation for SWRO IDAM en Barcelona	8,500	0.33	Dismantled
2005	Investigation for SWRO IDAM Alicante, phase 1	1,128	0.46	Operating
2006	IDAM Águilas (MU), Com. de Regantes	31,104	0.46	Operating
2007	Investigation SWRO, Tordera (Girona)	8,640	0.33	Dismantled
2008	Addition to desalination Plant, Alicante II	76,300	0.30	Operating
2008	Application CRAM (El Prat de Llobregat)	8,640	0.33	Operating

Note: Dismantled systems were customer's decisions after test and data collection.
Source: Catalana de Perforacions.

<u>General Construction Methodology</u>

The general construction methodology can be divided into the construction of the borehole and the insertion of the filter pipe. To establish an appropriately sized borehole, first a pilot hole is drilled with a guidance system to steer the drilling head along the desired route. A reamer is added to the drill string to expand the annulus of the borehole. Once the reaming is complete, the hole is swapped to insure passage of the filter pipe. General guidance on HDD is available[22,23,24] as well as industry standards.[25]

Float-and-Sink Method. For the insertion of the filter pipe, the preferred method is the float-and-sink method outlined in Chapter 10 Marine Installations of the Plastic Pipe Institute'

[22] Willoughby, David (2005). Horizontal Directional Drilling, p. 1-263. McGraw-Hill, New York. ISBN 0- 07-145473-X.
[23] Short, Jim (1993). Introduction to Directional and Horizontal Drilling, p. 1-222. PennWell Books, Tulsa, Oklahoma. ISBN 0-87814-395-5.
[24] HDD Consortium. (2008). Horizontal Directional Drilling–Good Practices Guidelines.
[25] ASTM International F1962, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

Handbook of Polyethylene Pipe[26]. Conventionally, filter pipes are pulled into the borehole with the float-and-sink method. Obviously, care and attention are required to the details of the design to insure a safe and successful operation.

The 'Push' Technique. Alternatively, a newer process developed by The HDD Company, is similar as drilling a water well. By directionally boring from shore into and through the offshore aquifer, a steel casing can be put into the borehole to greatly aid insertion of the well screen and avoid release of drilling fluids into the marine environment. Once the casing has been installed, the well screen is inserted, then the casing pipe can be removed and lateral well can be completed. Multiple wells can be placed into the aquifer.

A significant benefit of this "push" approach is the virtual elimination of marine support operations, thus considerably reducing installation costs and most disturbances to the seafloor. This benefit is an important development in subsurface intakes especially along environmentally sensitive coast lines in California. Operating well back from the beach, under the sea intakes can operate effectively with low environmental impact on the marine environment, nearshore coastal environment and foreshore habitat.

Permits should not be any more difficult than a permit for a typical water well. No fisheries would be impacted. The procedure is virtually the same as vertical water wells with the exception that HDD can drill further and place more well screen (horizontally) into the aquifers.

Operation and Maintenance

The operation and maintenance requirement are minimal with the Neodren system. According to Jordi Camps Querol, Technical Director of Catalana de Perforacions, who has been involved since the beginning of Neodren development, Neodren "only needs to be able to have some backwash, in case of fine sands." [27] Some installations prefer occasional backwash of the subsea intake system at approximately twice the inflow rate. Discussions with Neodren consultant Dr. Thomas Peter indicated that most plants do not backwash. Neodren systems have been deployed since 1996, and that experience shows Neodren is a long-lasting and less expensive solution over the long term.

b) The DEIR/EIS reasons for not analyzing Horizontal Wells are unsupported and inaccurate.

The DEIR/EIS (at p I1-5) states: "*Horizontal wells are not evaluated further for the following reasons: (1) the amount of pipeline that would be pushed under the sea floor (upwards of 2,500 feet) would be challenging in terms of construction time, physical limitations and the disposal of drilling sludge (and consequently much more expensive than other options); (2) installing artificial filter packs to stabilize unconsolidated formations like those found in the project area has yet to be demonstrated successfully and on a consistent basis, and; (3) HDD would not avoid or minimize any of the impacts associated with the proposed action*." There is no evidence provided to support any of the conclusion. As explained below, all three conclusions are inaccurate.

[26] Available online at the Plastic Pipe Institutes web site. The Plastic Pipe Institute Handbook of Polyethylene Pipe, Chapter 10 Marine Installations

[27] Email from Jordi Camps Querol to A.T. Jones, February 20, 2017

First, the DEIR/EIS dismisses the capabilities of Horizontal wells, but does not adequately address the limitations of this technology. The DEIR states that *"wells are not evaluated further for the following reasons: (1) the amount of pipeline that would be pushed under the sea floor (upwards of 2,500 feet) would be challenging in terms of construction time, physical limitations and the disposal of drilling sludge (and consequently much more expensive than other options)"*

Construction Time. The construction time for developing horizontal directionally drilled drains or lateral wells would be considerable shorter than the proponent's preference for angle wells based on construction times along the Spanish Mediterranean Coast for Neodren system. The closest example is Alicante II where an additional eight (8) laterals were commissioned using one HDD drilling rig. The drilling schedule was not the critical path for completion of the project. Construction on this project took about four (4) months. The intake flow was 20.15 MGD.[28]

Multiple HDD maxi-rigs could be used to accelerate schedules, if that is a requirement. The HDD Company (Cameron Park, CA) through its affiliate, The Crossing Company, operate 27 HDD rigs in western North America. As it is likely, if not certain, that Horizontal Wells could be constructed in less time that proposed slant wells, we believe the decision to exclude this alternative from analysis in the DEIR/EIS is unsupportable.

Physical Limitations. The DEIR/EIS's conclusions regarding the physical limitations of HDD are based on either no information or outdated information. In fact, the physical limitations of HDD are much less than the slant well technology proposed for the MPWSP. For example, in terms of length, HDD can extend further than the 2,500-foot maximum mentioned in the description of Horizontal Wells (Appendix I1 p. I1-5). Table 2 below summarizes select recent activities that highlight lengths more than 2,500 feet specifically related to shore approaches or ocean outfalls.[29] As a result, HDD wells can be located significantly further inland than slant wells and avoid impacts to sensitive habitats and impacts associated with potential exposure from erosion.

Table 2. Selected HDD Projects with Shore Approaches or Ocean Outfalls.

Project Name	Location		Formation
FASTER Cable Project	Bandon, Oregon	Beach Approach: Pacific Ocean 5,000' of 5" Steel Pipe	Sandstone / Siltstone Rock
ZA1 - 230KV UG Line	San Francisco, California	(6)-Beach Approaches into S.F. Bay 12" & 3" HDPE Bundle	Rock and Bay Mud
Mayport Naval Base	Jacksonville, Florida	Beach Approach - 4000' of 5" steel	Sand/Silts

[28] See attached Appendix with site profiles and photographs during construction.
[29] 'Shore approaches' or 'ocean outfalls' are terms used in HDD to describe drilling out under the sea.

OOI RSN	Pacific City, Oregon	(2) Beach Approaches 5000' of 5" Steel Pipe (ea.)	Sands/Silts/Clays
Hueneme Outfall Replacement	Port Hueneme, California	2540' of 36" HDPE Ocean Outfall in the Pacific Ocean	Sand, Silts, Cobble and Boulders
Wastewater Treatment Plant Outfall		4600 feet of 18" Steel Outfall Columbia River. Installation of 80-foot diffuser, pig launching facility, 500 feet of Ductile	Silt, Sand and Gravel
Twin Rocks Sanitary District Ocean Outfall	Twin Rocks, Oregon	4400' Beach Approach. 8" coated steel pipe.	Sand, Silt and Gravel
Effluent Disposal System.	Port Orford, OR	2200' of 12" HDPE for an Ocean Outfall	Mudstone
NOSD HDD Outfall Replacement	Netarts, Oregon	4150' of 14" HDPE Ocean outfall	Mudstone and Basalt

Source: The HDD Company

Moreover, unlike slant wells, HDD wells can avoid unfavorable subsurface conditions. Notably, The HDD Company has installed pipelines and utilities for ocean outfalls, under rivers, ship channels, creeks, wetlands, buildings and highways. The company is noted for execution in difficult situations. Therefore, as there is no support for rejecting Horizontal Wells on this basis, we believe the decision to exclude this alternative from analysis in the DEIR/EIS is unsupportable.

Disposal of Drilling Sludge. Finally, the disposal of drilling sludge is not an issue for this site. There are options within Monterey County including Johnson Valley part of the Salinas Valley Solid Waste Authority. Importantly, the proposed Slant Wells would have the same issues relating to drilling sludge, if not further concerns related to chemical nature of their deeper geologic materials. Therefore, as there is no support for rejecting Horizontal Wells on this basis, we believe the decision to exclude this alternative from analysis in the DEIR/EIS is unsupportable.

Number of Wells and Expense. The DEIR/EIS Appendix states that approximately 10 to 12 horizontal wells would be needed to provide sufficient source water for the 9.6-mgd MPWSP Desalination Plant. We believe this estimate is potentially reasonable, but would need additional information that was not provided in the DEIR/EIS to confirm. While we believe the DEIR/EIS's suggestion that Horizontal Wells would be more expensive than other options is likely inaccurate, there is insufficient information provided to comment on this issue. Based on our knowledge of the costs of slant wells to date, we do not believe that drilling Horizontal Wells is likely to be more expensive. We also note that using Horizontal Wells would eliminate the need for return water and the proposed Castroville Pipeline, which ironically would be installed beneath the Salinas River and Tembladero Slough using HDD. (See DEIR/EIS, p. 4.6-142.) Therefore, we believe that Horizontal Wells could actually reduce the MPWSP's costs.

Finally, there are more operating Horizontal Wells conveying seawater to reverse osmosis plants in the world than Slant Wells drawing water from deep aquifers for desalination. In fact, we are unaware of any operating Slant Wells drawing water from deep aquifers for desalination. Given the observed reduction in efficiency over a short period at Dana Point Slant Well (discussed below), it is possible, if not likely, that less Horizontal Wells would be needed to supply the required feedwater than slant wells over the life of the project.

Second, the DEIR/EIS's statement that "*(2) installing artificial filter packs to stabilize unconsolidated formations like those found in the project area has yet to be demonstrated successfully and on a consistent basis*" (Appendix I, page I1-5) is inaccurate.

Artificial Filter Packs. Starting in 1985 in the United States, artificial gravel-pack filters around horizontal well screens have been designed, constructed and operating per plan. One drilling and construction company, Layne, has installed tens of thousands of lineal feet of gravel-packed lateral well screens. Sites have been coastal and inland. Subsurface deposits at potential sites in and around the Monterey Bay area would fall within the range of depositional environments in which screens have been successfully installed.

Moreover, to date, artificial filter packs have not been required when utilizing the Spanish technology Neodren. The function of the artificial filter pack is to prevent unwanted sands and fines from entering the plant. The Neodren system accomplishes this goal by utilizing well screens with high porosity (35% to 45%) that match soil formation characteristics. The nature of the sintered high molecular weight polyethylene well screen allows uniform pore size distribution. A scanning electron micrograph of the material shows polymer structure with closely controlled pores allowing water movement towards the inner conduit (Figure 2).

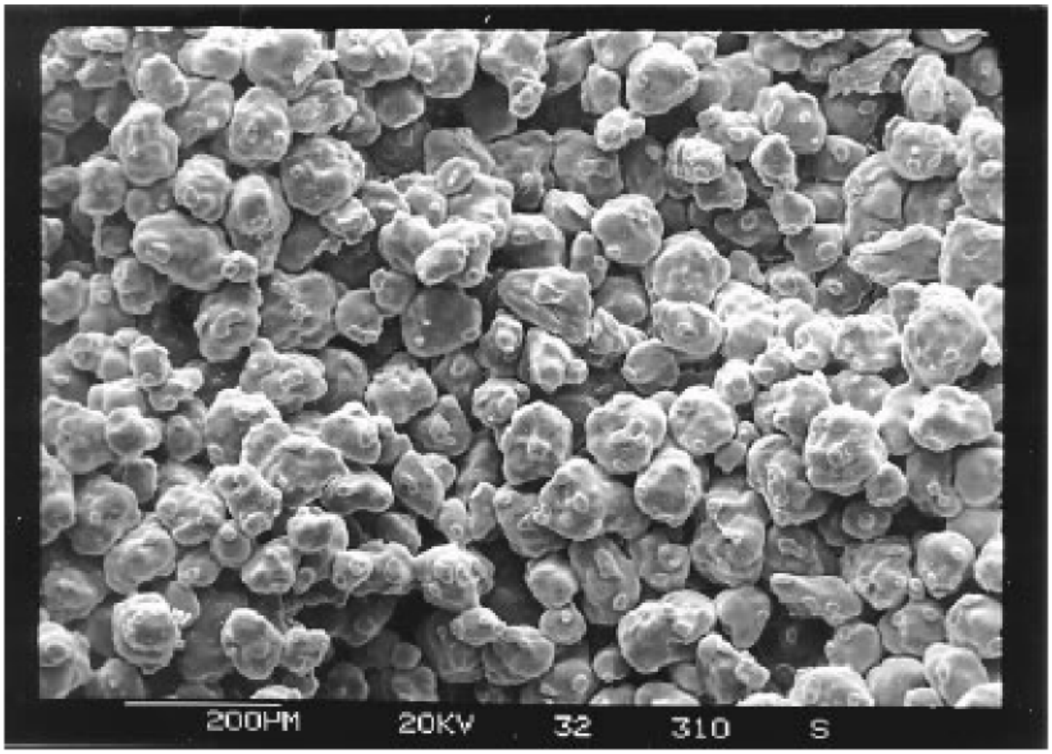

Figure 2. SEM Micrograph of sintered HDPE well screen

To illustrate this point, in the case of the current Intake Test Program comparing side by side screened open ocean intake with a subsurface intake, the San Diego County Water Authority selected a Neodren system which will have an average grain cut off size of 60 microns.

Finally, if filter packs are required, an offshore oil and gas product that uses an open-cell foam, which allows normal fluid production while controlling sand migration, could be used here.

Again, there is no support for rejecting Horizontal Wells on this basis. Therefore, the decision to exclude this alternative from analysis in the EIR/EIS is unsupportable.

Third, the DEIR/EIS's conclusion that "*HDD would not avoid or minimize any of the impacts associated with the proposed action"* is also based on unsupported conclusions and unsupportable for the reasons explained below.

Horizontal Wells Have the Potential to Avoid or Substantial Reduce the Projects Significant Environmental Impacts. At the CEMEX site, construction activities for the HDD intake could be located well further inland and outside any endangered species habitat avoiding impacts to endangered species along the coast. If HDD intake is designed to extract water from upper section of the marine sediment with direct conductance to the overlying seawater, then impacts to groundwater basin water levels would be circumvented and the groundwater quality would not be impacted. There would be no take from the Salinas Valley Groundwater Basin (SVGB), so there would be no need for the return water obligation. This method would reduce impacts associated with return water pipeline, reduce amount of water needed (thus less wells and less disturbance). As noted above, the Castroville Return Water Pipeline, would be installed beneath the Salinas River and Tembladero Slough using the same HDD drilling technology as Horizontal Wells to avoid impacts.

At the Potrero site, drawdown impacts on groundwater basin could be avoided, if properly designed and installed HDD intakes to take advantage of the transmission of seawater in the upper 15 to 25 feet of sea bottom sediments, therefore, eliminate impacts to Elkhorn Slough. If seawater is drawn into a HDD intake in the upper most section of the seafloor, the groundwater from SVGB would not be impacted and thus there would be no obligation to convey desalinated product water to the interior, which would reduce all impacts associated with return water pipeline.

By drawing seawater from the uppermost strata and eliminating the need for returning water to the SVGB as proposed, HDD intakes would avoid the impacts associated with the return water pipeline and reduce the amount of supply water necessary for the MPWSP thereby also reducing energy needs and impacts on GHG.

We would also note that Horizontal Wells could potentially be located at numerous other locations along the Monterey Coast Shoreline, including locations closer to CalAm's service area.

4. Comments on Ranney Wells

The DEIR/EIS's decision that Ranney Wells would have similar impacts to the MPWSP's proposed slant wells and, therefore, need not be evaluated further is based on the limited discussion in Appendix I1 and conclusory allegations in the DEIR/EIS. (DEIR/EIS, p. 5.3-18.) The discussion of Ranney Wells in Appendix I1, like the DEIR/EIS's conclusions is not supported by any meaningful analysis and appears to be inaccurate.

To illustrate Ranney Collector Wells functioning in the marine environment, the DEIR/EIS (at p. I1-6) cites the California Academy of Sciences in San Francisco as an example. Unfortunately, the Ranney Well that served the Steinhart Aquarium in Cal Academy has been shut down since July 2010.[30] Ranney seawater collector wells in Mexico, however, have been operating since 2000. The site was revisited by the Project Manager about ten (10) years after commissioning and showed no signs of "discernible degradation of the well screens." [31]

The DEIR/EIS's description of the approach in this analysis related to requiring a shaft 90 to 260 feet deep seems ridiculous if they are attempting to tap into the shallow marine aquifer. As proposed it is an extension of a vertical shaft with lateral jacked radial arms serving to extract groundwater from the deeper aquifers. This error, could be the reason the DEIR/EIS concludes the Ranney Wells would have similar groundwater impacts. If the Ranney Wells were properly designed to tap the shallow marine aquifer, this alternative would likely significantly reduce groundwater impacts.

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[30] Ed Miller, Senior Aquarist (retired), Steinhart Aquarium, personal correspondence with Arnell Bautista, Chief Engineer, Steinhart Aquarium, February 10, 2017.
[31] Henry Hunt, Senior Project Manager, Layne, personal correspondence, February 14, 2017.

The DEIR/EIS's statement about distance between Ranney Wells of 350 to 500 feet should be clarified to indicate that the objective of spacing Ranney Wells is to minimize hydraulic interference and is dependent on the well yields and aquifer characteristics.

The DEIR/EIS's statement that the construction area for a Ranney Well set up is larger than a Geoscience Slant Well construction site is suspect. If photographs during the construction phase of the Geoscience Dana Point Test Slant Well are indicative, then a Ranney Well could occupy the same footprint according to experts in Ranney Collector Wells operations.[32] As with other subsurface systems, the infrastructure including electrical panels can be below grade, if there is an aesthetic concern.

The construction process for Ranney Wells does not include dewatering as described in the Appendix I1. An upcoming Ranney Collector Well site is ½ acre, half the size used in this analysis. The duration of construction could be as short as 4 months and extend over a year depending on limitation to seasonal construction.

Contrary to the statements on page I1-7 related to submersible pumps, most collector wells employ vertical turbine pumps, although submersible pumps have also been used. Collector Wells could be connected by piping in such a way that the wells drain by gravity into a common wet well with pumping station located outside any sensitive habitat. For the MPWSP, vertical turbine pumps work satisfactory.

Regarding the DEIR/EIS's suggestion on the limitation on the lateral lengths, if they have any experts advising them, they should be aware that laterals are routinely installed to 150 to 300 feet using conventional Ranney technology, but that longer horizontal wells screens are available using modified methods. One project had lengths out to 800 ft. Thus, the statement that Ranney Collectors for water supply are limited to 150 feet is unsubstantiated and outdated. Typical projects are 150 to 200 feet or more in lateral extent.[33]

The DEIR/EIS's statement related to equivalency of Slant Wells occupying the same physical area is also unlikely. There would be, depending on the number of collector wells needed, likely fewer Ranney Wells than Slant Wells, which would reduce the Ranney Well footprint.

In summary, the DEIR/EIS will need evaluate the Ranney Wells as they are both feasible and would at least potentially reduce the project's significant impacts at the CEMEX site.

We also note, that one could envision Ranney Collectors at two or three sites along the Carmel Beach providing adequate feedwater for the smaller desalting option of 6.4 MGD. The relatively larger sand size at this site would be ideal for transmission of seawater from the shallower marine aquifer. This intake site could avoid issues of endangered species and is closer to where the water is to be delivered, thus is could drastically cut cost of conveyance of product water. Carmel Beach is a 2-km long continuous beach, part of the Carmel River littoral cell which delivers sand and sediment in a principally southward direction. According to the USGS,

[32] Henry Hunt, Senior Project Manager, Layne, personal correspondence, February 14, 2017.
[33] Henry Hunt, Senior Project Manager, Layne, personal correspondence, February 14, 2017.

the Carmel Beach has had a long-term accretionary trend from 1896 to 2002.[34] However, along the southern segment of the beach, the shorter-term influences (1952 to 2002) have been erosionary at a rate of 1.7 m/yr.[35] Finally, we note that with uncertainty in Pacific Ocean climate, having flexibility among several intake systems to draw feed water, is something the DEIR/EIS should consider.

5. *Comments on Slant Wells*

The DEIR/EIS's discussion of slant wells ignores the fact that slant wells are experimental unproven technology, with no track record in terms of long term operations. As noted above, we find this particular problematic given the DEIR's rejection of Horizontal Wells on this basis. Notably, an independent scientific technical advisory panel for an ocean desalination facility in Southern California convened as part of the California Coastal Commission proceedings addressed concerns about the engineering performance of a slant well in this manner[36]:

> Only one slant well has been successfully constructed to date, although a major installation to provide 20 MGD of feedwater capacity is under consideration in the Monterey Bay area *[this project*]. The successfully completed well is at Dana Point. When it was built and tested in 2006, it was test pumped at 2000 gpm and displayed a well efficiency of 95%. Recent longer term testing of the completed test well in 2012 documents the reduction in well efficiency from the original value of 95% in 2006 to 52% in 2012 (GeoScience 2012). Given this observed reduction in efficiency over a short period, the long-term performance of the technology has yet to be confirmed.
>
> … Slant wells completed in the Talbert aquifer would draw large volumes of water from the Orange County Groundwater Basin, which in itself is considered a fatal flaw. Recent public comments have suggested that pumping seawards of the Talbert Salinity

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[34] Dartnell, P., Maier, K.L., Erdey, M.D., Dieter, B.E., Golden, N.E., Johnson, S.Y., Hartwell, S.R., Cochrane, G.R., Ritchie, A.C., Finlayson, D.P., Kvitek, R.G., Sliter, R.W., Greene, H.G., Davenport, C.W., Endris, C.A., and Krigsman, L.M. (P. Dartnell and S.A. Cochran, eds.), 2016, California State Waters Map Series—Monterey Canyon and Vicinity, California: U.S. Geological Survey Open-File Report 2016–1072, 48 p., 10 sheets, scale 1:24,000, http://dx.doi.org/10.3133/ofr20161072.

[35] Hapke, C.J., Reid, D., Richmond, B.B., Ruggiero, P., and List, J., 2006, National assessment of shoreline change part 3—Historical shoreline change and associated coastal land loss along sandy shorelines of the California coast: U.S. Geological Survey Open-File Report 2006–1219, 72 p., available at http://pubs.usgs.gov/of/2006/1219/.

[36] CCC's "Final Report: Technical Feasibility of Subsurface Intake Designs for the Proposed Poseidon Water Desalination Facility at Huntington Beach, dated October 9, 2014, pp. 37, 56, 64, available at http://www.coastal.ca.gov/pdf/ISTAP_Final_Phase1_Report_10-9-14.pdf

> Barrier could have beneficial impacts in managing seawater intrusion. In the Panel's opinion, however, this benefit is too uncertain to overcome the ISTAP conclusion about the fatal flaw of this technology as applied to the proposed Huntington Beach site. The advantage of having a subsea completion is largely lost in confined aquifers. The performance risk is considered medium, as the dual-rotary drilling method used to construct the wells is a long-established technology, but there is very little data on the long-term reliability of the wells. Maintainability is also a critical unknown issue.
> … Slant wells tapping the Talbert aquifer would interfere with the management of the salinity barrier and the management of the freshwater basin, and further, would likely have geochemical issues with the water produced from the aquifer (e.g., oxidation states of mixing waters).

This report was available over two years prior to the release of the DEIR/EIS. Remarkably, the DEIR/EIS fails acknowledged or address the conclusions in the report. The DEIR/EIS's failure to disclose and discuss the reduced efficiency of the Dana Point Slant Well testing is particularly noteworthy because one of the representative on the Hydrogeology Working Group authored the report on the Slant Well's decline.[37]

The DEIR/EIS's failure to disclose and address the findings in both reports must be acknowledged and addressed in the DEIR/EIS as it bears on the project's potential environmental impacts. Specifically, the DEIR/EIS must evaluate the how many slant wells will likely need to be replaced over the course of the foreseeable life of the project, and the impacts of replacing that number slant wells. Even under a best-case scenario, it is likely that all of the slant wells will need to be replaced at least once if not more. Notably, the selection of metallic components for the well screen and well, even if stainless steel, are not advisable in the highly corrosive seawater environment. The use of sacrificial zinc anode to deter galvanic corrosion is putting a band aid on a pulsating wound. Corrosion will continue; requiring replacement of the Slant Wells. The DEIR/EIS must be revised to address these impacts and address the impacts of replacement slant wells.

[37] See GeoSciences's Aquifer Pumping Test Analysis and Evaluation of Specific Capacity and Well Efficiency Relationships SL-1 Test Slant Well, Doheny Beach, Dana Point, California, dated September 7, 2012, available at http://www.mwdoc.com/filesgallery/SL_1_Step_Test_Comp._FINAL_TM_Geoscience_12_09_2012.pdf

II. Comments on DEIR-EIS Project Description

Comments on *Pretreatment System* (3.2.2.1)

Without some understanding of the source water chemistry, it is difficult to comment on the pretreatment process outlined. Note that the decision on the pretreatment filtration (media versus pressure filtration) has not been decided, probably for the same reason that the water quality of source water is unknown.

The coagulation and flocculation processes outlined in the pretreatment subsystem may not be relevant to subsurface intake sourced feedwater. If subsurface intakes are properly installed, the dissolved organic matter generally seen in natural seawater is not a factor in RO operations. In discussions with the design-build consultants on the desalination facility, they did not have access to water quality of the feedwater, so a conservative approach of introducing the possibility of a coagulation and flocculation steps was acknowledged.

Comments on *Reverse Osmosis System* (3.2.2.2)

The configuration of the SWRO process is conventional with a first stage, followed by a partial second stage to reduce boron concentration to level acceptable to the drinking water standards of California (1 mg/l B). Other developers in the Monterey County have proposed a similar RO design.[38]

Comments on *Operation of the Seawater Intake System, MPWSP Desalination Plant, and Brine Discharges* (3.4.1)

The statement about periodic maintenance of slant wells, "*The slant wells would require maintenance every 5 years*." (3-57), seem highly optimistic given the state of development of the Slant Well technology. This information is unknown as there are no operating wells to derive maintenance records. When the casing is withdrawn, the slumping sand could enter the well screen. Additionally, after the first maintenance efforts, when the gravel/sand filter pack gets agitated, the introduction of sand into the well is likely. Attempts to mitigate this issue have been presented by GEOSCIENCE such as a half-moon cover of the well screen area to alleviate sand migration.

Comments on *Power Demand* (3.4.5)

Most seawater desalination plants with capacity proposed in this project built in the last ten years incorporate energy recovery, whether isobaric or centrifugal, as means to lower energy consumption which can be a significant cost component of the operating budget.

Qualifications of Intake Works LLC and Anthony T. Jones, Ph.D.

[38] Draft Process Design Report for the People's Moss Landing Water Desal Plant prepared by Watek Engineering, February 27, 2015. see http://thepeopleswater.com/Draft_Process_Design_Report_and_Cost_Information.pdf

Intake Works LLC is a group of oceanographers, marine geologists, marine ecologists, HDD drilling specialists and marine construction professionals engaged in developing under-the-sea intakes for delivering low-turbid ocean water for industrial processes such as desalination. The company has surveyed existing seawater desalination intakes internationally and visited intake facilities in Malta, Spain, Saudi Arabia, Mexico, US Virgin Islands, and the Bahamas, besides installations in Massachusetts, Florida and California. We have studied various types of seawater intake systems and been involved in developing a synthetic infiltration system for porting the correct filter media to a proposed site.[39] The company is currently comparing subsurface intake systems with a direct wedge-wire screen open intake system at Camp Pendleton for the San Diego County Water Authority. Additionally, we have projects in Baja California providing intake installation for an aquaculture development.

As it relates to HDD, we work closely with Catalana de Perforacions (Barcelona, Spain), the drilling company that developed the Neodren process of installing microporous filterpipe under the sea from shore with horizontal directional drilling. Intake Works is the licensed provider of this technology in California. A brochure from Catalana de Perforacions describing their project history with Neodren installations (Exhibit 3).

Anthony T. Jones, Ph.D is the primary author of these comments. Prior to joining Intake Works, Anthony T. Jones, Ph.D was the Chief Technology Officer for Campbell Applied Physics Inc. and its predecessor, Oases Global System, where he led a team that developed advanced seawater desalination systems incorporating technology transferred from the US Department of Energy national laboratories. The team he led demonstrated, at a 1/8th scale, 30% lower energy consumption and up to 70% lower carbon footprint for seawater reverse osmosis potable water production. As it relates to this assignment, he served as a taxonomic expert and provided science support for U.S. Navy studies on marine biological fouling in San Diego Bay as part of a Congress-mandated study of an anti-fouling paint, tributyl tin. While participating in a study of sediment transport along shore and down submarine canyons for the US Army Corp of Engineers, he made more than 200 dives in the head of Scripps Canyon and La Jolla Canyon to observe firsthand the migration of sand down canyons. Additionally, his scientific diving training began at dive sites along the Monterey Peninsula. His first research cruise was off Monterey coring the deep-sea Monterey and Delgada fan on a US Geological Survey research vessel. Finally, he worked on a retrofit of Marina Coast Water District's seawater desalination in 2002.[40] A copy of his CV is attached as Exhibit 4.

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[39] Jones, A. T. (2008). Can we reposition the preferred geological conditions necessary for an infiltration gallery? The development of a synthetic infiltration gallery. *Desalination*, *221*(1-3), 598-601.

[40] Campbell, R. L., Hanlon, J., Seamon, F., & Jones, A. T. (2003). Retrofit of a California coastal desalination plant: add technology, lower costs. In *OCEANS 2003. Proceedings* (Vol. 1, pp. 246-248). IEEE.

Conclusion

For the reasons outlined in the foregoing comments, we conclude the DEIR/EIS's conclusions regarding the Alternatives are unsupportable. To consider a reasonable range of alternatives, the DEIR/EIS must be revised to analyze, at minimum, the following potentially feasible alternatives, which would likely reduce the project's significant impacts:

(1) Horizontal Wells at CEMEX site

(2) Horizontal Wells at the Potrero site and/or other sites closer to CalAm's service area.

(3) Ranney wells at CEMEX and Potrero Road sites.

(4) Ranney wells at sites along Carmel Beach or other suitable locations closer to CalAm's service area.

As discussed above, each of these alternatives was dismissed based on misinformation about the design, installation, maintenance and cost savings in comparison to the unproven Slant Well technology proposed for the MPWSP. At minimum, the each of these alternatives is potentially feasible, would avoid or reduce the project's significant environmental impacts, and meet all (or most) the project objectives as well as the stated purpose and need statements declared in the EIR. Without a fuller analysis of these alternatives, the DEIR/EIS does not consider a reasonable range of alternatives, and lacks support for its conclusion regarding the environmentally superior alternative.

Sincerely,

Anthony T. Jones, Ph.D.
President

Attachments: Exhibit 1. City of Santa Barbara Desalination Reactivation Project information
Exhibit 2. Presentation on Neodren Subsurface Intake Technology
Exhibit 3. Brochure on Neodren Projects from Catalana de Perforacions
Exhibit 4. Curriculum Vitae Anthony T. Jones, Ph.D.

Exhibit 1.

City of Santa Barbara
Santa Barbara, CA

To restart a 20-year old non-operating desalination plant with a cost-effective project delivery method, the City of Santa Barbara Desalination Plant Reactivation Project choose a modular unit concept offered by IDE Technology. The prefabricated modular units were assembled offsite while civil works was concurrently preparing the site resulting in significant savings in construction time. In EPC project delivery, fabrication offsite in a controlled setting allows for reduced on site construction costs. From design to execution took 60 days. Three modular SWRO units at 0.95 MGD with pretreatment elements meet California Drinking Water Standards.

Charles E. Meyer Desalination Plant

First Water	April 2017
Capital Cost (estimate)	$70 million
Operating Cost (estimate)	
Full Production	$4.1 million annually
Standby mode	$1.4 million annually
Production Capacity	3 MGD 3125 AF/Y
Energy Consumption	10 – 12 kWh/1000 gal. 2.64 – 3.17 kWh/m^3
Finance	20 years at 1/6% interest rate

Link: http://www.santabarbaraca.gov/gov/depts/pw/resources/system/sources/desalination.asp

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Subsurface Intake Technologies

Neodren® Subsurface Intake Technology

Anthony T. Jones
Intake Works LLC

February 7 & 8, 2016
The Fess Parker: A Doubletree by Hilton Resort
Santa Barbara, California

Neodren® Subsurface Intake Technology

Anthony T. Jones
Intake Works LLC

Introduction

This paper provides a brief overview of the purpose of intake subsystems within desalination systems, the types of subsurface intake technologies that have been promoted, a historical context for the development of the Neodren® subsurface seawater intake system, an examination of the currently operating desalting facilities that utilize Neodren® intakes as well as some basic operating conditions and case studies, where that information is available.

Purpose of the Intake Subsystem

The intake subsystem in a seawater reverse-osmosis desalination system delivers a specified amount of seawater to the RO plant so that the plant can deliver a required production rate to the offtaker, distributor or end user. As one can imagine, there are various means in which to convey seawater to a desalination facility.

Besides quantity, the quality of the water can have significant bearing on operational and cost efficiency. For example, source water with low organic content will lead to longer cycles between membrane cleaning, as there will be less biological fouling, thus affecting the plant's bottom line in terms of operational expenditures.

Generally, there is an operational availability requirement for reliability of the production with appropriate allocation for preventative or routine maintenance. Uptimes in excess of 90% annually are not unheard of.

Due to the corrosive nature of seawater, Material Control is important in design and operations. For membrane systems, a key parameter is the amount of silt in the source water. Membrane manufacturers' specifications limit the density of silt particles in order to guarantee membrane performance in terms of salt rejection.

Types of Subsurface Intakes Technologies

With the adoption of regulations in California that give preference to subsurface intakes versus directly drawn source water from the sea into desalination plants, the time is ripe for development of an alternative means with which to convey raw seawater to be processed in coastal desalting plants.

In California, the recent Independent Scientific and Technical Advisory Panel (ISTAP)[1] for assessing technical feasibility of subsurface intake designs for the proposed Poseidon Water Desalination Facility at Huntington Beach, California -- jointly sponsored by the developer, Poseidon Resources (Surfside) LLC and the regulatory agency, the California Coastal Commission -- identified three general types of subsurface intake: wells, galleries and tunnels.

Wells

- Vertical Wells
- Collector Wells
- Slant Wells
- Horizontal Directionally Drilled (HDD) Wells

Galleries

- Surf Zone Infiltration Gallery
- Engineered Seafloor Infiltration Galley

Tunnels

- Water Tunnel

This paper focuses on the Neodren® subsea seawater intake system which has been generically referred to as HDD wells.

The Neodren® Story

Neodren® is a trademark of Catalana de Perforacions SA (Spain). Catalana de Perforacions is a family-owned drilling services company founded in 1968 with headquarters in Santpedor (Barcelona, Spain). The company's project portfolio relies on an array of drilling technologies, including horizontal directional drilling (HDD), mineral exploration (coring), and vertical drilling for water wells coupled with exploitation of low-temperature geothermal resources.

Catalana de Perforacions pioneered the use of HDD in Spain, becoming the first local company to install pipelines by this method in 1995. The company continues to hold a market leadership position in the Iberian Peninsula. Today, Catalana de Perforacions offers several solutions based on HDD for both urban and intercity projects such as installation of utilities, seawater intakes, land-sea connections and oil and gas pipelines.

In the late 1990s, the fish farming industry, a key market niche for Catalana de Perforacions, started demanding an alternative to vertical wells for seawater collection and circulation. The fish farmers were facing environmental challenges because vertical wells could allow seawater intrusion into onshore freshwater aquifers. The development of the seawater desalination

[1] Final Report: Technical Feasibility of Subsurface Intake Designs for the Proposed Poseidon Water Desalination Facility at Huntington Beach, California http://www.coastal.ca.gov/pdf/ISTAP_Final_Phase1_Report_10-9-14.pdf

industry in Spain faced a similar situation. Notwithstanding the limitation of vertical wells, open direct intakes became unfeasible across the Mediterranean coast due to the environmental sensitivity of extensive beds of a local seagrass, *Posidonia*, which became protected by law in 2000, thus restricting trenching in the near shore.

Catalana de Perforacions developed a technology that draws adequate water to industrial facilities continuously, but was also eco-friendly. Neodren® is a solution that fulfils a need in the emerging seawater desalination and fish farming markets for raw seawater without harming the marine ecosystem.

Three main advantages of Neodren are:

- Trenchless construction technique, as intakes are drilled from the shore by means of HDD, damaging neither the seabed nor the surrounding flora and fauna;
- The under-the-seabed (subsurface) intake provides a continuous flow of raw seawater, since drains are installed horizontally in the offshore aquifer; and
- The lateral drains supply high-quality seawater as it infiltrates through the seafloor before reaching the desalination facility.

Neodren® has been installed at 18 facilities spread across Spain. Their collective experiences have shown that Neodren® generates several positive externalities. For instance, the aforementioned pre-treatment filtering step has led to lower operation and maintenance costs as well as a smaller investment in equipment for the pre-treatment subsystem. Additionally, the micro-porous filter pipes do not need to be replaced or removed.

Along the Mediterranean Sea, the Neodren® subsurface intake system first began operating in 1996 at a fish farm. Since 2003, five seawater desalination plants have commissioned Neodren® subsurface seawater intake systems with a total capacity of 63 MGD (see Table 1).

Table 1
Inventory of Neodren® intakes at operating seawater desalination facilities in Spain

Plant	Year	No. Lateral Drains	Filter Section (ft)	Plant Capacity (MGD)
San Pedro del Pinatar	2003	20	14,911	21.9
Cabo Cope	2004	4	1,993	9.9
Águilas	2006	3	2,530	7.8
Tordera	2007	1	670	1.8
Alicante II	2008	8	8,530	21.9

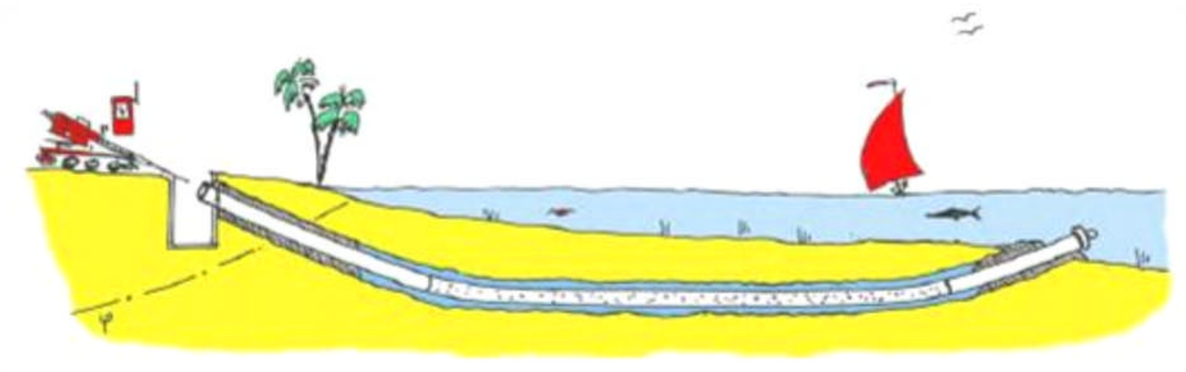

Figure 1. Cross section highlighting features of the Neodren® intake system

Neodren® is a viable solution for several planned ocean desalination projects along the California coast. Installed "drains"[2] could provide the required volume for processing at the desalination facility continuously while minimizing downstream operating and maintenance costs and protecting the environment both short- and long-term.

The subsurface drain intake system provides extremely low turbid water as source water for desalting. Non-corrosive HDPE pipes with microporous sections (60 µm pores) are inserted 20 feet below the seafloor. The HDD laterals can yield 1 to 2 million gallons per day (MGD) of source water without fish larvae, floating hydrocarbons and algal blooms, and have no contribution or exacerbation of the seawater intruding into the inland aquifer.

Where are there currently operating plants, what is their performance data?

Concerning performance of the Neodren® subsea intake system, the detailed information on operations is quite difficult to obtain. Once installed and commissioned by Catalana de Perforacions, the operations are turned over to the desalination plant operator. According to Spanish business culture, operational history is considered proprietary information and revealing it is not commonly done. Additionally, desalting facilities operate with different purposes at each installation, and the conditions are dissimilar. Having stated these restrictions, some information is available.

After the Neodren® system is commissioned; there is a period to reach a stable constant volumetric flow rate as evident in Figure 2 below. Mean specific flow rates for a time series is presented in Figure 3; note that the rates are within design criteria. Details of the illustrated drains are depicted in Table 2. Data is courtesy of Comunidad de Regantes de Águilas (Águilas Community Irrigation Authority).

Table 3
Parameters of drains displayed in Figures 2 and 3.

	Drain 1	Drain 2	Drain 3
Total length (m)	447	530	533
Filter length (m)	201	286	286
Pipe diameter (mm)	400	400	450

[2] The term 'drain' is adopted from terrestrial applications of irrigation for descriptive purposes.

San Pedro del Pinatar

This project was under the auspices of Pridesa – Abengoa. The Spanish group Acciona acquired the Spanish desalination and water management subsidiary Pridesa in 2006.

In 2003, Catalana de Perforacions installed 20 lateral drains comprised of a total pipeline length of 9190.7 m (30,153 ft.) of which the filter section comprised half, or 4545 m (14,911 ft.). The subsea geology was permeable fractured rock material. The total capacity was 2000 l/s (31,700 gpm) with specific capacity of 0.44 l/s/m (2.12 gpm/ft).

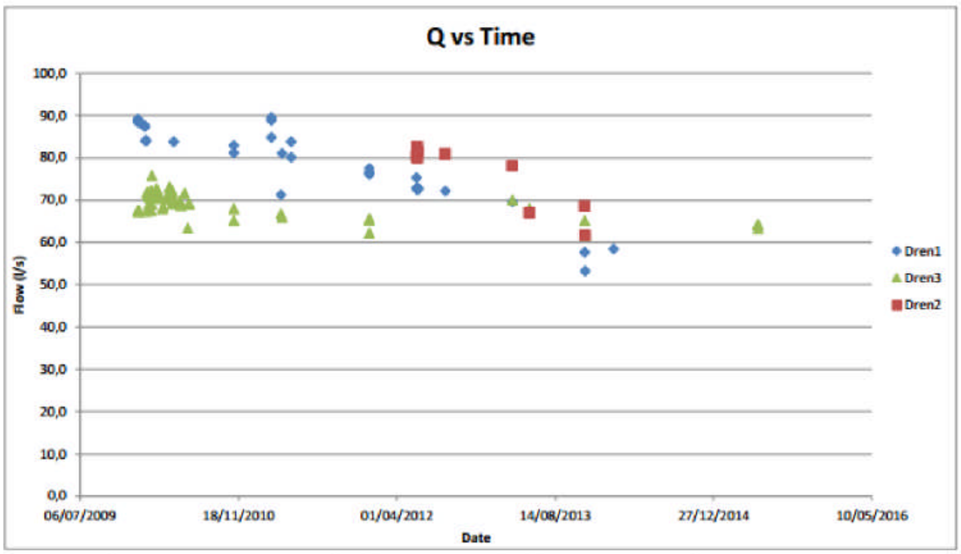

Figure 2. Volumetric flow rate, Q, for three drains overextended period

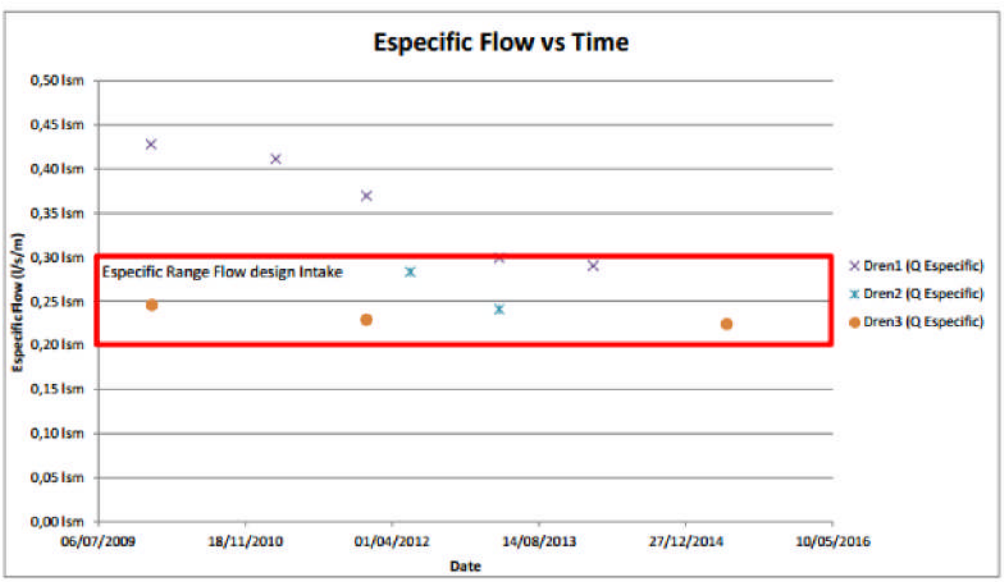

Figure 3. Specific flow for individual drains

The company reported silt density index (SDI) before the first pretreatment sand filter. Figure 4 displays the data extracted from Malfeito and Jimenez (2005), showing SDI generally below 4. Turbidity is shown in Figure 5 for the same period from the same drains. The Turbidity generally is below 1.5 NTU prior to sand filtration.

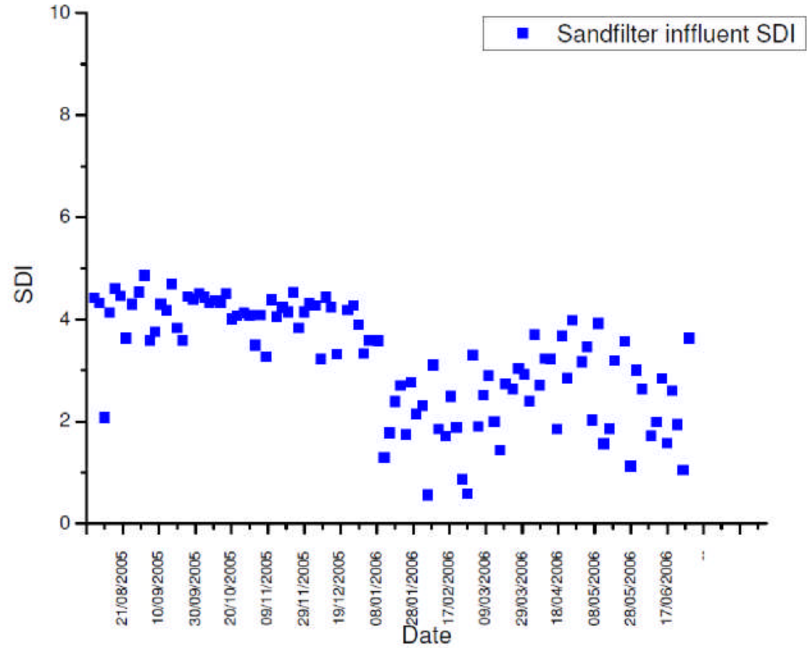

Figure 4. SDI at San Pedro del Pinatar from early 2005 to mid 2006

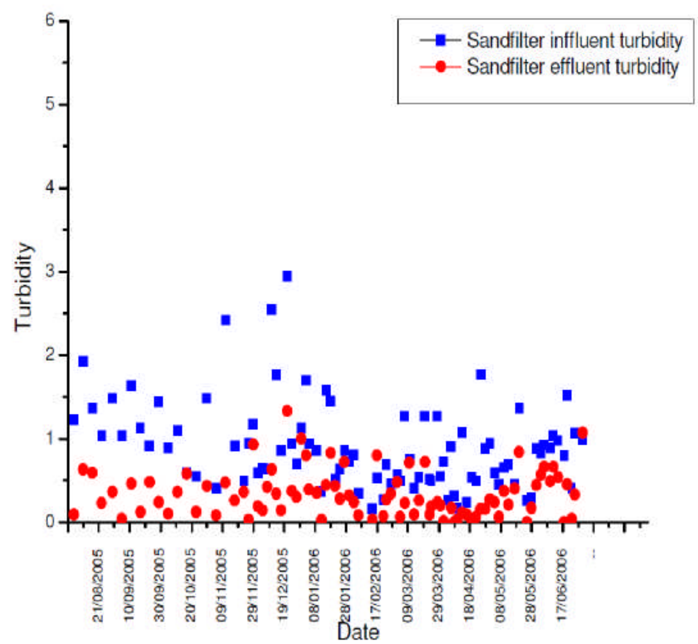

Figure 5. Turbidity from early 2005 to mid 2006 for influent and effluent of sand filter at San Pedro del Pinatar

In commenting on the reduction in pre-treatment process equipment at San Pedro del Pinatar, Dr. Thomas Peter, Dr. –Ing. Peters Consulting (Neuss, Germany) stated that "At the SWRO plant with Neodren® installed, one sand filter (sand), at the SWRO plant with the open intake have been installed using two filter stages, both with multilayer (anthracite + sand). In both cases, after these filters are installed, 5 µm cartridge filter. During our visit there we were informed that the SDI_{15} is usually about 3.1 to 3.2 after Neodren, about 0.9 after the sand filter and 0.8 after the 5 µm cartridge filter. The seawater has been reported to have had an SDI_5 of 14.5 at that day."[3]

In public testimony for the Carlsbad desalination project, the California Coastal Commission heard from Andrew Shea, US Development Director for the Acciona Corporation, a Spanish construction firm. Mr. Shea indicated that the San Pedro del Pinatar seawater desalination plant, which utilizes the Neodren® subsurface infiltration, had experienced significant "technical issues and limitations," leading the plant operators to switch to an open-water intake system for the second phase expansion.[4]

To counter this criticism, noted in the public record in California on the inadequacy of Neodren® intakes, we solicited observations from Acciona Aqua staff in Spain. Mr. Leopoldo Lainz Bejo, Business Development Manager, Acciona Aqua stated that "The subsea intakes at San Pedro del Pinatar are probably the best possible system in terms of water quality (and with a reasonable price as well). The soil works as a filtering system, allowing an extraordinary and stable water quality. That water quality allows for a reduction in Capex and Opex" [5]

Cabo Cope

For the Cabo Cope coastal irrigation district, Catalana de Perforacions installed four drains and a brine discharge line for a seawater desalination facility in 2004. The total length of the drains was 2025.8 m (6,646 ft.) with filtrate comprising 607.5 m (1993 ft.). In this case, the subsurface geology was calcarenite and conglomerate. The intake capacity was 434 l/s (6879 gpm) in total, with each drain providing 108 l/s (1711 gpm). The specific capacity was 0.71 l/s/m (3.42 gpm/ft).

Cala Gogó

For ATLL Aigües Ter Llobregat, a concessionaire for the Government of Catalonia, Catalana de Perforacions installed four drains of three different diameters (180 mm, 315 mm and 355 mm) for a seawater desalination facility in 2005. The total length of the drains was 836 m (2743 ft.) with filtrate comprising 204 m (669 ft.). In this case, the subsurface geology is composed of fine sand. The intake capacity was 355 l/s (5627 gpm) in total, with individual drains providing about 90 l/s (1427 gpm). The specific capacity was 0.44 l/s/m (2.11 gpm/ft).

[3] Thomas Peters (2009) personal communication (email January 17, 2009).

[4] California Coastal Commission COP application E-06-013 November 15, 2007, hearing transcript pages 170-171.

[5] Leopoldo Lainz Bejo (2014) personal communication (e-mail to April 3, 2014).

During the studies at this site, it was demonstrated that the Neodren® filtrate is buffered by seasonal temperature swings. The pH of the water shifted lower as seawater / open intake had a pH of 8 to 8.1, while the filtrate from the Neodren® system held pH from 7.5 to 7.7. The Turbidity was consistently under 2 NTU for the Neodren® filtrate. The SDI measured an average of 5.69 $\pm$ 0.21 for the Neodren® filtrate, while the sea had an SDI of average of 15 $\pm$ 6. During dredging seawater turbidity can exceed 31 NTU; on average, the sea had a Turbidity of 5.2 $\pm$ 0.5 NTU while the filtrate from the Neodren® intake had an average 1 $\pm$ 0.47 NTU.

Águilas

For the Community Irrigation Authority in Águilas, Catalana de Perforacions installed three drains for a seawater desalination facility in 2006. The total length of the drains was 1495 m (4905 ft.) with the filter section comprising 771 m (2530 ft.). The subsurface geology is calcarenite and conglomerate. With pipe diameters of 400 mm, the capacity per drain is 119 l/s (1886 gpm) with a total capacity of 345 l/s (5468 gpm). The specific capacity was 0.44 l/s/m (2.11 gpm/ft).

Alicante II

For UTE IDAM Alicante II, Catalana de Perforacions installed three investigative drains in April 2007. The total length of the drains is 1406 m (4612 ft.) with 755 m (2477 ft.) of filter section. The subsurface geology is calcarenite and conglomerate. With pipe diameters of 450 mm, the capacity of the drains are 95, 102, 139 l/s (1505, 1617, 2203 gpm) with a total capacity of 336 l/s (5325 gpm). The specific capacity was 0.44 l/s/m (2.11 gpm/ft).

Tordera

In July 2007, Catalana de Perforacions installed a single drain for Agència Catalana de L'Aigua. The total length of the drain is 450 m (1476 ft.) with 204 m (669 ft.) of filter section. The subsurface geology is medium sand. With pipe diameters of 450 mm, the capacity of the drain is 80 l/s (1268 gpm). The specific capacity was 0.36 l/s/m (1.73 gpm/ft).

Summary

Subsurface intakes such as the Neodren® subsurface seawater intake are a proven technology. The HDD method, originated in Spain, has been investigated and applied to several desalination plants along the Mediterranean Coast. Five desalination plants drawing 64 MGD have been operating for more than a decade, displaying good performance characteristics. With the amendment to the California Ocean Plan, introduction of Neodren® into California is ripe. A 12-month, side-by-side comparison at Camp Pendleton on this technique compared with directly screened ocean water is being watched closely by the industry.

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Neodren®

Historial de captaciones con el Sistema Neodren®

Enero 2011

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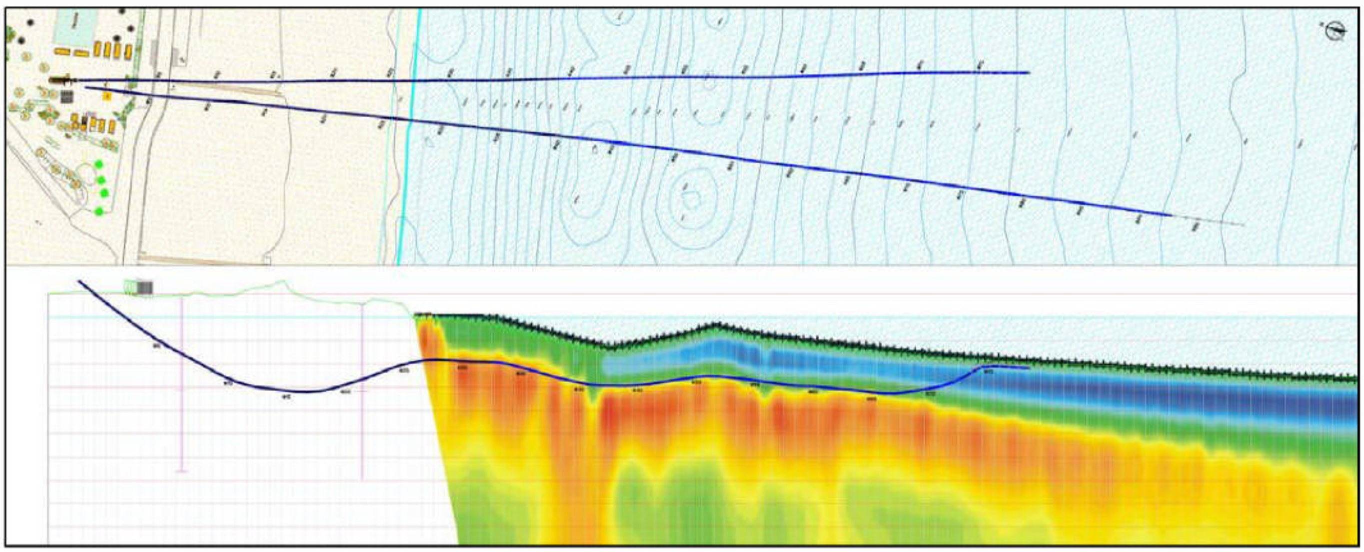
Neodren

Captación de agua marina para el futuro Centro de Recuperación de Animales Marinos (CRAM).

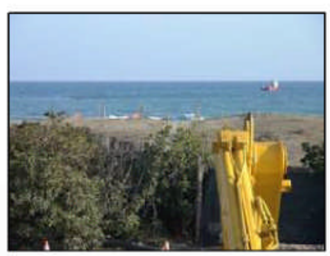
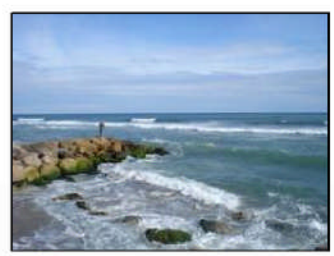
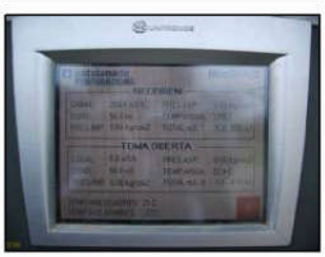
Cliente	Aigües del Prat de Llobregat
Situación	Can Camins - Platja del Prat
Província	Barcelona
Número de drenes	2
Longitud dren	Dren #1: 456.30 m (256.00 m filtro) Dren #2: 356.00 m (200.21 m filtro)
Terreno	Arena y limos
Caudal captación	Dren #1: 29 l/s (104.40 m^3/h) Dren #2: 70 l/s (252 m^3/h)

PLANO DEL TRABAJO



FOTOGRAFÍAS DEL PROCESO DE LA OBRA



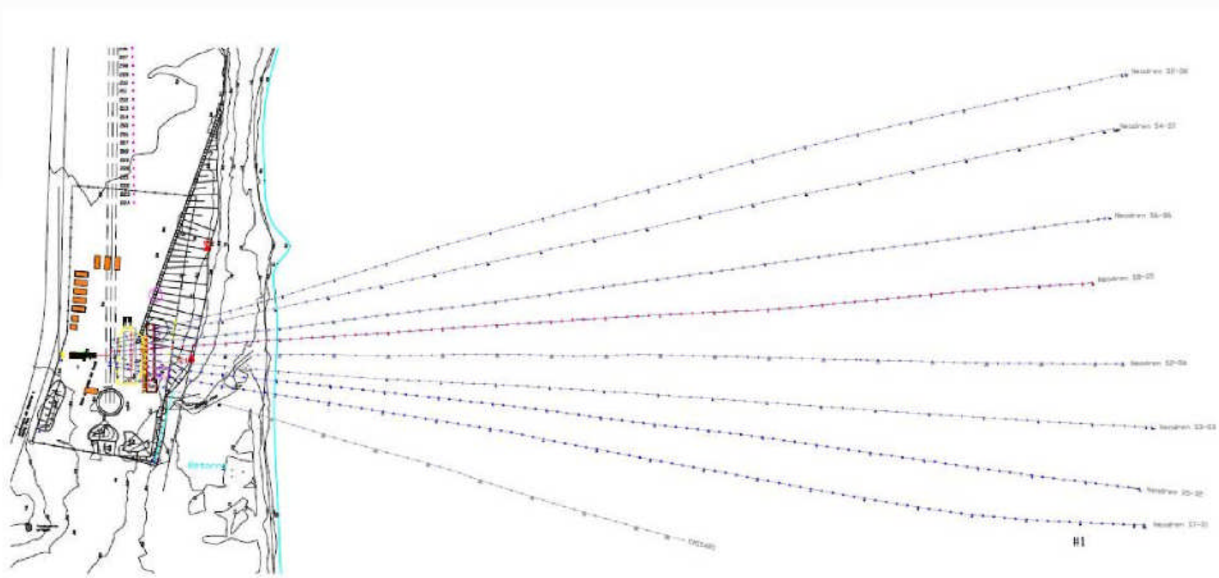




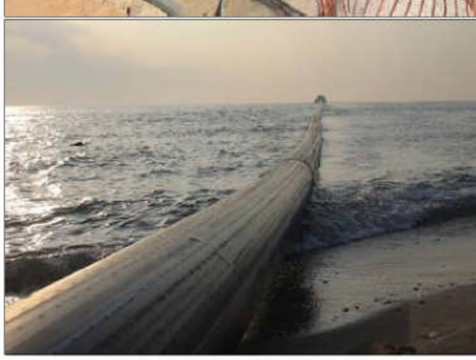

catalanade PERFORACIONS

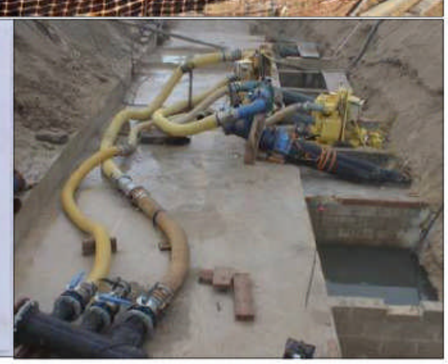
Neodren

IDAM Alicante II, Alicante (Sector Urbanova, pozo salida)

Cliente	UTE IDAM ALICANTE II
Ø tubería	PE100 PN10 Ø450mm
Longitud	450m
Filtro	325m
Terreno	Arenisca - Calcarenita
Caudal por dren	120 l/s
Caudal total	960 l/s
Caudal específico	0,43 l/s/m
Número de drenes	8 + emisario
Ejecución	Julio 2008





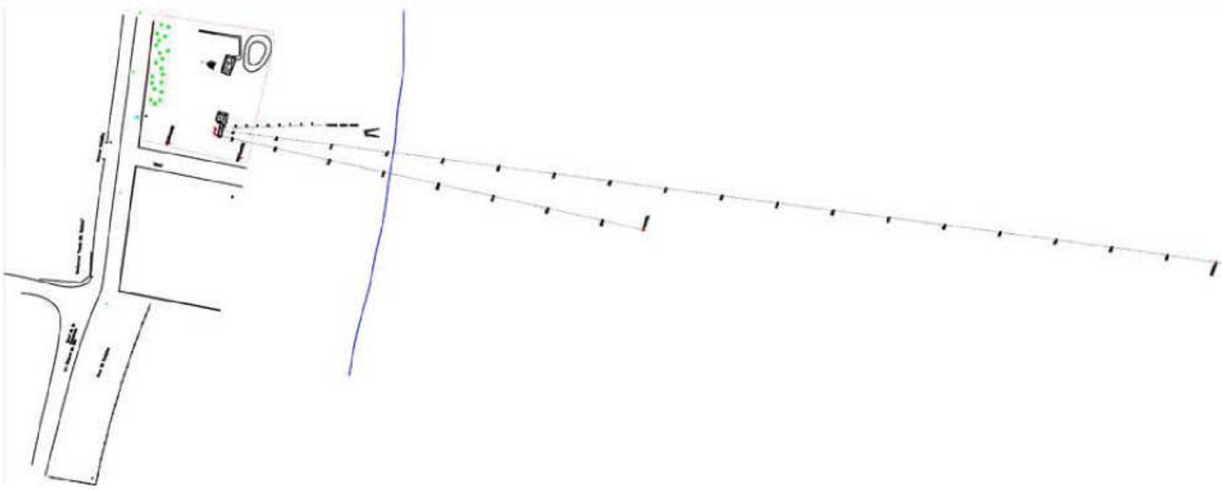


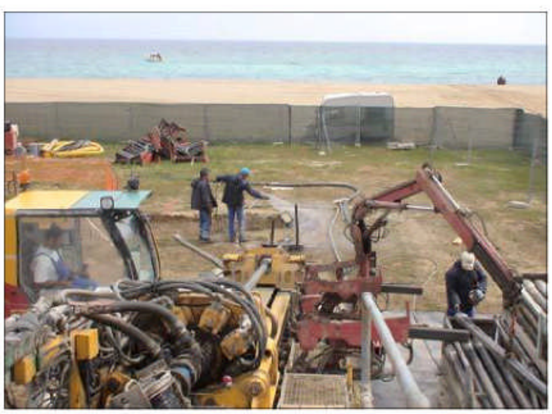
catalanade PERFORACIONS

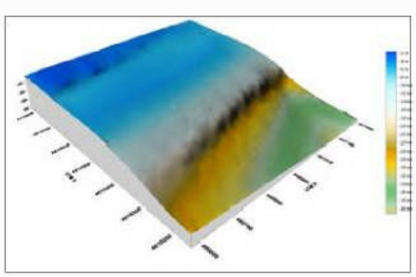
Neodren

IDAM La Tordera, Malgrat de Mar

Cliente	Agència Catalana de l'Aigua (ACA)
Ø tubería	PE100 PN10 Ø450mm
Longitud	450m
Filtro	204m
Terreno	Arena Grano medio
Caudal por dren	80 l/s
Caudal total	
Caudal específico	0,36 l/s/m
Número de drenes	1
Ejecución	Julio 2007

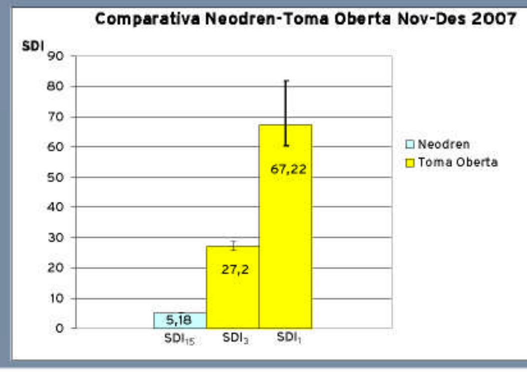


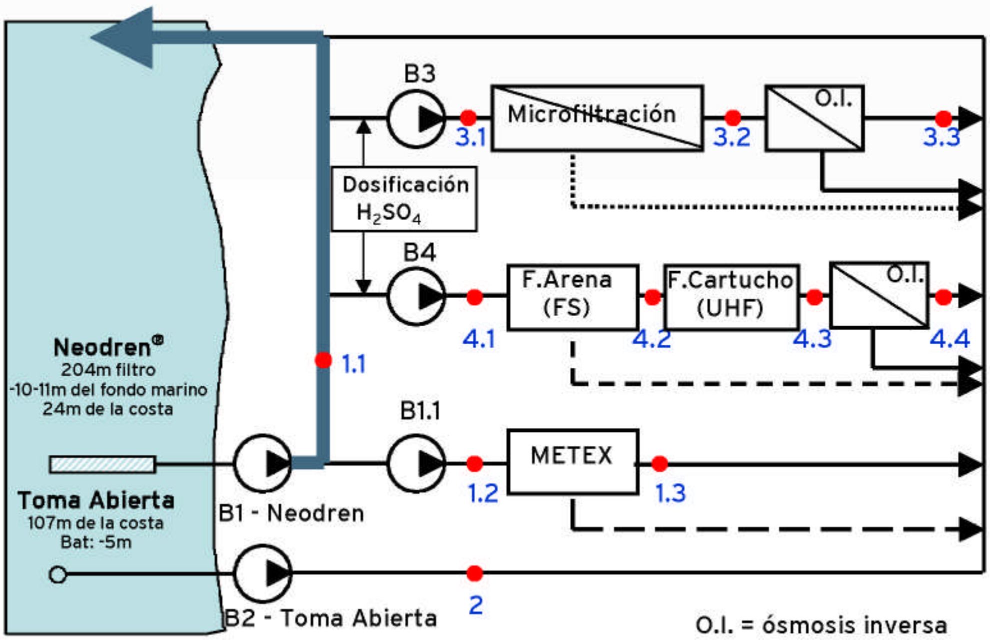




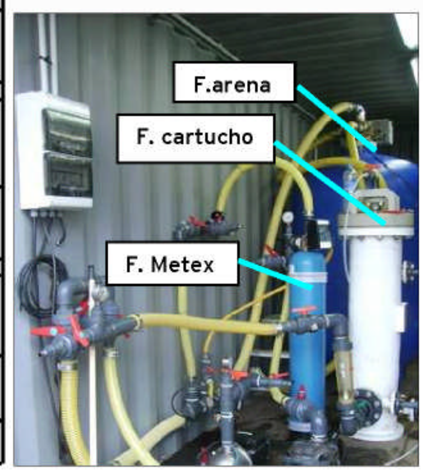
IDAM La Tordera, Malgrat de Mar – Planta Piloto de ósmosis inversa – julio 07- febrero 08

Estación de Bombeo Malgrat de Mar		Neodren®	Toma abierta	Mar
Parámetro	unidades	Promedio	Promedio	Promedio
pH	unt pH	7,48	8,29	8,28
Bor	mg/L B	4,39	4,5	4,6
Bacterias coliformes	ufc/100mL	0	21	30
Turbidez	NTU	1,82	3,24	7,33



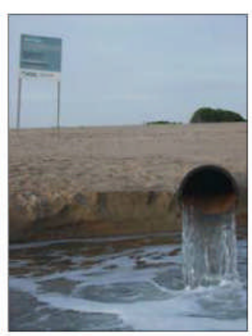


O.I. = ósmosis inversa



Montaje filtros pretratamiento

Estación de bombeo , contenedores de pretratamiento y planta piloto ósmosis inversa



Neodren® retorno al mar

Planta piloto de ósmosis inversa

catalanade PERFORACIONS

Neodren®

IDAM La Tordera, Malgrat de Mar – Planta Piloto de ósmosis inversa – julio 07- febrero 08
Resultados análisis químicos

Pretratamiento: Microfiltración (MF)		Neodren®	Entrada MF	Salida MF	Agua Osmotizada
Parámetros fisicoquímicos	**Unidades**	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%
Turbidez*	NTU	1,84±0,35*	2,5±0,49	0,2±0,1	0,1
Cloruros	mg/L Cl^-	19312±192	18700±679	18700±566	128±32
Potasio	mg/L K^+	471±14	489±38	490±43	2,9±0,3
Boro	mg/L B	4,39±0,18	4,10±0,17	3,97±0,13	0,8±0,9
Hierro total	Mg/L(Fe^{2+} + Fe^{3+})	2,62±0,20	1,97±0,02	1,90±0,2	<0,02
Parámetros microbiológicos					
Recuento aerobios a 22 º C	ufc/mL	6±4	3±1	3±1	<2
Bacterias coliformes	ufc/100mL	0	0	0	0

** La medida de turbidez del Neodren® se ha realizado "in situ" en vez de en el laboratorio, ya que se ha observado que ésta varía en función del tiempo.*

Pretratamiento: Filtro de Arena + Filtro de Cartucho (UHF)		Neodren®	Entrada Filtro Arena	Entrada UHF	Salida UHF	Agua Osmotizada
Parámetros fisicoquímicos	**unidades**	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%
Turbidez*	NTU	1,84±0,35*	2,4±0,5	0,7±0,4	0,3±0,1	<0,1
Cloruros	mg/L Cl^-	19312±192	17900±653	18160±606	18090±864	113±6
Potasio	mg/L SO_4^{2-}	2936±86	3220±91	3240±94	3252±86	<5
Boro	mg/L B	4,39±0,18	3,9±0,2	3,9±0,3	3,8±0,3	0,79±0,20
Hierro total	mg/L(Fe^{2+} + Fe^{3+})	2,62±0,20	2,09±0,11	1,84±0,1	1,75±0,14	<0,02
Manganeso Total	mg/L (Mn^{2+} + Mn^{3+})	1,33±0,12	1,13±0,11	1,17±0,12	1,14±0,10	<0,01
Parámetros microbiológicos						
Recuento aerobios a 22 º C	ufc/mL	6±4	2	25±27	16±19	<2
Bacterias coliformes	ufc/100mL	0	0	0±1	0	0

** La medida de turbidez del Neodren® se ha realizado "in situ" en vez de en el laboratorio, ya que se ha observado que ésta varía en función del tiempo.*

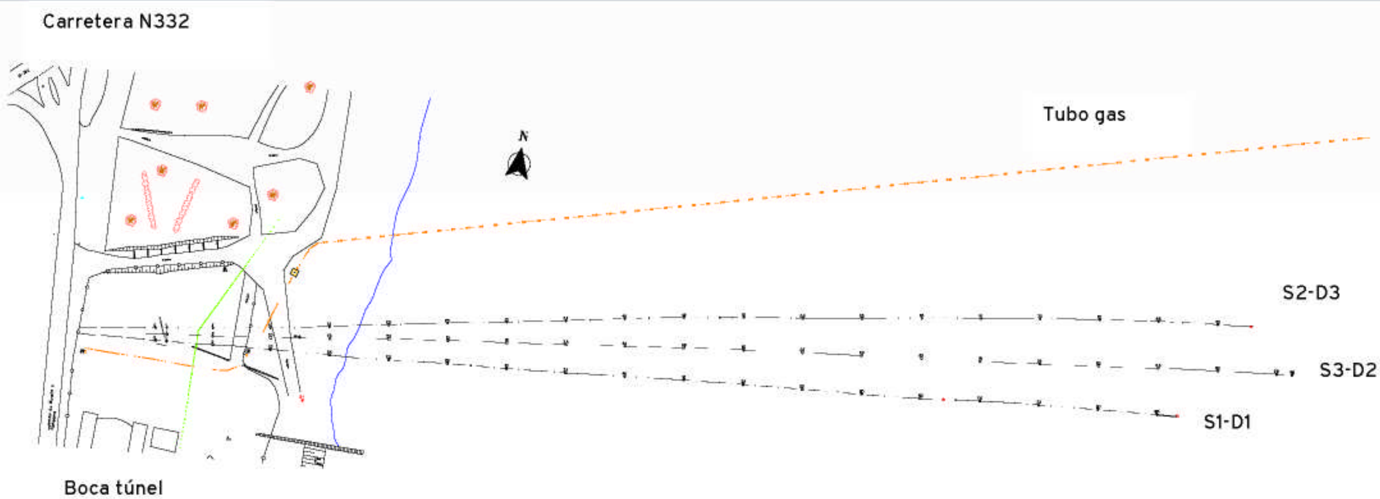
Pretratamiento: Filtro Metex		Neodren®	Entrada Metex	Salida Metex	
Parámetros fisicoquímicos	**unidades**	Promedio ±IC 95%	Promedio ±IC 95%	Promedio ±IC 95%	**Eficiencia %**
Boro	mg/L B	4,39±0,18	3,9±0,2	3,8±0,1	**2-10%**
Hierro disuelto muestra tamponada	mg/L Fe^{2+}	2,53±0,19	2,12±0,16	0,02±0,01	**99-99,5%**
Manganeso disuelto muestra tamponada	mg/L Mn^{2+}	1,33±0,10	1,17±0,06	1,01±0,11	**10-15%**
Estroncio	mg/L Sr	5,32±0,07	5,6±0,1	5,6±0,1	-
Oxidabilidad	mg/L O_2	24±2,3	28±6	27±1	-
Parámetros microbiológicos					
Recuento aerobios a 22 º C	ufc/mL	6±4	13±14	5±5	-
Bacterias coliformes	ufc/100mL	0	0	0	-

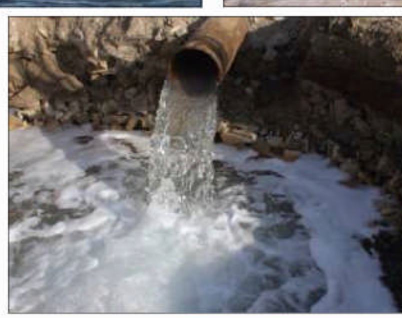
catalanade PERFORACIONS

Neodren

PHD investigación para la IDAM Alicante II, Alicante (sector Urbanova, pozo entrada)

Cliente	UTE IDAM ALICANTE II
Ø tubería	PE100 PN10 Ø450mm
Longitud	337m, 491m, 468m
Filtro	755m
Terreno	Calcarenita y conglomerado
Caudal por dren	95, 102, 139 l/s
Caudal total	336 l/s
Caudal específico	0,44 l/s/m
Número de drenes	3
Ejecución	Abril 2007





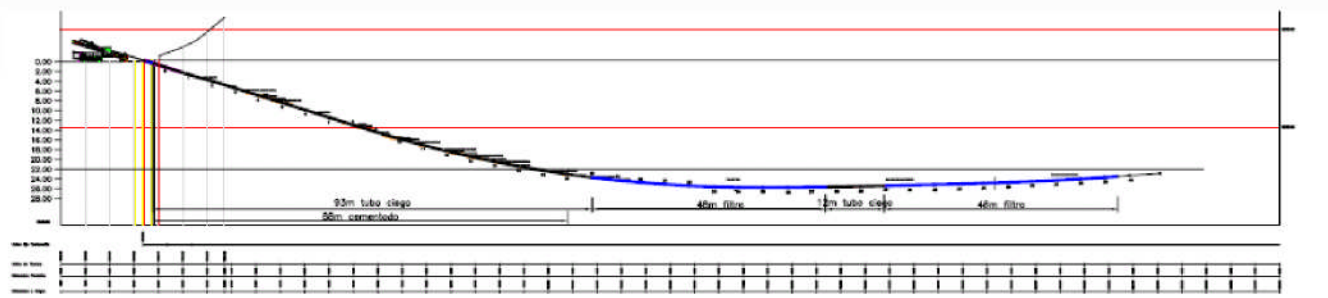
catalanade PERFORACIONS

Neodren

Captación de agua –Cañizar del Olivar - Teruel

Cliente	Tubkal Catalunya, S.L.
Ø TUBERÍA	PE100 PN10 Ø280 mm
Longitud	125 m
Casing	Si
Terreno	Roca
Ejecución	Septiembre 2006

PLANO DEL TRABAJO



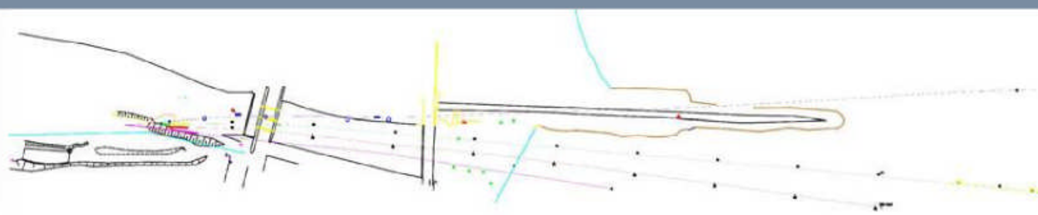
FOTOGRAFÍAS DEL PROCESO DE LA OBRA

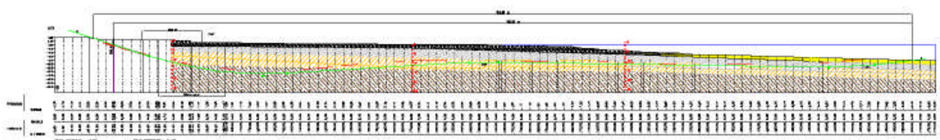
catalanade PERFORACIONS

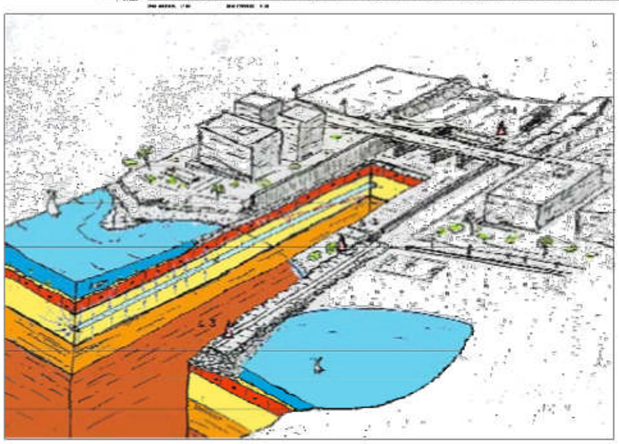
Neodren®

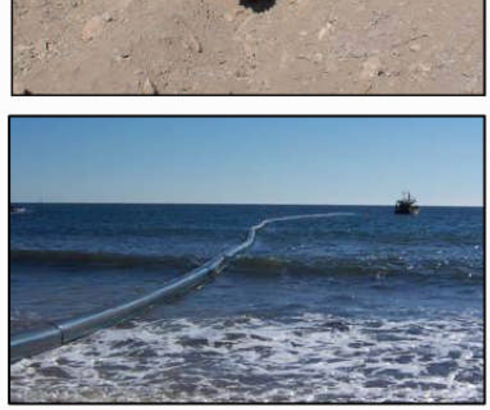
IDAM Águilas

Cliente	Comunidad de Regantes de Águilas
Ø tubería	PE100 PN10 Ø400mm
Longitud	1495m
Filtro	771m
Terreno	Calcarenita y conglomerado
Caudal por dren	119 l/s
Caudal total	345 l/s
Caudal específico	0,44 l/s/m
Número de drenes	3
Ejecución	Marzo 2006





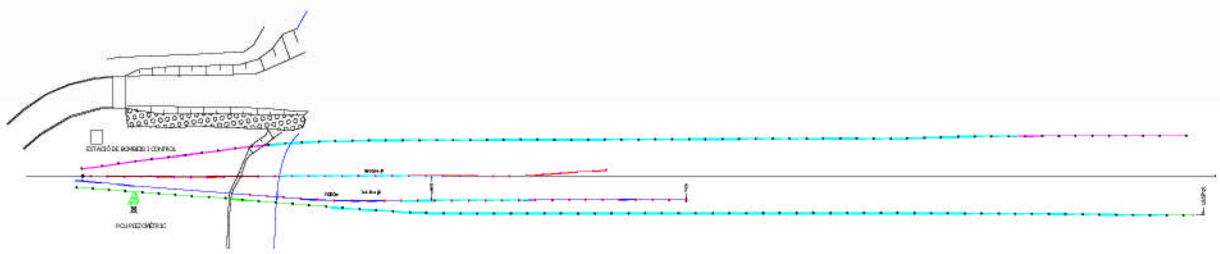




catalanade PERFORACIONS **Neodren**

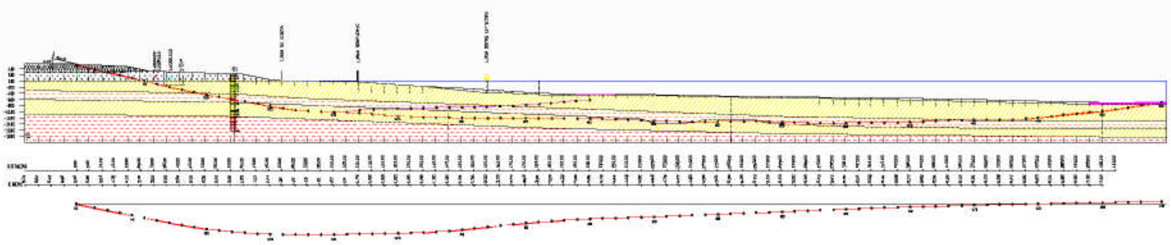
IDAM de Barcelona en Cala Gogó, El Prat de Llobregat

Cliente	Aigües Ter Llobregat (ATLL)
Ø tubería	PE100 PN10 Ø180mm PE microporoso Ø180mm PE100 PN10 Ø315mm PE microporoso Ø315mm
Longitud total	835,9m
Longitud 4º dren	325m
Filtro	204m
Terreno	Arena fina
Caudal Ø355	90 l/s
Caudal específico	0,44 l/s/m
Número de drenes	4
Ejecución	Abril 2005



PHD investigación para la IDAM del Canal de Alicante, Alicante

Cliente	CADAGUA - INFILCO
Ø tubería	PE100 PN10 Ø160mm
Longitud	423,9m
Filtro	285m
Terreno	Calcarenita
Caudal por dren	22 l/s (limitación hidráulica)
Caudal total	-
Caudal específico	0,07 l/s/m
Número de drenes	1
Ejecución	Agosto 2004



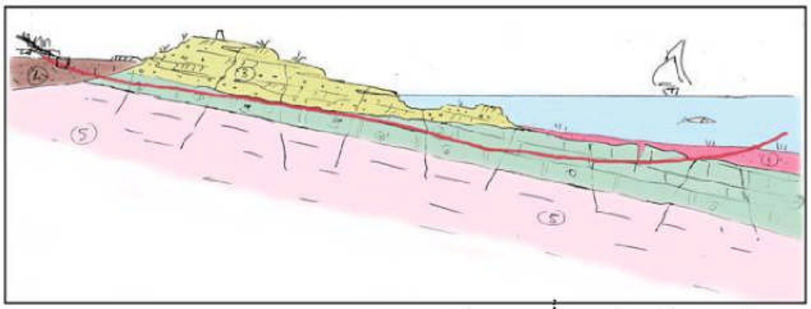
catalana de PERFORACIONS

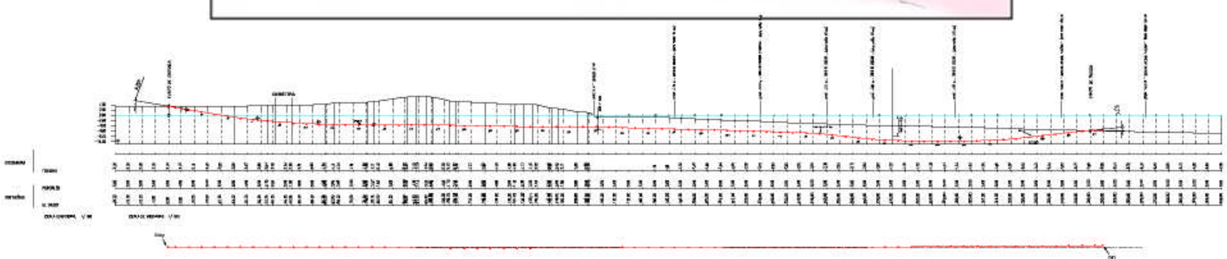
Neodren

Piscifactoría – Cabo COPE - Murcia

Cliente	Alevines del Sureste
Ø tubería	Ø355mm
Longitud	356m
Filtro	150m
Terreno	Roca (calcarenita)
Caudal total	100l/s
Caudal dren	100l/s
Caudal específico	0.48 l/s/m
Número de drenes	1
Ejecución	Julio 2004

PERFIL DEL TRABAJO





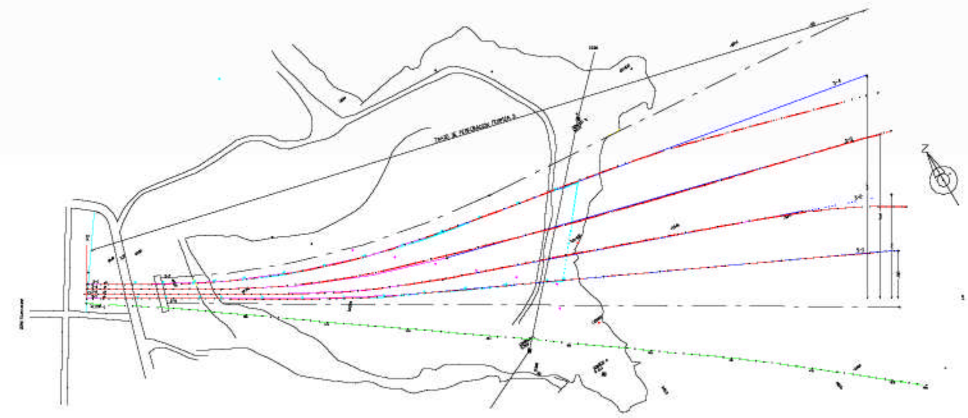
FOTOGRAFÍAS DEL PROCESO DE LA OBRA

catalana de PERFORACIONS

Neodren

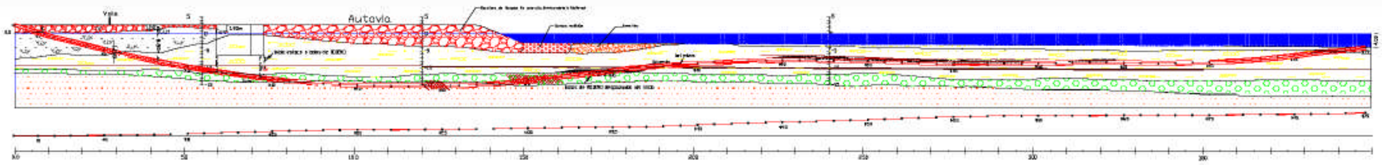
IDAM de la Marina de Cabo Cope

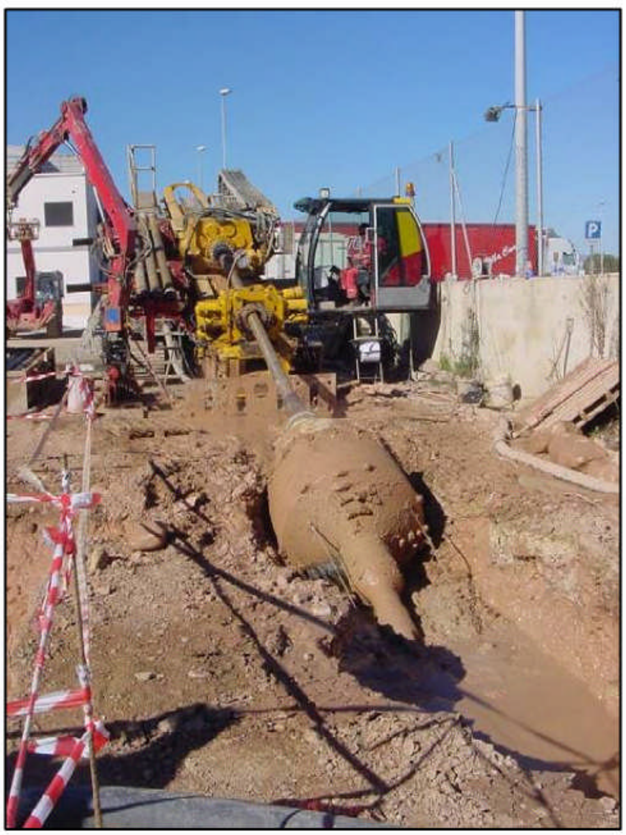
Cliente	Comunidad de Regantes La Marina
Ø tubería	PE100 PN10 Ø400mm
	PE100 PN10 Ø500mm
Longitud	2025,8m
Filtro	607,5m
Terreno	Calcarenita y conglomerado
Caudal total	434 l/s
Caudal dren	108 l/s
Caudal específico	0,71 l/s/m
Número de drenes	4 + 1 emisario
Ejecución	Marzo 2004



Central Térmica de Biomasa de Albuixech - Valencia

Cliente	Filantair Energía
Ø tubería	PE100 PN6 Ø710mm
Longitud	400,8m
Filtro	
Terreno	Arenisca
Caudal total	500 l/s
Caudal específico	2,9 l/s/m
Número de drenes	1
Ejecución	Febrero 2004





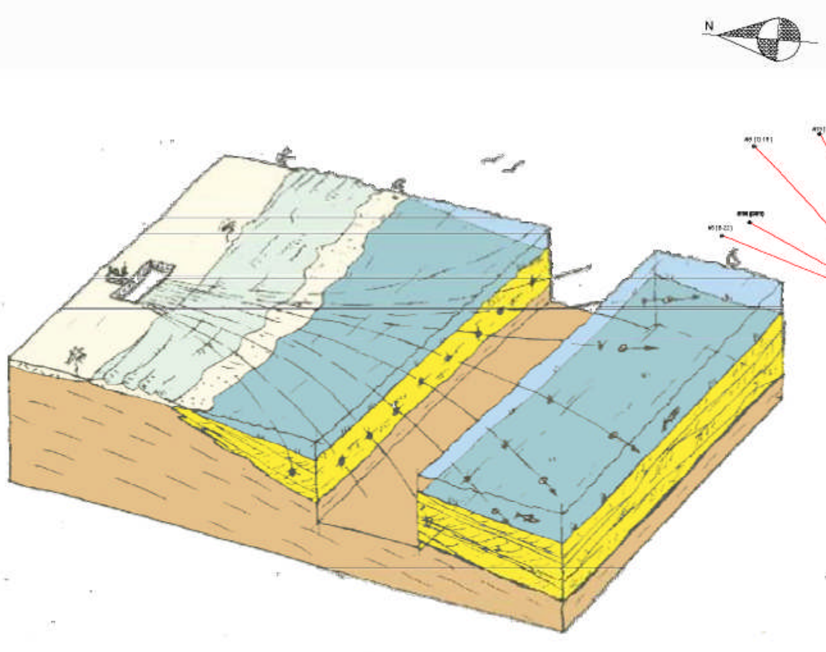
catalana de PERFORACIONS

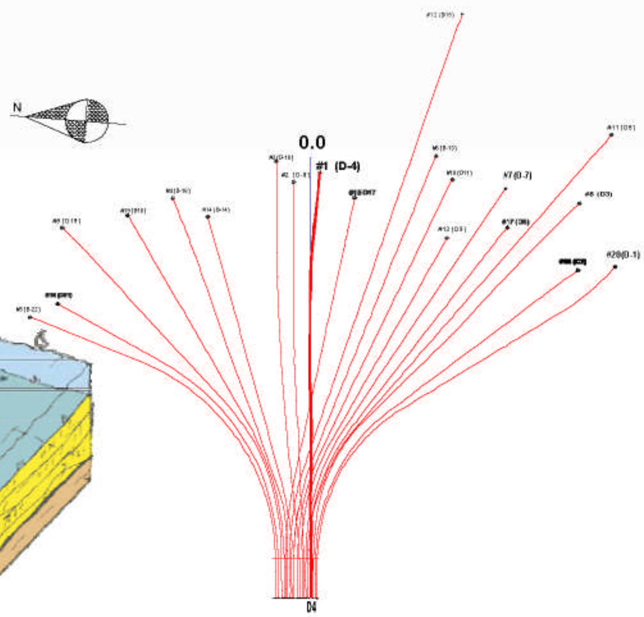
Neodren®

IDAM San Pedro del Pinatar - Murcia

Cliente	PRIDESA – ABENGOA
Ø tubería	PE100 PN10 Ø355mm
Longitud total	9.190,7 m
Filtro total	4.545m
Terreno	Roca fracturada con material permeable
Caudal total	2000 l/s
Caudal dren	100 l/s
Caudal específico	0,44 l/s/m
Número de drenes	20
Ejecución	Octubre 2003

PLANO DEL TRABAJO





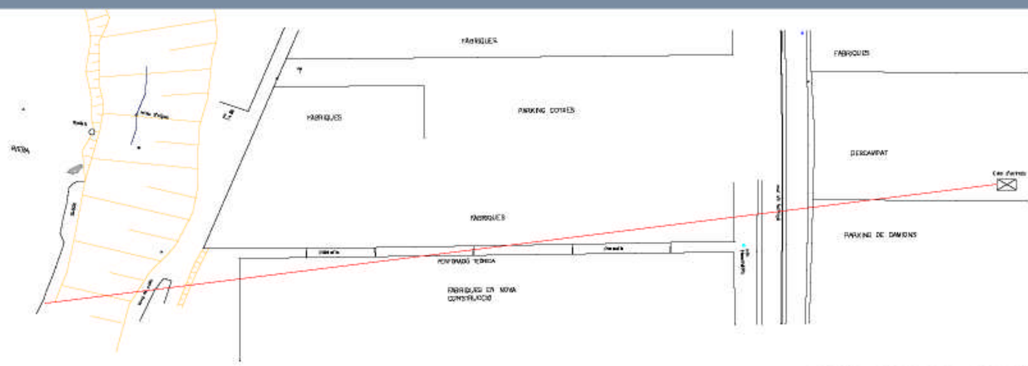
FOTOGRAFÍAS DEL PROCESO DE LA OBRA

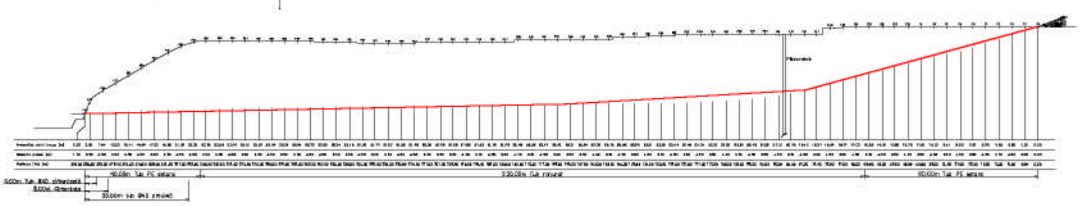
catalanade PERFORACIONS

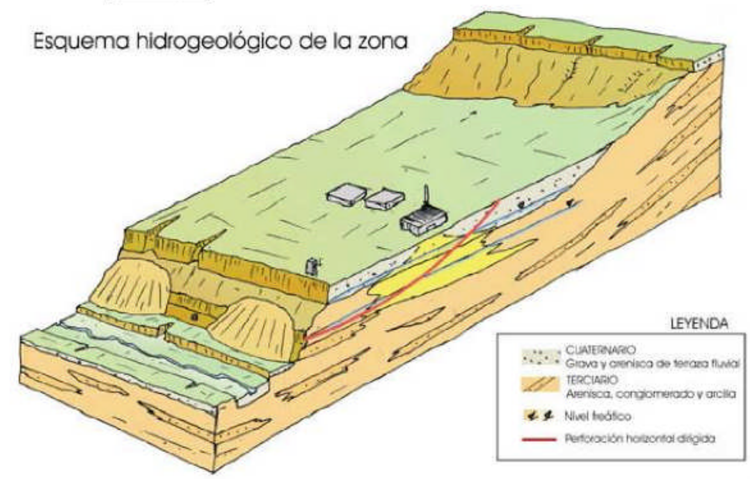
Neodren®

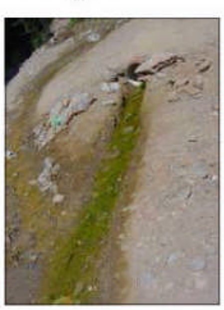
PHD para reducción contaminación Cromo Hexavalente en la riera de la Magarola, Esparraguera

Cliente	Agència Catalana de l'Aigua (ACA)
Ø tubería	Ø125mm PE100 PN10
Longitud	330m
Filtro	230m
Terreno	Areniscas
Caudal por dren	
Caudal total	
Caudal específico	
Número de drenes	1
Ejecución	Julio 2001







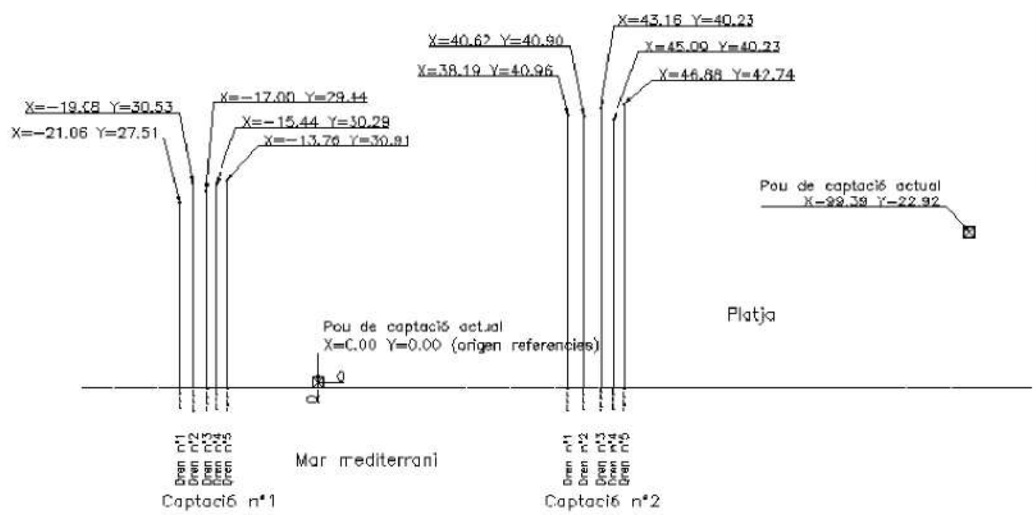


catalanade PERFORACIONS

Neodren

Piscifactoria en Sant Pere Pescador - Ampliació

Cliente	BASE VIVA, S.L.
Ø tubería	PE100 PN10 Ø180mm
Longitud	600m
Filtro	320m
Terreno	Arena fina
Caudal total	70 l/s
Caudal dren	7 l/s
Caudal específico	0,21 l/s/m
Número de drenes	10
Caudal total captación	6048 m3/día (70 l/s)
Ejecución	Mayo 2001



catalana de PERFORACIONS

Neodren

Piscifactoría en Sant Pere Pescador.

Cliente	BASE VIVA, S.L.
Longitud filtro	30 m
Terreno	Arena fina
Caudal específico	0.22 l/s/m
Número de drenes	3+3
Caudal total captación	25 l/s + 25 l/s
Ejecución	1996

FOTOGRAFÍAS DEL PROCESO DE LA OBRA

catalanade PERFORACIONS

Neodren

Anthony T. Jones, Ph.D.

Tel: + (916) 990 - 3699
e-mail: jxocean@yahoo.com

PROFILE

Environmental Scientist with broad experience in marine science and ecology. Thorough knowledge of theory, principles and practice of oceanography and related knowledge of seawater desalination. Demonstrated knowledge and experience required to design, implement and report on scientific investigations. Possess excellent skills in communication of scientific ideas and presentation of complex data sets.

PROFESSIONAL EXPERIENCE

Consultant Nov/2012- present
Intake Works LLC
Provide services to create and implement under the sea infiltration systems for desalination intakes. Developed brine discharge technologies that accelerated diffusion of highly saline water into the marine environment, and tools to rapidly assess coastal sites for desalination opportunities with unmanned aerial / autonomous underwater vehicles.

Vice President – Chief Technology Officer May/2008- Oct/2012
Campbell Applied Physics, Inc.
Guide the engineering department activities to:

- design new products, modify existing designs, improve production techniques, and develop test procedures,
- resolve problems using solutions that involve new techniques, technologies, or concepts,
- analyze technology trends, human resource needs, and market demand to plan projects,
- confer with management, production, and marketing staff to determine engineering feasibility, cost effectiveness, and customer demand for new and existing products, and
- forecast operating costs of department and directs preparation of budget requests.

Directed System Engineering for the development of advanced seawater reverse osmosis systems, resulting in demonstrated success of 30% lower overall energy use and up to 70% lower carbon footprint.

Vice President -- Technical Services Jan/2005- Feb/2008
ReEnergy Desalination Inc., San Diego, California (formerly Oases Global Systems)

- Direct systems engineering for reverse osmosis designs
- Develop new business opportunities
- Represent enterprise with major customers, shareholders and the public
- Develop synthetic intakes for seawater desalting operations
- Build relationships with new technologies applicable to seawater desalination
- Analyze new technologies and run competitive analysis
- Liaison with original equipment manufacturers and RO fabricators
- Manage projects for long-term technical objectives with long-term profitability goal

Senior Oceanographer 40 hr/wk Sep/1999-Dec/2005
oceanUS Consulting, San Francisco, California
- Advise on issues related to regulatory and environmental concerns for planning of submarine fiber optic cables
- Consult on business strategies for development of ocean-based energy systems.
- Develop of management strategies for environmental aspects of desalination.

Lecturer, Department of Geosciences Jan/2002-May/2002
San Francisco State University
- Taught oceanography laboratory

Marine Biologist Aug/1997-Aug1999
International Seabed Authority, Kingston, Jamaica
- Developed environmental monitoring program for international seabed authority
- Developed environmental guidelines for deep seabed mining

Manager, Coastal and Marine Resources 1995-1996
Triton Environmental Consultants Ltd., Richmond, BC
- Developed new business and identified funding sources for research and training
- Project manager for coastline evaluation, marine environmental impact assessment and marine resource inventory
- Provided comprehensive technical expertise for projects related to marine biology and coastal geological processes

Vice-President, Environmental Affairs 1994 - 1995
Oceanus Flotation Technologies Inc., Vancouver, BC
- Directed environmental surveys for start-up company in the design of 3-acres floating theme park
- Conducted geochemical baseline surveys for international coastal mining operations
- Performed mine site environmental assessment and developed monitoring program for marine life

Senior Scientist 1993 - 1994
Rescan Environmental Services Ltd., Vancouver, BC
- Project manager for significant submarine disposal of tailings for mine in Southern Peru
- Developed safe method of relocating mine tailings so as not to jeopardize health and safety

Research Assistant, Department of Oceanography 1987 - 1993
University of Hawaii, Honolulu, HI
- Assessed geological hazards and routing for submarine power cable between the islands of Hawaii and Maui
- Conducted submersible studies
- Performed environmental assessment for cable operation
- Organized/facilitated interpretation walks of coarl reefs, review sessions, exams, lectures and discussion groups
- Provided instruction of special skills related to equipment utilization

Senior Biologist 1986 - 1987
Computer Science Corporation, San Diego, CA

- Directed field and laboratory experiments on the effect of antifouling paint in San Diego Bay

Researcher & Consultant 1983 - 1986
Westec Environmental Services, San Diego, CA

- Performed various tasks associated with field water quality monitoring and identification of marine organisms including initial sorting of benthic infauna marine samples, curation of samples, taxonomic identification of mollusk, crustacean and other invertebrates and fish, supervised and assisted three sorters, boat operator, set and retrieved gill nets.

Research Associate 1978 - 1982
Lawrence Berkeley Laboratory, Berkeley, CA

- oceanographic monitoring for federal ocean energy project
- analyzed biochemical parameters

EDUCATION

Ph.D., Oceanography, University of Hawaii, HI 1993
M.S., Biology, San Diego State University, San Diego, CA 1987
B.A., Zoology and Marine Biology, University of California, Berkeley, CA 1978

PROFESSIONAL AFFILIATIONS

Instructor, National Association of Underwater Instructors (NAUI 8323)
Research Associate, Bernice P. Bishop Museum, Honolulu, HI
Member, International Desalination Association
Life Member, American Geophysical Union

COMMUNITY INVOLVEMENT

Director, Offshore Technology Conference (2001-2011)
Society for Mining, Metallurgy and Exploration, Offshore Technology Planning Committee
Elected member of Executive Board of Artificial Reef Society of British Columbia
Former Director, Jamaican Diplomatic Association
Former Member, Geological Society of Jamaica
Former Director, International Marine Minerals Society
Marine Technology Society, Hawaii Chapter
Director 1989-1991
Secretary 1987-1989
Diving Control Board
University of Hawaii, 1987-1989
University of California, 1977-1978
Member, Desalination Committee, California-Nevada Section
American Water Works Association
Member, Water Desalting Committee, American Water Works Association

AWARDS

Harold T. Stearns Fellowship, 1990
Fellow, Royal Geographic Society, 1991
Geological Society of America Research Award 1990, 1991, 1992.